A

APPENDIX A INFRASTRUCTURE TABLE, TIMING & COST ESTIMATES

INFRASTRUCTURE TABLE

KEY	PRECINCT	ROAD NAME / ITEM	LOCATION	INTERSECTIONS	ROAD SEAL			$ 800.00	KERB & CHANNEL	$ 100.00
				Upgrade Required?	Existing road (m)	Existing surface	Proposed seal (m)	Cost	Proposed kerb & channel (m)	Cost
	PRECINCT A						**539.2397726**	**$ 431,391.82**	**4516.139094**	**$ 451,613.91**
1	Precinct A	**Community Park Unsealed Road**	Existing Path within Nyora Community Park		272.3721279	Unsealed	0	$ -	0	$ -
2	Precinct A	**Davis St**	Between Mitchell St and Lang Lang-Poowong Rd		300.9013915	Sealed	0	$ -	601.802783	$ 60,180.28
3	Precinct A	**Grundy Av**	Between Davis St and School		266.0215402	Sealed	0	$ -	532.0430804	$ 53,204.31
4	Precinct A	**Henley St**	Between Hewson St and Mitchell St		187.1106508	Sealed	0	$ -	374.2213017	$ 37,422.13
5	Precinct A	**Henley Street**	Proposed Crossing over Railway Land Linking Henley to Yannathan		182.1048873	Unmade Road Reserve	0	$ -	0	$ -
6	Precinct A	**Lang Lang - Poowong Rd**	From Forster Dr and adjacent to Community Park	Yes	95.82784787	Sealed	0	$ -	191.6556957	$ 19,165.57
7	Precinct A	**Mitchell St**	Between Henley St and Davis St		259.9483441	Sealed	0	$ -	519.8966882	$ 51,989.67
8	Precinct A	**Mitchell St**	Between Walters Rd and Henley St		287.008784	Sealed	0	$ -	574.0175679	$ 57,401.76
9	Precinct A	**Unnamed Laneway**	Between Walters Rd and Davis St		539.2397726	Unsealed	539.2397726	$ 431,391.82	1078.479545	$ 107,847.95
10	Precinct A	**Walters Rd**	North of Mitchell Street in Precinct A		233.8060188	Unsealed	0	$ -	467.6120375	$ 46,761.20
11	Precinct A	**Walters Rd**	Between Laneway and Mitchell St		88.20519722	Sealed	0	$ -	176.4103944	$ 17,641.04
	PRECINCT B						**1769.712737**	**$ 1,415,770.19**	**5738.654376**	**$ 573,865.44**
12	Precinct B	**Berrys Rd**	Adjacent to GRZ1		107.4600562	Unsealed	107.4600562	$ 85,968.04	214.9201125	$ 21,492.01
13	Precinct B	**Cornishs Rd**	Emergency Access Only		459.1336962	Unsealed	459.1336962	$ 367,306.96	918.2673925	$ 91,826.74
14	Precinct B	**Davis St**	Between Lang Lang-Nyora Rd and Hewson St		375.9073914	Sealed	0	$ -	0	$ -
15	Precinct B	**Grundy Ave**	Cornishs Rd to School		347.800459	Sealed	0	$ -	695.600918	$ 69,560.09
16	Precinct B	**Henley St**	Between Lang Lang-Nyora Rd and Hewson St	Yes	527.1120988	Unsealed	527.1120988	$ 421,689.68	1054.224198	$ 105,422.42
17	Precinct B	**Henley St**	Northern Sealed Section		25.41835978	Sealed	0	$ -	50.83671957	$ 5,083.67
18	Precinct B	**Henrys Rd**	In GRZ1 and Precinct B		75.13335955	Sealed	0	$ -	150.2667191	$ 15,026.67
19	Precinct B	**Hewson St**	Between Walters Rd and Davis St		530.8438397	Sealed	0	$ -	1061.687679	$ 106,168.77
20	Precinct B	**Lang Lang - Poowong Rd**	West from Davis Street		1015.362485	Sealed	0	$ -	0	$ -
21	Precinct B	**Walters Rd**	Between Lang Lang-Nyora Rd and Hewson St	Yes	676.0068862	Unsealed	676.0068862	$ 540,805.51	1352.013772	$ 135,201.38
22	Precinct B	**Walters Rd**	Between Hewson and Laneway		120.4184325	Sealed	0	$ -	240.8368649	$ 24,083.69
	PRECINCT C						**611.6152972**	**$ 489,292.24**	**0**	**$ -**
23	Precinct C	**Walters Rd**	Northern Boundary of Precinct C, West of Precinct B		611.6152972	Unmade Road Reserve	611.6152972	$ 489,292.24	0	$ -
	PRECINCT D						**0**	**$ -**	**0**	**$ -**
24	Precinct D	**Heylens Rd**	Northern Boundary Precinct D		479.0662369	Sealed	0	$ -	0	$ -
	PRECINCT E						**1309.790636**	**$ 1,047,832.51**	**2657.898521**	**$ 265,789.85**
25	Precinct E	**Forster Dr**	Between Lang Lang-Poowong Rd and Hogans Rd		654.6943093	Sealed	0	$ -	0	$ -
26	Precinct E	**Grayden St**	Unsealed section on west connecting to Patman Dr		122.5082251	Unsealed	122.5082251	$ 98,006.58	0	$ -
27	Precinct E	**Grayden St**	Unmade section on west of Yannathan Rd	Yes	239.1780249	Unmade Road Reserve	239.1780249	$ 191,342.42	0	$ -
28	Precinct E	**Grayden St**	Between Forster Dr and Yannathan Rd	Yes	203.042637	Unsealed	203.042637	$ 162,434.11	0	$ -
29	Precinct E	**Hatchs Rd**	Between Lang-Lang-Poowond Rd and Hogans Rd		661.6971088	Sealed	0	$ -	0	$ -
30	Precinct E	**Hogans Rd**	Between Patman Dr and Yannathan Rd		338.0893769	Unsealed	338.0893769	$ 270,471.50	0	$ -
31	Precinct E	**Lang Lang - Poowong Rd**	Between Follett Dr and Forster Rd, Shared Path is Recreation Loop		579.7666526	Sealed	0	$ -	0	$ -
32	Precinct E	**Patman Dr**	Section intersecting Adams Creek towards northern end of Patman Dr		170.0806619	Unmade Road Reserve	0	$ -	0	$ -
33	Precinct E	**Patman Dr**	Southern Section connecting to Watts Rd and finishing at Pony Club		406.9723719	Unsealed	406.9723719	$ 325,577.90	0	$ -
34	Precinct E	**Watts Rd**	West of Patman Dr		191.7523069	Unsealed	0	$ -	0	$ -
35	Precinct E	**Watts Rd**	Section east of Yannathan Rd connecting to Lang Lang-Poowong Rd		458.767478	Sealed	0	$ -	917.5349559	$ 91,753.50
36	Precinct E	**Watts Rd**	Watts Rd near corner of Patman Dr		88.22637552	Unsealed	0	$ -	176.452751	$ 17,645.28
37	Precinct E	**Yannathan Rd**	Between Hogans Rd and Watts Rd		681.5656326	Sealed	0	$ -	1363.131265	$ 136,313.13
38	Precinct E	**Yannathan Rd**	Connection to Watts Rd		100.3897743	Unsealed	0	$ -	200.7795486	$ 20,077.95

FOOTPATHS			$ 120.00	SHARED PATHS		$ 180.00	STREET TREES		$ 5,000.00	$ 2,000.00		NOTES	
Existing Path (m)	New paths footpaths proposed	Proposed footpath (m)	Cost	New shared paths proposed	Proposed shared path (m)	Cost	Sides required	No. trees (m/14)	Mature street trees ($)	Street tree saplings ($)	Total ($)		Archive_Key
		1546.592809	**$ 185,591.14**		**1667.128643**	**$ 300,083.16**					**$ 557,495.06**		
0	1	272.3721279	$ 32,684.66	0	0	$ -	0	0		$ -	$ -		15
179.99233	1	120.9090615	$ 14,509.09	1	300.9013915	$ 54,162.25	2	43		$ 85,971.83	$ 85,971.83	Part Davis Street existing footpath length covers both sides of street	86
266.0215402	0	0	$ -	1	266.0215402	$ 47,883.88	0	0		$ -	$ -	Kerb and channel one side only; Footpath existing on one site	48
93.8536066	1	93.25704423	$ 11,190.85	1	187.1106508	$ 33,679.92	2	27		$ 53,460.19	$ 53,460.19	Footpath existing at northern end of Henley St	53
0	0	0	$ -	1	182.1048873	$ 32,778.88	0	0		$ -	$ -		104
117.3	0	0	$ -	1	95.82784787	$ 17,249.01	2	14		$ 27,379.39	$ 27,379.39		14
259.9483441	0	0	$ -	1	259.9483441	$ 46,790.70	2	37	$ 185,677.39		$ 185,677.39	Footpath existing on one side	64
0	1	287.008784	$ 34,441.05	1	287.008784	$ 51,661.58	2	41	$ 205,006.27		$ 205,006.27	Footpath to be implemented on both sides (one shared, one footpath)	13
0	1	539.2397726	$ 64,708.77		0	$ -	0	0		$ -	$ -		19
0	1	233.8060188	$ 28,056.72		0	$ -	0	0		$ -	$ -		80
0	0	0	$ -	1	88.20519722	$ 15,876.94	0	0		$ -	$ -		70
		1473.344984	**$ 176,801.40**		**2506.378964**	**$ 451,148.21**		0		$ -	**$ 549,175.35**		
0	1	107.4600562	$ 12,895.21	0	0	$ -	0	0		$ -	$ -		69
0	1	459.1336962	$ 55,096.04	1	459.1336962	$ 82,644.07	0	0		$ -	$ -		23
0	1	375.9073914	$ 45,108.89	1	375.9073914	$ 67,663.33	2	54		$ 107,402.11	$ 107,402.11		65
99.58026403	0	0	$ -	1	347.800459	$ 62,604.08	0	0		$ -	$ -		45
0	0	0	$ -	1	527.1120988	$ 94,880.18	0	0		$ -	$ -		28
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		54
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		72
0	1	530.8438397	$ 63,701.26	0	0	$ -	2	76		$ 151,669.67	$ 151,669.67		20
0	0	0	$ -	0	0	$ -	2	145		$ 290,103.57	$ 290,103.57		59
0	0	0	$ -	1	676.0068862	$ 121,681.24	0	0		$ -	$ -		27
0	0	0	$ -	1	120.4184325	$ 21,675.32	0	0		$ -	$ -		71
		0	**$ -**		**0**	**$ -**		0		$ -	**$ -**		
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		46
		0	**$ -**		**0**	**$ -**		0		$ -	**$ -**		
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		50
		2626.182054	**$ 315,141.85**		**2100.46822**	**$ 378,084.28**		0		$ -	**$ 545,347.40**		
0	1	654.6943093	$ 78,563.32	0	0	$ -	0	0		$ -	$ -		57
0	1	122.5082251	$ 14,700.99	0	0	$ -	0	0		$ -	$ -		32
0	1	239.1780249	$ 28,701.36	0	0	$ -	0	0		$ -	$ -		52
0	1	203.042637	$ 24,365.12	0	0	$ -	0	0		$ -	$ -		8
0	1	661.6971088	$ 79,403.65	0	0	$ -	0	0		$ -	$ -		38
0	1	338.0893769	$ 40,570.73	0	0	$ -	0	0		$ -	$ -		10
0	0	0	$ -	1	579.7666526	$ 104,358.00	2	83		$ 165,647.62	$ 165,647.62	This shared path could be provided by funds raised in development of Precinct F	93
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		76
0	1	406.9723719	$ 48,836.68	0	0	$ -	0	0		$ -	$ -		56
0	0	0	$ -	1	191.7523069	$ 34,515.42	0	0		$ -	$ -		90
0	0	0	$ -	1	458.767478	$ 82,578.15	2	66		$ 131,076.42	$ 131,076.42		102
0	0	0	$ -	1	88.22637552	$ 15,880.75	2	13		$ 25,207.54	$ 25,207.54		25
0	0	0	$ -	1	681.5656326	$ 122,681.81	2	97		$ 194,733.04	$ 194,733.04		82
0	0	0	$ -	1	100.3897743	$ 18,070.16	2	14		$ 28,682.79	$ 28,682.79		24

KEY	PRECINCT	ROAD NAME / ITEM	LOCATION	INTERSECTIONS	ROAD SEAL			$ 800.00	KERB & CHANNEL	$ 100.00
				Upgrade Required?	Existing road (m)	Existing surface	Proposed seal (m)	Cost	Proposed kerb & channel (m)	Cost
	PRECINCT F						**0**	**$ -**	**0**	**$ -**
39	Precinct F	**Glovers Rd**	Eastern Section Connecting to Lang Lang-Poowong Road, For Multi-Purpose Loop		468.0476112	Unsealed	0	$ -	0	$ -
40	Precinct F	**Glovers Rd**	North of Precinct F (Unmade Section), For Multi-Purpose Loop		351.9745338	Unmade Road Reserve	0	$ -	0	$ -
41	Precinct F	**Glovers Rd**	North of Precinct F, For Multi-Purpose Loop		1616.732356	Unsealed	0	$ -	0	$ -
42	Precinct F	**Glovers Rd**	Unmade Slip Lane to Glovers Rd		87.73489814	Unsealed	0	$ -	0	$ -
43	Precinct F	**Hogans Rd**	Between Yannathan Rd and Hatchs Rd, for Multi-Purpose Loop		569.2023626	Unmade Road Reserve	0	$ -	0	$ -
44	Precinct F	**Lang Lang - Poowong Rd**	Between Glovers Rd and Follett Dr, Shared Path is Multi-Purpose Loop		982.1771276	Sealed	0	$ -	0	$ -
45	Precinct F	**Yannathan Rd**	Eastern Boundary Precinct C, Shared Path Recreation Loop	Yes	361.7862961	Sealed	0	$ -	0	$ -
46	Precinct F	**Yannathan Rd**	Adjacent to Precinct E and F, Shared Path Recreation Loop		121.1514515	Sealed	0	$ -	0	$ -
	PRECINCT G						**0**	**$ -**	**0**	**$ -**
47	Precinct G	**Cornishs Rd**	Unsealed section to east of Speedway and Rail Trail, for Multi-Purpose Loop		299.2792787	Unsealed	0	$ -	0	$ -
48	Precinct G	**Follett Dr**	Includes newly constructed court in east		1012.434652	Sealed	0	$ -	0	$ -
49	Precinct G	**Glovers Rd**	Unmade road east of Precinct G connecting to Cornishs Rd in west, for Multi-Purpose Loop		780.9765476	Unmade Road Reserve	0	$ -	0	$ -
50	Precinct G	**Ian Ct**	Existing Court		125.4312629	Sealed	0	$ -	0	$ -
	PRECINCT H						**742.4862758**	**$ 593,989.02**	**0**	**$ -**
51	Precinct H	**Anna Cl**			242.8510964	Sealed	0	$ -	0	$ -
52	Precinct H	**Berrys Rd**	East of Carlisle Cl		549.8230608	Unsealed	549.8230608	$ 439,858.45	0	$ -
53	Precinct H	**Berrys Rd**	Adjacent to GRZ1		192.6632151	Unsealed	192.6632151	$ 154,130.57	0	$ -
54	Precinct H	**Carlisle Cl**			405.7719406	Sealed	0	$ -	0	$ -
55	Precinct H	**Cornishs Rd**	Unsealed section adjacent to Speedway, for Multi-Purpose Loop		369.1498515	Unsealed	0	$ -	0	$ -
56	Precinct H	**Cornishs Rd**	Sealed section in north-west of Precinct H		25.09669573	Sealed	0	$ -	0	$ -
57	Precinct H	**Eagle Rise**			492.6289502	Sealed	0	$ -	0	$ -
58	Precinct H	**Henrys Rd**	In GRZ1 and Precinct B		874.7462529	Sealed	0	$ -	0	$ -
59	Precinct H	**Henrys Rd**			92.56760604	Unsealed	0	$ -	0	$ -
60	Precinct H	**Mia Cr**			68.62437414	Sealed	0	$ -	0	$ -
								$ 3,978,275.78		**$ 1,291,269.20**

Special Charge Scheme Items	*Address existing issues. Costs shared by Council and precinct ratepayers*
Developer Directly Funded Items	*Addresses items reasonably paid for by developers as part of construction*
Potential Developer Contribution Items	*Addresses items potentially funded by developer contributions*

FOOTPATHS			$ 120.00	SHARED PATHS		$ 180.00	STREET TREES		$ 5,000.00	$ 2,000.00		NOTES	
Existing Path (m)	New paths footpaths proposed	Proposed footpath (m)	Cost	New shared paths proposed	Proposed shared path (m)	Cost	Sides required	No. trees (m/14)	Mature street trees ($)	Street tree saplings ($)	Total ($)		Archive_Key
482.9377476		**482.9377476**	**$ 57,952.53**		**4471.071739**	**$ 804,792.91**		0		$ -	**$ 137,982.21**		
0	0	0	$ -	1	468.0476112	$ 84,248.57	0	0		$ -	$ -		37
0	0	0	$ -	1	351.9745338	$ 63,355.42	0	0		$ -	$ -		51
0	0	0	$ -	1	1616.732356	$ 291,011.82	0	0		$ -	$ -		99
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		11
0	0	0	$ -	1	569.2023626	$ 102,456.43	0	0		$ -	$ -		103
0	0	0	$ -	1	982.1771276	$ 176,791.88	0	0		$ -	$ -		26
0	1	361.7862961	$ 43,414.36	1	361.7862961	$ 65,121.53	2	52		$ 103,367.51	$ 103,367.51		555
0	1	121.1514515	$ 14,538.17	1	121.1514515	$ 21,807.26	2	17		$ 34,614.70	$ 34,614.70	Item cost could be borne by Precinct D developer	81
1137.865915		**1137.865915**	**$ 136,543.91**		**1080.255826**	**$ 194,446.05**		0		$ -	**$ -**		
0	0	0	$ -	1	299.2792787	$ 53,870.27	0	0		$ -	$ -		43
0	1	1012.434652	$ 121,492.16	0	0	$ -	0	0		$ -	$ -		61
0	0	0	$ -	1	780.9765476	$ 140,575.78	0	0		$ -	$ -		77
0	1	125.4312629	$ 15,051.75	0	0	$ -	0	0		$ -	$ -		34
192.6632151		**192.6632151**	**$ 23,119.59**		**369.1498515**	**$ 66,446.97**		0		$ -	**$ -**		
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		18
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		92
0	1	192.6632151	$ 23,119.59	0	0	$ -	0	0		$ -	$ -		68
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		21
0	0	0	$ -	1	369.1498515	$ 66,446.97	0	0		$ -	$ -		42
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		74
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		17
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		73
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		35
0	0	0	$ -	0	0	$ -	0	0		$ -	$ -		22
			$ 895,150.41			**$ 2,195,001.58**					**$ 1,790,000.02**		

FIGURE 31. INFRASTRUCTURE REFERENCE MAP - ALL PRECINCTS

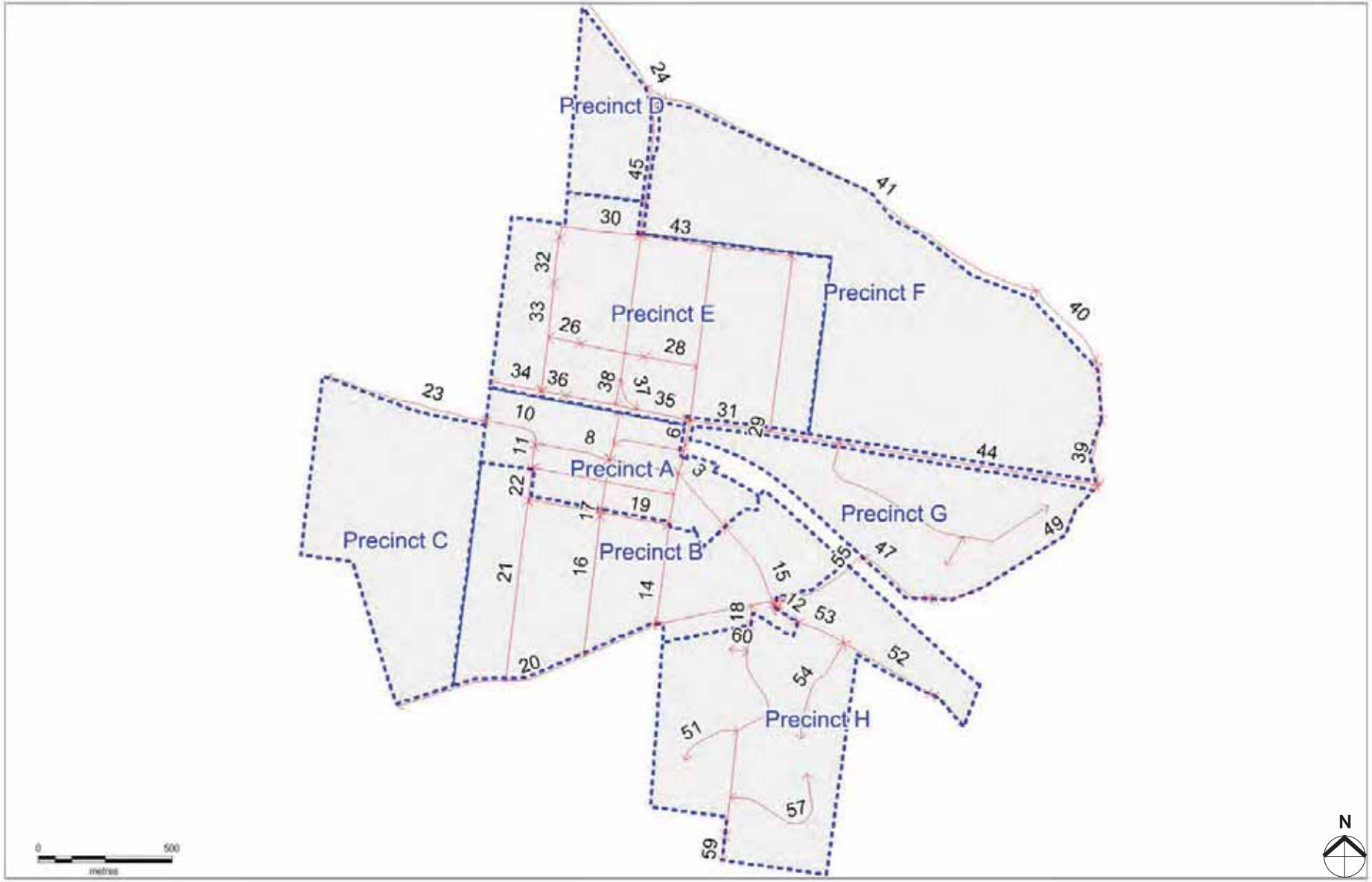


FIGURE 32. INFRASTRUCTURE REFERENCE MAP - PRECINCT A

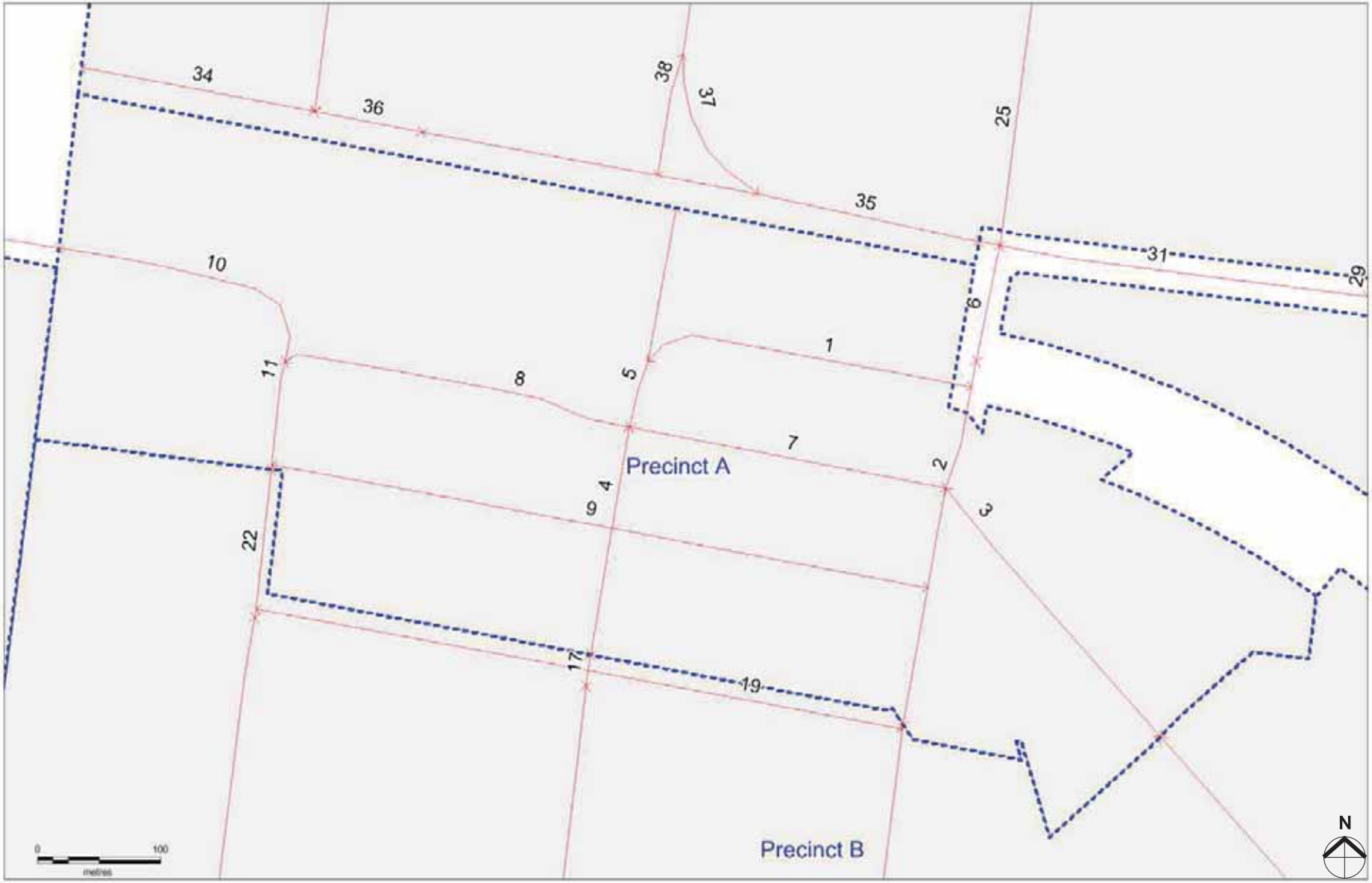


FIGURE 33. INFRASTRUCTURE REFERENCE MAP - PRECINCTS B & C

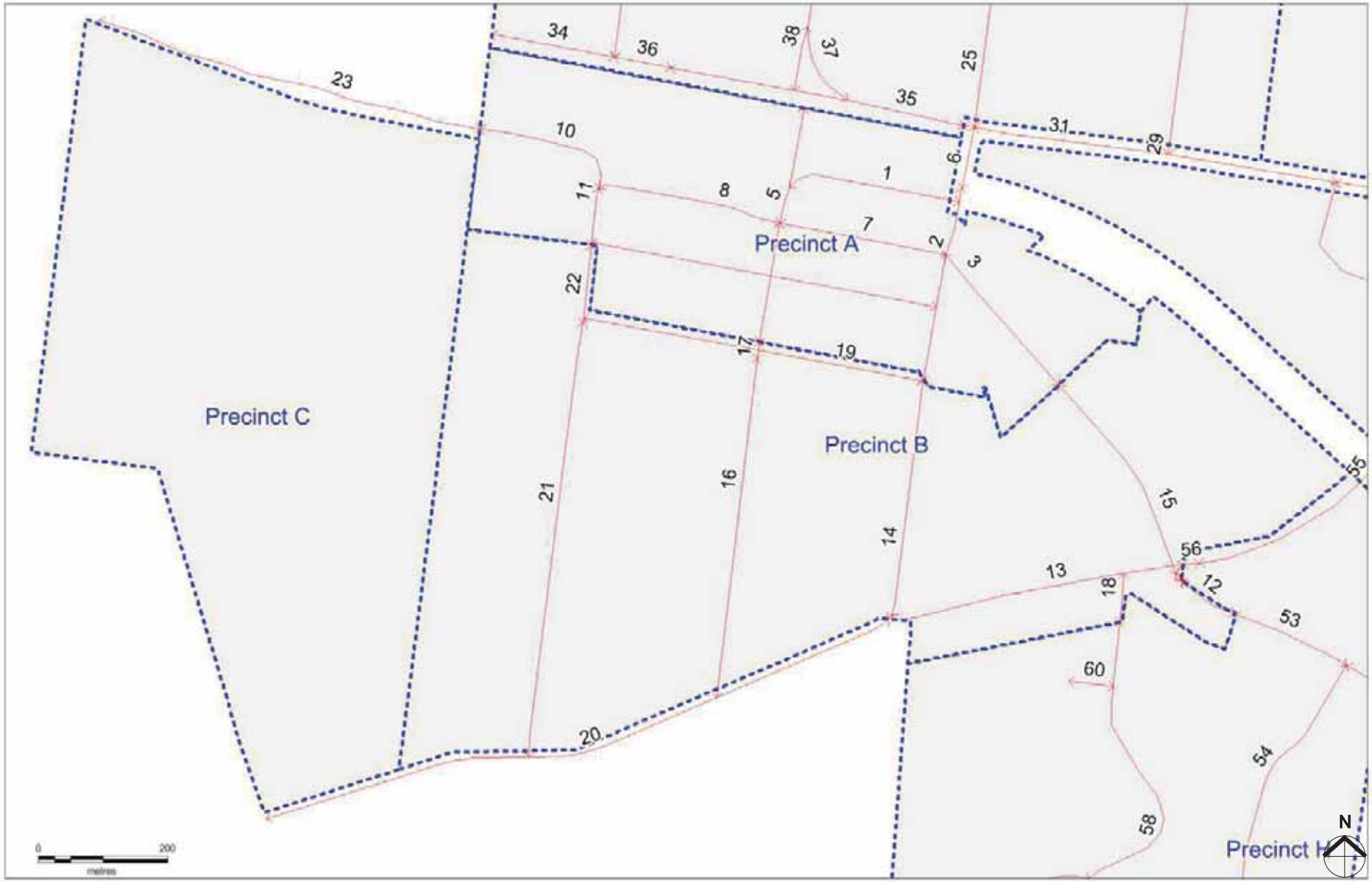


FIGURE 34. INFRASTRUCTURE REFERENCE MAP - PRECINCTS D, E & F

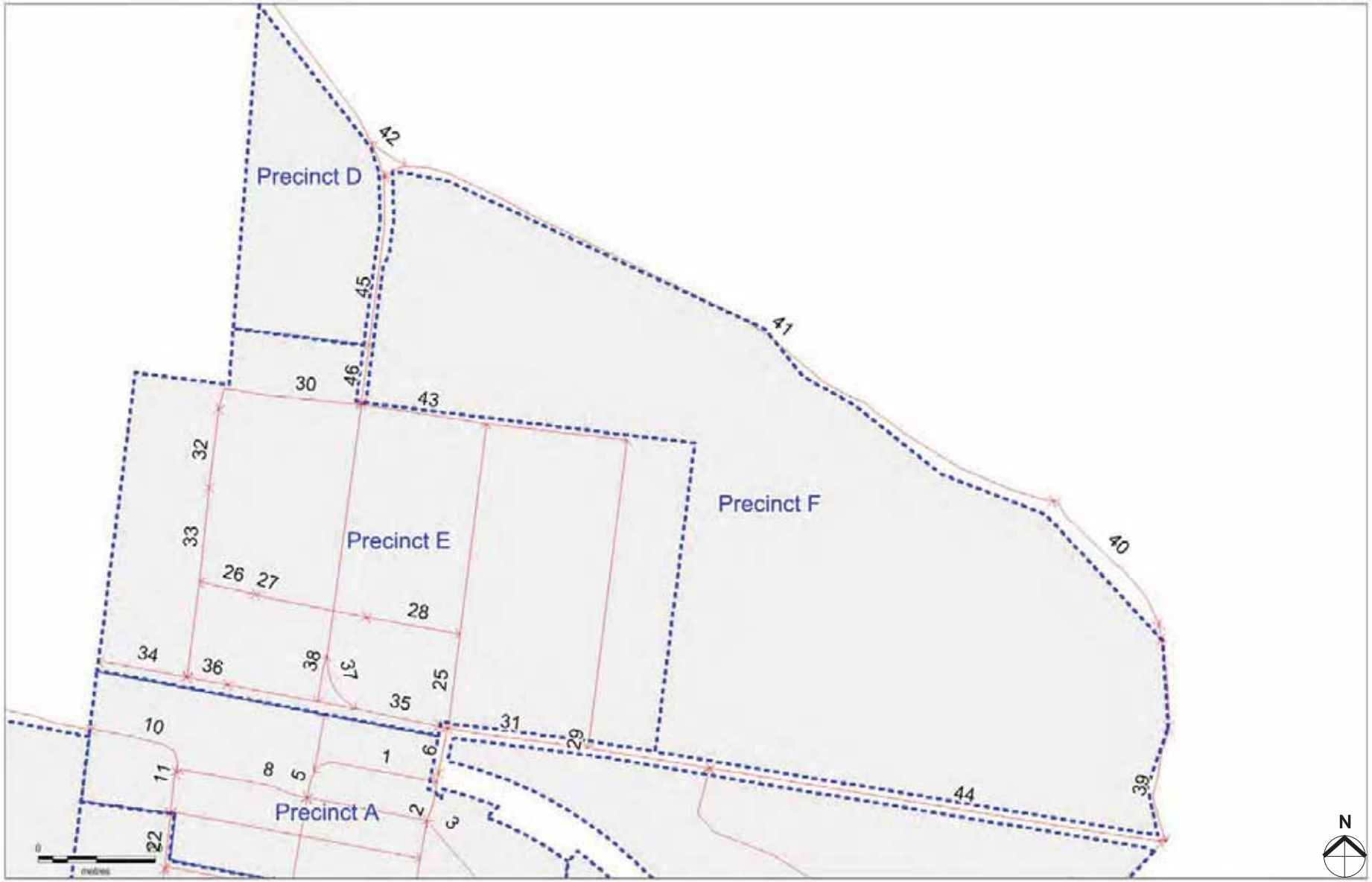
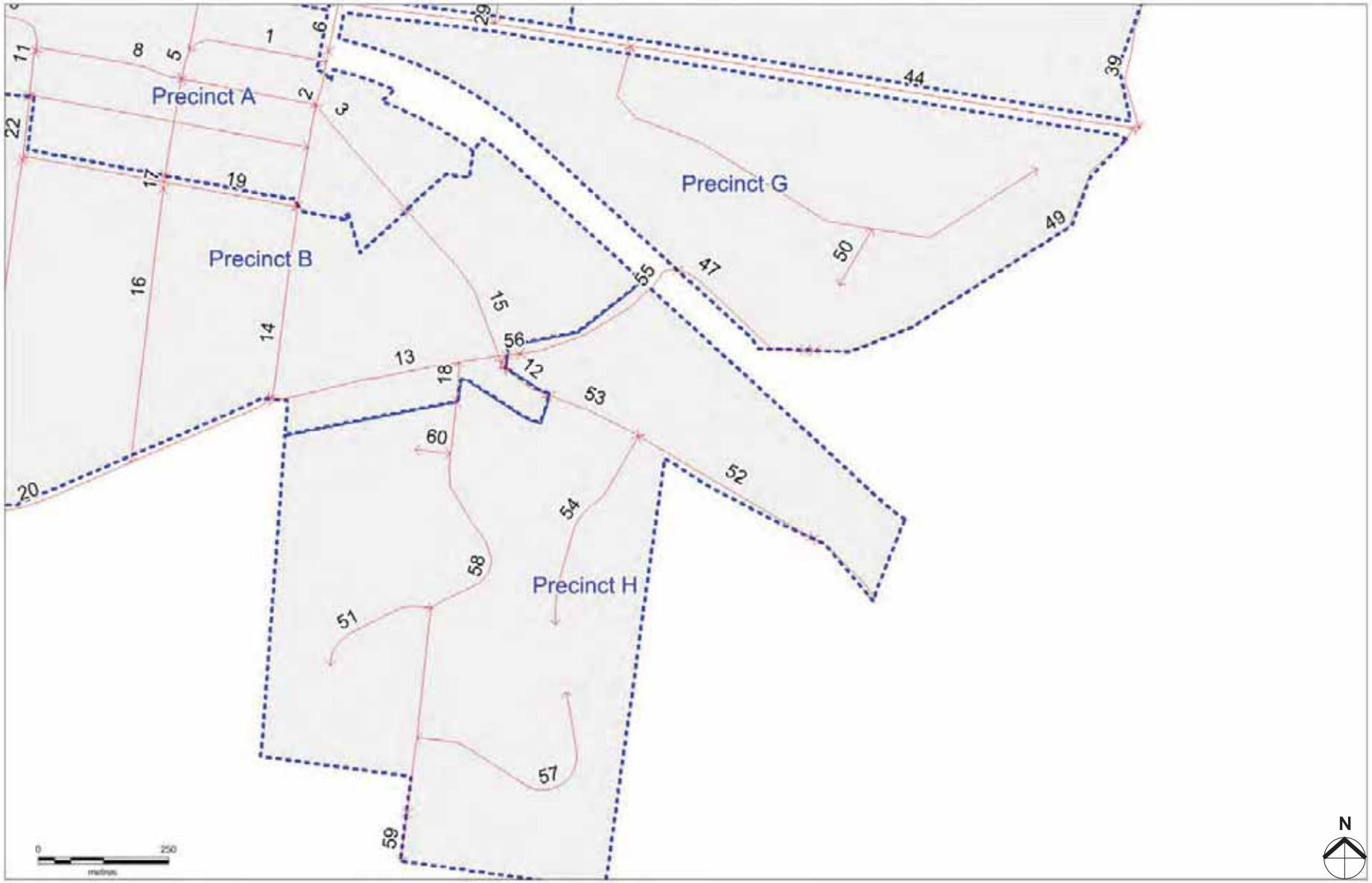


FIGURE 35. INFRASTRUCTURE REFERENCE MAP - PRECINCTS G & H



IMPLEMENTATION: TIMING

The Precinct plans on the following pages show proposed timing for infrastructure implementation, including:

- Road seal
- Kerb and channel
- Footpath
- Shared paths
- Multi-purpose recreation loop
- Intersection upgrades.

The plans show the likely timing of infrastructure implementation based on anticipated development patterns. In some cases, the timing and implementation will be reliant on development occurring, as the costs may be covered by development contributions linked to that Precinct, or collected by Council for off-site use (for example, in the case of the Multi-Purpose Recreation Trail).

Davis Street, viewed from the former railway line and looking south

FIGURE 36. PRECINCT A STAGING PLAN

LEGEND

- Precinct A
- Public Open Space (POS)
- Former Railway Line

PROPOSED INFRASTRUCTURE REQUIREMENTS

- Footpath - Medium-term
- Shared Path - Short-term
- Sealed Road - Medium-term
- Kerb and Channel
- Street Trees
- Traffic Management Works
- Facilities Upgrades

Nyora Community Park Upgrade

- Proposed Pedestrian Crossing
- Proposed Vegetation

Refer to Proposed Storm-water Management Plan (Engeny, 2016) for detailed drainage and storm-water management infrastructure requirements.

0 200m

N

Proposed path network is indicative and final implementation will be determined as development occurs

FIGURE 37. PRECINCT B STAGING PLAN

LEGEND

- Precinct B
- Public Open Space (e.g. Parks)
- Former Railway Line

PROPOSED INFRASTRUCTURE REQUIREMENTS

- Footpath - Short-Medium-term
- Shared Path - Short-Medium-term
- Sealed Road - Medium-Long-term
- Kerb and Channel - Medium-Long-term
- Essential East West Links and Drainage Trunks
- Street Trees
- Very Long-Term Intersection Improvements
- Facilities Upgrades

Refer to Proposed Storm-water Management Plan (Engeny, 2016) for detailed drainage and storm-water management infrastructure requirements.

N

0 300m

Proposed path network is indicative and final implementation will be determined as development occurs

Provision of public open space will be required as part of development plans as development occurs

FIGURE 38. PRECINCT C STAGING PLAN

LEGEND

- Precinct C
- Railway Line

PROPOSED INFRASTRUCTURE REQUIREMENTS

- Footpath - Very Long-term
- Shared Path - Long-term
- Sealed Road - Long-term
- Sealed Road - Very Long-term
- Kerb and Channel
- Piped Option or WSUD Option; depending on preference
- Street Trees
- Indicative Location Public Open Space (POS)

Refer to Proposed Storm-water Management Plan (Engeny, 2016) for detailed drainage and storm-water management infrastructure requirements.

0 300m

N

Proposed path network is indicative and final implementation will be determined as development occurs
Location of access/connector roads indicative only: roads must connect to Precinct B road links in future

FIGURE 39. PRECINCT D STAGING PLAN

LEGEND

- Precinct D
- Public Open Space (POS)
- Former Railway Line

PROPOSED INFRASTRUCTURE REQUIREMENTS

- Footpath - Very Long-term
- Multi-Purpose Trail - Long-term
- Sealed Road - Very Long-term
- Kerb and Channel
- Street Trees

Refer to Proposed Storm-water Management Plan (Engeny, 2016) for detailed drainage and storm-water management infrastructure requirements.

N

0 300m

Proposed path network is indicative and final implementation will be determined as development occurs
Road connections are indicative only and must link logically with adjoining precincts in future
More road connections with footpaths and street trees will be required and determined through the Development Plan process

FIGURE 40. PRECINCT E STAGING PLAN

LEGEND

- Precinct E
- Public Open Space (e.g. Parks)
- Former Railway Line

PROPOSED INFRASTRUCTURE REQUIREMENTS

- Footpath - Short-Medium-term
- Footpath when subdivided
- Shared Path - Medium-term (Between Forster Dr and Wallis Watson land provided by the developer)
- Shared Path - Short-Medium-term
- Multi-Purpose Trail
- Sealed Road - Medium-Long term
- Kerb and Channel - Long-Very Long-term
- Street Trees - Short-term
- Traffic Management Works
- Long-Term Intersection Improvements

Refer to Proposed Storm-water Management Plan (Engeny, 2016) for detailed drainage and storm-water management infrastructure requirements.

0 75m

N

Proposed path network is indicative and final implementation will be determined as development occurs

FIGURE 41. PRECINCT F STAGING PLAN

LEGEND

- Precinct F
- Public Open Space (e.g. Park)
- Former Railway Line

PROPOSED INFRASTRUCTURE REQUIREMENTS

- Footpath - Short-term
- Footpath - Long-term
- Shared Path - Short-term
- Multi-Purpose Trail - Long-term
- Stormwater Management (e.g. Retarding Basin)
- Intersection Upgrades
- Long-Term Intersection Improvements
- Street Trees

Refer to Proposed Storm-water Management Plan (Engeny, 2016) for detailed drainage and storm-water management infrastructure requirements.

Footpaths are to be expected on all roads.

0 400m

N

Proposed path network is indicative and final implementation will be determined as development occurs

The Precinct F subdivision / street layout shown below is indicative only and will be determined as part of Development Plan

FIGURE 42. PRECINCT G STAGING PLAN

LEGEND

- Precinct G
- Public Open Space (e.g. Parks)
- Former Railway Line

PROPOSED INFRASTRUCTURE REQUIREMENTS

- Footpath - Long-term
- Multi-Purpose Trail - Long-term
- Street Trees

Refer to Proposed Storm-water Management Plan (Engeny, 2016) for detailed drainage and storm-water management infrastructure requirements.

0 200m

N

 Proposed path network is indicative and final implementation will be determined as development occurs

FIGURE 43. PRECINCT H STAGING PLAN

LEGEND

- Precinct H
- Public Open Space (POS)
- Former Railway Line

PROPOSED INFRASTRUCTURE REQUIREMENTS

- Sealed Road - Long-term
- Kerb and Channel

Refer to Proposed Storm-water Management Plan (Engeny, 2016) for detailed drainage and storm-water management infrastructure requirements.

0 120m

N

Proposed path network is indicative and final implementation will be determined as development occurs

COST ESTIMATES*

TABLE 23. PROPOSED INFRASTRUCTURE COST ESTIMATES

GENERAL ITEMS (excludes intersection upgrades, open space & community facilities)						TOTALS		
Precincts	**Road Seal**	**Kerb & Channel** *(Both sides of road)*	**Footpath**	**Shared Path**	**Street Trees** *(Both sides of street)*	**Sub-total**	**Contingency (30%)**	**Total**
Precinct A	$ 431,392	$ 451,614	$ 185,591	$ 300,083	$ 557,495	$ 1,926,175	$ 577,853	$ 2,504,028
Precinct B	$ 1,415,770	$ 573,865	$ 176,801	$ 451,148	$ 549,175	$ 3,166,761	$ 950,028	$ 4,116,789
Precinct C	$ 489,292	$ -	$ -	$ -	$ -	$ 489,292	$ 146,788	$ 636,080
Precinct D	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Precinct E	$ 1,047,833	$ 265,790	$ 315,142	$ 378,084	$ 545,347	$ 2,552,196	$ 765,659	$ 3,317,855
Precinct F	$ -	$ -	$ 57,953	$ 804,793	$ 137,982	$ 1,000,728	$ 300,218	$ 1,300,946
Precinct G	$ -	$ -	$ 136,544	$ 194,446	$ -	$ 330,990	$ 99,297	$ 430,287
Precinct H	$ 593,989	$ -	$ 23,120	$ 66,447	$ -	$ 683,556	$ 205,067	$ 888,622
TOTAL COST	**$ 3,978,276**	**$ 1,291,269**	**$ 895,150**	**$ 2,195,002**	**$ 1,790,000**	**$ 10,149,697**	**$ 3,044,909**	**$ 13,194,606**

STORMWATER ITEMS			
Works Description	**Est. Basic Construction Cost**	**Provisions**	**Total**
Pipes	$ 2,642,125.00	$ 184,949.00	$ 2,827,074.00
Channels	$ 832,923.00	$ -	$ 832,923.00
Culverts	$ 179,584.00	$ 34,121.00	$ 213,705.00
Retarding Basins	$ 1,162,711.00	$ 232,542.00	$ 1,395,253.00
Sediment Basins	$ 1,426,074.00	$ 285,215.00	$ 1,711,289.00
Litter Traps	$ 119,160.00	$ 23,832.00	$ 142,992.00
Bio-Retention Basins	$ 717,491.00	$ 143,498.00	$ 860,989.00
	$ 7,080,068.00	**$ 904,157.00**	**$ 7,984,225.00**

GRAND TOTAL
$21,178,831

SPECIAL CHARGE SCHEME ITEMS						TOTALS		
Precincts	**Road Seal**	**Kerb & Channel** *(Both sides of road)*	**Footpath**	**Shared Path**	**Street Trees** *(Both sides of street)*	**Sub-total**	**Contingency (30%)**	**Total**
Precinct A	$ -	$ 162,596	$ 34,441	$ -	$ -	$ 197,037	$ 59,111	$ 256,148
Precinct B	$ 85,968	$ 91,052	$ 12,895	$ -	$ -	$ 189,915	$ 56,975	$ 246,890
Precinct C	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Precinct D	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Precinct E	$ 856,490	$ 109,399	$ 315,142	$ -	$ -	$ 1,281,031	$ 384,309	$ 1,665,340
Precinct F	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Precinct G	$ -	$ -	$ 136,544	$ -	$ -	$ 136,544	$ 40,963	$ 177,507
Precinct H	$ 593,989	$ -	$ 23,120	$ -	$ -	$ 617,109	$ 185,133	$ 802,241
TOTAL COST	**$ 1,536,447**	**$ 363,047**	**$ 522,142**	**$ -**	**$ -**	**$ 2,421,635**	**$ 726,491**	**$ 3,148,126**

DEVELOPER DIRECT FUNDED ITEMS						TOTALS		
Precincts	**Road Seal**	**Kerb & Channel** *(Both sides of road)*	**Footpath**	**Shared Path**	**Street Trees** *(Both sides of street)*	**Sub-total**	**Contingency (30%)**	**Total**
Precinct A	$ 431,392	$ 172,250	$ 92,765	$ -	$ -	$ 696,408	$ 208,922	$ 905,330
Precinct B	$ 1,415,770	$ 390,987	$ 118,797	$ -	$ 549,175	$ 2,474,729	$ 742,419	$ 3,217,148
Precinct C	$ 489,292	$ -	$ -	$ -	$ -	$ 489,292	$ 146,788	$ 636,080
Precinct D	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Precinct E	$ 191,342	$ -	$ -	$ -	$ -	$ 191,342	$ 57,403	$ 248,745
Precinct F	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Precinct G	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Precinct H	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL COST	**$ 2,527,797**	**$ 563,237**	**$ 211,563**	**$ -**	**$ 549,175**	**$ 3,851,772**	**$ 1,155,531**	**$ 5,007,303**

POTENTIAL DEVELOPER CONTRIBUTION ITEMS						TOTALS		
Precincts	**Road Seal**	**Kerb & Channel** *(Both sides of road)*	**Footpath**	**Shared Path**	**Street Trees** *(Both sides of street)*	**Sub-total**	**Contingency (30%)**	**Total**
Precinct A	$ -	$ -	$ -	$ 119,295	$ -	$ 119,295	$ 35,789	$ 155,084
Precinct B	$ -	$ -	$ -	$ 451,148	$ -	$ 451,148	$ 135,344	$ 586,493
Precinct C	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Precinct D	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Precinct E	$ -	$ -	$ -	$ 104,358	$ -	$ 104,358	$ 31,307	$ 135,665
Precinct F	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Precinct G	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Precinct H	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL COST	**$ -**	**$ -**	**$ -**	**$ 674,801**	**$ -**	**$ 674,801**	**$ 202,440**	**$ 877,242**

BALANCE TO BE FUNDED BY OTHER SOURCES						TOTALS		
TOTAL COST	**-$ 85,968**	**$ 364,986**	**$ 161,446**	**$ 1,520,200**	**$ -**	**$ 1,960,664**	**$ 588,199**	**$ 2,548,863**

**The cost estimates outlined above are based on proposed infrastructure outlined in Chapters 5 and 6 of this strategy. Costs have been calculated based on $ per linear metre and pricing is based on the current construction index and may be subject to change in future. ^The cost of road seal assumes a 6m pavement width and includes excavation, Class 3 FCR, Class 2 FCR and 2 coat seal.*

B

APPENDIX B DESIGN GUIDELINES

DRAFT DESIGN GUIDELINES

INTRODUCTION

As outlined in the main part of the Future Nyora Strategy, it is recommended that a series of guidelines be used to design new development and subdivision as growth occurs across Nyora in future.

The design guidelines are intended to help preserve the important rural township character. They will provide detailed information about how this character can be maintained and enhanced through new development.

These guidelines have been derived from key statements and strategies contained in **Chapter 3**, **Chapter 4** and **Chapter 5**. They may be used as a tool to accompany planning decision-making, and could help inform creation of a new local policy or design objectives in new planning policy implemented under the recommendations of the Future Nyora Strategy.

GUIDELINES

These guidelines provide detailed direction for the siting and design of new development to address the following elements:

- Land maintenance
- Indigenous vegetation
- Established planting
- Views and vistas
- Siting and design of buildings and structures
- Signage and infrastructure
- Cultural heritage.

The guidelines include direction for development specifically in the town centre, which is likely to be the area of most change (for more information, refer to **Chapter 4** of the main Strategy).

They should be read in conjunction with the strategies and vision set out for each precinct in the main part of the Future Nyora Strategy.

DRAFT TOWN CENTRE DESIGN & DEVELOPMENT OVERLAY (DDO)

A draft Design and Development Overlay (DDO) has been created for the town centre, to guide development in that location. The DDO is based on town centre design guidelines outlined in the table on the following pages.

A copy of the draft DDO has been included in **Appendix C**.

ELEMENT	DESIGN GUIDELINE	AVOID
Native Vegetation & Landscape Setting	Where practical, protect and rehabilitate significant stands of remnant native vegetation, particularly at roadsides, throughout paddocks, and along river and creek corridors (such as Adam's Creek), subject to logical infrastructure requirements, fire protection and safety Minimise removal of native vegetation in new development Where vegetation loss cannot be avoided, balance the loss of vegetation with rehabilitation on the site or nearby areas, and replace any native or indigenous trees lost with indigenous trees that will grow to a similar size Encourage dwellings on the edge of townships to use drought-resistant and locally found plants and screen development to enhance a rural and non-suburban feel Minimise the removal of native vegetation in private property and new developments as well as along roadsides	Loss of significant stands of vegetation Ad hoc clearing and removal of vegetation (pursuant to Clause 52.17 of the South Gippsland Planning Scheme) Development which requires permanent clearing of native vegetation Lack of landscaping and substantial vegetation appropriate to the surrounding natural environment and existing landscape character Hard surfaces and hard edges in landscaping Loss of significant stands of vegetation Ad hoc clearing and removal of vegetation
Town Centre: Public Realm	Design buildings that can provide passive surveillance for open space, while expressing a clear delineation between public and private land New commercial development along Mitchell Street should reflect the pattern of existing retail development with narrow frontages located with 0m setback constructed to the front property boundary and with awnings/verandahs providing weather protection over the footpath Ground level façades should present well-articulated and active frontages to the street with high proportions of transparent glazing New development should be designed to allow vehicle access from the rear laneway only Materials and colours in new development should reference the existing rural township character, using timber, masonry and muted colours or tonings Development on Davis Street and Hewson Street should present active frontages to the street Use landscaping to soften the sides of buildings	Inactive frontages Large expanses of blank walls facing Mitchell Street The appearance of unarticulated façades and street walls that create a sense of visual bulk to the streetscape Over-provision of vehicle access along Mitchell Street that interrupts the pedestrian experience, lessens pedestrian safety and the feeling of a main street shopping strip Bright colours and highly reflective materials that do not reference existing rural township character and starkly contrast the natural landscape environment beyond the town Inactive frontages with small areas of glazing and poorly located entrances New buildings in the town centre that are not oriented towards the streetscape

ELEMENT	DESIGN GUIDELINE	AVOID
Building Design & Siting	General ▪ Ensure buildings respect the dominant building scale and forms in the area ▪ Ensure the height of buildings respects the landscape characteristics of the area ▪ Encourage the retention of older dwellings that contribute to the character of the area Residential Areas ▪ In lower density areas, ensure buildings and structures are set back sufficient distances from roads and side boundaries to ensure minimal visual intrusion ▪ Minimise the number and floor area of storage areas, outbuildings and ancillary structures, wherever possible ▪ Buildings should be setback a minimum of 3m from at least one side boundary to allow for landscaping, rear access and view lines between buildings Town Centre ▪ Ensure new commercial development is visually and physically connected to the street using glazing and entrances that are well-oriented to engage with the public realm ▪ Building façades in the town centre should not exceed 7.5m to preserve the feeling of fine grain development and a sense of openness ▪ Development above the 7.5m street facade should be setback to ensure the feeling of openness is maintained in the town centre ▪ Building materials should reflect the character of the area, such as masonry and timber ▪ Advertising signs should be designed to integrate with building design and avoid protrusion above roof lines, verandahs or parapets ▪ Roof forms should be typically pitched or make visual reference to the prevailing character of built form	Loss of a sense of openness Visual clutter Large expanses of blank walls should be avoided where visible from the street Advertising clutter on new buildings that protrudes from key building lines (above roof lines, verandahs or parapets) Visual clutter created by numerous sheds and outbuildings scattered around lower density residential buildings

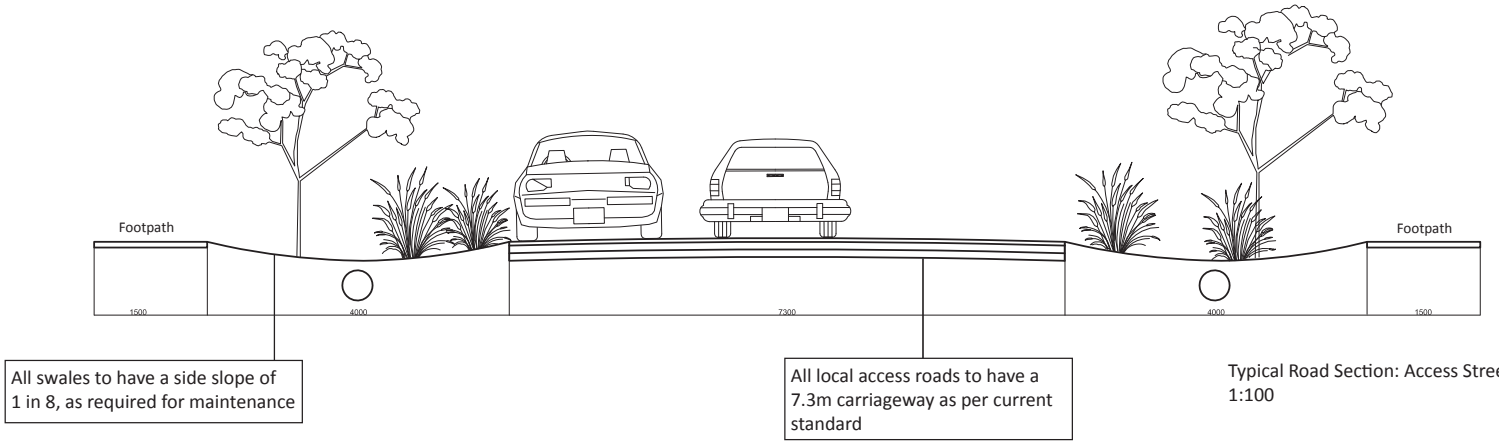
ELEMENT	DESIGN GUIDELINE	AVOID
Streets & Layout	Create and maintain wide open street profiles (particularly for main / collector roads) in new subdivisions that enhance a feeling of spaciousness Plant and retain large canopy trees in road reserves and median strips (where relevant) Use grid-based street and lot configuration oriented to follow contours / topography and designed at a scale to enhance walkability Create clear and logical connections to the existing street network from new subdivisions Provide areas of open space in larger developments that is well designed to take advantage of topography and flatter areas	Cul-de-sac style street layouts Curvilinear street layouts (other than is appropriate dependent on topography)
Size & Spacing	In residential areas: ▪ Create and maintain a feeling of spaciousness ▪ Retain views to surrounding areas and landscapes that contribute to the character of Nyora ▪ Maintain the sense of openness in the streetscape and the rhythm of spacing between buildings ▪ Buildings should be set back along at least one side boundary to allow for rear access, landscaping and view lines between buildings In the town centre: ▪ Use separation between taller built form to preserve a feeling of openness ▪ Encourage the appearance of 'fine grain' frontages on Mitchell Street in keeping with the pattern of existing development between Henley and Davis Street in that location	Narrow front and side setbacks Narrow rear setbacks which restrict space for the planting of large canopy trees Avoid a 'wall of development' appearance in the town centre Avoid 'boundary-to-boundary' style development with no side setbacks
Access	Minimise the dominance of car parking structures, driveways and number of vehicular crossovers Minimise the loss of garden space to car parking and vehicle storage Ensure development plans provide appropriate connections as outlined in the Strategy	Hard surfaces and hard edges in landscaping Cul-de-sacs and dead-ends in the road network

POSSIBLE STREET SECTIONS

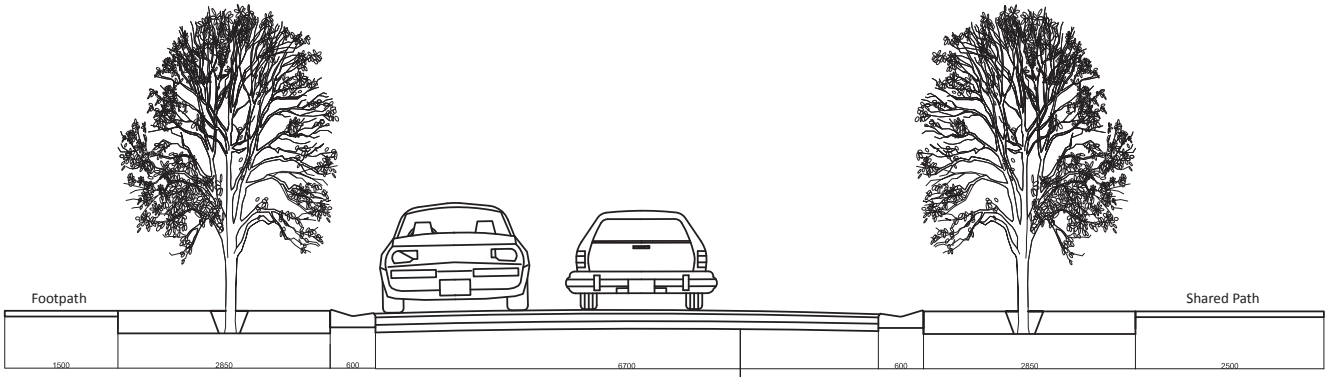
The following diagrams illustrate how the street sections might look throughout the town centre. These sections are indicative only, but show what a typical street width might be in some parts of the town centre. The sections also illustrate how space for pedestrians and shared paths will be incorporated into the design.

In the following chapter, the Precinct Plans show the possible location of shared and footpaths, which may have a similar layout to the sections shown here.

These sections are indicative only, but have been designed to include the spatial requirements from Council's Infrastructure Design Manual. In future, further work will be required to determine the ultimate configuration for the town centre, and other, streetscapes.

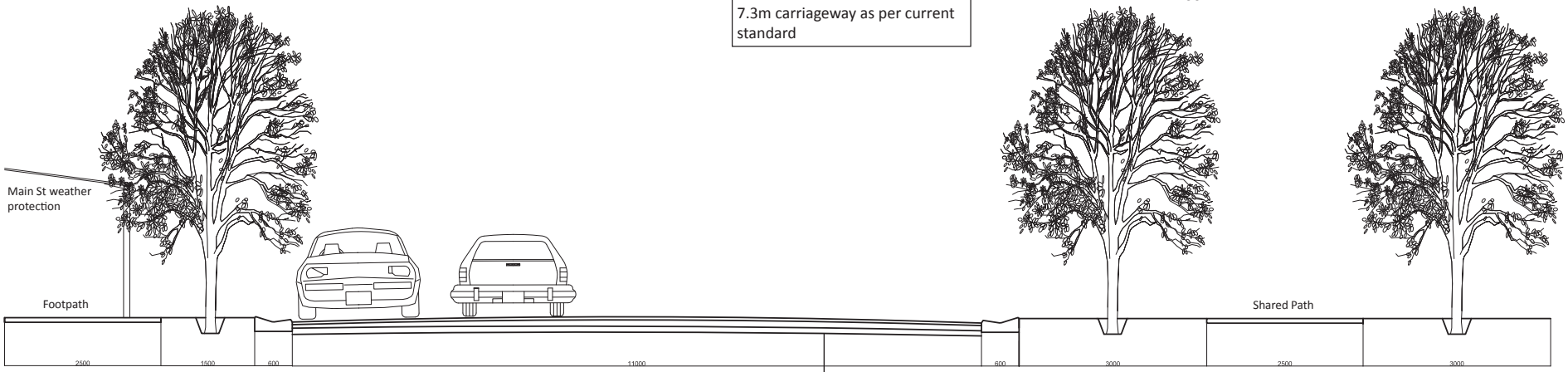


Typical Road Section: Access Street (Swale & Pipe)
1:100



All local access roads to have a 7.3m carriageway as per current standard

Typical Road Section: Access Street (SM2-M Modified Kerb as per standard)
1:100



11.6m carriageway to allow car parking on both sides

Typical Road Section: Main Access Street (Collector Function) Mitchell St
1:100

C

APPENDIX C DRAFT TOWN CENTRE DESIGN & DEVELOPMENT OVERLAY

TOWN CENTRE DRAFT DESIGN & DEVELOPMENT OVERLAY

A draft Design and Development Overlay (DDO12) for the town centre has been prepared to guide the implementation of urban design and planning outcomes put forward in **Chapter 3** (Town Centre Masterplan).

The DDO is a planning overlay control which puts in place objectives and strategies to achieve a desired look and feel for buildings and street layouts in new development or as new development occurs.

The purpose of the DDO is to "identify areas which are affected by specific requirements relating to the design and built form of new development." For certain types of development, the DDO triggers a planning permit. The following elements can be affected by the control and required by a planning permit:

- Construct a fence (if specifically required)
- Building setbacks (buildings set back from front, side or rear boundaries)
- Building height (e.g. maximum building height)
- Plot ratio (e.g. the percentage of the site covered by buildings)
- Landscaping (e.g. the need to plant new trees when building a new development).

This draft DDO specifically relates to land in the Nyora Town Centre and sets out objectives (e.g. desired outcomes) and ways to achieve these outcomes for people wanting to develop in the area. The design guidelines set out in **Appendix B** of this report could be made into a brochure to help people respond to the DDO requirements when designing a new development. A map showing the proposed boundary of the new DDO (where it applies) is included in **Chapter 6** of this report, in the implementation section.

The design guidelines and requirements included in the draft DDO12 are derived from the Town Centre Masterplan discussion, set out in **Chapter 4** of the Future Nyora Strategy.

In the proposed DDO12, a permit is needed for buildings and works which must respond to the design objectives and requirements set out under the relevant sections of the policy:

- Street activation
- Height and setbacks
- Design and materials
- Movement
- Landscaping.

The draft DDO12 outlined below includes a discretionary maximum height control of 7.5m in some areas of the town centre. This building height is commonly used in the DDO to preserve built a form scale that responds to low-rise character and view sharing (i.e. this height accommodates two storey built form).

The recommended building height also creates opportunities for pitched roof forms on two storey buildings, or the use of parapets, skillion roof forms or advertising signage to mask building plant from the public realm. The recommended maximum height also relates to the opportunities and qualities identified for the town centre, seeking to maintain connection with the surrounding rural area, while allow for some densification through two storey built form opportunities in future.

In the Movement section of the draft DDO12 the opportunity to create a link between the core retail strip of Mitchell Street opposite the Nyora Community Park and the laneway to the south of Mitchell Street, which is proposed to be sealed, has been identified. New development on lots central to the block between Davis Street and Henley Street should create opportunities for this link by creating a side setback.

It is recommended that wider frontages be subject to this principle (e.g. 18m) to enable lots to retain a frontage of approximately 15m in line with the existing streetscape. To address weather protection, arcades could also be used to create links to the laneway. This will improve pedestrian connectivity and walkability around the town centre in line with the objectives of the Town Centre Masterplan in Chapter 4.

For further details, refer to the draft DDO12 included over the following pages.

SCHEDULE 12 TO THE DESIGN AND DEVELOPMENT OVERLAY

Shown on the planning scheme map as **DDO12**

NYORA TOWN CENTRE

1.0 Character statement

Nyora Town Centre will have a vibrant country town character; active street frontages; identifiable, distinctive main street; strong physical and visual linkages to the historic railway reserve and surrounding residential areas; and a variety of retail, commercial and service activities that provide for a growing population.

2.0 Design objectives

Town centre growth and change

To provide a town centre framework that allows for orderly development over time, while protecting valued township features.

To consolidate retail, commercial and community services within a high amenity, pedestrian-friendly precinct bounded by Mitchell, Davis, Hewson and Henley Streets.

To reinforce Mitchell Street as the 'main street' of the town and the focus of retail and pedestrian public activity.

To provide for a supermarket development fronting Davis Street that is physically and visually connected to the Mitchell Street precinct.

To create a civic spine of community-based activity along Henley Street.

Built form and landscape character

To ensure new development maintains a moderately scaled, fine grain 'country town' character.

To maintain visual links between buildings to the landscape backdrop and create opportunities for new landscaping and pedestrian access.

To create an attractive, safe and active town centre.

To encourage high quality public spaces and buildings that are easy to maintain.

Movement

To enable easy pedestrian movement between residential areas, public open space and other destinations such as the school and shops.

To establish a pedestrian movement network that effectively connects public spaces with future commercial and community infrastructure developments.

3.0 Buildings and works

Permit requirement

A planning permit is not required to:

- Install an automatic teller machine.
- Alter an existing building facade provided:
  - The alteration does not include the installation of an external roller shutter.
  - At least 80 per cent of the building facade at ground floor level is maintained as an entry or window with clear glazing.
- Make alterations and additions to a dwelling.
- Construct an outbuilding normal to a dwelling.

Street activation

Buildings on land abutting Mitchell Street, Davis Street, Hewson Street and Grundy Avenue must be designed with a primary facade and entrance fronting the street.

Buildings abutting pedestrian spaces and accessways should include entrances and windows in order to encourage activity and provide passive surveillance.

Ground level façades on Mitchell Street, Davis Street, Hewson Street and Grundy Avenue should present active frontages to the street with high proportions of transparent glazing.

Weather protection must be provided along the Mitchell Street by providing shelter in the form of canopies, verandas and awnings.

Height and setbacks

Building façades should not exceed 7.5 metres in height above natural ground level.

Portions of buildings in excess of 7.5 metres in height should be setback behind the front facade to maintain a human scale when viewed from the adjacent footpath.

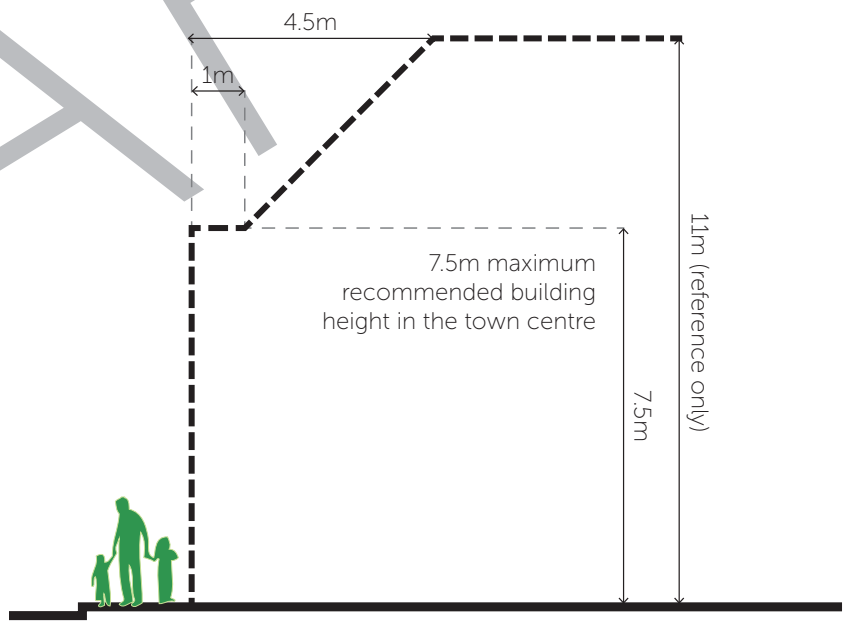
New buildings should have front setbacks as follows:

- 0 metres for lots fronting Mitchell Street, Davis Street (east side) and Grundy Avenue;
- 7.5 metres for lots fronting Davis Street (west side), Hewson Street and Henley Street.

Front setback areas must be landscaped and may provide for outdoor dining or temporary retail displays. No vehicle parking is to be provided between the building facade and the front boundary.

New buildings constructed on the following corners should have 0m setbacks to both streets:

- Mitchell Street and Henley Street;
- Mitchell Street and Davis Street;
- Davis Street and Grundy Avenue (both corners).



Indicative envelope showing maximum recommended extent of built form (building height to 7.5m may include signage, parapet, etc.)

Design and materials

Building elevations facing street frontages should be extensively glazed and constructed predominantly in masonry or timber.

Large expanses of blank walls should be avoided where visible from the street.

Roof forms should be pitched.

Plant, equipment, waste disposal, and loading bays must be completely screened from Mitchell and Davis Streets and softened by landscaping when viewed from other streets.

Any supermarket development should be designed to provide an active frontage to the adjoining street and support pedestrian connectively within the precinct, particularly to Mitchell Street.

Movement

New buildings on lots with a frontage to Mitchell Street of at least 18 metres, as appropriate, should be setback from one side boundary to provide for landscaped pedestrian access between Mitchell Street and the rear lane.

Vehicular access and loading within the block bounded by Mitchell, Davis, Hewson and Henley Streets must be provided from the rear or side of the lot.

No new vehicle crossings should be created on Mitchell Street.

Existing vehicle crossings on Mitchell Street should be removed as part of new development where the opportunity exists to provide an alternative access from the rear or side of the property.

Car parks on adjoining property should be designed to facilitate integration and ease of movement by vehicles and pedestrians.

Landscaping

Design buildings to retain healthy large canopy trees that contribute to the streetscape or will enhance proposed landscape areas.

Applications for new development should include a landscape plan. Where practical, provision should be made for the planting of canopy trees with designated root protection zones.

All new car parks with 10 or more spaces should be include areas for landscaping that are designed to provide shade, break up expanses of hard surfaces, and improve the quality of stormwater.

4.0 Subdivision

A permit is not required to subdivide land.

5.0 Advertising signs

Advertising signs should be designed to integrate with building designs and avoid protrusions above verandahs, roof lines or parapets.

Avoid the use of pole, promotion and billboard signs.

6.0 Decision guidelines

Whether the proposed development supports the character statement, design objectives and requirements of this Schedule.

PRECINCT E DRAFT DESIGN & DEVELOPMENT OVERLAY

To ensure that urban development can occur in Precinct E in the long-term, restrictions on subdivision and development are proposed to apply in the short to long-term. Now that sewer is available in these areas, lots can be subdivided as small as 2,000sqm. The proposed controls aim to prevent subdivision configurations and development that will stifle orderly subdivision at urban densities in the future. Examples of the type of development and subdivision that these controls seek to prevent are:

- Development, particularly dwellings and large outbuildings, located on or in close proximity to long-term road reservations
- Creation of irregularly shaped lots or other types of lot boundaries not aligned with the Very Long-Term Subdivision Concept that are difficult to re-subdivide

These controls provide benefits to land owners because they provide certainty and protect investment in the land over the long-term as well as ensuring orderly development in the very long-term.

The draft Precinct E Design and Development Overlay (DDO13) responds to the "Nyora at 5,000" discussion in **Chapter 5**. That section considers the very long-term prospect that Precinct E may become a more urban-style precinct, with smaller lot sizes and new subdivision layouts. This is a very long-term concept for the future; e.g. beyond 30 years.

The draft DDO13 has been designed to guide new subdivision layouts in the short- to long-term.

The DDO13 triggers a planning permit for the following:

- Construct a fence other than a post and wire fence with a maximum height of 1.2m above ground level
- Construct a building or carry out works on land within a 'long term road reservation' (refer to map in the DDO13)
- Construct a building or carry out works on land within 7.5m of a 'long term road reservation' (refer to map in the DDO13)
- Subdivision.

A copy of the draft DDO13 is included on the following pages.

The key design objectives that the DDO13 seeks to achieve are laid out in the draft policy, and are as follows:

- To provide for the creation of high amenity, full-serviced, low density residential allotments.
- To preserve the potential for the precinct to be rezoned and re-subdivided for urban development in the very long term.
- To facilitate development that will contribute to improvements in pedestrian access, drainage and road connectivity.
- To avoid land use conflicts and amenity impacts at the interface between residential and industrial zones.

For subdivision applications, the DDO13 seeks to achieve the objectives above by requiring applications include a site analysis, demonstrating how the proposed subdivision will be consistent with the Long Term Subdivision Concept shown on the plan included in the draft policy. New habitable development (e.g. dwellings) constructed in Precinct E will be required to be connected to reticulated sewerage and water, and new lots will be required to have direct access to an existing road reservation.

When assessing an application for subdivision in the DDO13 (Precinct E), the Council will need to consider how the design objectives and requirements of the DDO13 have been addressed by a landowner / developer.

For further details refer to the draft DDO13 policy, over the following pages.

SCHEDULE 13 TO THE DESIGN AND DEVELOPMENT OVERLAY

Shown on the planning scheme map as **DDO13**

NYORA NORTH LOW DENSITY PRECINCT

1.0 Design objectives

To provide for the creation of high amenity, low density residential allotments.

To ensure that development (including subdivision) preserves the potential for the precinct to be rezoned and re-subdivided for urban development in the very long-term.

To facilitate development that will contribute to improvements in pedestrian access, drainage and road connectivity.

To avoid land use conflicts and amenity impacts at the interface between residential and industrial zones.

2.0 Buildings and works

Permit requirement

A planning permit is not required to construct a building or carry out works where:

- Land is outside a 'long term road reservation'; and
- Land is not within 7.5 metres of a 'long term road reservation';

as shown in Map 1 – 'Very Long Term Subdivision Concept'.

A planning permit is not required to construct or extend an out-building (other than a garage or carport) on a lot provided that the gross floor area of the out-building does not exceed 10 square metres.

A planning permit is required to construct a fence other than a post and wire fence with a maximum height of 1.2 metres above natural ground level.

A fence must not be constructed between two abutting accessways where both provide access to a battle axe lot. This does not apply to a post and wire fence with a maximum height of 1.2 metres above natural ground level.

Buildings and works must be constructed in the 'long-term road reservation.'

Unless otherwise specified by the responsible authority:

- Buildings must not be constructed within 4m of the 'long-term road reservation'
- Built form must be wholly contained within a future lot set out on the 'Indicative Lot Layout' in the very long-term subdivision concept plan as shown on Map 1
- Where a lot has an interface with the industrial zone, provide greater setbacks to minimise potential amenity conflicts.

3.0 Subdivision

An application must be accompanied by a site analysis, documenting the site in terms of land form, vegetation coverage and the relationship with surrounding land, and a report explaining how the proposed subdivision has responded to the site analysis. The report must:

- Demonstrate that each lot is capable of being connected to reticulated sewerage and water;
- Demonstrate that the subdivision is generally consistent with the Very Long Term Subdivision Concept shown in Map 1;

- Show for each lot:
  - A building envelope and driveway to the envelope; and
  - Existing vegetation.
- Show how the proposed subdivision relates to the existing and likely use and development of adjoining and nearby land.
- Address any known infrastructure deficiencies or flooding issues and demonstrate how the subdivision will assist in mitigating them.
- All lots must be provided with direct access to an existing road reservation.
- Building envelopes should be orientated so that each dwelling fronts a 'long term road reservation' as shown in Map 1.

The creation of battle-axe lots should be avoided. Where they cannot be avoided accessways should be located:

- Within a 'long term road reservation' shown in Map 1 – Long Term Subdivision Concept;
- So as to avoid the creation of more than two accessways that directly abut.

Unless otherwise approved by the responsible authority, subdivision layouts should be generally consistent with the Indicative Lot Layout in the Very Long Term Subdivision Concept at Map 1.

4.0 Decision guidelines

Whether the proposed development supports the design objectives and requirements of this schedule.

Whether development and subdivision is undertaken generally in accordance with the Very Long Term Subdivision Concept.

MAP 1: Long Term Subdivision Concept

[SEE VERY LONG TERM SUBDIVISION CONCEPT ON OPPOSITE PAGE]

FIGURE 44. DDO12 MAP: VERY LONG TERM SUBDIVISION CONCEPT

LEGEND

- Surrounding Precincts
- Existing Industrial Area
- Existing Public Open Space (POS)
- Adam's Creek with 40m riparian protection buffer (80m total distance)
- Transition from Precinct E to F
- Interface with Farming Zone
- Interface with Industrial Area

INDICATIVE SUBDIVISION LAYOUT - CONCEPT

- Indicative Lot Layout
- Proposed Long-Term Road Reservation (Typical reservation width 20m)
- Possible Future Pedestrian Connections

N

0 75m

D

APPENDIX D TRAFFIC IMPACT ASSESSMENT REPORT

TRAFFIC IMPACT ASSESSMENT REPORT

Refer to document attached

TraffixGroup

Traffic Engineers and Transport Planners

Traffic Impact Assessment Report

Nyora Development Strategy – Town Centre Masterplan

Prepared For
South Gippsland Shire Council

June, 2016
19584R#2

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Traffic Impact Assessment Report

Nyora Development Strategy – Town Centre Masterplan

Document Control

Issue No.	Type	Date	Prepared By	Approved By
A	Draft	14/06/16	B. Chisholm	N. Woolcock
B	Final	17/06/16	B. Chisholm	N. Woolcock

Our Reference: 19584R#2

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List of Appendices

1 Introduction

Traffix Group has been engaged by South Gippsland Shire Council as part of a consultant team led by Planisphere for the preparation of the Nyora Development Strategy.

This report provides a Traffic Impact Assessment (TIAR) of the proposed Nyora Town Centre Masterplan.

2 Existing Conditions

Traffix Group has previously prepared a 'Background Summary Report' as part of the earlier stages of the project (Our Ref: 19584R#1C). This report should be referred to for existing conditions information including the following:

- road network details (i.e. surface materials, carriageway widths, and speed limits),
- traffic volumes,
- crash statistics,
- footpaths, and
- public transport.

Our Background Summary Report is attached at Appendix A.

3 Town Centre Masterplan

The proposed Nyora Town Centre Masterplan (TCMP) is provided at Section 4.1 of the Nyora Development Strategy.

The proposed Town Centre Masterplan area is primarily bounded by Mitchell Street (to the north), Hewson Street (to the south), Henley Street (to the west) and Davis Street (to east). Additionally, the masterplan area includes a small number of commercial zoned properties on the east side of Davis Street as shown at Figure 1.

The objective of the Nyora Town Centre Masterplan is to provide a concept layout of land allocations and spatial arrangements for the town centre. It is noted that the layout and land-uses shown on the Masterplan are indicative only and may be subject to changes in the future when the town centre develops.

Figure 1: Town Centre Masterplan Area

4 Traffic Engineering Assessment

4.1 Road Network

The key roads within the TCMP are summarised following:

4.1.1 Davis Street

Davis Street is an arterial road managed by VicRoads and is aligned in a north-south direction in the vicinity of the town centre. Davis Street accommodates a single traffic lane in each direction. The existing carriageway of Davis Street is to be retained.

A footpath is proposed along the west side whilst a shared path is proposed along the east side of Davis Street through the town centre.

4.1.2 Mitchell Street

Mitchell Street is a local street aligned in an east-west direction. As part of the TCMP, Mitchell Street is to be prioritised as the 'main street' for Nyora.

The carriageway for Mitchell Street (between Davis Street and Henley Street) is proposed to be widened to approximately 11.6m. This carriageway width will provide parallel kerbside parking on both sides whilst accommodating simultaneous two-way traffic.

Mitchell Street has an existing footpath along its south side which is proposed to be widened. A new shared path is proposed along the north side of Mitchell Street.

4.1.3 Hewson Street

Hewson Street is a local street aligned in an east-west direction. As part of the TCMP, Hewson Street will have more importance as the primary carpark and loading access route for the town centre.

The carriageway width for Hewson Street is proposed to be widened to 7.3m. This carriageway width is sufficient to accommodate simultaneous two-way traffic when vehicles are parked on one side of the road only. It is recommended that parking is banned on one side of the road to ensure this is permanently possible.

Footpaths are proposed along both sides of Hewson Street.

4.1.4 Henley Street

Henley Street is a local street aligned in a north-south direction.

The carriageway width for Hewson Street is proposed to be widened to at least 7.3m, noting that the existing carriageway is wider than this to the north of the Nyora Town Hall (approximately 9.7m). This carriageway width is sufficient to accommodate kerbside parking on both sides and a single lane of through traffic. Alternatively, simultaneous two-way traffic when vehicles are parked on one side of the road only.

4.1.5 Laneway

An existing unsealed laneway is aligned in an east-west direction through the town centre. This laneway provides rear access to existing commercial zoned land fronting Mitchell Street

As part of the TCMP, this laneway is proposed to be upgraded to a sealed carriageway with footpaths on both sides.

It likely that this laneway will operate in one-way direction (eastbound) in the future.

4.2 Key Intersections

Improvements are proposed at the following key intersections located within the town centre:

4.2.1 Davis Street / Mitchell Street / Grundy Avenue

A concept roundabout layout has been prepared by Traffix Group for the Davis Street/Mitchell Street/Grundy Avenue intersection to replace the existing unsignalised cross-intersection. This concept plan is attached as an appendix to the Nyora Development Strategy report.

The concept roundabout has been designed to accommodate B-double truck movements in a north-south direction given that Davis Street is an approved B-double route. Furthermore, the roundabout has been designed to accommodate rigid truck movements (up to 12.5m in length) to/from Mitchell Street and Grundy Avenue.

The concept roundabout layout includes a single lane on each approach and departure and a single circulating lane. This roundabout layout will be more than sufficient from a capacity point of view to accommodate the predicted ultimate traffic volumes as presented later in this report at Section 4.4.

4.2.2 Davis Street / Hewson Street

Traffix Group has prepared a concept intersection layout for improvements at the Davis Street/Hewson Street intersection.

Hewson Street will become the primary access to the town centre carpark and loading areas. The potential large long-term supermarket will likely have deliveries undertaken by 19m semi-trailers.

Accordingly, the concept layout for the Davis Street/Hewson Street intersection has been designed to accommodate 19m semi-trailer movements between Davis Street and Hewson Street.

The existing carriageway width of Davis Street is sufficient for linemarking of two (2) southbound traffic lanes which provides for a southbound vehicle to pass a vehicle that is 'propped' waiting to turn right into Hewson Street.

4.3 Car Parking Provision Assessment

We have undertaken a car parking assessment for the TCMP based on the potential future uses and floor areas identified.

The TCMP identifies the following:

- Supermarket – short-term 1,000m^2, long-term 3,800m^2
- Commercial/Medical – 600m^2
- Proposed commercial/medical properties along Hewson Street (identified in grey)
- Community Hub – 900m^2
- Existing commercial zoned land along Mitchell Street
- Existing commercial zoned land along Davis Street

For the purposes of our assessment, we have made the following assumptions:

- 40% of the total site area for existing commercial zoned land along Mitchell Street assumed to be leasable floor area. The rest will be for landscaping, car parking, etc.
- An average car parking generation rate of 4 spaces per 100m^2 leasable floor area for existing commercial zoned land and proposed commercial/medical. This is to account for a range of potential uses including shop, retail, food and drink premises, office, medical centre, etc.
- 20% discounting for total car parking demands to allow for multi-purpose trips and sharing of parking due to different uses peaking at different times.
- For the proposed commercial/medical properties along Hewson Street, we have assumed that the car parking requirement for any potential use will be accommodated on-site.
- For the existing commercial zoned land along Davis Street, we have assumed the car parking requirement for any potential use will be accommodated on-site.
- For the existing commercial zoned land along Mitchell Street, we have assumed that 25% of car parking demand would be generated by staff who can park within the rear of individual sites with access via the laneway.

A detailed summary of our car parking assessment and other assumptions for the long-term scenario is attached at Appendix B.

We have estimated a total car parking provision of 376 car spaces for the town centre precinct. This includes off-street car parking identified on the TCMP as well as on-street car spaces along Mitchell, Henley and Hewson Streets. We have estimated the number of on-street spaces by assuming parallel parking along both sides of Mitchell Street and Henley Street (except where there is existing 90-degree parking) and on one side of Hewson Street.

We have calculated a potential long-term town centre car parking demand for 366 spaces which is exceeded by the total identified car parking provision for 376 spaces.

Based on the above assessment, we are satisfied that sufficient car parking appears to be identified for the potential long-term town centre outcome.

4.4 Traffic Impacts

As part of our involvement with the preparation of the Nyora Development Strategy, we undertook traffic modelling to determine ultimate daily traffic volumes throughout Nyora.

Our modelling was based on a high growth scenario and assumed maximum development potential throughout Nyora. Based on advice from Council, we adopted a daily traffic generation rate of 6 vehicle trip ends per allotment per day.

The predicted long-term traffic volumes in the vicinity of the town centre are shown below at Figure 2. Full output of our traffic modelling is attached as an appendix to the Nyora Development Strategy.

Our traffic modelling assumes that all traffic generated by the town centre would be internal trips generated by residential areas of Nyora (i.e. no vehicle trips from external areas given all surrounding townships already have a supermarket and other similar facilities).

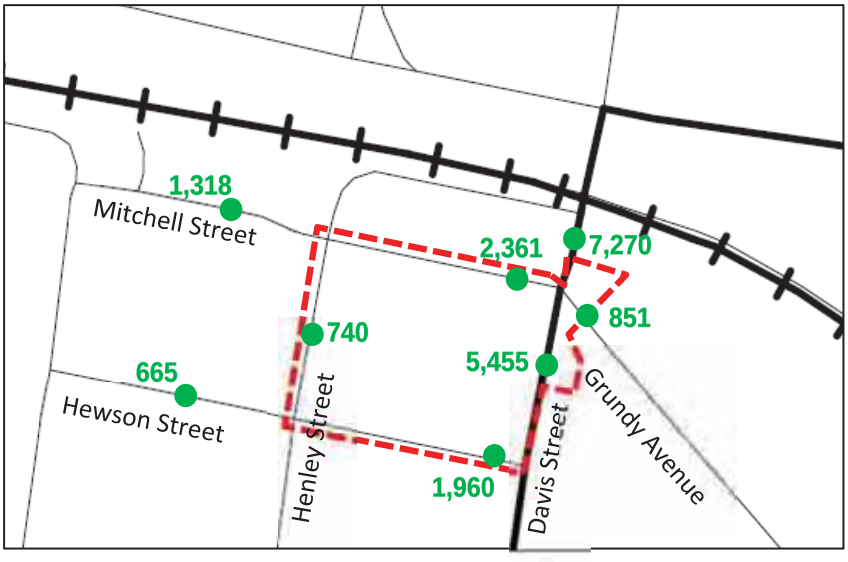

Figure 2: Predicted Ultimate Daily Volumes

We are satisfied that the proposed road cross-sections and improvements in the vicinity of the town centre (as discussed previously) will adequately accommodate the potential ultimate traffic predicted to be generated by the town centre.

4.5 Loading Arrangements

The potential loading routes for the Nyora TCMP are shown at Figure 3.

The east-west laneway will provide rear loading provision for the commercial zoned properties along the south side of Mitchell Street.

Loading access for larger trucks (potentially up to 19m semi-trailers for the supermarket) will be accommodated via Hewson Street and the proposed north-south access road. As previously discussed, the concept layout for the Davis Street/Hewson Street intersection has been designed to accommodate 19m semi-trailers.

We note that layout of the potential future supermarket will need to be designed to accommodate the relevant size trucks that are required.

We are satisfied that appropriate loading arrangements can be accommodated for the future Nyora town centre based on the TCMP.

Figure 3: Potential Loading Routes

4.6 Pedestrian and Cyclist Provisions

The TCMP identifies footpaths as a minimum on both sides of all roads within the town centre precinct. Furthermore, a shared path is identified along the northern side of Mitchell Street, eastern side of Davis Street and also the western side of Henley Street. A new pedestrian walkway is proposed between Mitchell Street and the centre of the town centre which will provide an important link for pedestrians.

This is a significant improvement to existing conditions where very limited footpaths are provided in Nyora as shown in our Background Summary Report.

Cyclists will be accommodated along each of the proposed shared path routes and also informally along all roads within the town centre.

As part of future town planning applications, bicycle parking for staff and customers will be required to be provided in accordance with the Planning Scheme rates under Clause 52.34. There is scope within the future town centre to provide bicycle parking rails at various locations including potentially within verges along Mitchell Street, Hewson Street and Davis Street.

We are satisfied that the TCMP identifies an appropriate level of pedestrian and cyclist provisions.

4.7 Public Transport

A V-Line bus service currently operates through Nyora along Lang Lang-Poowong Road (Davis Street). Existing bus stops are located on Davis Street just north and south of Mitchell Street for the northbound and southbound directions respectively.

As identified on the Town Centre Masterplan, the existing bus stops are proposed to be relocated to a more central and convenient location for the town centre on Davis Street to the south of Mitchell Street.

5 Conclusions

Having undertaken a traffic engineering assessment of the proposed Nyora Town Centre Masterplan, we are of the opinion that:

a) the proposed road cross-sections are consistent with what is required to accommodate appropriate carriageways, footpaths, services, etc. and appropriately facilitate all relevant user groups in accordance with relevant standards and current practice,

b) the proposed intersection concept layouts have been designed to adequately accommodate the relevant design vehicle movements and provide an improved outcome for pedestrians,

c) appropriate pedestrian and cyclist provisions are identified for the town centre,

d) all relevant vehicles will be able to adequately access and circulate through the town centre including service and emergency vehicles,

e) traffic predicted to be generated by the long-term growth scenario for Nyora will be adequately accommodated by the proposed road network and intersections, and

f) there are no traffic engineering reasons why the proposed Nyora Town Centre Masterplan should not be adopted.

Appendix A:
Background Summary Report

TraffixGroup

Traffic Engineers and Transport Planners

Background Summary Report

Nyora Development Strategy

Prepared For
South Gippsland Shire Council

April, 2016
19584R#1C

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Background Summary Report

Nyora Development Strategy

Document Control

Issue No.	Type	Date	Prepared By	Approved By
A	Draft	02/12/2015	B. Chisholm	N. Woolcock
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Our Reference: 19584R#1C

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1 Introduction

Traffix Group has been engaged by South Gippsland Shire Council as part of a consultant team led by Planisphere for the preparation of the Nyora Development Strategy.

This report provides a background summary of the traffic engineering related components of the project.

2 Existing Conditions

2.1 Study Area

The township of Nyora is located in South Gippsland, approximately 100km driving distance southeast of the Melbourne CBD. A locality plan of Nyora is presented at Figure 1.

Figure 1: Locality Plan

A map of existing land zoning within Nyora is provided at Figure 2.

A large proportion of the town comprises low-density residential and rural living allotments. A general residential zone is located to the east and west of Davis Street which comprises more standard size allotments.

There are limited commercial uses within Nyora, consisting primarily of a small strip of commercial land along the south side of Mitchell Street and east side of Davis Street. Furthermore, there is a small area of light industrial land with a number of businesses along the north side of Watts Road.

Nyora Primary School and Nyora Recreation Reserve are located along Grundy Avenue.

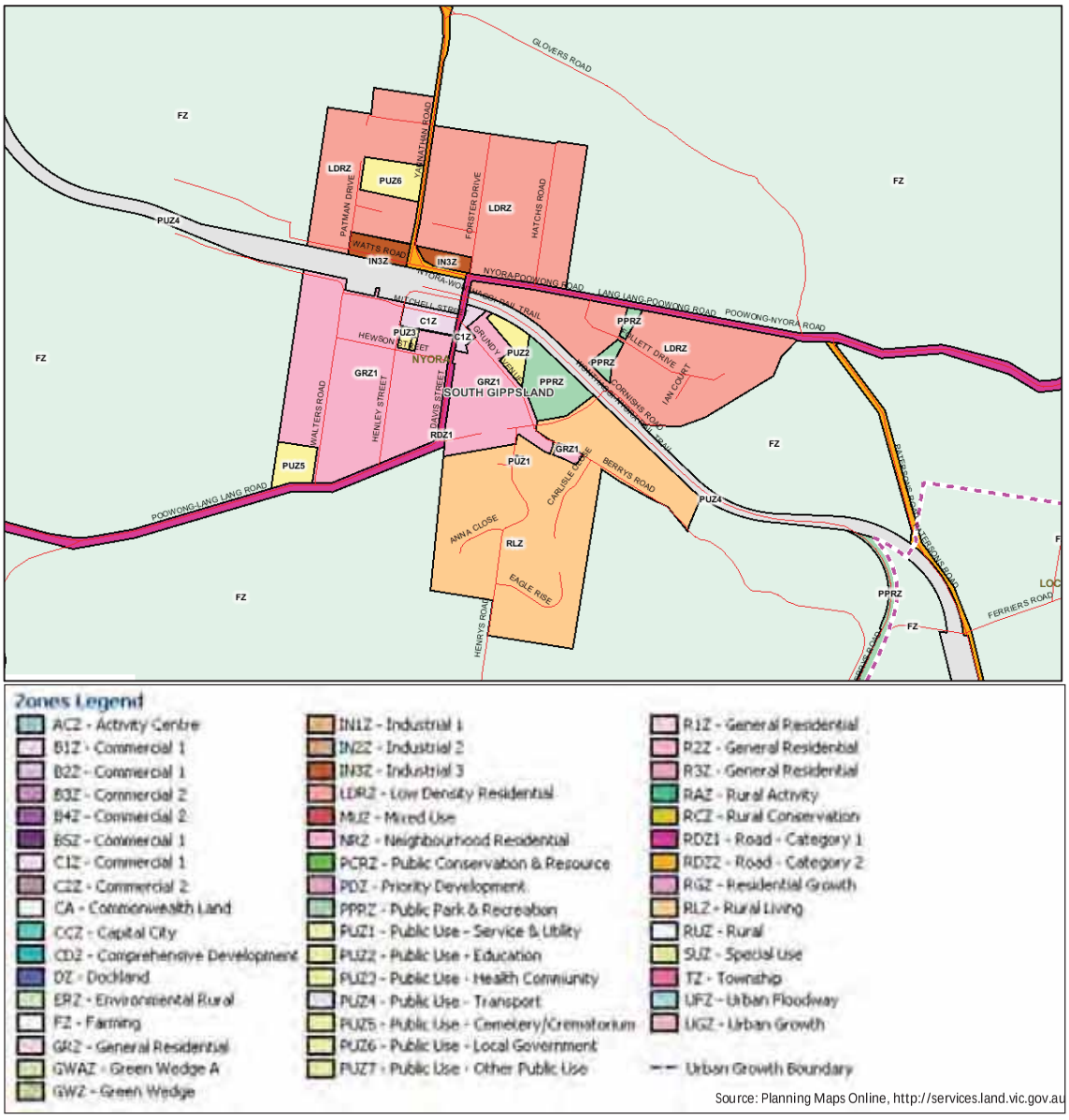


Figure 2: Planning Scheme Zoning Map

2.2 Road Network

The key roads within the Nyora Township are as follows:

- **Lang Lang-Poowong Road (Davis Street)** is an arterial road managed by VicRoads and is zoned 'Road Zone Category 1' under the Planning Scheme. Lang Lang-Poowong Road is aligned in a general northeast-southwest orientation between South Gippsland Highway and southern boundary of the township. The road then deviates to a north-south orientation with this section through the tPown known as Davis Street. At Watts Road, Lang Lang-Poowong Road deviates to an east-west orientation towards Poowong to the east. Lang Lang-Poowong Road accommodates a single traffic lane in each direction.
- **Watts Road** is a higher order road managed by Council and is zoned 'Road Zone Category 2' under the Planning Scheme between Davis Street/Lang Lang-Poowong Road and Yannathan Road. To the east of Yannathan Road, Watts Road becomes a local access street and terminates to the west of Patman Drive.
- **Yannathan Road** is a higher order road managed by Council and is zoned 'Road Zone Category 2' under the Planning Scheme. Yannathan Road is aligned in a general north-south direction and accommodates a single traffic lane in each direction.
- **Mitchell Street** is a local street aligned in an east-west direction between Davis Street (to the east) and to the west of Walters Road where it terminates. The Nyora General Store and Post Office are located along the south side of Mitchell Street whilst Toby's Paddock located on the north side. Informal kerbside parking is generally accommodated along the south side of Mitchell Street between Davis Street and Henley Street.
- **Grundy Avenue** is a local street aligned in a general northwest-southeast orientation between Davis Street (to the northwest) and Cornishs Road (to the southeast). Several major land-uses within Nyora are located along Grundy Avenue including the primary school, recreation reserve and speedway.
- **Henley Street is** a local street aligned in a north-south orientation between Mitchell Street (to the north) and Lang-Lang Poowong Road (to the south). The Nyora Hall is located on the east side of Henley Street, between Mitchell Street and Hewson Street. Henley Street is unsealed to the south of Hewson Street.
- **Walters Road** is a local street aligned in a north-south orientation between Mitchell Street (to the north) and Lang-Lang Poowong Road (to the south). Walters Road is unsealed to the south of Hewson Street.

A summary table of existing road reservations and carriageway widths for all roads within the study area is attached at Appendix A.

A plan of existing road surfaces (sealed or unsealed) and unmade road reservations is attached at Appendix B.

A plan of existing speed limits within the Nyora Township is attached at Appendix C.

2.3 Existing Traffic Volumes

We have reviewed traffic volume data provided to us by Council. This data was collected by traffic counts (tube counts) undertaken by Council at numerous locations throughout Nyora.

We have also reviewed traffic volume data along Lang Lang-Poowong Road provided by VicRoads. This includes Annual Average Daily Traffic (AADT) estimates for the year 2014.

The existing traffic volumes within Nyora are presented at Appendix D.

Overall, existing traffic volumes throughout Nyora were found to be reasonably low and well within acceptable operating capacities for each type of road. The highest traffic volumes were recorded along Yannathan Road and Watts Road (approximately 1,100 to 1,400 vehicles per day on each). These roads provide a connection between Nyora and Lang Lang. Traffic volumes along Lang Lang-Poowong Road (and Davis Street) were found to be less than 1,000 vehicles per day which is very low for an arterial road.

Traffic volumes along each of Mitchell Street and Grundy Avenue were found to be approximately 700 vehicles per day with lower traffic volumes recorded throughout the remainder of the township.

2.4 Pedestrian and Bicycle Facilities

There is currently limited existing pedestrian and bicycle facilities within Nyora.

Footpaths are currently provided within Nyora as follows:

- Mitchell Street – south side between Davis Street and Henley Street
- Henley Street – east side between Mitchell Street and the south boundary of Nyora Hall
- Davis Street – both sides just south of Mitchell Street to a bus stop
- Toby's Paddock - between Mitchell Street and Davis Street

An existing gravel shared path is provided adjacent to the railway line between Davis Street and the Nyora Recreation Reserve in the southeast part of the town.

The existing footpaths and shared trails are shown at Figure 3.

Figure 3: Existing Pathways

2.5 Public Transport

Nyora has limited access to public transport consistent with most small regional townships.

A V-Line bus route operates through Nyora along Lang Lang-Poowong Road (Davis Street). Bus stops are located along Davis Street on both sides of the road near Mitchell Street.

This bus service operates between Melbourne and Yarram, via Koo Wee Rup, Korumburra and Leongatha.

The Nyora Railway Station is located on the north side of Mitchell Street and is currently unused. A tourist railway service operates along the South Gippsland Railway Line between Leongatha and Korumburra, however, we understand that it is not operating at all at present 'due to unforeseen circumstances'.

We understand that this service previously extended to Nyora but due to maintenance and bridge stabilisation works the section of railway between Korumburra and Nyora is currently closed.

2.6 Crash Statistics

A review of the State Road Accident Records (CrashStats) has been undertaken for the past 5 years of available data (1/01/2009 to 31/12/2013). We have also reviewed the 'Crashes Last Five Years' data set from *data.vic.gov.au* which provides an extra year of crash statistics up to 31/12/2014.

The crash investigation area with recorded crash locations and details is provided at Appendix E.

Only six (6) crashes were recorded within the crash investigation area during the review period. The recorded crashes all occurred at different locations with the exception of two (2) crashes at the Davis Street/Watts Road/Forster Drive cross-intersection.

Based on our review, we are satisfied that there are no existing crash patterns in the study area.

3 Issues & Opportunities

3.1 Unmade Road Reserves

There are a number of unmade road reserves throughout the Nyora township (refer to Road Surface Plan at Appendix B).

There is opportunity to construct roads within unmade road reservations where appropriate within the Nyora Township to provide links and improve road infrastructure to accommodate future development and growth.

However, some of the unmade road reservations are located within areas that wouldn't provide connections for residential subdivisions within Precincts C, D and F and general growth throughout the remainder of Nyora. Furthermore, there are other constraints that impact the viability of some unmade road reservations being constructed.

An assessment of the unmade road reservations and our comments on the need/benefit to construct these roads is provided below.

Unmade Road Reservation	Our Comments
Hogans Road - to the east of Yannathan Road	We understand that it was agreed not to construct Hogans Road as part of rezoning application for the Wallis Watson site to provide a buffer. There is limited benefit to construct this road although pedestrian/cyclist facilities should be provided.
Grayden Street - to the east and west of Yannathan Road	There is opportunity to construct the unmade section of Grayden Street to facilitate subdivision opportunities for adjacent land if development is desired.
Patman Drive - across creek	Minimal benefit from a traffic perspective. It is very unlikely to occur due to extensive vegetation and cost of constructing a bridge across the creek
Watts Road - to the west along railway line	Minimal benefit from a traffic perspective.
Walters Road (east-west section) - along railway line	There is good opportunity to construct/seal Watts Road along the railway line if an access location is desired to this road for future subdivisions within Precinct C.
Cornishs Road – in part between Davis Street and Henrys Road	The extension of Cornishs Road through the unmade reservation is a possible new link which would improve access for the town in general, although it wouldn't really be used by growth areas C, D and F. We see this potential link as providing a new route option for residents/visitors, particularly to/from the southeast part of the township.
Glovers Road – in part to the north of Lang Lang-Poowong Road	Minimal benefit from a traffic perspective and unlikely to be feasible due to extensive vegetation.

Extension of Glovers Road from Lang Lang-Poowong Road to Cornishs Road	There is an unmade section of Glovers Road to the southwest of Lang Lang-Poowong Road which continues to Cornishs Road. Although there is potential to construct this road reservation, it would not be feasible given that a new railway crossing or modification to an existing crossing would require grade separation based on discussions with VicTrack. Accordingly, the extension of Glovers Road to Cornishs Road is not a realistic option.

3.2 Unsealed Roads

There are numerous sections of unsealed roads throughout the Nyora Township. Many of these unsealed roads (Watts Road, Glovers Road, Berrys Road, Patman Drive, Hogans Road, etc.) are unlikely to experience much growth in traffic volumes as a result of future development, particularly within Precincts C, D and F. Two unsealed roads that are expected to experience growth in traffic are Walters Road and Henley Street.

Walters Road and Henley Street are both unsealed to the south of Hewson Street and provide a connection with Lang Lang-Poowong Road to the south. Although current traffic volumes are currently very low along the unsealed sections, as a result potential future subdivision in Precinct D and densification (particularly within Precincts A and B) traffic volumes are expected to increase along both of these roads. There is opportunity to seal these roads and widen the carriageway to accommodate simultaneous two-way vehicle movements.

There is also opportunity to upgrade the intersections of each of these roads with Lang Lang–Poowong Road. We note that existing sight distance at the Walters Road/Lang Lang–Poowong Road to/from the west is slightly below the relevant AustRoads guideline due to a crest along Lang Lang–Poowong Road. Much greater sight distance is available at the Henley Street intersection with Lang Lang–Poowong Road.

3.3 Mitchell Street / Davis Street / Grundy Avenue Intersection

The Mitchell Street/Davis Street/Grundy Avenue intersection is currently an unsignalised cross-intersection with priority given to north-south movements along Davis Street. Two unusual traffic islands are provided at this intersection which effectively provide a median within Davis Street for turning movements.

This intersection is one of the highest traffic carrying intersections in Nyora and traffic volumes are likely to continually increase with development and population growth throughout Nyora.

There is opportunity to improve this intersection with upgrade works, potentially to a roundabout. A roundabout would provide improved vehicle accessibility to Mitchell Street and Grundy Avenue from Davis Street and also improve safety and control speed within the town centre.

Pedestrian and cyclist movements should be considered as part of any proposed intersection upgrade works.

3.4 Davis Street / Watts Road / Lang Lang-Poowong Road / Forster Road intersection

The Davis Street/ Watts Road/Lang Lang-Poowong Road/Forster Road intersection is the most critical intersection within the Nyora Township when considering existing traffic volumes and future traffic volumes following development and growth within Nyora. Furthermore, this intersection was the only location found to have multiple recorded crashes (2 No.) within the last 5 years of most recent crash statistics data.

This existing layout of this intersection is an unsignalised cross-intersection with priority in the east-west direction (Lang Lang-Poowong Road / Watts Road). A left-turn slip lane is provided from the east leg to the south leg of this intersection. There are no existing right turning provisions at this intersection. The northern leg (i.e. Forster Road) provides local access only and has significantly lower traffic volumes than the other three legs.

There is opportunity for improvement works at this intersection to provide greater safety and capacity to accommodate future growth in traffic volumes. This could potentially include right turning provision on the west approach and/or separate left and right turning lanes on the south approach. A roundabout is a potential alternative intersection arrangement subject to capacity being available to accommodate the predicted future traffic volumes. Furthermore, it will also need to be investigated whether sufficient land is available to accommodate the required roundabout geometry.

Pedestrian and cyclist movements should be considered as part of any proposed intersection works.

3.5 Grundy Avenue / Davis Street Corner Site

The Grundy Avenue/Davis Street vacant corner site located opposite the former Nyora Pub provides good opportunity for development. We note that access to this site would likely be required from Grundy Avenue when considering that Davis Street is zoned 'Road Zone Category 1'.

We are of the opinion that potential development of this site would not create any unacceptable traffic impacts particularly when considering the opportunity for upgrade works at the Mitchell Street/Davis Street/Grundy Avenue intersection as discussed earlier.

3.6 Lack of Footpaths and Bicycle Facilities

As identified at Figure 3, there are very limited footpaths and shared paths throughout the township and these are currently concentrated along and within close proximity of Mitchell Street and Grundy Avenue. There is opportunity to provide improved pedestrian facilities along existing streets throughout the township. There is also opportunity to provide new and improved shared paths including extension of the rail trail.

Future development within Precincts C, D and F should also strongly consider providing footpaths along new roads and also bicycle lanes/paths where appropriate.

3.7 Parking

Although there are no current issues associated with on-street parking demands within the Nyora township, the provision of formalised on-street/off-street parking should be considered in areas where proposed future retail/commercial activities are proposed.

3.8 Topography of Precincts C & D

Precincts C and D both appear to be reasonably flat and we do not see any traffic engineering issues as a result of topography at this stage. Sight distance will need to be considered when deciding upon potential connections with the existing road network.

3.9 New East-West Connector Road

There is an opportunity to provide a new east-west connector road within the southwest part of the township within Precinct B. A potential future east-west road could provide a connection between Walters Road and Davis Street and potentially extend further to the west to provide a key connection for Precinct C.

This potential road will require land to be acquired from a number of properties within Precinct B. Whether this potential east-west road is required from a traffic capacity point of view will be assessed as part of the next stage of the project.

We understand that there are significant waterway issues in a general east-west direction through the centre of Precinct B. Accordingly, there is opportunity to integrate a new east-west road as part of a potential waterway management solution.

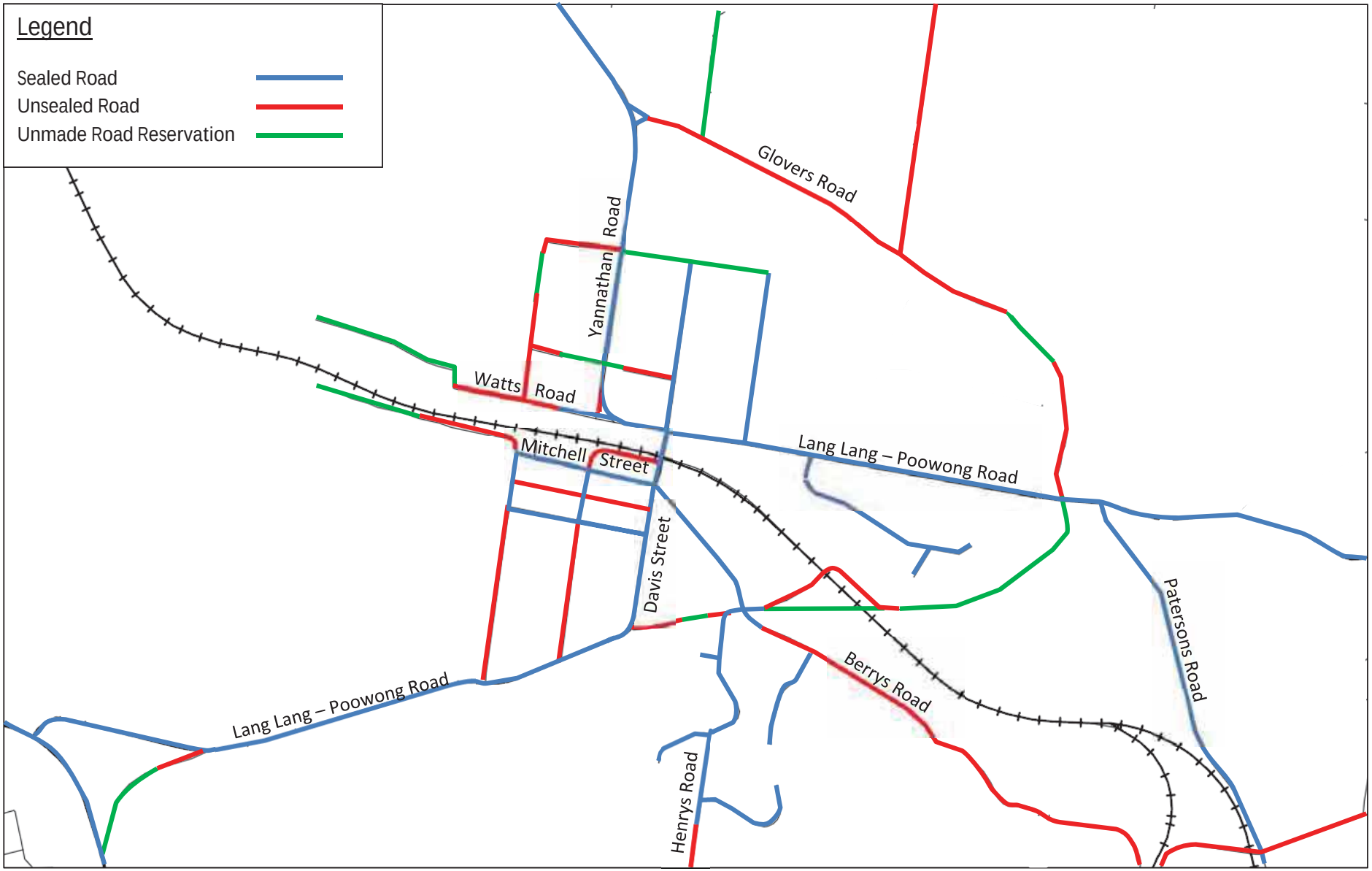
Appendix A:
Road Summary Table

Road Summary Table

Road	Authority	Section	Road Reservation (m)	Carriageway (m)	Intersection Controls
Lang Lang - Poowong Road	VicRoads	South Gippsland Hwy to Davis St	40	6.4	GW at South Gippsland Highway
		Davis St to Pattersons Rd	30	7.5	-
Davis Street	VicRoads	Lang Lang Poowong Rd to Hewson St	30	7.6 seal, 0.5 shoulder	Stop at Lang Lang - Poowong Road
		Hewson St to Mitchell St	20	-	-
		Mitchell St to Watts Rd	30	-	-
Yannathan Road	Council	Watts Rd to Glovers Rd	20	6.4	-
		Glovers Rd to McDonalds Track	40	-	-
Watts Road	Council	Davis St to Yannathan Rd	30	-	-
		Yannathan Rd to Patman Dr	30	5.7 seal, 0.8 shoulders	GW at Yannathan Rd
		Patman Dr to dead end	30	4.15	-
Walters Road	Council	Lang Lang Poowong Rd to Hewson St	20	4	Stop at South Gippsland Highway
		Hewson St to Mitchell St	20	4.6	-
		Mitchell St to Railway	30	3.5	-
Henley Street	Council	Lang Lang Poowong Rd to Hewson St	20	5.5	Stop line (no sign) at South Gippsland Highway, Stop at Hewson St
		Hewson St to Mitchell St	20	9.7	None at Mitchell St
			20	8.2	Stop at Hewson St
Hewson Street	Council	Walters Rd to Henley St	20	5.3	None at Walters Rd
		Henley St to Davis St	20	-	GW at Davis St
Mitchell Street	Council	Walters Rd to Henley St	30	9.7	None at Walters Rd
		Henley St to Davis St	30	8.9	GW at Davis St
			30	7.2	
ROW parallel to Mitchell Street	Council	Davis St to Walters Rd	6.5	2.9	-
Grundy Avenue	Council	Davis St to Cornishs Rd	30	6.4	GW at Davis St
Berrys Road	Council	Cornishs Rd to Carlisle Cl	20	5.1	-
Cornishs Road		Grundy Ave to Railway	40	3.2	None at Grundy Ave, GW at Railway
		Railway to dead end	40	3.7	GW at Railway
Henrys Road	Council	Grundy Ave to Eagle Rise	20	6.7	None at Grundy Ave
Follet Drive	Council	Lang Lang - Poowong Rd to dead end	20	5.5	GW at Lang Lang - Poowong Rd
Hatches Road	Council	Lang Lang - Poowong Rd to dead end	20	4.6	GW at Lang Lang - Poowong Rd
Forster Road	Council	Lang Lang - Poowong Rd to dead end	30	5.5	Stop at Lang Lang - Poowong Road
Patman Drive	Council	Watts Rd to dead end	20	4.6	None at Watts Rd
Hogans Road	Council	Yannathan Rd to dead end	20	4.8	None at Yannathan Rd
Glovers Road	Council	Yannathan Rd to dead end	40	3.9	GW at Yannathan Rd

Appendix B:
Existing Road Surface Plan

Existing Road Surface Plan

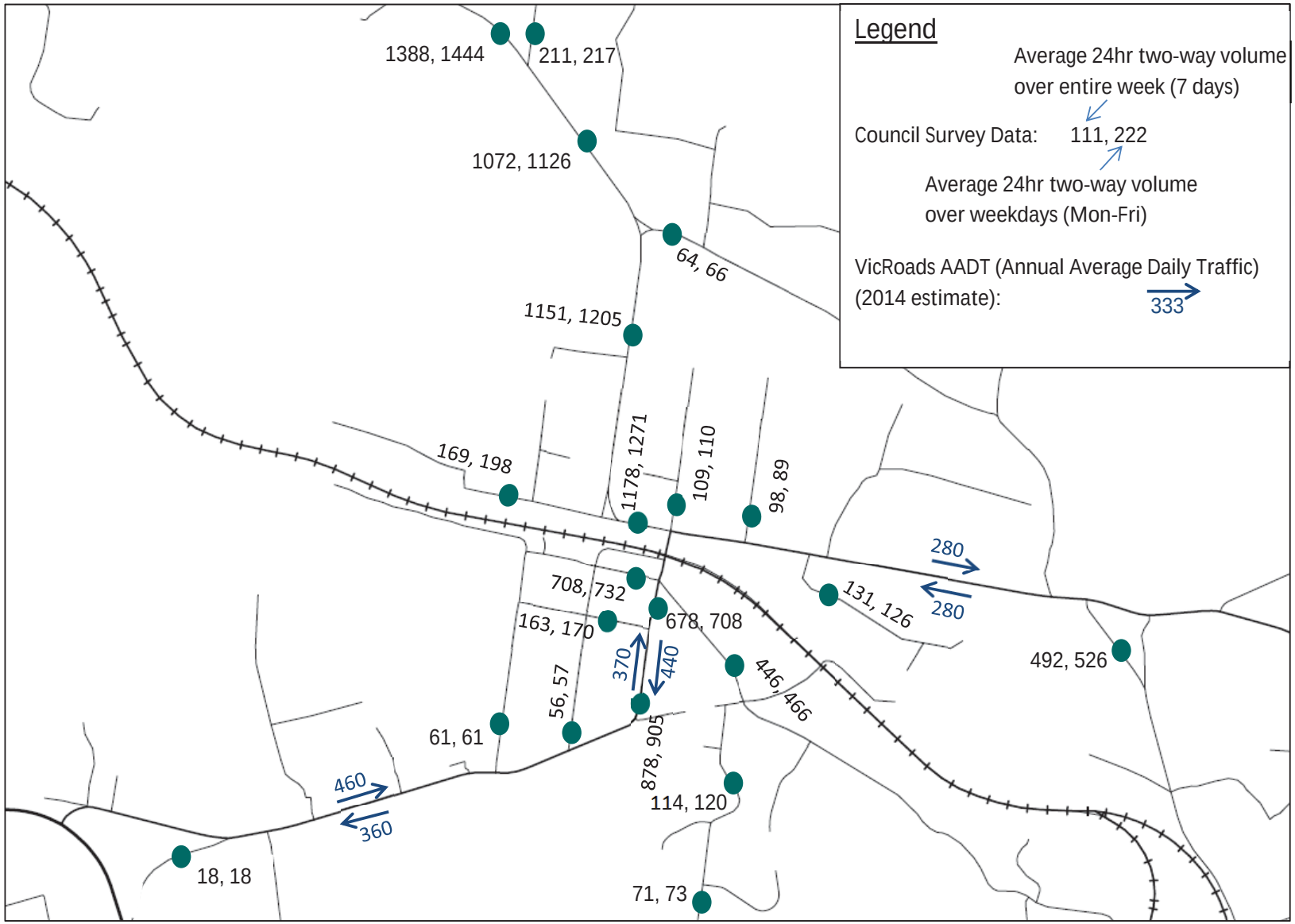


Appendix C:
Existing Speed Limits Plan

Existing Speed Limits Plan

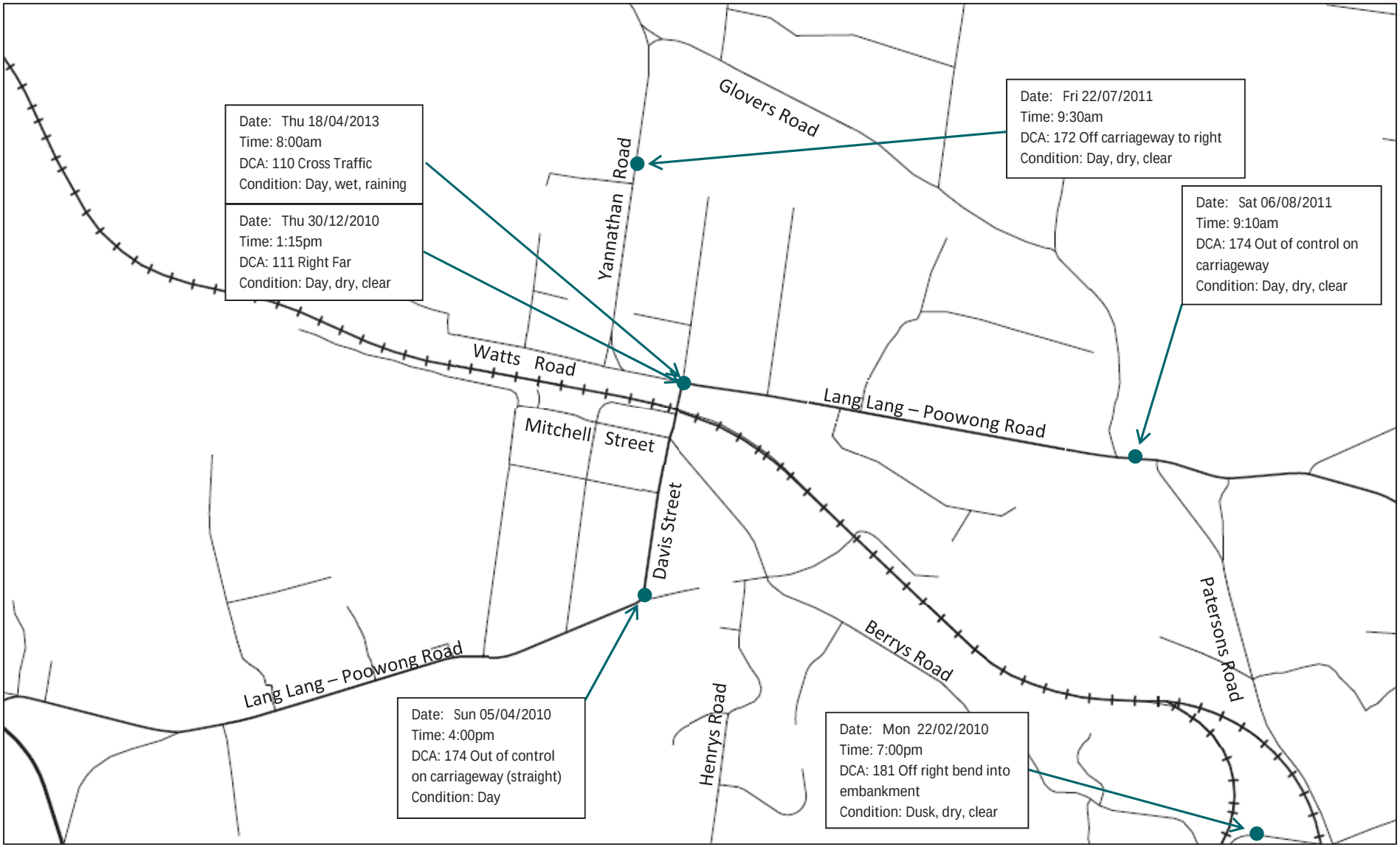
Appendix D:
Existing Traffic Volumes Summary

Existing Traffic Volumes Summary



Appendix E:
Crash Statistics Summary

Crash Statistics Summary



Appendix B:
Car Parking Assessment

Town Centre Car Parking Generation

Uses (long-term)	Area	Rate (per 100m2)	Car Parking Generation	Notes & Assumptions
Supermarket (long-term)	3800	5	190	Clause 52.06 rate for supermarket
Commercial/Medical (Hewson Street-red)	600	4	24	An estimated rate based on a mixture of uses
Commercial/Medical (Hewson Street-grey)	2196	4	88	An estimated rate based on a mixture of uses
Community Hub	1400	NA	45	45 spaces required as per project brief from Council
Existing Commerical Land (Mitchell St)	6626	4	265	Clause 52.06 rate for shop, food and drink premises
Existing Commerical Land (Davis St)	3253	4	130	Clause 52.06 rate for shop, food and drink premises
		Total	742	
		Discounted	**594**	20% discouting for multi-purpose trips
			218	Assume parking requirement for potential future uses on these larger sites are completely accommodated on-site - Davis Street commercial/medical and Hewson St
			66	Assume 25% of demands are staff parking and accommodated on-site at rear via laneway
		Total (reduced)	458	
		Discounted	**366**	20% discouting for multi-purpose trips, sharing, different uses peaking at different times
Short-term Supermarket	**Area**	**Rate (per 100m2)**	**Car Parking Generation**	**Notes & Assumptions**
Supermarket (short-term)	1,000	5	50	Clause 52.06 rate for supermarket

Town Centre Car Parking Provision

Use			Spaces	Notes & Assumptions
Supermarket carpark (long-term)			170	As identified on Masterplan, calculated by Planisphere
Community Hub carpark			45	As identified on Masterplan, calculated by Planisphere
Mitchell Street (on-street)			70	Assumes parallel parking on both sides at average 6m length, 20m setback from Davis street, 10m setback from Henley Street
Hewson Street (on-street)			35	Assumes parallel on one side only at average 6m space length, 20m setback from Davis street, 10m setback from Henley Street
Henley Street (on-street)			42	Assumes parallel parking on boths sides at average 6m space length except adjacent to Town Hall. 10m setback from intersection streets and laneway.
Existing Town Hall Spaces			14	Estimated from aerial
		Total	**376**	

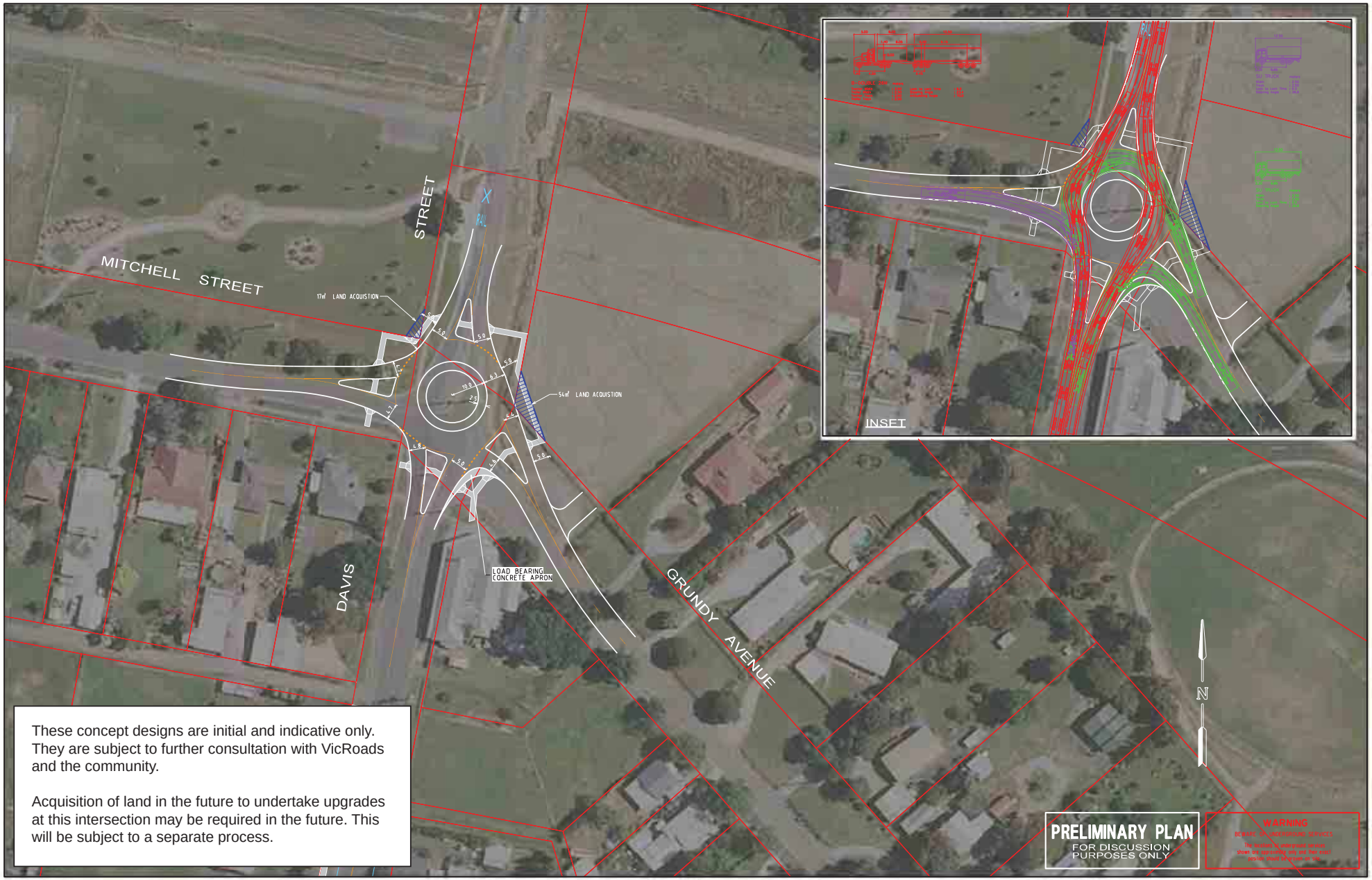
Short-Term Supermarket			
Supermarket (short-term)			90

Other Notes

Assummed no on-street car parking along Davis Street

Have not considered any parking generated by Town Hall at peak times (weekday lunchtime)

Henley Street has an existing 9.7m carriageway between Mitchell and Town Hall, but narrower to south



ISSUE	ISSUE DESCRIPTION	ISSUE DATE
A	ROUNDABOUT MODIFIED SLIGHTLY TO ALLOW B-DOUBLES THROUGH (NORTH/SOUTH) MOVEMENT	02 JUNE 2016

GENERAL NOTES
1. BASE INFORMATION FROM AERIAL PHOTOGRAPHY SUPPLIED BY COUNCIL.
2. ALL DIMENSIONS ARE TO FACE OF KERB & CHANNEL.
3. MAIN ROAD - DAVIS STREET (SPEED ZONE 60km/h).
4. ALL PROPOSED FOOTPATHS AND PRAM CROSSINGS ARE TO BE CONSTRUCTED WITH TACTILE GROUND SURFACE INDICATORS TO DDA COMPLIANCE GUIDELINES. REFER TO AS 1428.4:2009.

DESIGNED R.CARBARNS 01 APR 2016
CHECKED/APPROVED B.CHISHOLM 01 APR 2016
FILE NAME G19584A-00.dgn

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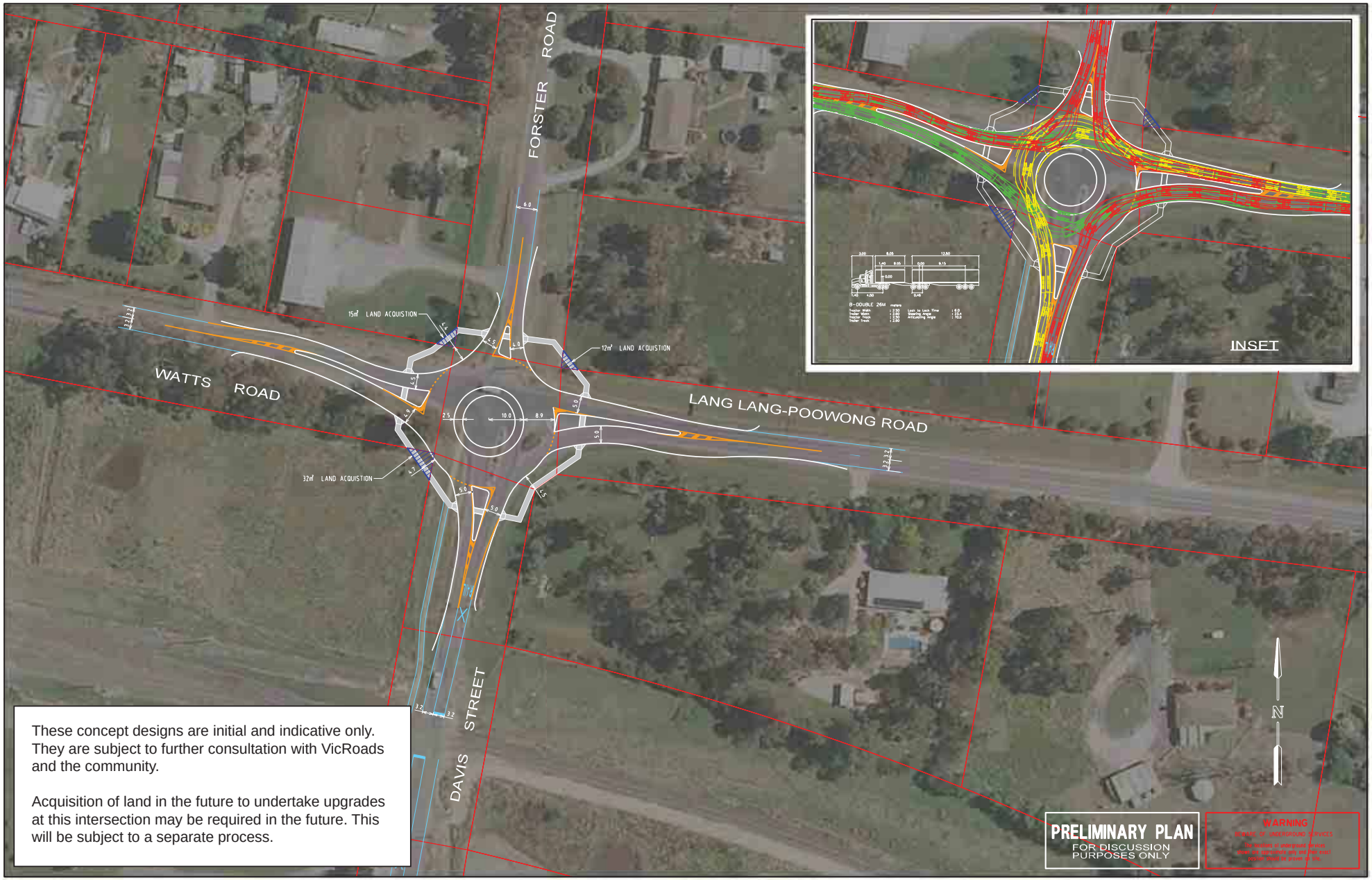
DAVIS STREET - NYORA
MITCHELL STREET - GRUNDY AVENUE
SOUTH GIPPSLAND SHIRE
CONCEPT FUNCTIONAL LAYOUT PLAN

SCALE 0 5 10 15 20 | SHEET No. | DWG No. G19584-01



ISSUE	ISSUE DESCRIPTION	ISSUE DATE

GENERAL NOTES
1. BASE INFORMATION FROM AERIAL PHOTOGRAPHY SUPPLIED BY COUNCIL & VICMAP DATA.
2. ALL DIMENSIONS ARE TO FACE OF KERB & CHANNEL.
3. MAIN ROADS - DAVIS STREET (SPEED ZONE 60km/h)
- LANG LANG-POOWONG ROAD (SPEED ZONE 60km/h)
- WATTS ROAD (SPEED ZONE 60km/h)
LOCAL ROAD - FORSTER ROAD (DEFAULT SPEED ZONE 50km/h)
4. ALL PROPOSED FOOTPATHS AND PRAM CROSSINGS ARE TO BE CONSTRUCTED WITH TACTILE GROUND SURFACE INDICATORS TO DDA COMPLIANCE GUIDELINES. REFER TO AS 1428.4:2009.

DESIGNED G.RAKITA 01 JUNE 2016
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FILE NAME G19584A-00.dgn

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WATTS ROAD - LANG LANG POOWONG ROAD
SOUTH GIPPSLAND SHIRE
CONCEPT FUNCTIONAL LAYOUT PLAN

SCALE 0 5 10 15 20 | SHEET No. | DWG No. G19584-02

ISSUE	ISSUE DESCRIPTION	ISSUE DATE

GENERAL NOTES
1. BASE INFORMATION FROM AERIAL PHOTOGRAPHY SUPPLIED BY COUNCIL.
2. ALL DIMENSIONS ARE TO FACE OF KERB & CHANNEL.
3. MAIN ROAD - DAVIS STREET (SPEED ZONE 60km/h).
   LOCAL ROAD - HEWSON STREET (DEFAULT SPEED ZONE 50km/h).
4. ALL PROPOSED FOOTPATHS AND PRAM CROSSINGS ARE TO BE CONSTRUCTED WITH TACTILE GROUND SURFACE INDICATORS TO DDA COMPLIANCE GUIDELINES REFER TO AS 1428.4:2009.

DESIGNED
G RAKITA 06 JUNE 2016

CHECKED/APPROVED
B CHISHOLM 06 JUNE 2016

FILE NAME
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DAVIS STREET / HEWSON STREET
NYORA
SOUTH GIPPSLAND SHIRE
CONCEPT FUNCTIONAL LAYOUT PLAN

SCALE 0 5 10 | SHEET No. | DWG No. G19584-03

E

APPENDIX E STORMWATER MANAGEMENT PLAN & REPORT

STORMWATER MANAGEMENT PLAN

Refer to document attached

South Gippsland Shire Council

ENGENY WATER MANAGEMENT

Planisphere Pty Ltd and South Gippsland Shire

Nyora Development Strategy

Nyora Stormwater Management Plan




July 2016

V1128_001

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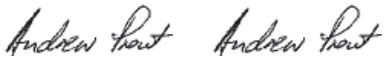
JOB NO. AND PROJECT NAME: V1128_001 Nyora Development Precinct Stormwater Management Strategy					
DOC PATH FILE: V:\Projects\V1128 Planisphere\V1128_001 Nyora Development Strategy\07 Deliverables\Documents\Report\Nyora Stormwater Managment Strategy_Rev1					
REV	**DESCRIPTION**	**AUTHOR**	**REVIEWER**	**APPROVED BY**	**DATE**
Rev 1	Client Issue	Nick Andrewes	Andrew Prout	Andrew Prout	23 June 2016
Rev 0	Client Issue	Nick Andrewes	Andrew Prout	Andrew Prout	18 July 2016
Signatures					

EXECUTIVE SUMMARY

Nyora is located in South Gippsland, approximately 90 kilometres south east of Melbourne. The town is forecast to grow considerably as people are attracted to the affordable semi-rural lifestyle on offer and its relatively close proximity to Melbourne and other commercial centres. The Nyora Stormwater Management Plan (SMP) is a catchment scale stormwater infrastructure plan that was developed with and informed by the Nyora Development Strategy, prepared by Planisphere Pty Ltd. (Planisphere) on behalf of South Gippsland Shire Council (SGSC).

The Nyora SMP provides an approach to managing stormwater in Nyora that meets appropriate standards for drainage, flood protection, water quality, waterway health and amenity.

Flooding

Hydraulic modelling was undertaken using TUFLOW 1D/2D hydrodynamic software and RORB to generate catchment flows. The modelling identified that there are a number of locations in Nyora that are currently flood prone, including 2 properties (located on Yannathan Road and the corner of Henley Street and Hewson Street respectively) that were considered likely to experience above floor flooding for the 18% AEP event. Glovers Road and Walters Street were concluded to experience frequent and significant flooding. Flood mitigation options were proposed to mitigate flooding at these locations and two additional locations; at Hatchs Road near the intersection of Hewson Street and Davis Street.

Hatchs Road was an area raised in relation to flooding concern by residents in a community consultation session undertaken by Planisphere. This location was identified by the modelling as flood prone but with no floors affected. A local ground shaping and bunding mitigation option was proposed to keep flow out of what was understood to be the affected property however further investigation and discussion with the residents is recommended to inform this solution (refer to **Section 5.3** for further discussion). The location near the intersection of Hewson Street and Davis Street has no formal existing flow path and development in the upstream Precinct A catchment area is likely to result an increased flood risk to building floors. A flood mitigation solution involving a pipe upgrade and inlet works was proposed to convey major storm flows at this location.

Administration of flood prone land

In many locations existing overland flow paths can be incorporated into future development precincts as part of future major and minor drainage systems or as part of designated waterway corridors. However in some locations existing flooding will not be resolved as part of future development or flood mitigation works, such as behind the railway embankment and major road embankments.

Urban Flood Zone (UFZ) and flood overlays, the Special Building Overlay (SBO), Land Subject to Inundation Overlay (LSIO) and the Floodway Overlay (FO) designate land that

is subject to flooding and provide statutory authorities with a means for regulating or prohibiting development within a hazardous area under Section 62(e) of the Planning and Environment Act 1987. The statutory authorities responsible for collecting flood information and managing development in flood prone land in Nyora are SGSC and Melbourne Water.

Given Nyora's relatively small size it is considered that SGSC could potentially manage development applications on a case by case basis without the implementation of flood related planning zones or overlays. However it is recommended that SGSC further consider the practical implementation and internal processes required to assess development applications in flood prone areas and the option of using overlays such as an SBO or LSIO.

Stormwater management for future development in Nyora

Existing natural values, future urban form and Nyora's vision (refer to **Section 3.1**) were used to inform the type and location of stormwater assets that were proposed for the SMP.

The long term plan (>20 years) for the management of stormwater flows in Nyora is summarised as follows:

- Construct piped systems with kerb and channel roads in the urban growth areas of precincts A, B, C, D and F, the commercial centre in precinct A and the industrial area on Yannathan Road.
- Maintain existing open swales to convey flow in the low density and rural living areas of precinct E, G and H.
- Designate waterway corridors for existing waterways where the GGEO shows the presence of the Giant Gippsland Earthworm.
- Implement on site detention in accordance with the IDM standards to retard minor development flows back to existing conditions in infill development precincts.
- End of line retarding basins to mitigate the 1% AEP peak flow back to existing conditions at town boundaries, prior to discharge to downstream properties.
- End of line sedimentation basins and bioretention basins and distributed street scale bioretention basins to manage stormwater quality to BPEM targets in greenfield development precincts and precincts A and B.
- On-lot WSUD within the low density and rural living precincts E, G, H.
- GPT's are proposed at 3 locations to intercept flows discharging from the commercial and industrial areas in precincts A and E respectively.

Costing

Concept level costing of stormwater assets at Nyora was undertaken using the development services scheme costing spreadsheet that is used by Melbourne Water for these projects.

The cost estimation included the following works:

- flood mitigation
- water quality
- future drainage works for properties greater than 0.4 hectares.

The total estimated cost of the stormwater works required to achieve the long term stormwater water management strategy at Nyora is $11,150,000.

The cost estimate excluded land acquisition for drainage assets. The total land acquisition required for drainage assets is approximately 10.7 hectares. The land requires includes some publically owned land (VicTrack) and is located across a range of zones according to the current planning zones.

Funding mechanisms

A number of mechanisms may be available to SGSC for the funding of works required to mitigate existing flooding, including Special Charge Schemes and Section 173 Agreements. Based on discussions with SGSC, the preferred mechanism for funding flood mitigation works in Nyora is by way of Section 173 agreements between SGSC and landowners proposing development. There are existing examples of Section 173 agreements in Nyora (refer to the Nyora Development Strategy for details) where a contribution to drainage improvement works is included in the agreement.

There are a number of mechanisms available to fund the stormwater infrastructure required to convey, treat and retard additional stormwater that results from development, including a Developer Contributions Plan (DCP) administered by SGSC and a Development Services Scheme (DSS) administered by Melbourne Water. The funding approach for major drainage works should be determined in discussions with Melbourne Water and may include a combined Section 173 agreement and DSS approach in areas such as precinct B where existing and greenfield development will occur (refer to **Section 13.5** for further discussion).

It is recommended that SGSC consider adopting the Nyora SMP as a framework for managing development and stormwater infrastructure into the future. Further discussion with Melbourne Water and GGE specialists is recommended as part of future development of the plan with respect to managing funding and the treatment and retardation approaches adopted in some locations.

CONTENTS

Appendices

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1. INTRODUCTION & BACKGROUND

1.1 Introduction

Nyora is located in South Gippsland, approximately 90 kilometres south east of Melbourne. The town is forecast to grow considerably as people are attracted to the affordable semi-rural lifestyle on offer and its relatively close proximity to Melbourne and other commercial centres. The Nyora Stormwater Management Plan (SMP) is a catchment scale stormwater infrastructure plan that was developed with and informed by the Nyora Development Strategy, prepared by Planisphere Pty Ltd. (Planisphere) on behalf of South Gippsland Shire Council (SGSC).

The Nyora Development Strategy outlines a strategic vision for managing development in Nyora over the next 20 years which includes the densification of existing development in some areas and the establishment of new development precincts in currently undeveloped areas. Eight (8) separate precincts with different existing and future development values cover Nyora. A description of the existing development and development values for each precinct is provided in the Nyora Development Strategy (Planisphere, 2016).

The increase in development density and coverage in Nyora will lead to an increase in stormwater runoff and a subsequent increase in pollutant wash-off. Without appropriate stormwater management it could also have detrimental effects on the receiving waterways. In setting the urban structure, it is critical that assets required for drainage purposes are determined early. This allows for the impacts from the increase of stormwater runoff arising from urbanisation to be mitigated and all new development to proceed without the risk of flooding the development site, without the risk of flooding neighbouring properties and without impacting on the natural environment, receiving waterways and ultimately, Western Port Bay.

The Nyora SMP provides an approach to managing stormwater in Nyora that meets appropriate standards for drainage, flood protection, water quality, waterway health and amenity. The infrastructure requirements identified in the SMP are costed to establish contributions under the Water Act 1989 that could be utilised by SGSC or the catchment management authority, Melbourne Water, to fund the implementation of the infrastructure. Engeny Water Management (Engeny) was engaged by Planisphere to prepare the Nyora SMP.

1.2 Supporting documents

The following reports and investigations have been undertaken for Nyora and were used to inform the SMP.

- Nyora Structure Plan (Planisphere, 2013)
- Nyora Structure Plan Submission (Beveridge Williams, 2011)

- development forecasts for Nyora (Nott and More, 2010)
- strategy and audit for social community infrastructure 2014 - 2029 (South Gippsland Shire Council)
- Flood Management Plan for South Gippsland Shire Council, Melbourne Water and West Gippsland CMA (prepared in collaboration, 2013).

Prior to this SMP Melbourne Water undertook investigations to inform the Draft Nyora Development Services Scheme (DSS) which was put on hold pending the outcome of a decision to provide a reticulated sewerage system to the town (refer to the Nyora Development Strategy, Planisphere 2016 for further details). The following documentation from the Draft DSS was provided by Melbourne Water and used to inform this study.

- Part A - Nyora Development Services Scheme Summary Report (Alluvium, 2009)
- Part B - Preliminary Environmental Assessment (DRAFT) Nyora Development Services Scheme (Alluvium, 2009)
- Nyora Development Services Scheme Water Quality Report (BMT WBM, 2009)

Additional background information is provided in the Drainage Investigation report presented in **Appendix A**.

2. PLAN PREPARATION METHODOLOGY

The following key steps were undertaken to prepare the Nyora SMP:

- review of background information
- drainage and existing flooding investigations (refer to the Drainage Investigation Report in **Appendix A**):
  - TUFLOW flood modelling the existing conditions 18% AEP and 1% AEP event
  - identification of existing flooding hotspots
  - stormwater issues and opportunities identification
- preliminary stormwater infrastructure delineation, including location of flood mitigation assets
- meetings with SGSC and Melbourne Water
- pipe sizing based on Rational Formula calculations to size works in accordance with IDM / Melbourne Water methods (refer to **Section 6**)
- identification of waterway protection corridors and constructed waterways (refer to **Section 7.3.3 and 7.3.4** respectively**)**
- MUSIC modelling to size treatment assets (refer to **Section 7.3.3**)
- plan costing using Melbourne Water's Development Services Scheme (DSS) costing spreadsheet (refer to **Section 11**).

3. OBJECTIVES AND VISION

3.1 Vision

The Nyora Development Strategy (Planisphere, 2016) describes Nyora's vision around community and open space, environment and water, economy and infrastructure and the movement network. **Figure 3.1** from the Nyora Development Strategy presents Nyora's vision in each of these areas.

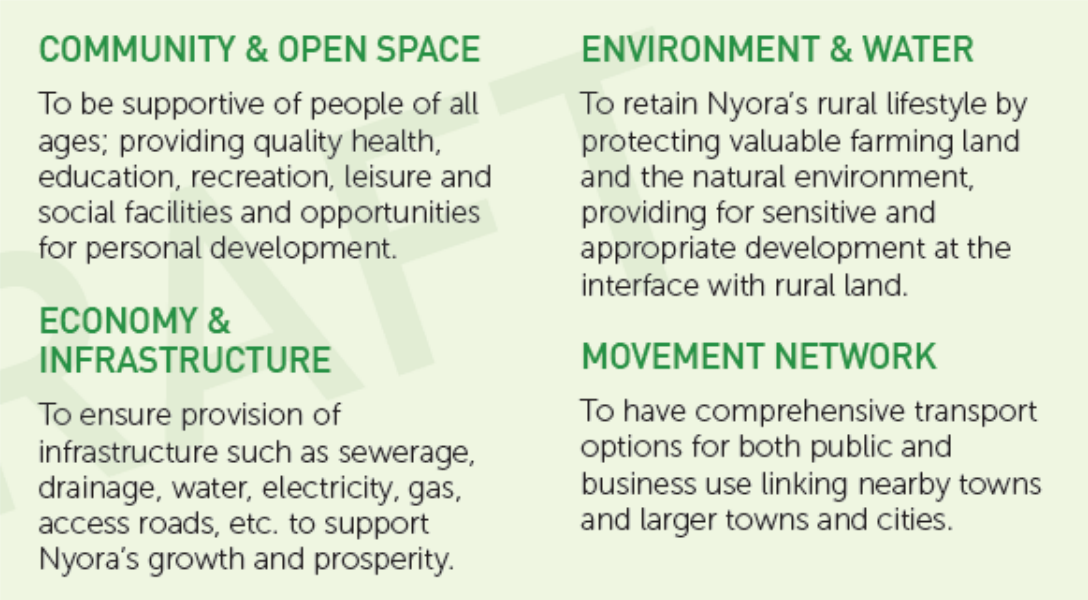

Figure 3.1 Nyora's vision (source: Nyora Development Strategy, Planisphere 2016)

The Nyora vision was used to guide the development of the SMP which was undertaken in collaboration with SCSC, Melbourne Water and the community.

3.2 Objectives

Key objectives of the Nyora SMP that were developed in consultation with SGSC, Melbourne Water and via community feedback through submissions through the Nyora Development Strategy include:

- Resolve existing flooding at hotspot locations.
- Treatment of all urban runoff derived from future development to Best Practice Environmental Management Guidelines (BPEMG) in terms of water quality. The urban runoff treatment objectives are[1]:

[1] Schedule F8 of the State Environment Protection Policy (Waters of Victoria) is for Waters of Western Port and Catchment and applies to the catchment areas in Nyora. The associated water quality targets are more stringent than the BPEMG targets. Discussion on the utilisation of the F8 objectives at Nyora is presented in **Section 8**.

- 80% removal of total suspended solids
- 45% removal of total phosphorous
- 45% removal of total nitrogen.

- Natural waterways are to be protected and retained.

- Giant Gippsland Earthworm habitat and significant vegetation is to be protected.

- A drainage outlet from the low point of all developable properties greater than 0.4 hectares is to be provided.

- Pipe capacities have been sized based on SGSC drainage design standards. SGSC adopts the Infrastructure Design Manual (IDM) which specifies the following standards:

- urban residential: 18% AEP2
- commercial centres: 10% AEP
- industrial areas: 10% AEP
- rural living: 18% AEP.

- Peak flow control to maintain existing conditions peak flows.

Previous work by or on behalf of Melbourne Water has identified that the receiving waterways are environmentally sensitive and may be prone to erosion. The SMP outlines a strategic direction for protecting the receiving waterways from changes to hydrological regimes that may occur as catchments are developed.

[2] Storm event terminology referenced by the Infrastructure Design Manual (v4.4.2) has been adopted for this report. Refer to the Drainage Investigations Report (Appendix A) for a definition of the AEP terminology and how it relates to ARI event description.

4. THE CATCHMENT

4.1 Description

Nyora is located amongst undulating hills in the fertile west Gippsland region and has an annual rainfall that exceeds 1000 mm. Eight (8) catchments were defined around existing waterways to include all the Nyora development precincts. The catchments discharge into three (3) major waterways, the Little Lang Lang River, Bass River and Adams Creek and include a total area of approximately 580 hectares. All of these waterways ultimately discharge into Western Port Bay. **Figure 4.1** shows the location of the Nyora catchments and identifies the receiving waterway for each catchment.

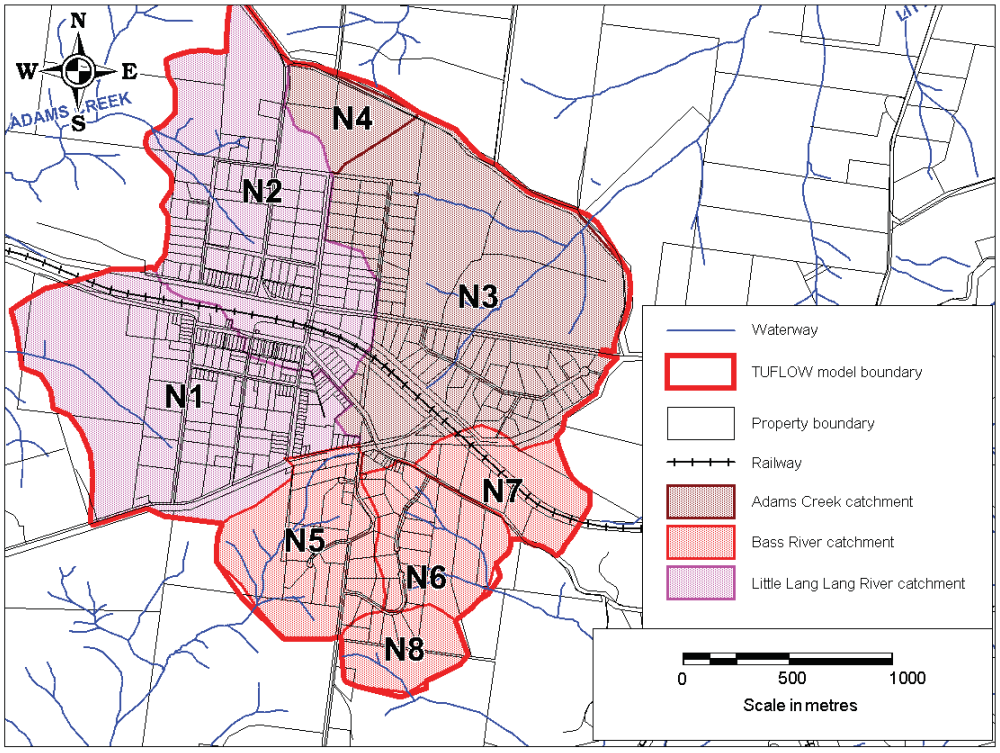

Figure 4.1 Nyora catchments

Catchment areas in Nyora vary between 172 hectares (N3) and 18 hectares (N4).

Section 2.2 of the Drainage Investigations Report (presented in **Appendix A**) provides a more comprehensive description of existing catchment conditions. Photographs from a site visit undertaken by Engeny, SGSC and other members of the Nyora development strategy team are presented in Section 3.2 of the Drainage Investigations Report.

The existing drainage network is comprised of open channels and underground pipe drainage. SGSC is responsible for the majority of the drainage network but VicTrack and VicRoads are responsible for culverts that cross the South Gippsland tourist railway and the Lang Lang - Poowong Road respectively.

4.2 Existing Planning Surface Water Planning Controls

4.2.1 Planning zones and overlays

Figure 4.2 shows the planning scheme at Nyora. At the time of reporting the land that is located between Glovers Road and Lang Lang - Poowong Road (precinct F) was being re-zoned from Farming Zone (FZ) to General Residential Zone 1 (GRZ1) as part of Planning Scheme Amendment C97.

Figure 4.2 Nyora planning zones (source: Department of Land Water and Planning)

At Nyora there are currently no stormwater related planning zones or overlays. However land use and development in flood prone land that is located in Precinct H, between Cornishes Road and the Lang Lang - Poowong Road, is currently being controlled by a Public Parks and Recreation Zone (PPRZ).

The Giant Gippsland Earthworm Overlay (provisional at the time of reporting) and the existing vegetation layer (EVC100) do not designate land that is subject to flooding. However the habitat of Giant Gippsland Earthworm and remaining vegetation in Nyora correlate very closely with overland flow paths and waterways in many locations. A key objective of the SMP is to protect land covered by these overlays.

4.2.2 Development Plan Overlays

The following Development Plan Overlay's (DPO's) are active in Nyora:

- DPO5 was implemented following the C72 Planning Scheme Amendment which rezoned areas of Nyora located in Precinct A and B to GRZ1. The DPO5 considers that subdivision of the area "must plan for and contribute towards improved road, pedestrian and drainage infrastructure and avoid isolated, internally-focused developments, especially on larger lots."

- DPO10 applies to Precinct F (recently introduced by Amendment C97 to the South Gippsland Planning Scheme) which requires a stormwater and drainage management plan to be prepared with detailed costings of all stormwater drainage works to occur on public land or outside of the development plan area if directly related to the development. A section 173 agreement is in place with the land owners of Precinct F for the land owners to provide contributions of $9,000 per lot as development occurs. Some of these funds are expected to be used to address drainage issues in the area.

Development that is proposed in areas controlled by DPOs generally requires a planning permit which will not be issued unless the developer's plan for the development is submitted and approved by the relevant authorities.

5. FLOODING

5.1 Existing flooding

The Infrastructure Design Manual (IDM) has been adopted by SGSC and provides the current design standards for major and minor drainage systems according to the land-use type. The current minor system drainage standards that are applicable to development in Nyora are summarised below:

- urban residential: 18% AEP
- commercial centres: 10% AEP
- industrial areas: 10% AEP
- rural living: 18% AEP.

The major system standard is for the 1% AEP event.

Refer to Section 6 of the Drainage Investigations Report located in **Appendix A** for definitions of major and minor drainage systems.

An investigation of existing flooding in Nyora was undertaken using a 1D/2D hydrodynamic TUFLOW flood model with inflows generated using a RORB hydrological model. Modelling was undertaken for the 18% and 1% AEP events. Details of the flood modelling methodology are presented in the Drainage Investigations Report that is located in **Appendix A**.

The following summarises the findings of the investigation:

- Walters Road and Glovers Road are subject to nuisance flooding for the 18% AEP event and major flooding for the 1% AEP event.
- Two properties are at risk of significant flooding for the 18% AEP event. The properties are located on the corner of Henley and Hewson Street and on Yannathan Road respectively.
- Twenty eight (28) properties are at risk of significant flooding for the 1% AEP event.

The criteria used to determine major flooding at roads was a depth of ≥ 200 mm and velocity depth produce of ≥0.35 m^2/s.

The criteria used to determine major flooding at properties was where flood waters on main flow paths inundates building footprints to a depth of ≥ 100 mm which was assumed to be the point where above floor flooding occurs. As floor levels were not available for this study, the actual flooding that occurs at some properties may not be as significant as

this study reports. It is recommended that SGSC consider undertaking floor level survey to further inform the hydraulic modelling and associated flood risk within the catchment.

Further discussion on the existing conditions flood modelling is presented in the Drainage Investigations Report that is presented in **Appendix A**. Flood mitigation works that are proposed to mitigate existing flooding at Nyora are presented in **Section 5.3**.

5.2 Locations of increased risk of flooding from development

Increase in development density results in a higher fraction of the catchment being covered by surfaces that are impervious to rainfall and runoff. This in turn results in increased runoff volumes and peak flows. If appropriate flow management measures are not implemented to control flow changes that result from new development, then increased flooding can occur. Flow management measures include retardation basins to reduce peak flows and upgraded drainage systems to capture and convey development flows.

Flood modelling of the ultimate development conditions (1% AEP event) was undertaken using the TUFLOW hydraulic model to determine existing development that is most at risk from increased flooding from increased development densities **if** appropriate measures are **not** introduced to manage development flows. **Table 5.1** presents the average lot size and impervious fractions assumptions adopted for the developed conditions flood modelling. Impervious fraction assumptions for existing conditions are document in Table 2 of the Drainage Investigations Report in **Appendix A.**

Table 5.1 Developed conditions impervious fractions for GRZ1 and LDRZ zoned land

Precinct (ID)	Average Lot Size (m^2)	Impervious Fraction	Zone Code
A	667	0.55	GRZ1
B	750	0.5	GRZ1
C	750	0.5	GRZ1
D	750	0.5	GRZ1
E	2000	0.3	LDRZ
F	750	0.5	GRZ1
G	4000	0.25	LDRZ
H	10000	0.2	RZ

The results of the flood modelling show that the locations most at risk of increased flooding are those where there is:

- a large increase in development density
- existing development is already flood prone
- the existing development is located on flatter land and near embankments (formed by roads or other features) where a small increase in flow can result in a large increase in flood extent.

These locations include areas upstream of Walters Road and Glovers Road, the industrial area at Yannathan Road and properties subject to existing flooding on Hewson Street.

Appendix B presents the results of the TUFLOW modelling for ultimate development conditions with **no** flow management controls in place

5.3 Flood mitigation works

Priority flood mitigation works were identified at Yannathan Road and Henley Street where the flood modelling indicated that flooding to building floors is likely to occur for the 18% AEP event.

Flood mitigation works were also proposed for properties located on Hewson Street between Davis Street and Henley Street. At this location there is no allowance for an overland flow path to convey major flows and building floor levels are likely to be effected if development in the upstream precinct A catchment is initiated.

Flood mitigation works were also identified at Walters Road, Glovers Road and a property at the north end of Hatchs Road, which was identified as subject to flooding during the community consultation period. The flood modelling indicated that flooding at the rear of the property occurs at Hatchs Road but that it does not affect the building. This could be a function of the resolution of the model at this location and further investigation including discussion with the landowner regarding the location of problem flooding is recommended before mitigation works are undertaken. The mitigation works at Walters Road and Glovers Street will become more of a priority as local areas develop.

The major and minor drainage systems prepared for this SMP identifies an approach for mitigating 1% AEP flooding at existing properties and roads in other locations. It also identifies approaches to prevent flooding from increasing due to future development.

The flood mitigation works presented have been investigated using a high level assessment appropriate for this plan, based on available information. It is recommended that further investigation and design be undertaken prior to implementation of these works.

Table 5.2 presents a description of flood mitigation works at the various locations. **Figure 5.1** to **Figure 5.6** present concept sketches of the flood mitigation works.

Table 5.2 Description of flood mitigation works

Flooding Hotspot	Issue	Mitigation approach	Development context
1. Hewson Street between Davis Street and Henley street	No dedicated major drainage flow path exists. Flows in excess of the pipe drainage system are conveyed through residential development. Insufficient minor drainage system capacity (400 mm diameter pipe). 4 no. properties effected.	Construct 1% AEP capacity drainage pipe (1 no. 525 mm diameter) and inlets to replace existing pipe.	1% AEP capacity defined on ultimate development density. Works to be completed prior to construction occurring within the upstream Precinct A catchment. Consider funding mechanisms through the development of upstream catchment.
2. Henley and Hewson Street	Trapped low point upstream of residential property. Flows in excess of the pipe drainage system are conveyed through the property	Construct 1% AEP capacity drainage pipe (1 no. 375 mm diameter) and inlets to replace existing pipe.	1% AEP capacity defined on ultimate development density. Works to be completed prior to construction occurring within the upstream Precinct A catchment. Consider funding mechanisms through the development of upstream catchment.
3. Yannathan Road industrial properties	Insufficient minor drainage system capacity (open channel). No major drainage system pathway in the road reserve.	Regrade the Davis Street / Lang Lang – Poowong Road intersection to direct major flows from LDRZ east of Forster Drive into the VicTrack land north of the railway. Formalise the existing defacto storage on the VicTrack land located north of the railway by constructing a retarding basin and associated open drains and culverts. Construct pipe drainage to replace existing	The ultimate drainage solution could be rolled out as development occurs within the Industrial zone. Future development in the industrial area would be required to have onsite detention in accordance with the requirements presented in **Table 7.4**. An alternative solution to providing a major drainage flow path down Yannathan Road could include requiring future development to mitigate the 1% AEP event to the developed conditions 18% AEP event in order to reduce property discharges to a flow rate that can be contained within the

		open channel drainage on both sides of Yannathan Road. Pipe drainage sized to convey the 10% existing conditions AEP event on Yannathan Road. Lower Yannathan Road by approximately 200 mm and provide kerb and channel drainage for major event flows.	proposed pipe network.
4. Walters Road	Existing road cross drainage insufficient capacity	Excavate open channel to convey the 1% AEP event into the existing waterway. The open channel extends through the Giant Gippsland Earthworm Overlay. Construct 2 no. 1050 mm pipe culverts under Walters Road with inlet works. These culverts will form the outlets of the underground pipe drainage system for the fully developed Precinct A and B catchment.	An open channel is required downstream to outlet the culvert assuming the finished road surface remains at the existing road surface level. The size and location of the Walters Road culverts should be consistent with the future minor drainage system for the area.
5. Glovers Road	Existing road cross drainage insufficient capacity	Construct 2 no. 450 mm culverts to convey the existing conditions 10% AEP flow. Excavate existing channel upstream and downstream of crossing as required.	The impact of the Glovers Road flood mitigation works requires further consideration given the potential impact of the works on Giant Gippsland Earthworm habitat and significant vegetation.
6. Hatchs Road residential property	No formal major or minor drainage system.	Local terrain shaping and a 300 mm high bund to prevent overland flow entering the Hatchs Road property	Future minor and major drainage system is proposed as part of the stormwater management works plans for Precinct E and Precinct F that are presented in **Section 0** and **Section 9.6** respectively.

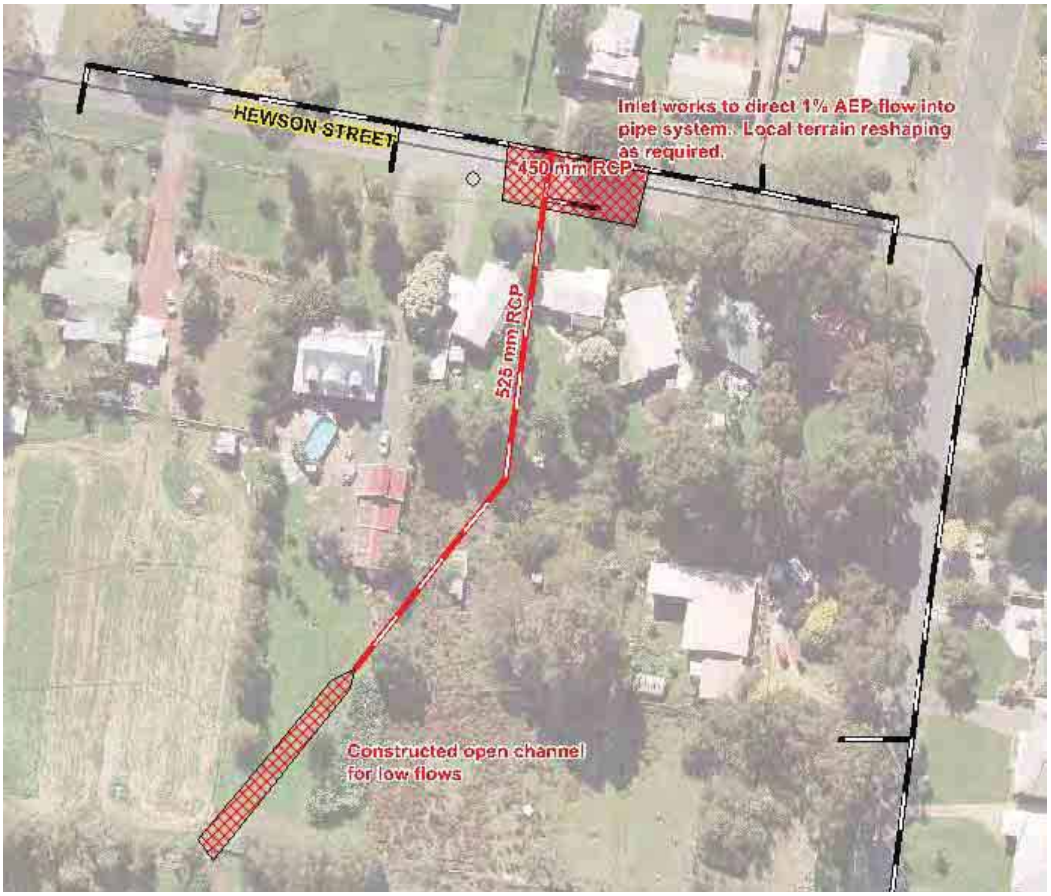

Figure 5.1 Hewson Street flood mitigation works

Figure 5.2 Henley and Hewson Street flood mitigation works

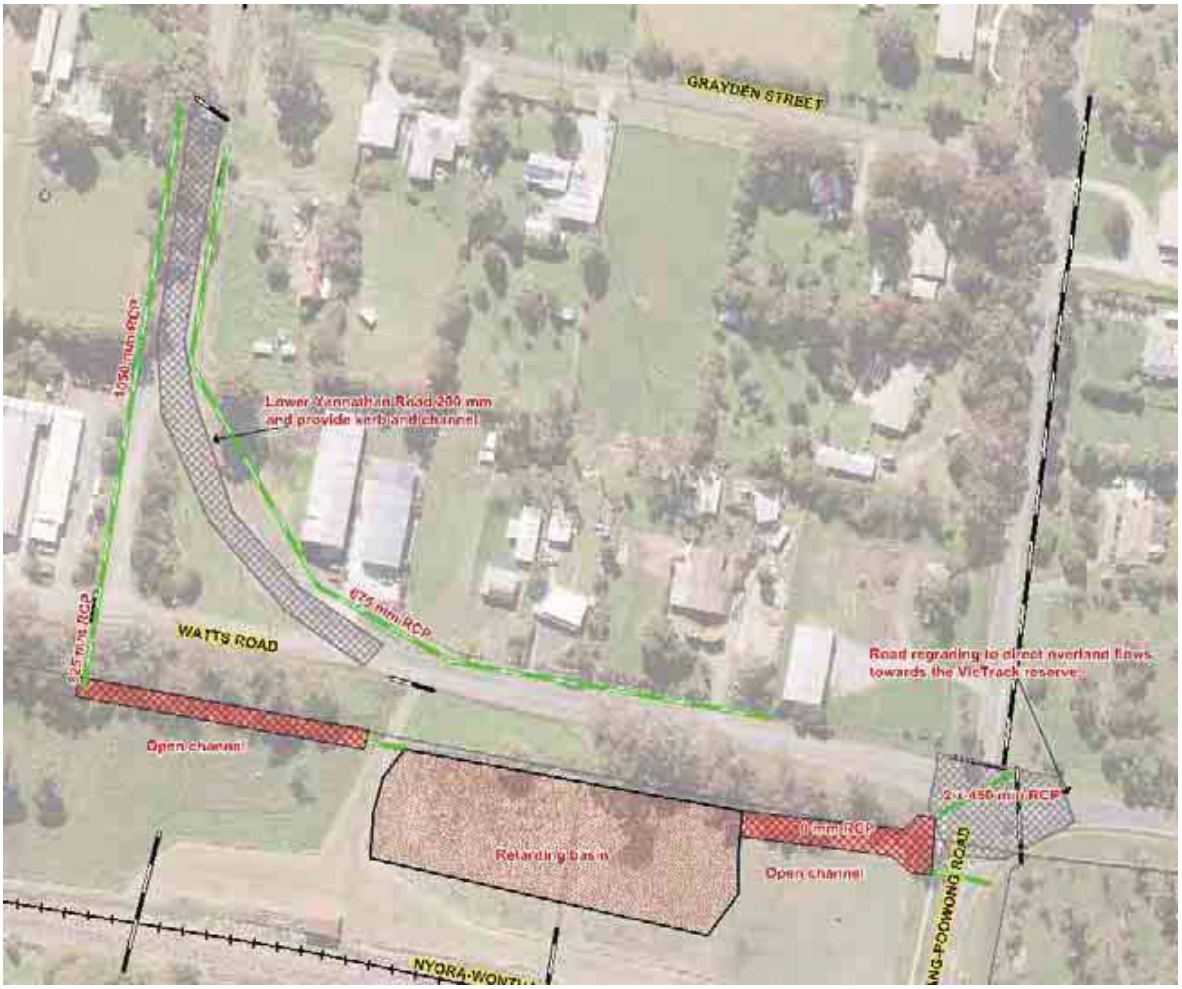

Figure 5.3 Yannathan Road flood mitigation works

Figure 5.4 Walter Street flood mitigation works

Figure 5.5 Glovers Road flood mitigation works

Figure 5.6 Hatchs Road flood mitigation works

6. ADMINISTRATION OF DEVELOPMENT IN FLOOD PRONE AREAS

6.1 Planning overlays

Planning zones are used to control land use as well as development. The Urban Flood Zone (UFZ) and flood overlays, the Special Building Overlay (SBO), Land Subject to Inundation Overlay (LSIO) and the Floodway Overlay (FO) designate land that is subject to flooding and provide statutory authorities with a means for regulating or prohibiting development within a hazardous area under Section 62(e) of the Planning and Environment Act 1987. The statutory authorities responsible for collecting flood information and managing development in flood prone land in Nyora are SGSC and Melbourne Water.

A planning scheme amendment is required to incorporate a flooding overlay or zone into the planning scheme, which can be an arduous and expensive process. The decision is sometimes made to avoid implementing a flooding overlay, such as in circumstances where the proposed planning scheme is a temporary measure that will be removed once flood mitigation works are implemented or where there are existing zones or overlays that can be used to manage development appropriately. Further discussion on the application of flood related planning zones and overlays including implementation examples can be found in *Planning Practice Note 12: Applying the Flood Provisions in Planning Schemes, a guide for Councils (June 2015).*

The TUFLOW flood modelling undertaken for the existing conditions 1% AEP event (refer to **Appendix A** for details) shows that there are a number of overland flow paths where SGSC could consider implementing planning scheme controls such as the SBO, LSIO or UFZ in Nyora. In many locations the overland flow paths can be incorporated into the development precincts as part of future major and minor drainage systems or as part of designated waterway corridors. However in some locations existing flooding will not be resolved as part of future development or flood mitigation works, such as behind the railway embankment and major road embankments.

Given Nyora's relatively small size it is considered that SGSC could potentially manage development applications on a case by case basis without the implementation of flood related planning zones or overlays. This approach is understood to be SGSC's preference and further discussion on how this might be undertaken on a zone by zone basis is provided in **Section 6.2**. However it is recommended that SGSC further consider the practical implementation and internal processes required to assess development applications in flood prone areas and the option of using overlays such as an SBO or LSIO.

6.2 Planning approvals

6.2.1 General Residential Zones (GRZ)

An Outline Development Plan (ODP) includes a stormwater and drainage management plan and is a requirement of the IDM (and therefore SGSC) where land is subject to a Development Planning Overlay (DPO). Existing DPO's (DPO5 and DPO10) cover areas in Nyora that are currently zoned or currently being re-zoned as GRZ1, including those located within Precinct A, B and F (refer to **Section 4.2.2** for more information).

The information required as part of an ODP submission is given in Section 4.3 of the IDM (v4.4.2). It is recommended that the flood modelling undertaken for this SMP be used by SGSC to assess ODP's and establish minimum requirements for overland flow paths, floor levels and building layouts.

6.2.2 Other Zones

Land zoned Low Density Residential (LDRZ) and Rural Living (RLZ) cover large areas of Nyora, particularly to the north and south east of the town centre. In both zones the landowner requires a permit for subdivision and the construction of a building of >100 square metres.

Land zoned Industrial Zone 3 (IN3Z) is located on the Lang Lang - Poowong Road north of the town centre. A landowner requires a permit for subdivision and for construction (with some exceptions).

Land zoned C1Z is located in the Nyora town centre. A landowner requires a permit for subdivision and for construction of a building.

It is recommended that SGSC consider adopting the flood modelling undertaken for this SMP as part of the permit assessment process for any proposed subdivisions and buildings in these zones to ensure that the proposed development does not result in adverse flooding to neighbouring properties and to ensure appropriate offsets and floor levels are applied.

7. STORMWATER QUANTITY

7.1 Guiding principles

Existing natural values, future urban form and Nyora's vision (refer to **Section 3.1**) were used to inform the type and location of stormwater assets that were proposed for the SMP.

The Giant Gippsland Earthworm is a federally protected species and its location is identified by the provisional Giant Gippsland Earthworm Overlay (ESO9 C107). Works in areas covered by the Giant Gippsland Earthworm Overlay (GGEO) were avoided where possible and retardation solutions such as on-site detention proposed to minimise development changes to the hydrological regime that could also affect the Earthworm. The proposed drainage layout also considered existing stands of existing vegetation, which were avoided where possible.

The drainage system at Nyora should be designed to ensure no urban property flooding occurs for events up to the 1% AEP and stormwater runoff can be safely conveyed through the development to the receiving waterway. To achieve this, a minor / major drainage system philosophy is proposed. This approach is outlined in Chapter 14 of Australian Rainfall and Runoff – Flood Analysis and Design 2001. The principals of major and minor drainage systems are discussed further in the Drainage Investigation Report presented in **Appendix A**.

The following guidelines were used to inform the development of the Nyora stormwater quantity plan:

- Waterway Corridors in Greenfield Development Guidelines (Melbourne Water, 2013)
- Constructed Waterways in Urban Development Guidelines (Melbourne Water, 2009)
- Principles for Provision of Waterway and Drainage Services for Urban Growth (Melbourne Water, 2007)
- Infrastructure Design Manual (v4.4.2).

7.2 Nyora stormwater quantity plan

The long term plan (>20 years) for the management of stormwater flows in Nyora is summarised as follows:

- Construct piped systems with kerb and channel roads in the urban growth areas of precincts A, B, C, F and D, the commercial centre in precinct A and the industrial area on Yannathan Road.

- Maintain existing open swales to convey flow in the low density and rural living areas of precinct E, G and H.
- Designate waterway corridors for existing waterways where the proposed Giant Gippsland Earthworm Overlay (GGEO) shows Giant Gippsland Earthworm habitat.
- Implement on site detention in accordance with the IDM standards to retard minor development flows back to existing conditions in infill development precincts.
- End of line retarding basins to mitigate the 1% AEP peak flow back to existing conditions at town boundaries, prior to discharge to downstream properties.

7.3 Methodology

7.3.1 Pipe drainage

Stormwater pipes were sized for fully developed conditions using the lot densities presented in **Section 5.2** and in accordance with SGSC underground pipe system design standards from the IDM (presented in **Section 3.2**).

Stormwater pipes were sized using Melbourne Water's DSS costing spreadsheet.

7.3.2 Major flow paths (roads)

Indicative locations for proposed roads to convey major flow paths were determined for precinct B and presented on **Figure 7.1.**

The location of roads in greenfield precincts (C,D and F) should be determined by the developer (in accordance with the methodology described in the IDM). No roads were required by the Nyora Development Strategy in other precincts.

An urban access road cross section with a SM2 kerb and minimum 20 metre road reserve width was used to check the flow capacity of the proposed road reserves against the gap flow between the 18% AEP pipe system capacity and the 1% AEP event.

The edge of the road reserve was assumed to be 150 mm higher than the top of kerb irrespective of the width of the reserve.

Table 7.1 presents the road locations, flows for the pipe system and roads based on the Rational Method and a minimum road reserve width required to convey the flow. Final road designs and checks for safely conveying overland flow will need to be done at the subdivision design stage.

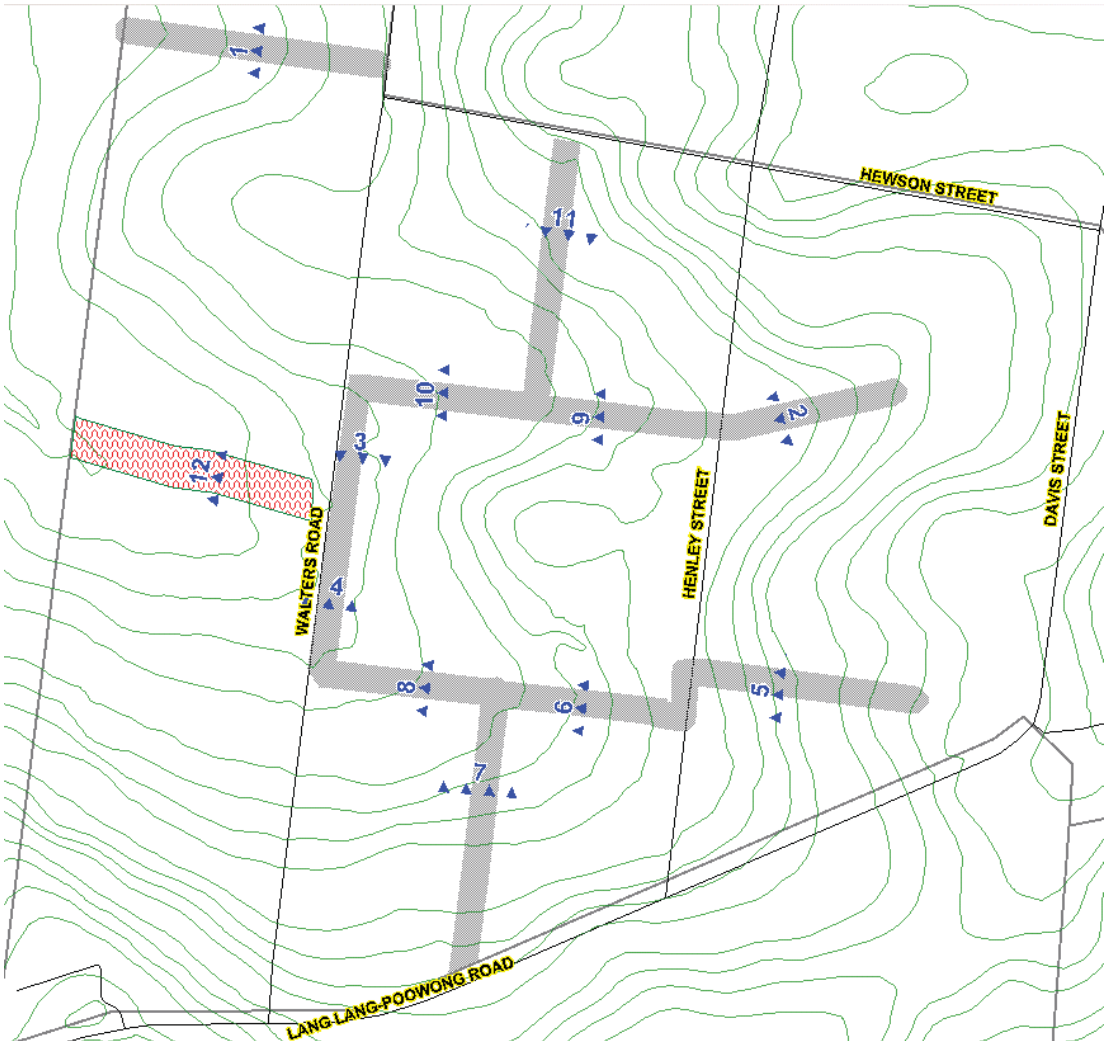

Figure 7.1 Precinct B major drainage system

The flow major flow path in the area of flow locations 8, 6 and 7 passes through vegetation that SGSC may wish to retain. An alternative approach to constructing a road through this area is to allow the existing overland flow path to remain through the vegetated area with the major and minor road and pipe system positioned to capture flow as it leaves the vegetated area. Further hydraulic analysis is required to confirm the feasibility of this option.

Table 7.1 Major flow paths in roads

Road (location)	Pipe ID	1% AEP developed conditions flow (m^3/s)	18% AEP developed conditions pipe flow (m^3/s)	Gap flow in the road reserve (m^3/s)	Road reserve width (m)
1	B41-B42	1.2	0.5	0.7	20
2	B11-B12	2.8	1.2	1.7	20
3	B15-B16	5.0	2.0	2.9	30
4	B33-B34	4.8	2.0	2.8	30
5	B29-B30	0.9	0.4	0.6	20
6	B31-B32	1.8	0.7	1.0	20
7	B37-B32	0.2	0.1	0.1	20
8	B32-B33	4.1	1.7	2.4	25
9	B13-B14	3.6	1.5	2.1	20
10	B14-B15	4.4	1.8	2.6	25
11	B27-B14	0.3	0.1	0.2	20
12	WW1-WW2	8.1	-	-	

7.3.3 Waterway corridors

Waterway corridors were used to identify development limits adjacent to existing waterways that are declared under Section 188 of the Water Act 1989 and should be preserved an existing state due to environmental considerations. The preservation of existing waterway corridors in Nyora was determined on a precinct by precinct basis:

- In greenfield precincts (e.g. C and F) where designated waterways exist, waterway corridors were generally proposed instead of constructed waterways for the primary reason of minimising impact to the Giant Gippsland Earthworm habitat, which covers the majority of waterways in Nyora.
- In precincts with existing development the Giant Gippsland Earthworm habitat was generally less prevalent and additional consideration was given to public amenity, economic factors and stormwater requirements.

Existing designated waterways within Nyora either have a Strahler value of 1 or 2 based on the methodology for classifying stream type that is described in the Waterway Corridors in Greenfield Development Guidelines (Melbourne Water, 2013). In accordance with the guidelines, waterway corridors in Nyora are generally proposed to have a width of 45 metres, which is based on a 5 metre top of bank width between reference points (as shown in **Figure 7.2)** and a 20 metre setback distance from these reference points. The waterway corridor in Precinct C is a 60 metre width which extends from the constructed open waterway and is positioned where it is for the purposes of maintaining Giant Gippsland Earthworm habitat. Melbourne Water has indicated that a 60 metre waterway corridor width may be required in other locations in Nyora to preserve existing environmental values. It is therefore recommended that further discussion be had with Melbourne Water to determine the appropriate width of waterway corridors around Nyora.

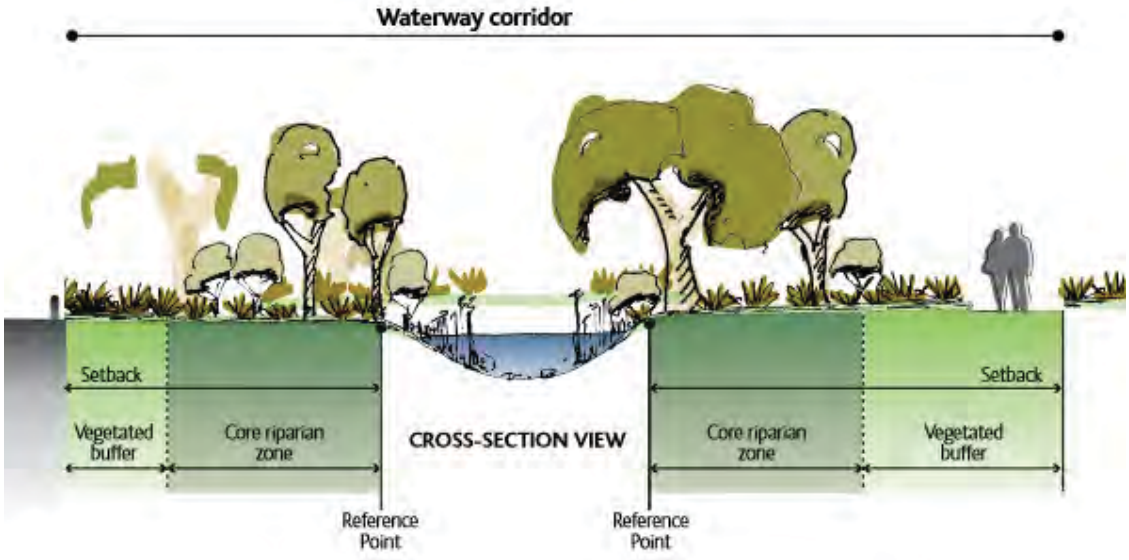

Figure 7.2 Waterway Corridor (Source: Melbourne Water's Waterway Corridors Guidelines, 2013)

7.3.4 Constructed waterways

Constructed waterways were proposed where:

- development flows are discharged to a waterway without mitigation
- waterway works are required to mitigate existing flooding.

Two (2) constructed waterways are proposed at Nyora. These are located west of Walters Road (Precinct B and C) and downstream of an existing dam located in Precinct F which will be removed when development occurs.

Figure 7.3 shows a typical cross section adopted by Melbourne Water for constructed waterways.

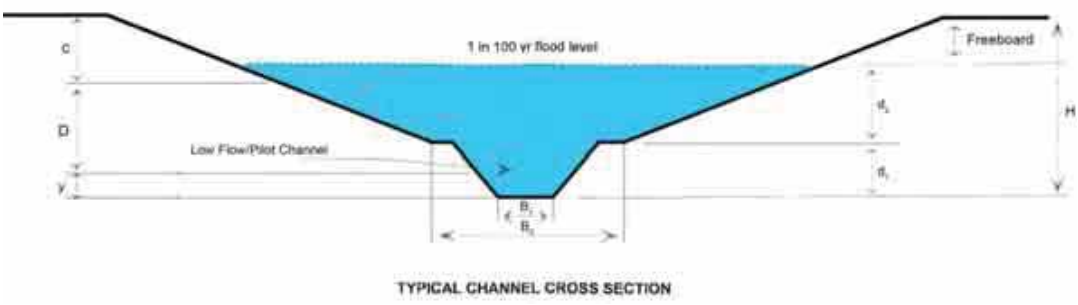

Figure 7.3 Constructed waterway typical cross section

Constructed waterways were sized to convey the unmitigated developed conditions 1% AEP event.

Table 7.2 presents the constructed waterway dimensions.

Table 7.2 Constructed waterways

Precinct	Pipe ID	1% AEP developed conditions flow (m^3/s)	Low flow channel base width	Min depth (including 600 mm freeboard)	Top width (including 600 mm freeboard)	Total Corridor Width including setbacks (m)
C	WW1-WW2	8.8	1.5	1.4	27.1	60
F	WW4-WW5	5.0	1	1.4	26.6	60

Both constructed waterways will require works within the GGEO and it is recommended that further investigations be undertaken to determine whether alternative works can be undertaken to reduce the impact to the Giant Gippsland Earthworm.

As part of the development of this SMP with the Nyora Development Strategy (Planisphere, 2016), the option of a possible green East-West connection was identified for Precinct B. The provision of a constructed waterway at this location was not investigated but is considered to be a potentially viable alternative to the pipes and road approach documented in this SMP.

7.3.5 End of line retardation basins

End of line retarding basins were proposed to mitigate the peak 1% AEP development conditions flow back to existing conditions at the town boundaries.

The location and sizing of retarding basins was based on the following assumptions:

- Retarding basins were located at the downstream boundaries of precincts that discharge outside the town boundaries.

- Retarding basins were located at the downstream boundaries of precincts that discharge to other precincts (within the town boundaries) where retarding basins could not be located downstream. For example no retarding basins were proposed on Adam's Creek in precinct E to avoid impact to the existing environmental values of that waterway.

- Where possible, a single retarding basin was preferred over multiple retarding basins on the same waterway. For example a single retarding basin located in precinct C that captures flows from precinct B and C was adopted over two retarding basins that capture flows from precinct B and C separately.

- Concept retarding basins sizing was based on the attenuation of development conditions 1% AEP flows back to existing conditions 1% AEP flows. Based on advice from Melbourne Water, existing conditions flows were estimated using TUFLOW assuming existing farm dams were full at the start of the design storm event.

- Retarding basins were sized using Boyd's method. The peak existing conditions flow at each retarding basin was established using the Rational Method or using hydrographs extracted from the existing conditions TUFLOW results. The results are considered to be suitable for strategy level sizing estimates however it is recommended that the sizes of the retarding basins be confirmed at later stages of design.

- Concept retarding basins were modelled to be at least partially in-cut in order to minimise the associated dam-break hazard. However retarding basins that were located in areas covered by the provisional GGEO were assumed to require headwalls rather than being in-cut. It is recommended that SGSC undertake further consultation with Melbourne Water to determine whether this design approach is appropriate and whether there are any special design approaches that could be adopted to reduce the impact of proposed retarding basins to existing GGE populations.

Table 7.3 presents the retarding basin concept designs for each precinct.

Table 7.3 Retarding basin concept designs by precinct.

Precinct	Retarding Basin	Catchment (ha)	Invert (m AHD)	Design Storage Volume (m^3)	Peak outflow (m^3/s)
A	RB8	35.9	118.3	3650	2.14
B	-	-	-	-	-
C	RB1	126.3	98.00	19000	5.48
C	RB2	6.5	105.00	800	0.45
C	RB3	0.8	105.00	80	0.07
D	RB4	8.2	113.00	660	0.81
D	RB7	4.8	129.00	360	0.49
D	RB10	2.5	131.00	230	0.26
E	-	-	-	-	-
F	RB5	5.8	114.20	370	0.58
F	RB6	5.6	114.00	3800	0.59
F	RB9	164.7	101.00	23500	6.62
G	-	-	-	-	-
H	-	-	-	-	-

The design of retarding basins in Nyora should be undertaken in accordance with the design standards described in the IDM.

Retarding basins were considered to be the most cost effective approach for mitigating catchment flows up to the 1% AEP from a construction and maintenance perspective.

The VicTrack land located north of the railway currently acts as a defacto retarding basin by providing storage for flood waters. The land is undulating and poorly drained and areas are understood to remain inundated for long periods after a rainfall event. The formalisation of this land into a shallow dry retarding basin, in combination with the associated pipe drainage system upgrades on Yannathan Road, is intended to mitigate flooding at the nearby industrial properties.

7.3.6 On site detention

On site detention (OSD) is a lot scale approach used to mitigate increases to catchment flows due to development. The objectives of OSD typically relate to preserving the capacity of the existing minor drainage system by mitigating against increases to flows from more frequent events (the 18% AEP for residential developments) that would otherwise occur from a development. OSD is often required by drainage authorities where incremental development occurs on a small spatial scale, such as infill development, where it is not practical to construct an end of line retarding basin. Where development occurs on a larger scale such as in greenfield developments an end of line retardation approach is typically preferred as this is the most cost effective approach and provides flood mitigation for events up to the 1% AEP.

The main considerations for the implementation of OSD at Nyora are:

- the nature of the development (infill areas versus greenfield)
- the capacity of the existing drainage system and existing flooding
- the type of development (e.g. Commercial versus residential)
- environmental sensitivity of the receiving waterways
- inspection, maintenance and management.

Table 7.4 presents the recommended on-site detention approach for Nyora based on precinct and land-use type. The storage volume requirements and allowable discharges were adopted from Table 13 of the IDM (v4.4.2).

On site detention can often be incorporated into rainwater tanks. By combining rainwater tanks and on site detention other benefits can be achieved, including:

- reduction in potable water demand
- reduction in pollutant load discharged to receiving waters
- reduction in the volume of water discharged to receiving waters, which can partly offset the overall increase in runoff caused by urban development.

Table 7.4 On-site detention requirements for new development by precinct and land-use type

Precinct	Land use type (Planning Zone)	Storage volume per m² of development	Allowable discharge (L/sec/ha)
A	GRZ1	9	37
A	C1Z	11	64
B	GRZ1	9	37
C	GRZ1	NO OSD	NO OSD
D	GRZ1	NO OSD	NO OSD
E	LDRZ	9	37
E	IN3Z	13	30
F	GRZ1	NO OSD	NO OSD
G	LDRZ	9	37
H	RLZ	9	37

7.3.7 Private dams

As per the advice from Melbourne Water, all existing dams that are located within properties proposed for development are to be decommissioned and demolished.

8. STORMWATER QUALITY

8.1 Water quality objectives

Urbanisation leads to an increase in stormwater runoff and a subsequent increase in pollutant wash-off. This has detrimental effects on the receiving waterways and ultimately Western Port Bay. Melbourne Water and Council are required to protect and enhance the water quality of waterways in accordance with clauses contained within the State Environment Protection Policy (Waters of Victoria) SEPP and the Victorian Planning Provisions (VPP).

The State Environment Protection Policy (Waters of Victoria) defines the required water quality conditions for urban waterways. The aim of stormwater quality treatment is to reduce typical pollutant loads from urban areas to Best Practice Environmental Management (BPEM) as defined by the targets presented in **Table 8.1**.

Table 8.1 BPEM stormwater quality targets

Pollutant	Performance Objective
Total Suspended Solids (TSS)	80% reduction from typical urban load
Total Phosphorous (TP)	45% reduction from typical urban load
Total Nitrogen (TN)	45% reduction from typical urban load
Gross Pollutants (GP)	70% reduction from typical urban load

Source: Urban Stormwater: Best Practice Environmental Management Guidelines – Victorian Stormwater Committee, 1999.

Schedule F8 of the State Environment Protection Policy (Waters of Victoria) is for Waters of Western Port and Catchment and applies to the catchment areas in Nyora. The schedule recognises that Western Port and its associated catchment is more ecologically sensitive than other waters of Victoria and therefore requires an increased level of protection. **Table 8.2** presents the recommended water quality targets to achieve the environmental indicators listed in the SEPP Schedule F8.

Table 8.2 SEPP Schedule F8 Pollutant Reduction Targets for Western Port

Pollutant	Performance Objective
Total Suspended Solids (TSS)	93% reduction from typical urban load
Total Phosphorous (TP)	66% reduction from typical urban load
Total Nitrogen (TN)	63% reduction from typical urban load

The best practice water quality targets presented in **Table 8.1** are a requirement for new residential development under clause 56.07 of the Victorian Planning Provisions (VPP) and are enforced by Melbourne Water and SGSC. The provision of water quality treatment for commercial and industrial development is not currently legislated for however it is common practice by Melbourne Water and Local governments to require that these development types meet water quality treatment standards.

The BPEM stormwater quality targets (**Table 8.1**) have been adopted for the purposes of sizing all water quality infrastructure at Nyora. Our understanding is that the Schedule F8 targets are not legally binding and have not been adopted to size stormwater quality infrastructure for this plan. They are also very difficult to achieve using current best practice water sensitive design methods. However it is recommended that SGSC consider in consultation with Melbourne Water whether the more stringent Schedule F8 targets should be adopted at Nyora.

8.2 Water quality plan

The stormwater quality plan at Nyora was developed for all precincts. In determining the appropriate water quality treatment for a given location, consideration was given to a number of factors, including:

- the type of development and the pollutants it was likely to generate - for example commercial areas are likely to generate more gross pollutants than residential areas
- the nature of the terrain and the constructability of treatment assets
- the size and nature of the development process that is likely to occur, for example:
  - End of line treatment assets were generally considered to be more appropriate for large greenfield developments where existing development does not restrict the construction of these typically larger assets.
  - On-lot treatment was proposed where subdivision is likely to occur on a lot by lot basis by the existing owner of the property, such as precincts E, G and H.
  - Street scale distributed water quality treatment was proposed for the future higher density residential and commercial areas in precincts A and B. In these locations, significant re-shaping of the street scape will be required to transition to the future urban form. This provides opportunities to construct water quality treatment assets that also add value to the urban landscape.
- environmental considerations, particularly the Giant Gippsland Earthworm - treatment assets were located to avoid impacting the Giant Gippsland Earthworm (as identified by the proposed Environmental Significance Overlay) where possible.

8.3 Treatment devices

8.3.1 Treatment summary by precinct

Table 8.3 summarises the stormwater treatment devices proposed for Nyora.

Table 8.3 Treatment devices

Scale	Treatment device	Precinct
On-lot	Bio-retention basins, vegetated swales, buffer strips, rainwater tanks	E, G and H
Street	Bioretention basins / tree pits	A and B. Some areas of C, D and F
	Gross Pollutant Trap (litter only)	A
	Gross Pollutant Trap (litter and sediment)	E (industrial area)
End of line (offline from waterways)	Sedimentation basins	B, C, D and F
	Bioretention basins	C, D and F

End of line wetlands located offline from waterways were considered where catchment areas were considered large enough for a sustainable wetland to be implemented. These locations were Precinct C (within RB1) and Precinct F (RB9). Wetlands were ultimately not adopted at these locations as it was considered that the earthworks required would be likely to impact negatively on the Giant Gippsland Earthworm. Given offline wetlands in these locations could reduce the maintenance burden associated with the distributed network of sedimentation and bioretention basins that is currently proposed, it is recommended that further investigation into the viability of constructing wetlands is undertaken in consultation with the river health team at Melbourne Water and Giant Gippsland Earthworm specialists.

8.3.2 Treatment devices

Bioretention basins

On-lot, street scale and end of line bioretention basins have been proposed for the Nyora SMP. Bioretention basins consist of rock mulch and vegetation, a filtration layer, a submerged zone and a drainage layer, similar to that depicted in **Figure 8.1**.

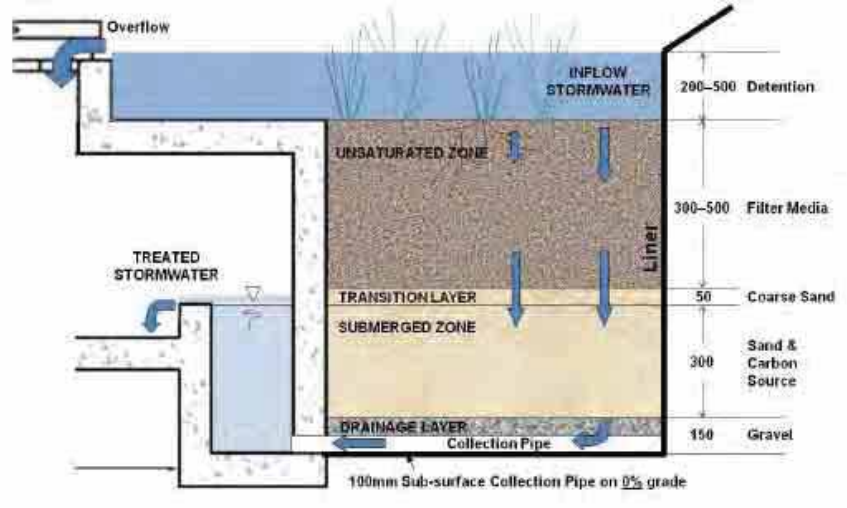

Figure 8.1 Cross section of bioretention basin (Source: Stormwater Biofiltration Systems Adoption Guidelines, FAWB, 2009)

Bioretention basins can be integrated within the urban landscape and planted with vegetation that provides effective vegetation removal (as shown in **Figure 8.2**) or grassed with turf. Recent cooperative research undertaken by the City of Manningham, Melbourne Water and the CRC for Water Sensitive Cities into Zero Additional Maintenance Water Sensitive Urban Design (ZAM-WSUD) is presented in ZAM-WSUD Handbook that provides design and construction advice for the implementation of grassed and planted biofiltration systems that require no additional maintenance relative to what would ordinarily be required by a grassed nature strip or planted area. It is recommended that ZAM-WSUD designs be considered for implementation of street scale WSUD in Nyora.

Figure 8.2 Street scale bioretention basin

Sedimentation basins

End of line sedimentation basins have been proposed at a number of locations by the Nyora SMP. Sedimentation basins are basins specifically designed to remove medium to coarse sized suspended solids via a settling process. Sedimentation basins use temporary detention to promote sediment settling and reduction of velocities. These basins can either be permanent or used as a temporary measure during construction.

Figure 8.3 Sedimentation basin (Source: Chapter 4 Urban Stormwater: Best Practice Environmental Management Guidelines. CSIRO, 2006)

Gross Pollutant Traps

Gross pollutant traps (GPT) are used as a primary treatment measure to remove litter, debris and coarse sediments. Gross pollutant traps designed specifically to remove litter have been proposed on the major drainage systems downstream of the commercial centre in Precinct A. A gross pollutant trap that captures litter and sediment has been located downstream of the industrial area in precinct E.

GPT's are advantageous in that they can be located underground in the form of a large drainage pit. They do, however, only remove a small portion of total phosphorous and total nitrogen from the runoff, only that which is attached to the coarse sediments being retained in the trap.

GPT's require regular manual maintenance to clean out the litter and debris, but are an ideal treatment for removal of unsightly gross pollutants as they have a very small footprint.

8.4 Water quality modelling

Water quality modelling was undertaken in MUSIC (version 6.1.).

Water quality models were developed to represent the fully developed catchment for the purposes of assessing pollutant reduction requirements and the size and distribution of water quality treatment assets required.

Figure 8.4 and **Figure 8.5** present screen shots from two of the MUSIC models created to assess the treatment performance of proposed water quality assets.

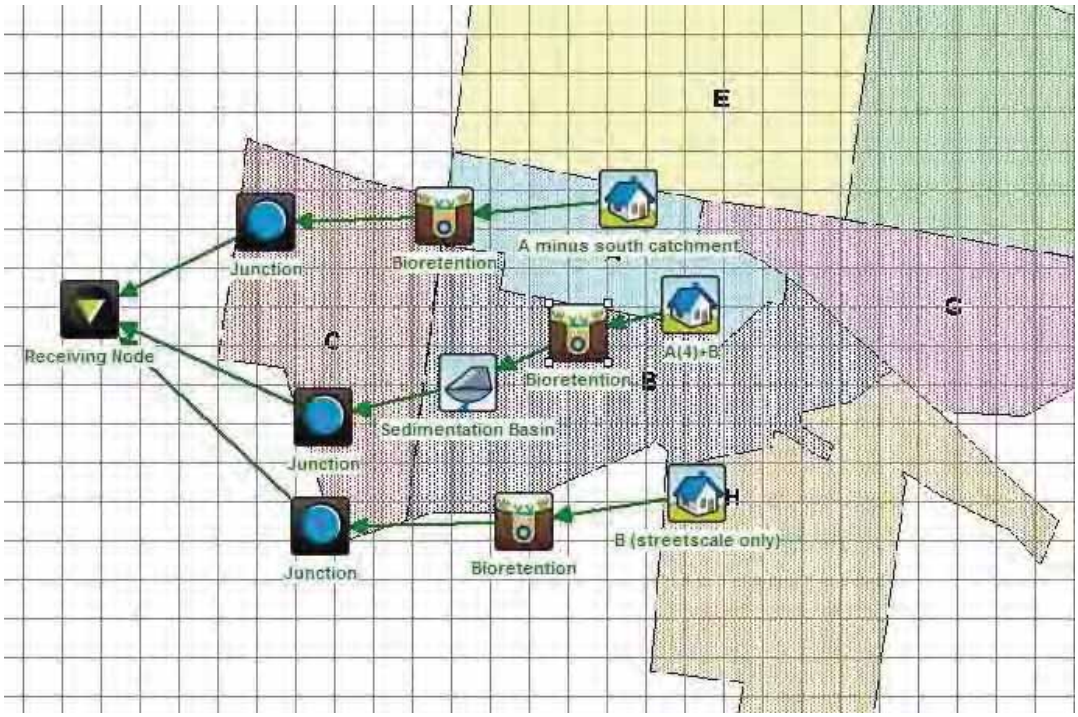

Figure 8.4 Street scale and end of line water quality modelling for precincts A and B

Figure 8.5 Street scale and end of line water quality modelling for precinct F

8.5 Pollutant generation

Table 8.4 presents the modelled volumes of key indicator pollutants, Total Phosphorus (TP), Total Nitrogen (TN), Total Suspended Solids (TSS) and Gross Pollutants (GP) generated in the fully developed catchment.

Table 8.4 Annual pollutant generation for the fully developed catchment

Precinct	Area (ha)	Developed Conditions FI	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
A	33.2	0.48	170	30700	64.7	482	5730
B	66.5	0.48	349	63800	134	977	12100
C	52.5	0.5	283	52100	110	803	9970
D	15.5	0.5	83.6	15600	32.6	235	2940
E	82.4	0.34	378	65900	141	1050	11300
F	114.3	0.5	617	114000	241	1740	21700
G	49.2	0.31	219	37400	80.7	606	6190
H	70.1	0.21	282	45900	103	770	6210

Table 8.5 presents the removal volumes for the key indicator pollutants in accordance with the BPEM objectives that are presented in **Table 8.1**. The treatment plan for Nyora achieves these removal volumes.

Table 8.5 Removal volumes required to meet BPEM water quality targets

Precinct	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
A	24560	13815	29.115	4011
B	51040	28710	60.3	8470
C	41680	23445	49.5	6979
D	12480	7020	14.67	2058
E	52720	29655	63.45	7910
F	91200	51300	108.45	15190
G	29920	16830	36.315	4333
H	36720	20655	46.35	4347
TOTAL	**340320**	**191430**	**408.15**	**53298**

8.6 Water quality assets

8.6.1 MUSIC modelling parameters

Water quality treatment assets were sized using MUSIC.

Bioretention basins were sized using the generic parameters presented in **Table 8.6**.

Table 8.6 Bioretention basin parameters for MUSIC modelling

Parameter	Value
Low flow bypass (m^3/s)	0
High flow bypass (m^3/s)	100
Extended detention depth (m)	0.30
Filter depth (m)	0.5
Exfiltration rate (mm/hr)	0
Saturated hydraulic conductivity (mm/hr)	180
Orthophosphate content (mg/kg)	55

Sedimentation basins were sized using the Fair and Geyer equation to achieve a clean out frequency of 5 years and BPEM water quality treatment. The minimum constructible sediment basin size was assumed to be 300 m^2. **Table 8.7** presents the generic parameters adopted to size sediment basins at Nyora.

Table 8.7 Sediment pond surface area calculation

Parameter	Description	Value
λ	Hydraulic efficiency	0.41 (based on length to width ratio of 3:1)
n	Turbulence or short-circuiting factor (Equation 4.2 of WSUD Engineering Procedures)	1.7
v_s	Settling velocity for target sediment (0.125mm)	0.011 m/s
Q	Design flow	3 month flow ARI
d_e	Extended detention depth	0.3 m
d_p	Depth of the permanent pool	1.0 m
d*	Depth below permanent pool that is sufficient to retain sediment	0.5 m
R	Fraction of target sediment removed	>0.95
F_r	Desired clean-out frequency	5 years

8.6.2 Asset sizes

End of line assets were adopted where the upstream catchment exceed 5 hectares in area (subject to terrain, existing development and environmental constraints). **Table 8.9** presents a summary of the end of line sedimentation basin sizes by precinct. The location of each asset is presented in a plan presented in **Appendix C**.

Table 8.8 End of line sedimentation basins sizes

Precinct	Asset ID	Catchment Area (m^2)	Design Flow (m^3/s)	Surface Area (m^2)
A	-	-	-	-
B*	SB1	46.99	0.64	900
C	SC1	19.97	0.31	500
D	SD1	8.25	0.14	300
E	-	-	-	-
F	SF1	5.57	0.09	300
F	SF2	18.75	0.30	500
F	SF3	26.64	0.39	650
F	SF4	6.26	0.10	300
F	SF6	10.39	0.17	350
G	-	-	-	-
H	-	-	-	-
TOTALS	-	142.82	-	3800

*Inclusive of 3.99 hectares of precinct A

Table 8.9 presents a summary of the end of line bioretention basin sizes by precinct. End of line bioretention basins were located downstream of end of line sedimentation basins. The location of each asset is presented in a plan presented in **Appendix C**.

Table 8.9 End of line bioretention basin sizes

Precinct	Asset ID	Catchment Area (m^2)	Design Flow (m^3/s)	Filter Area (m^2)
A	-	-	-	-
B	-	-	-	-
C	BC1	19.97	0.31	600
D	BD1	8.25	0.14	100
E	-	-	-	-
F	BF1	5.57	0.09	40
F	BF2	18.75	0.30	550
F	BF3	26.64	0.39	650
F	BF4	6.26	0.10	80
F	BF6	10.39	0.17	240
G	-	-	-	-
H	-	-	-	-
TOTALS	-	95.83	-	2260

Distributed street scale bioretention were modelled for locations where drainage to a single end of line system was considered impractical due to the terrain, environmental values or existing development. Total filter areas for distributed street scale bioretention are presented by precinct in **Table 8.10**.

Table 8.10 Street scale distributed bioretention

Precinct	Catchment Area (ha)	Total Filter Area (m²)
A*	29.18	1100
B*	46.99	2100
C	32.08	2620
D	7.78	300
E	-	-
F	46.72	1780
G	-	-
H	-	-
TOTALS	**158.26**	**8000**

*Inclusive of 3.99 hectares of precinct A

On-lot WSUD treatment could be achieved by a variety of methods including buffer strips, swales and infiltration trenches. It is recommended that SGSC direct developers to demonstrate that their development achieves best practice. Valid methods for sizing and designing the WSUD asset requirements include the use of MUSIC and Melbourne Water's STORM calculator.

The total areas presented in the tables above cannot be simply added together as this would result in double counting of some areas that are treated by multiple WSUD assets. However the following statistics summarise the treatment requirements:

- The total treated catchment area is 484 hectares, consisting of 282 hectares of end of line and street scale WSUD and 202 hectares of on-lot WSUD.
- The portion of the impervious catchment area required for treatment using end of line and street scales systems is approximately 1.0%. This estimate is for the treatment area only and a larger area around each asset will be required for the purposes of constructing access tracks, sediment laydown areas and other assets.
- Concept area requirements for each asset that include access and other requirements were estimated at a high level and have been included in the cost estimates. Refer to **Section 11**.

8.7 Stormwater and rainwater harvesting

A stormwater harvesting opportunity was identified near the Nyora Primary School. An existing dam located within the Public Parks and Recreation Zone appears to intercept water from the main flow path through this area and could be harvested to irrigate sports ovals. It is recommended that the ownership of this asset and the potential for it to be utilised for stormwater harvesting be investigated further.

Other stormwater and rainwater harvesting opportunities should be considered on a case by case basis as development occurs. Stormwater harvesting in the new development areas, particularly at the large retarding basins in Precinct F and C should be explored, particularly where opportunities to utilise water to irrigate areas of open space exist.

The use of rainwater tanks on lots should also be further considered by SGSC in all areas of Nyora. The use of rainwater tanks is likely to reduce the impact on the GGE by reducing changes to the flow regime. Rainwater tanks could be implemented in development areas using a Section 173 agreement with the developer.

9. STORMWATER MANAGEMENT BY PRECINCT

9.1 Precinct A

Table 9.1 presents a summary of the stormwater management plan for Precinct A. Refer to **Appendix D** for an A3 plan of the stormwater management plan.

Table 9.1 Precinct A stormwater management summary

Stormwater Management	Description
Description	Town centre
Flood Mitigation	Upgrade existing pipe drainage on Henley Street and Hewson Street. Upgrade existing pipe drainage on Hewson Street between Davis Street and Henley Street.
Minor Drainage System	Piped drains
Major Drainage system	Road Reserve
Flow Retardation	On site detention where development occurs. End of line retarding basin located in precinct C Retarding basin located north of the railway.
Waterways	N/A
WSUD	Distributed bio-retention and street trees, GPT (litter traps) at Walters Road (north) and Hewson Street

9.2 Precinct B

Table 9.2 presents a summary of the stormwater management plan for Precinct B. Refer to **Appendix D** for an A3 plan of the stormwater management plan.

Table 9.2 Precinct B stormwater management summary

Stormwater Management	Description
Development	Density transition area
Flood Mitigation	New pipe drainage on Hewson Street between Davis Street and Henley Street to 1% AEP standard to protect existing flood prone properties. This pipe or an alternative flood mitigation solution should be constructed prior to further development of the south east corner of precinct A between Henley Street and

	Davis Street.
Minor Drainage System	Piped drains
Major Drainage system	Road Reserve
Flow Retardation	On site detention where development occurs
Waterways	Constructed waterway between Walters street and the precinct boundary.
WSUD	Distributed bio-retention and sediment basin at Walters Street (south)

9.3 Precinct C

Table 9.3 presents a summary of the stormwater management plan for Precinct C. Refer to **Appendix D** for an A3 plan of the stormwater management plan.

Table 9.3 Precinct C stormwater management summary

Stormwater Management	Description
Description	Urban investigation area
Flood Mitigation	N/A
Minor Drainage System	Pipe drainage (network to be determined when development occurs)
Major Drainage system	Kerb and channel
Flow Retardation	End of line retarding basin Onsite detention to be further considered in addition to end of line retarding basin subject to further investigation on the impact of locally increasing catchment flows on the GGE.
Waterways	Waterway corridor for main flow path.
WSUD	Distributed bio-retention, end of line bioretention and sedimentation basins.

The ultimate drainage layout in precinct C will be subject to final approved subdivision layout and stormwater management plan.

9.4 Precinct D

Table 9.4 presents a summary of the stormwater management plan for Precinct D. Refer to **Appendix D** for an A3 plan of the stormwater management plan.

Table 9.4 Precinct D stormwater management summary

Stormwater Management	Description
Description	Urban investigation area
Flood Mitigation	N/A
Minor Drainage System	Pipe drainage (network to be determined when development occurs)
Major Drainage system	Road Reserve
Flow Retardation	End of line retarding basins
Waterways	N/A
WSUD	Distributed bio-retention, end of line bioretention and sedimentation basins.

The ultimate drainage layout in precinct D will be subject to final approved subdivision layout and stormwater management plan.

9.5 Precinct E

Table 9.5 presents a summary of the stormwater management plan for Precinct E. Refer to **Appendix D** for an A3 plan of the stormwater management plan.

Table 9.5 Precinct E stormwater management summary

Stormwater Management	Description
Description	Established low density residential with subdivision potential
Flood Mitigation	Retardation basin located in VicTrack land south of the Lang Lang – Poowong Road (in precinct A), new culverts under the Lang Lang – Poowong Road and pipe replacement of the open channel system on both sides of Yannathan Road. Works to provide for the existing 1% AEP flow to be contained within the pipe drainage system. SGSC to consider alternative option of lowering Yannathan Road to provide conveyance for major flows.
Minor Drainage System	Existing open drainage network to be maintained. Easement pipe drains to be constructed
Major Drainage system	Road Reserve and waterway corridors
Flow Retardation	On site detention where development occurs

Waterways	N/A
WSUD	On lot rainwater tanks, bio-retention, swales, infiltration strips and other WSUD as subdivision occurs. GPT downstream of the industrial precinct at Yannathan Road.

9.6 Precinct F

Table 9.6 presents a summary of the stormwater management plan for Precinct F. Refer to **Appendix D** for an A3 plan of the stormwater management plan.

Table 9.6 Precinct F stormwater management summary

Stormwater Management	Description
Description	Urban investigation area
Flood Mitigation	N/A
Minor Drainage System	Pipe drainage (network to be determined when development occurs)
Major Drainage system	Road Reserve in development areas, constructed waterway and waterway corridors in other locations.
Flow Retardation	End of line retarding basins
Waterways	Constructed waterway and waterway corridors
WSUD	Distributed bio-retention, end of line bioretention and sedimentation basins

The ultimate drainage layout in precinct F will be subject to final approved subdivision layout and stormwater management plan.

9.7 Precinct G

Table 9.7 presents a summary of the stormwater management plan for Precinct G. Refer to **Appendix D** for an A3 plan of the stormwater management plan.

Table 9.7 Precinct G stormwater management summary

Stormwater Management	Description
Description	New low density residential area
Flood Mitigation	Description of infrastructure required

Minor Drainage System	Existing open drainage network to be maintained.
Major Drainage system	Waterway corridor
Flow Retardation	On site detention where development occurs
Waterways	N/A
WSUD	On lot rainwater tanks, bio-retention, swales, infiltration strips and other WSUD determined by SGSC as subdivision occurs.

9.8 Precinct H

Table 9.8 presents a summary of the stormwater management plan for Precinct H. Refer to **Appendix D** for an A3 plan of the stormwater management plan.

Table 9.8 Precinct H stormwater management summary

Stormwater Management	Description
Description	Rural Lifestyle
Flood Mitigation	Description of infrastructure required
Minor Drainage System	Piped drains
Major Drainage system	Road reserve and existing natural flow paths
Flow Retardation	Onsite detention
Waterways	N/A
WSUD	Rainwater tanks, bio-retention, swales, infiltration strips and other WSUD determined by SGSC as subdivision occurs.

10. IMPLEMENTATION PLAN

The staging and timing of development in Nyora will ultimately determine the construction of the stormwater management system. Maps presenting a staged approach for implementing the stormwater management plan in the short term (5-10 year horizon), medium term (10-20 year horizon) are presented in **Appendix E**. The long term approach is presented as the ultimate stormwater management plan presented in **Appendix C** and **D**. The staged approach presented attempts to balance drainage, flood mitigation and water quality requirements at Nyora. A summary vision of the major stormwater works for construction in the short, medium and long term is presented below.

Short term (5 – 10 years)

- Partially construct flood mitigation works at Yannathan Road to divert flows from upstream residential development into VicTrack land north of the railway (subject to permission from VicTrack).
- Construct pipe upgrades in Precinct A and B on Hewson Street.
- Construct 1% AEP flood mitigation pipe on Hewson Street and Henley Street
- Construct bunding to mitigate existing flooding at Hatchs Road.
- Construct culverts under Walter Street and downstream open channel.
- Construct GPT at Yannathan Road.

Medium term (10 - 20 years)

- Construct trunk drainage system in precinct B.
- Construct sedimentation basin at Walters Road.
- Construct GPT at Walters Street.
- Construct underground pipe drainage system to replace open channel system at Yannathan Road.
- Construct stage 1 of retarding basin to mitigate precinct B development flows
- Construct GPT at Hewson Street.

Long term (>20 years)

- Lower Yannathan Road and provide kerb and channel major flow path.
- Construct remainder of the pipe drainage in Precinct A, B, E and H as subdivision requires.

- Development of precinct C and construction of stormwater management works, including the stage 2 upsizing of the retarding basin.
- Development of precinct D and construction of stormwater management.

11. PLAN COSTING

Concept level costing of stormwater assets at Nyora was undertaken using the development services scheme costing spreadsheet that is used by Melbourne Water for these projects.

Table 11.1 provides the summary table from the cost estimating spreadsheet for unallocated works in Nyora. Full details of rates and assumptions associated with costs are provided in the cost estimating spreadsheet, supplied to SGSC with this report.

The cost estimation includes the following works:

1. flood mitigation[3]
2. water quality
3. future drainage works for properties greater than 0.4 hectares

Private easement drains that were will be required as part of internal drainage to properties were not included in the costing. The figures in **Appendix D** identify which drainage was included in the costing.

No special allowance was made for filling in the large dam in precinct F.

In some locations, due to the low density development and sufficient open space, a 'greenfields' or 'reserve' rate has been adopted for costing pipes.

Table 11.1 Capital costs for unallocated works in Nyora

Works Description	Estimated Basic Construction Cost	Provisions
Pipes	$2,642,125	$184,949
Channels	$832,923	$0
Culverts	$179,584	$34,121
Retarding Basins	$1,162,711	$232,542
Sediment Basins	$1,426,074	$285,215
Litter Traps	$119,160	$23,832
Bio-Retention Basins	$717,491	$143,498

[3] Pipe drainage, permanent open channels and other works that form part of the ultimate stormwater plan were costed. Temporary works such as bunding and low flow channel excavation have not been costed. The cost of road works for lowering Yannathan Road were also excluded from the costing.

Sub-total 'A'	$7,080,068	$904,157
'A' x Site Establishment, Preparation & Reinstatement Costs @ 6%	$424,804	
'A' x Site Environmental & Traffic Management Plans @ 2.5%	$177,002	
Sub-total 'B'	$7,681,874	$904,157
'B' x Engineering Fee @ 15%	$1,152,281	$135,624
Sub-total 'C'	$8,834,155	$1,039,780
'C' x Administration Fee @ 9%	$795,074	$93,580
(Land Acq only) 'C' x Administration Fee @ 1%	-	-
Sub-total 'D'	$9,629,229	$1,133,361
'B' x Contingencies @ 5%	$384,094	-
UNALLOCATED COST	$10,013,322	$1,133,361
TOTAL COST (unallocated works only)	**$11,146,683**	
Rounded Estimate	**$11,150,000**	

Engeny has made no allowance for land acquisition. Some land acquisitions costs may be associated with the sediment basins and end of line bio-retention basins and this should be reviewed by SGSC. Estimated areas for the land acquisition required for the plan are provided in **Table 11.2**.

Table 11.2 Stormwater asset land-take estimates

Stormwater asset	Land take (hectares)
Channels	3.49
RBs	4.11
Sediment Basins	1.65
Bioretention Basins (end of line)	0.28
Bioretention Distributed	0.87

Pipes[4]	0.25
TOTAL	10.66

[4] Estimated allocation for a 2 metre width pipe easement at back of lot pipe drainage in precinct E and A.

12. FUNDING MECHANISMS

12.1 Context

The advice provided by Engeny in the following sections is in the context of our experience as stormwater consultants. Other funding mechanisms that are not mentioned here may be available to Council and it is recommended that SGSC engage the appropriate specialists to provide further advice on the implementation of the appropriate funding arrangement.

12.2 Flood mitigation works

A number of mechanisms may be available to SGSC for the funding of works required to mitigate existing flooding, including Special Charge Schemes and Section 173 Agreements.

The Local Government Act 1989 allows SGSC to recover the cost of underground drainage and other capital infrastructure work from the owner of a property that generally gains a special benefit from the construction works using a Special Charge Scheme. Implementing Special Charge Schemes to pay for flood mitigation in Nyora could be problematic in residential areas as many landowners are from low income households and may be unable to pay the required contributions. However a Special Charge Scheme applied to industrial properties on Yannathan Road may be appropriate to mitigate existing flooding at that location

Section 173 of the Planning and Environment Act 1987 refers to a voluntary and legally binding agreement between Council and another party such as a landowner. In discussion with SGSC the preferred mechanism for funding flood mitigation works in Nyora is by way of Section 173 agreements between Council and landowners proposing development. There are existing examples of Section 173 agreements in Nyora (refer to the Nyora Development Strategy for details) where a contribution to drainage improvement works is included in the agreement.

12.3 Development works

There are a number of mechanisms available to fund the stormwater infrastructure required to convey, treat and retard additional stormwater that results from development, including a Developer Contributions Plan (DCP) administered by SGSC and a Development Services Scheme (DSS) administered by Melbourne Water

The Planning and Environment Act (1987) allows the use of a DCP as a mechanism to levy new development for contributions to fund infrastructure (including stormwater infrastructure). The contribution is a dollar value across developable land to ensure equity in the payment contributions from all developers. A Development Contributions Plan Overlay (DCPO) and associated schedule is required to identify the area subject to the

DCP. A DCP could be considered by SGSC to manage large areas where relatively dense development is projected such as Precincts A and B.

A DSS could be an alternative to a DCP for the management of large development areas in Nyora. At the time of this SMP, Melbourne Water had indicated that it would consider renewing the Draft Nyora DSS if this was acceptable to Council. Renewing and implementing the DSS would mean that development contributions and works are managed through Melbourne Water rather than SGSC. Melbourne Water also indicated that it would also be acceptable if it was SGSC's preference not to initiate the DSS. If a DSS is implemented than funding contributions for stormwater infrastructure by developers in the DSS area would be administered by Melbourne Water.

Further collaboration is required between SGSC and Melbourne Water to determine whether Nyora is to be managed under a DSS arrangement. If SGSC choses to pursue a DSS arrangement then further discussions with Melbourne Water are required to define the boundaries of the DSS. The Draft Nyora DSS covers the greenfield areas of precinct C, D and F and most of the land now zoned as GRZ1 in precinct B. Given precinct A and precinct B discharge through precinct C, further consideration should be given to whether the DSS boundaries should include the total area of these precincts.

Based on discussions with SGSC and in lieu of a DSS and a DCP it is understood that Council's preferred mechanism for funding stormwater works required for new development is by way of a voluntary Section 173 agreement. From an administrative perspective this approach is likely to work most effectively where small numbers of developers are involved, such as where there is a single entity developing an area in which they can construct all of the works required to service their development and the use of an agreement will give Council and the landowner certainty of the infrastructure to be provided..

13. CONCLUSIONS

The Nyora SMP presents an approach to managing stormwater in Nyora that meets appropriate standards for drainage, flood protection, water quality, waterway health and amenity.

13.1 Flooding

Hydraulic modelling was undertaken using TUFLOW 1D/2D hydrodynamic software and RORB to generate catchment flows. The modelling identified that there are a number of locations in Nyora that are currently flood prone, including 2 properties (located on Yannathan Road and the corner of Henley Street and Hewson Street respectively) that were considered likely to experience above floor flooding for the 18% AEP event. Glovers Road and Walters Street were concluded to experience frequent and significant flooding. Flood mitigation options were proposed to mitigate flooding at these locations and two additional locations; at Hatchs Road and near the intersection of Hewson Street and Davis Street.

Hatchs Road was an area raised as flooding concern by residents in a community consultation session undertaken by Planisphere. This location was identified by the modelling as flood prone but with no floors affected. A local ground shaping and bunding mitigation option was proposed to keep flow out of what was understood to be the effected property however further investigation and discussion with the residents is recommended to inform this solution. The location near the intersection of Hewson Street and Davis Street has no formal existing flow path and development in the upstream Precinct A catchment area is likely to result an in increased flood risk to building floors. A flood mitigation solution involving a pipe upgrade and inlet works was proposed to convey major storm flows at this location.

13.2 Administration of flood prone land

In many locations existing overland flow paths can be incorporated into future development precincts as part of future major and minor drainage systems or as part of designated waterway corridors. However in some locations existing flooding will not be resolved as part of future development or flood mitigation works, such as behind the railway embankment and major road embankments.

Urban Flood Zone (UFZ) and flood overlays, the Special Building Overlay (SBO), Land Subject to Inundation Overlay (LSIO) and the Floodway Overlay (FO) designate land that is subject to flooding and provide statutory authorities with a means for regulating or prohibiting development within a hazardous area under Section 62(e) of the Planning and Environment Act 1987. The statutory authorities responsible for collecting flood information and managing development in flood prone land in Nyora are SGSC and Melbourne Water.

Given Nyora's relatively small size it is considered that SGSC could potentially manage development applications on a case by case basis without the implementation of flood related planning zones or overlays. However it is recommended that SGSC further consider the practical implementation and internal processes required to assess development applications in flood prone areas and the option of using overlays such as an SBO or LSIO.

13.3 Stormwater management for future development in Nyora

Existing natural values, future urban form and Nyora's vision (refer to **Section 3.1**) were used to inform the type and location of stormwater assets that were proposed for the SMP.

The long term plan (>20 years) for the management of stormwater flows in Nyora is summarised as follows:

- Construct piped systems with kerb and channel roads in the urban growth areas of precincts A, B, C, F and D, the commercial centre in precinct A and the industrial area on Yannathan Road.
- Maintain existing open swales to convey flow in the low density and rural living areas of precinct E, G and H.
- Designate waterway corridors for existing waterways where the proposed Giant Gippsland Earthworm Overlay (GGEO) shows Giant Gippsland Earthworm habitat.
- Implement on site detention in accordance with the IDM standards to retard minor development flows back to existing conditions in infill development precincts.
- End of line retarding basins to mitigate the 1% AEP peak flow back to existing conditions at town boundaries, prior to discharge to downstream properties.
- End of line sedimentation basins and bioretention basins and distributed street scale bioretention basins to manage stormwater quality to BPEM targets in greenfield development precincts and precincts A and B.
- On-lot WSUD within the low density and rural living precincts E, G, H.
- GPT's are proposed at 3 locations to intercept flows discharging from the commercial and industrial areas in precincts A and E respectively.

13.4 Costing

Concept level costing of stormwater assets at Nyora was undertaken using the development services scheme costing spreadsheet that is used by Melbourne Water for these projects.

The cost estimation included the following works:

- flood mitigation
- water quality
- future drainage works for properties greater than 0.4 hectares.

The total estimated unallocated cost of the stormwater works required to achieve the long term stormwater water management plan at Nyora is $11,150,000.

The cost estimate excluded land acquisition for drainage assets. The total land acquisition required for drainage assets is approximately 10.7 hectares. The land includes some publically owned land (VicTrack) and is located across a range of zones according to the current planning zones.

13.5 Funding mechanisms

A number of mechanisms may be available to SGSC for the funding of works required to mitigate existing flooding, including Special Charge Schemes and Section 173 Agreements. Based on discussions with SGSC, the preferred mechanism for funding flood mitigation works in Nyora is by way of Section 173 agreements between SGSC and landowners proposing development. There are existing examples of Section 173 agreements in Nyora (refer to the Nyora Development Strategy for details) where a contribution to drainage improvement works is included in the agreement.

There are a number of mechanisms available to fund the stormwater infrastructure required to convey, treat and retard additional stormwater that results from development, including a Developer Contributions Plan (DCP) administered by SGSC and a Development Services Scheme (DSS) administered by Melbourne Water. The funding approach for major drainage works should be determined in discussions with Melbourne Water.

14. RECOMMENDATIONS

14.1 General

1. SGSC consider adopting the Nyora SMP.

14.2 Flood modelling

The following recommendations are made with respect to flood modelling at Nyora:

2. SGSC consider undertaking floor level survey to further inform the hydraulic modelling and associated flood risk within the catchment.
3. SGSC consider undertaking a climate change investigation to inform the likely impacts of climate change at Nyora.
4. SGSC consider using the results of the flood modelling to inform development approvals.

14.3 Flood mitigation works

The following recommendations are made with respect to the proposed flood mitigation works that are presented in **Section 5.3**.

5. The impact of the Glovers Road flood mitigation works requires further consideration given the potential impact of the works on Giant Gippsland Earthworm habitat and significant vegetation.
6. Onsite detention for future development at Yannathan Road could be required to mitigate peak 1% AEP flows to the 18% AEP event by way of onsite detention. This would not eliminate the requirement to undertake pipe upgrades and intersection regrading works at Yannathan and Davis Street. However it may provide an alternative to lowering Yannathan Road.
7. Further investigation and discussion with landowners regarding the existing flooding and proposed mitigation solution at the north end of Hatchs Road.

14.4 Stormwater quantity

8. Retarding basins that were located in areas covered by the provisional GGEO were assumed to require headwalls rather than being in-cut. It is recommended that SGSC undertake further consultation with Melbourne Water to determine whether this design approach is appropriate and whether there are any special design approaches that could be adopted to reduce the impact of proposed retarding basins to existing GGE populations.
9. The risk of dam break for retarding basin headwalls should be further considered in accordance with ANCOLD principles.
10. Constructed waterways will require works within the GGEO and it is recommended that further investigations be undertaken to determine whether alternative works can

be undertaken to reduce the impact to the Giant Gippsland Earthworm. For example whether the provision of additional retarding basins located upstream of the proposed constructed waterways would result in the habitat values of the Giant Gippsland Earthworm being preserved and enable the constructed waterways to be converted to waterway corridors

11. As part of the development of this SMP with the Nyora Development Strategy (Planisphere, 2016), the option of a possible green East-West connection was identified for Precinct B. The provision of a constructed waterway at this location was not investigated but is considered to be a potentially viable alternative to the pipes and road approach documented in this SMP.

14.5 Stormwater quality

12. The water quality plan has sized assets to achieve Best Practice Environmental Management targets. The more stringent (but non-legally binding) Schedule F8 targets for Western Port Bay should be considered by SGSC in consultation with Melbourne Water for this area.
13. Rainwater tanks could provide hydrological benefits by reducing development flow volumes which could be beneficial to reduce the impact of development on the Giant Gippsland Earthworm (GGE). It is recommended that the implementation of rainwater tanks on all development areas is considered further by SGSC in consultation with GGE specialists and Melbourne Water river health team.
14. End of line wetlands located offline from waterways were considered where catchment areas were considered large enough for a sustainable wetland to be implemented. These locations were Precinct C (within RB1), Precinct F (RB9). Wetlands were ultimately not adopted at these locations as it was considered that the earthworks required would impact negatively on the GGE. Given offline wetlands in these locations could reduce the maintenance burden associated with the distributed network of sedimentation and bioretention basins that is currently proposed, it is recommended that further investigation into the viability of constructing wetlands is undertaken in consultation with the river health team at Melbourne Water and GGE specialists.

14.6 Administration

15. In lieu of implementing planning overlays to control development in flood prone areas, it is recommended that SGSC further consider the practical implementation and internal processes required for assessing development applications in flood prone areas, and how the flood modelling undertaken for this SMP could be used to inform this process.
16. It is recommended that SGSC discuss the mechanisms for managing development contributions in the form of a Development Service Scheme (DSS) with Melbourne Water.

15. QUALIFICATIONS

a. In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

b. Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

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g. This report does not provide legal advice.

16. REFERENCES

Alluvium, 2009, Part A - Nyora Development Services Scheme Summary Report

Alluvium, 2009, Part B - Preliminary Environmental Assessment (DRAFT) Nyora Development Services Scheme

Australian Rainfall and Runoff, 2001, Flood Analysis and Design

Beverage Williams, 2011, Nyora Structure Plan Submission

BMT WBM, 2009, Nyora Development Services Scheme Water Quality Report

CSIRO, 2006, Urban Stormwater: Best Practice Environmental Management Guidelines

Engineers Australia, 1987, Australian Rainfall and Runoff

Growth Areas Authority, April 2011, Engineering Design and Construction Manual

Infrastructure Design Manual (v4.4.2)

Melbourne Water, 2015, Planning and Building website page

Melbourne Water, 2013, Waterway Corridors in Greenfield Development Guidelines

Melbourne Water, 2010, MUSIC modelling guidelines

Melbourne Water, 2009, Constructed Waterways in Urban Development Guidelines

Melbourne Water, 2007, Principles for Provision of Waterway and Drainage Services for Urban Growth

Nott and More, 2010, Development forecasts for Nyora

Planisphere, 2013, Nyora Structure Plan

South Gippsland Shire Council, Strategy & audit for social community infrastructure 2014 – 2029

South Gippsland Shire Council, Melbourne Water and West Gippsland CMA, 2013, Flood Management Plan for South Gippsland Shire Council, Melbourne Water and West Gippsland CMA

Victorian Planning Provisions, 2015, Planning Practice Note 12: Applying the Flood Provisions in Planning Schemes, a guide for Councils.

APPENDIX A

Drainage Investigations Report

South Gippsland Shire Council

ENGENY WATER MANAGEMENT

South Gippsland Shire

Nyora Development Precinct

Drainage Investigations Report




July 2016

V1128_001

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Signatures					

EXECUTIVE SUMMARY

This report

This report presents the findings of drainage investigations undertaken to inform the stormwater management strategy for the town of Nyora, located in West Gippsland, including:

- background investigation
- data review
- the results of the existing conditions flood mapping undertaken for the 18% AEP and 1% AEP events using a 1D/2D TUFLOW hydrodynamic model and RORB hydrological model.
- identification of existing flooding hotspots
- identification of existing stormwater issues and opportunities that are to be addressed by the stormwater management plan
- development of the stormwater management strategy framework
- next steps for the development of the stormwater management strategy.

Existing conditions flood modelling

Flood modelling and mapping were undertaken in accordance with Melbourne Water standards as described in the November 2012 Flood mapping guidelines and technical specifications. Modelling methodologies were also informed by the DRAFT March 2015 Flood mapping guidelines and technical specifications where appropriate.

Flood modelling was undertaken using the combination of a RORB hydrological model to generate rainfall excess catchment flows and a 1D/2D TUFLOW hydraulic model to route flows, and estimate flood depths and velocities. The extent of both models covered the entire future development area for Nyora.

The 18% AEP event and 1% AEP events were modelled as these events represent the objective design capacity of the minor and major drainage systems respectively.

The results of the existing conditions flood modelling and mapping are presented in the table below. Refer to **Section 4.6** for a definition of minor and major flooding.

Location	18 % AEP	1 % AEP
Properties with minor flooding	61	98
Properties with major flooding	2	28
Roads with minor flooding	3	6
Roads with major flooding	0	2
Railway	0	2
Railway with major flooding	0	0

The two roads subject to major flooding are Walters Road and Glovers Road.

The two properties subject to major flooding for the 18% AEP event are located on the corner of Henley and Hewson Street and on Yannathan Road respectively.

Issues and Opportunities

The stormwater management strategy for Nyora has the opportunity to address existing flooding problems and set a strategic direction for implementing best practice, multifunctional stormwater assets that achieve the primary water quality, drainage and flood mitigation objectives and also provide environmental, public amenity and other benefits to the community.

A number of strategic stormwater issues have been identified and used as a basis for developing objectives for the stormwater management strategy, including:

- existing flooding problems
- development in flood-prone areas
- legal issues regarding drainage outlet permission
- downstream impacts to existing landowners and the environment
- increased pollution in stormwater runoff from urbanisation
- reduced annual rainfall due to climate change resulting in increased pressure on the potable water supply
- increased rainfall intensity due to climate change resulting in increased flooding
- poor public amenity due to intrusive drainage infrastructure development

- damage to the environment as a result of future drainage infrastructure.

Further discussion is presented in **Section 5.2.**

Documentation of specific opportunities and issues is presented in **Section 5.3** followed by a framework for the Nyora stormwater management plan and the next steps for developing the plan.

Engeny Water Management (Engeny) was engaged by Planisphere Pty Ltd. on behalf of South Gippsland Shire to undertake the stormwater management plan and drainage investigations for the Nyora Development Strategy.

CONTENTS

Appendices

Glossary

The following definitions are from the Infrastructure Design Manual (version 4.4.2).

Annual Exceedance Probability (AEP) The long-term average probability that the defined magnitude will be exceeded in any given year.

Average Recurrence Interval (ARI) The long-term average interval elapsing between successive events of the defined magnitude.

The stormwater industry is transitioning towards adopting the AEP terminology over other terminologies (including ARI) for consistency and simplicity across projects. The use of AEP is recommended in the new AR&R guidelines, which were in draft form at the time of reporting, and has been adopted for the Infrastructure Design Manual.

The following table relates ARI to AEP.

ARI (years)	AEP (%)
1	63
2	39
5	18
10	10
20	5
50	2
100	1

ASCII American Standard Code for Information Interchange (a common simple GIS file format)

AHD Australian Height Datum

DEM Digital Elevation Model

GIS Graphical Information System

IFD Intensity Frequency Duration

Hydraulic Modelling The representation of the passage of flood waters across the DEM by computational means. Hydraulic

	modelling for the Nyora Stormwater Management Plan was undertaken in TUFLOW.
LiDAR	Light Detection And Ranging (used to gather data to develop a DEM of large areas)
Long Term	A timeframe for the implementation of development works at Nyora of greater 20 years into the future (>2035).
Medium Term	A timeframe for the implementation of development works at Nyora of between 10 to 20 years into the future (2025 - 2035).
Nuisance Flooding	Minor flooding to roads and properties that occurs frequently for events smaller than or equal to the 18% AEP.
RORB	RORB is a general runoff and streamflow routing program used to calculate flood hydrographs from rainfall and other channel inputs
Short Term	A timeframe for the implementation of development works at Nyora of between 5 to 10 years into the future (2020- 2025).
TUFLOW	TUFLOW is a computational engine that provides one-dimensional (1D) and two-dimensional (2D) solutions of the free-surface flow equations to simulate flood and tidal wave propagation.
1D	One Dimensional – Refers to modelling of pipes, culverts and waterways which are modelled using one dimensional methods.
2D	Two Dimensional – Refers to hydraulic modelling of overland flows using two dimensional methods.

1. INTRODUCTION

1.1 This report

Engeny Water Management (Engeny) was engaged by Planisphere Pty Ltd on behalf of South Gippsland Shire to undertake the stormwater management plan and drainage investigations for the Nyora Development Strategy. Nyora is a town of approximately 1300 people and is located in West Gippsland.

This report presents the findings of drainage investigations undertaken to inform the stormwater management strategy for the town of Nyora, located in West Gippsland, including:

- background investigation
- data review
- the results of the existing conditions flood mapping undertaken for the 18% AEP and 1% AEP events using a 1D/2D TUFLOW hydrodynamic model and RORB hydrological model.
- identification of existing flooding hotspots
- identification of existing stormwater issues and opportunities that are to be addressed by the stormwater management plan.
- development of the stormwater management strategy framework
- next steps for the development of the stormwater management strategy.

2. BACKGROUND

2.1 Previous studies

The following reports and investigations have been undertaken for Nyora and were used to inform this study.

- Nyora Structure Plan (Planisphere, 2013)
- Nyora Structure Plan Submission (Beverage Williams, 2011)
- Development forecasts for Nyora (Nott and More, 2010)
- Strategy & audit for social community infrastructure 2014 -2029 (South Gippsland Shire Council)
- Flood Management Plan for South Gippsland Shire Council, Melbourne Water and West Gippsland CMA (prepared in collaboration, 2013).

Melbourne Water has undertaken a number of stormwater investigations as part of preparing a development services scheme for Nyora. The scheme was not completed and was put on hold whilst the provision of sewer infrastructure for the town was determined by other authorities. The following surface water reports that were undertaken for the scheme were provided by Melbourne Water and used to inform this study:

- Nyora Development Services Scheme Summary Report (Alluvium, 2009)
- Water Quality Report (BMT WBM, 2009).

2.2 Catchment Conditions

Nyora is located amongst undulating hills in the fertile west Gippsland region. The average annual rainfall for Nyora is 1026 mm based on the 45 year rainfall data record from the Nyora Post Office (Bureau of Meteorology station 086281) and the region surrounding the town contains a mix of agricultural and forested land (refer to **Figure 2.1**).

Figure 2.1 View north east from Glovers Road showing the agricultural and forested land located to the North of Nyora.

The Nyora development strategy is encompassed by eight (8) catchments totalling an area of approximately 580 hectares. The catchments discharge into three (3) major waterways, Little Lang Lang River, Bass River and Adams Creek, which all ultimately discharge into Western Port. The headwaters of six (6) of the largest catchments are located near the town centre which results in a pattern of major flow paths radiating outwards in different directions from the town. A plan showing the major flow paths and catchment boundaries is presented in **Figure 2.2**.

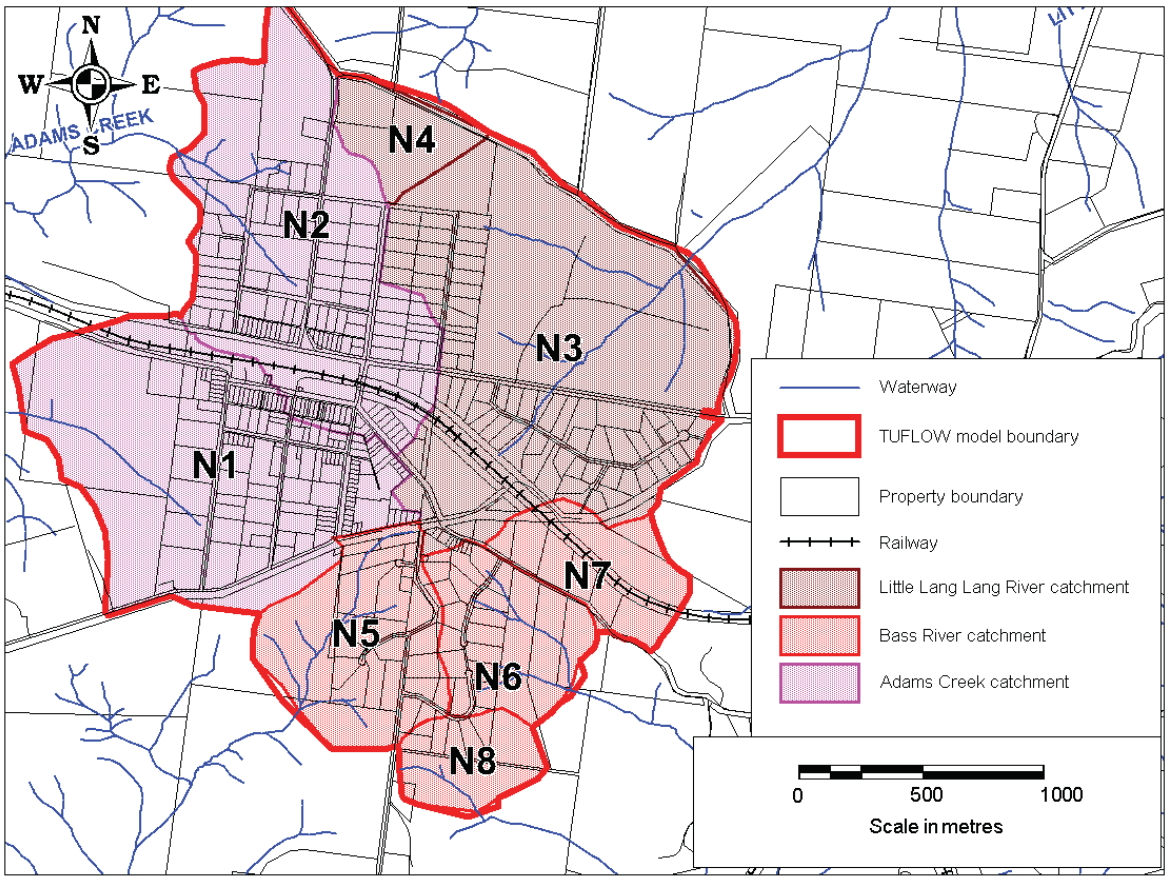

Figure 2.2 Nyora catchments

The region's waterways have been characterised by the Development Services Scheme Summary Report (Alluvium, 2009) as being largely intact and in good geomorphic condition. Waterways are generally of moderate to steep longitudinal grade with grades of 2-3 % in the north east and north west catchments(N2 and N3), a slightly gentler grade in the south west (catchment N1). The steepest grades occur in the south east (catchments N5, N6 & N8) where waterway slopes exceed 5 % in some locations.

Roads within the area generally lack a kerb and channel system and the minor drainage flows are conveyed within open channels, with the exception of a central drainage network near Mitchell Street and in the Henry Street area in south Nyora.

The existing development in Nyora contains a mix of traditional lot sizes (750 – 800 m^2) and large low density lot sizes (8,000 – 12,500 m^2), with the higher density areas typically located closer to the town centre near Mitchell Street. An area of light industrial development is located on the north side of the Nyora – Wonthaggi Rail line.

The Nyora-Wonthaggi Rail line bisects the town and acts as a major control to the distribution of overland flows in some locations.

3. DATA

3.1 Base data

The data presented in **Table 3.1** was provided by South Gippsland Shire Council (SGSC) Council and was used as a basis for the hydraulic and hydrological modelling that was undertaken to estimate the existing and future flood conditions at Nyora. Some of the data provided by Council is understood to have been sourced from the Department of Land Water and Planning (DEWLP) and Melbourne Water Corporation (MWC).

Table 3.1 Base data

Data	Format	Description
Stormwater_Pipes	.tab	Council stormwater drainage pipes
Stormwater_Pits	.tab	Council stormwater drainage pits
TableDrains_InProgress	.tab	Council table drains
Nyora_FASTLOOK_12Apr2012 _RGB_10cm_MGA55	.ecw	Aerial photograph
Stockyard Rise Estate, Nyora Stages 3,4 & 5 Plans	.pdf	Plans showing the drainage system and layout for the development in the Eagle Rise / Carlisle Close area
Gambrae Park Estate, Nyora – Stage 5 Plans	.pdf	Plans showing the drainage system and layout for the development on Follett Drive
Proposed Road Reconstruction Henrys Road, Nyora – Stage 1	.pdf	Plans showing the road reconstruction and drainage plans for Henrys Road
PLAN_ZONE	.tab	Planning zones
PLAN_OVERLAY	.tab	Planning overlays
e3xxn57xx_Desalination_Corridor_10cm	.xyz	LiDAR tiles

3.2 Site Visit

Engeny undertook a site visit to Nyora with Council and other members of the development strategy team on the 26th of October, 2015. The site visit was used to inform our understanding of the catchment and existing drainage system characteristics.

Photographs taken on the site visit are presented below.

Figure 3.1 View south near the railway crossing on the east side of Davis Street

Figure 3.2 View west towards the station from near the railway crossing at Davis Street.

Figure 3.3 View north to Adams Creek from Patman Drive

Figure 3.4 View north on Walters Road near the low point between Hewson Street and the Lang Lang - Poowong Road

Figure 3.5 View north to the inlet of the 2 no. 1200 mm wide by 600 mm high box culverts located under Follett Drive

Figure 3.6 View north east across the Nyora Speedway from Grundy Avenue

Figure 3.7 View west to new side entry pit and kerb and channel on Henrys Road near the intersection with Eagle Rise.

Figure 3.8 View north on Henrys Road showing new kerb and channel and road reconstruction works

Figure 3.9 View west on Hewson Street

3.3 Data review

A review was undertaken to determine any deficiencies in the drainage data before modelling was undertaken. The review included the following checks of the pipe drainage system:

- pipe diameters:
  - All 166 pipes had diameters.
  - A number of pipes had non-standard diameters including, twenty one (21) pipes with diameters of 400 mm, four (4) pipes with diameters of 500 mm and three (3) pipes with a diameter of 325 mm. These pipe diameters were not changed as it is understood that some pipes may be imperial sizes and modification of the pipes was considered unlikely to make a significant difference to the flow capacity of the network.
- pipe direction:
  - Pipe directions were reversed where the direction was found to be opposite to the direction of flow.
- snapping pipes together:
  - Pipes were snapped together where gaps were found between pipes.

- invert levels:
  - Invert levels were based on the depth of the upstream and downstream pits (as per Stormwater_pits.tab layer provided by Council). Where invert levels were not available the following equation was used to set the invert level:
  - Ground level RL – 600mm (pipe cover) – pipe diameter.

Following the site visit and an initial model run, missing Council, VicTrack and VicRoads drainage data was identified. VicTrack and VicRoads data was not available in time for use in this study, however Council undertook a field survey of thirteen (13) culverts identified by Engeny as missing from the drainage system data. The additional culverts are presented in **Table 3.2.**

Table 3.2 Additional culvert data collected by Council and included in the hydraulic model

Culvert No	Size (mm)	Type	Location	Notes
1	450	CP	Under railway line near station – invert 1.5 m below ballast	Extends for over 40 m into flat land
2	750	CP	Under railway line near station – invert 1.5 m below ballast	Extends for 40 m into flat land
3	300	CP	Under road the Lang Lang - Poowong Road – invert 1 m below road	Discharges into open drain along south side of rails
4	900	RCP	Under road the Lang Lang - Poowong Road – invert 2.5 m below road	Very deep
5	375	CP	Under the Lang Lang - Poowong Road – invert 3.5 m below road	Very deep – no discernible low point though has rock beaching on HS
6	2x 1200x 600	BC	Under Follett Drive – invert 900 mm below road	
7	900x 450	BC	Under Follett Drive – invert 600 mm below road	
8	600	RCP	Under railway line near Speedway – invert 1.2 m below ballast	Appears to be newer pipe taking discharge from reserve
9			Within private property north of the Nyora – Poowong Road	Subject to proposed Wallis Watson subdivision
10	900	CP	Under railway line near the south east development boundary – invert 3 m below ballast	Very old & very deep. Could not find inlet.
11	375	CP	Under Yannathan Road – invert 1.5 m below road	Very poor condition
12	300	CP	Under Glovers Road – invert 600 mm below road	
13			Within private property north of the Nyora – Poowong Road	Subject to proposed Wallis Watson subdivision

In addition to the drainage data surveyed by Council, pipe drainage systems in Follett Drive, Henrys Road and Eagle Rise were included in the modelled pipe drainage system. The locations, diameters and inverts of these pipe drainage systems were manually digitised using the plans provided by Council as a basis (refer to **Section 3**).

3.4 Assumptions and Limitations of Data

While all possible care has been taken to ensure the accuracy and robustness of this study there are some underlying limitations in the data that may reduce the accuracy of the flood mapping results in some locations:

- The pipe data provided by SCSC did not contain all pipe inverts. Where inverts where not available it has been assumed that all pipes have 0.6 m of cover and that they all grade downhill towards the outfall.
- The LiDAR data was captured between 2007 and 2009, since this time it is possible that the topography of some areas within Nyora has been locally re-shaped. In these areas the LiDAR data may not correctly represent the current topography and therefore flood conditions may be miss-represented.

4. EXISTING CONDITIONS FLOODING

4.1 Approach

Existing flooding conditions were modelled to determine the performance of the existing drainage system and identify flooding hotspots.

The flood modelling and mapping was undertaken in accordance with Melbourne Water standards as described in the *November 2012 Flood mapping guidelines and technical specifications*. Modelling methodologies were also informed by the *DRAFT March 2015 Flood mapping guidelines and technical specifications* where it was considered appropriate.

Flood modelling was undertaken using the combination of a RORB hydrological model to generate rainfall excess catchment flows and a 1D/2D TUFLOW hydraulic model to route flows, and estimate flood depths and velocities. The extent of both models covered the entire future development area for Nyora.

The 18% AEP event and 1% AEP events were modelled as these events represent the objective design capacity of the minor and major drainage systems respectively.

4.2 Hydrology

4.2.1 RORB hydrologic modelling

Engeny developed an undiverted RORB hydrological model to estimate catchment flows across the Nyora development area for the 18% AEP and 1% AEP events. The RORB model was used to produce rainfall excess hydrographs that were input to the TUFLOW hydraulic model.

Subareas were delineated within the RORB model and assigned impervious fraction value. The method employed in delineating subarea boundaries was based on a combination of the following considerations:

- 1% AEP overland flooding behaviour
- separation of areas dependent on underground drainage pipes from those where no underground drainage exists
- existing land use types based on identified planning zones
- proposed land use type based on future precinct areas.

4.2.2 Intensity-Frequency-Duration Data

Intensity-Frequency-Duration (IFD) data for Nyora was sourced from the Bureau of Meteorology using the online IFD tool (AR&R 1987 methodology) and used to estimate catchment rainfall excess hydrographs in RORB.

The adopted IFD parameters are presented in Table 4.1

Table 4.1 IFD parameters for Nyora

Parameter	Value
Intensity - 1 hour duration, ARI = 2 years ($^{2}I_{1}$)	17.89
Intensity - 12 hour duration, ARI = 2 years ($^{2}I_{12}$)	3.96
Intensity - 72 hour duration, ARI = 2 years ($^{2}I_{72}$)	1.15
Intensity - 1 hour duration, ARI = 50 years ($^{50}I_{1}$)	33.31
Intensity - 12 hour duration, ARI = 50 years ($^{50}I_{12}$)	7.2
Intensity - 72 hour duration, ARI = 50 years ($^{50}I_{72}$)	2.21
Skew (G)	0.39
F_2	4.25
F_{50}	15.01

4.2.3 RORB model parameters

The RORB model adopted a runoff coefficient model with parameters consistent with Melbourne Water flood modelling methodology, including:

- Filtered Temporal patterns
- Uniform spatial patterns
- Siriwardena and Weinmann areal reduction factor
- m = 0.8
- Initial loss = 15 mm
- 18% AEP runoff coefficient = 0.25
- 1% AEP runoff coefficient = 0.60.

4.2.4 Fraction Impervious

Fraction impervious values were assigned by land use type for the Nyora township area as presented in **Table 4.2**. All values depicted are based on typical values suggested by Melbourne Water guidelines and verified by inspecting aerial photography with adjustments made as necessary. The table was used to assign a fraction impervious value to all existing land use polygons. In some instances, a polygon was split to vary the fraction impervious based on aerial observations. A fraction impervious for each RORB subarea was then determined based on the fraction impervious values applied to the land use polygons within each subarea.

Table 4.2 Fraction impervious by land use type

Plan Zone	Land Use	Existing conditions Fraction Impervious
PUZ1	Service and Utility	0.2
LDRZ	Low Density Residential Zone	0.25
PPRZ	Public Park and Recreation Zone	0.1
PUZ4	Transport	0.3
PUZ3	Health and Community	0.2
C1Z	Commercial 1 Zone	0.7
PUZ2	Education	0.7
GRZ1	General Residential Zone (Schedule 1)	0.35
FZ	Farm Zone	0.1
PUZ5	Cemetary / Crematorium	0.15
IN3Z	Industrial Zone 3	0.45
PUZ6	Local government	0.1
RDZ2	Secondary and Local road	0.6
RLZ	Rural Living Zone	0.15

4.3 Hydraulics

4.3.1 TUFLOW hydraulic modelling

Engeny developed a two-dimensional hydraulic model for the Nyora township catchments, which have been utilised to determine design flood levels and extents for the 18% and 1% AEP events.

The model adopted a grid size of three meters, which allows for appropriate definition of the catchment terrain and is consistent with recommendations in Melbourne Water's Flood Mapping Guidelines.

4.3.2 1-D Network data

Engeny has modelled all assets identified in Council's GIS as well as those identified in Engeny's site visit to the township, with the exceptions of culverts located under private driveways. The removal of these culverts from the model is not considered to have a significant impact on the results for the events modelled.

Council provided Engeny with concept and detailed plans of pipe alignments not already depicted within Council's GIS layer. Further discussion on the data used and the methodology used to check and the base data is provided in **Section 3.3**

Information regarding the type of each existing stormwater pit was included within Council's GIS pit layer. Side entry and grated pits were modelled as weir type pit inlets to ensure no restriction of flow due to inlet capacity, whilst end walls where modelled as a boundary condition which transfers stormwater into/out of the two-dimensional domain from a 1-dimensianal element (pipe). Junction pits were not modelled.

4.3.3 Pipe and Pits Losses

Tuflow has the ability to automatically determine pit losses. A manhole layer is automatically created and used to apply the losses to the pits. The losses are based the Englehund Method. This method recalculates losses at each time step using the angle of the entry and exit pipes, water levels and flow distributions. Engeny checked the losses calculated by this automatic approach to ensure they are reasonable and flow patterns have been checked to ensure that the pit losses have not resulted in any unexpected surcharges.

4.3.4 Open Channels/Waterways

Within the modeling area there a number of waterways, including several unnamed waterways and Adams Creek, which is located to the north west of the town centre.

Review of the LiDAR found that it provides a satisfactory definition of the waterways and as such it was determined that the waterways can be effectively modelled in the 2-D domain.

Inverts of the waterways, roadside drains along Yannathan Rd and within the railway reserve north of Mitchell Street, and all drainage channels contained with Council's Drainage channel GIS layer were represented in the TUFLOW model using breaklines.

4.3.5 Retarding Basins

There are no formal retarding basins located within the Nyora area, however a number of depressions located upstream of major roads or the railway act as defacto retarding basins and provide varying degrees of attenuation to catchment flows.

4.3.6 Private dams

Over 60 dams were identified within the area covered by the Nyora TUFLOW model. The capacity of these dams to provide retention to flood storage varies and is based on the difference between the dam water surface level (that was picked up by the LiDAR data when the survey was flown) and the surrounding land surface. Given the farm dams are not designated flood storage assets and could be removed by the private land owner at any time, a sensitivity analysis was undertaken with all dams filled to determine the effect of the dams on catchment flows and the flood extent.

The sensitivity analysis found that in most catchments, removal of the dams resulted in an increase in peak 1% AEP flood flows of 5% - 15%. The largest increase in peak flows was found in the north east catchment where removal of a large dam results in a 40% increase in the peak 1% AEP flood flow.

The existing conditions flood maps presented in **Appendix A** represent flooding conditions where dams are included. However the adoption of pre-development conditions flood flows based on conditions where dams are removed requires further discussion with Melbourne Water and other stakeholders.

4.4 Verification

Verification of the existing conditions 1% AEP flood modelling flows was undertaken against the rural rational method. The rural rational method in Victoria adopts Adam's formula to estimate the catchment time of concentration (T_c) based on catchment size, and a 10 year ARI[1] runoff coefficient (0.14 adopted). The method is described in Section 5.4.3. of AR&R (1987). The results of the verification are presented in **Table 4.3**.

[1] ARI terminology as per the AR&R 1987 guidelines. Refer to the Glossary for the definition of this term.

Table 4.3 1% AEP TUFLOW peak flow verification against the rural rational method

Catchment	Receiving Waterway	Area (ha)	Rural Rational (m^3/s)	TUFLOW - dams not filled (m^3/s)	Difference
N1	Adams Creek	129.7	3.05	5.31	74%
N2	Adams Creek	122.3	2.92	4.46	53%
N3	Little Lang Lang River	172.0	3.76	4.78	27%
N4	Little Lang Lang River	18.5	0.69	0.63	-9%
N5	Bass River	53.8	1.56	2.76	77%
N6	Bass River	57.2	1.18	2.05	73%
N7	Bass River	29.3	1.00	1.27	27%
N8	Bass River	20.2	0.76	N/A	N/A

The verification results presented in **Table 4.3** show that the TUFLOW modelled flows are generally between 20 and 80 % higher than the rural rational method. This result is not an unexpected result as all the catchments except N4 and N7 have some low density residential development within them which is likely to increase catchment flows. Catchment N4 was the only catchment where it was found that the TUFLOW model flow was lower than the rural rational method estimate. This result is considered to be due to the attenuation of flow by the defacto detention storage upstream of Glovers Road.

A flow comparison was also undertaken between the existing 1% AEP flows from TUFLOW and the flows from *Nyora Development Services Scheme Summary Report* (Alluvium, 2009). The Development Services (DS) methodology utilised a diverted RORB model to estimate catchment flows for the Adams Creek catchment that incorporates precincts B and C (Engeny catchment N1), and the Little Lang Lang River catchment that incorporates precincts F and G (Engeny catchment N3). The flows for these catchments are presented in **Table 4.4** together with the Engeny TUFLOW results for the base case scenario where existing dams were represented by the LiDAR data and the sensitivity analysis where existing dams are filled.

Table 4.4 Existing conditions 1% AEP event peak flow comparison

Catchment	TUFLOW - base case (m^3/s)	TUFLOW - dams filled (m^3/s)	DS RORB flow (m^3/s)
N1	5.31	5.44	6.1
N2	4.46	4.53	-
N3	4.78	6.68	8.9
N4	0.63	0.65	-
N5	2.76	3.03	-
N6	2.05	2.37	-
N7	1.27	1.44	-
N8	N/A	N/A	N/A

The comparison presented in **Table 4.4** shows the increases in the 1% AEP existing conditions flows between the base case and dams filled scenarios for the various catchments. It also shows that the TUFLOW model flows are lower than the RORB model flows produced for the DS scheme. In both cases it is considered that the difference is predominantly due to the additional (and explicit) accounting of catchment storage that the TUFLOW model provides. This is particularly evident in the Little Lang Lang River catchment (N3) where significant existing defacto detention storages exist upstream of the Lang Lang – Poowong Road and upstream of the Nyora – Wonthaggi Railway.

1% AEP existing conditions flood extents, developed for the Nyora DS scheme, were provided by Melbourne Water and compared to the Engeny TUFLOW model results. A 1D HEC-RAS model is understood to have been used to develop the DS extents. **Figure 4.1** and **Figure 4.2** present a comparison between the two extents for the major flow paths in catchments N3 and N1 respectively.

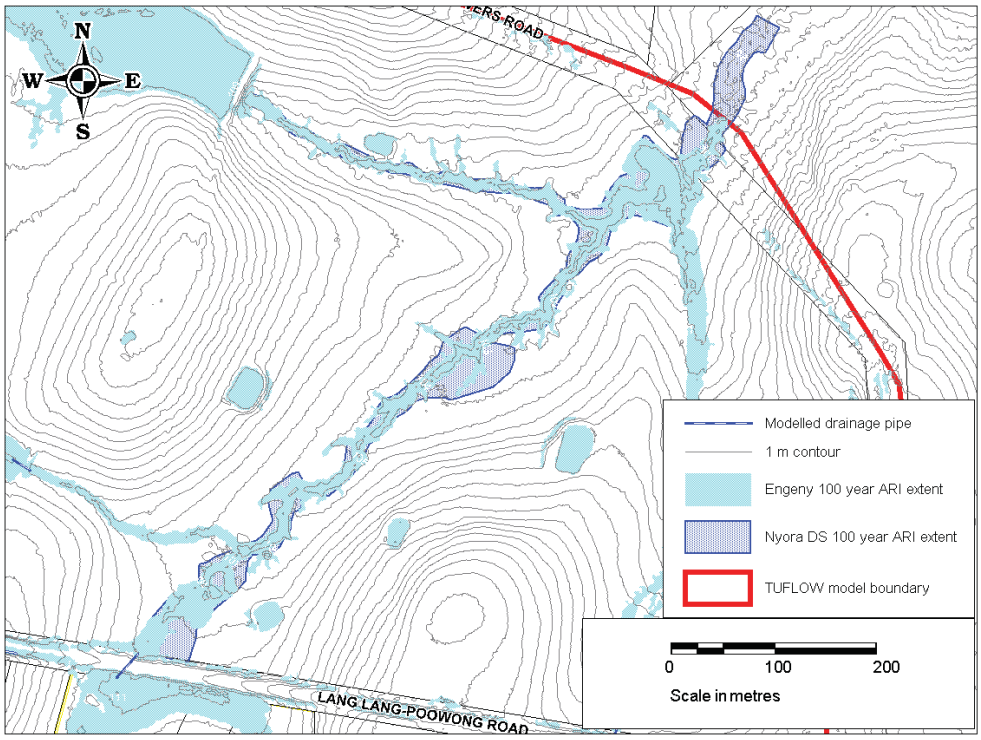

Figure 4.1 Catchment N3 flood extent comparison

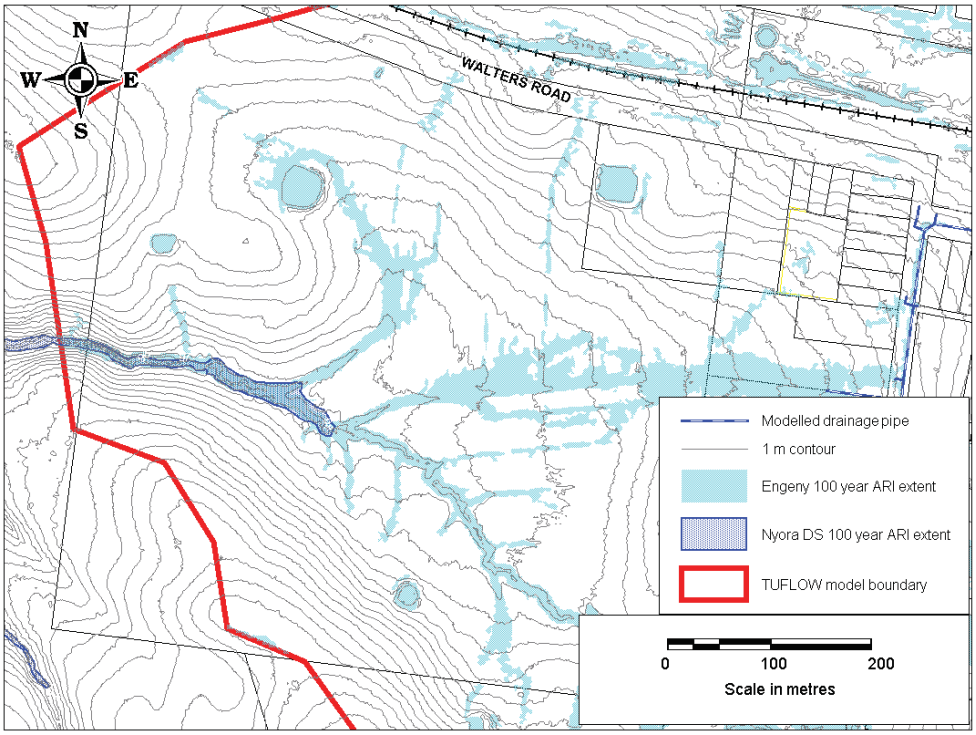

Figure 4.2 Catchment N1 flood extent comparison

Figure 4.1 and **Figure 4.2** show that the existing conditions flood extents generated by the two studies are consistent in most locations and highlight the improved flood shape definition that the 2D TUFLOW flood model provides.

Additional verification of the flood modelling results was attempted with the South Gippsland Flood Management Plan, however the flood maps presented in the report provided insufficient detail to make a meaningful comparison and the background data was not available.

4.5 Existing conditions flood maps

The preliminary flood modelling results for existing climate and development conditions at Nyora are presented for the 1% AEP and 18% AEP events in **Appendix A.**

4.6 Flooding Hotspots

4.6.1 Properties and Roads

The results indicate that significant flooding within private property and inundation of some buildings occurs for existing climate conditions. Locations that have been identified as particularly vulnerable to flooding include the area of low density development south of Hewson Street, the light industrial area near the intersection of Watts Road and Yannathan Road and on the south side of Follett Drive.

Existing flooding was categorised into minor or major flooding with the definitions provided properties, roads and the railway below:

- **Minor** Flooding:
  - properties containing a main flow path as indicated by a flood extent that forms a continuous connection to a waterway
  - roads or railway where flooding is to a depth of ≥ 50 mm.
- **Major** Flooding:
  - properties where flood waters on main flow paths inundates building footprints to a depth of ≥ 100 mm
  - roads or railway where flooding is to a depth of ≥ 200 mm or the velocity depth exceeds 0.35 m^2/s.

The flooding assessment criteria were applied for the 18% and the 1% AEP events to determine the impact of flooding for each event. The number of properties and locations where roads and railways were subject to minor or major flooding for these events is presented in **Table 4.5**.

Table 4.5 Categorisation of existing flooding

Location	18% AEP	1% AEP
Properties with minor flooding	61	98
Properties with major flooding	2	28
Roads with minor flooding	3	6
Roads with major flooding	0	2
Railway with minor flooding	0	2
Railway with major flooding	0	0

The two roads subject to major flooding are Walters Road and Glovers Road.

The two properties subject to major flooding for the 18% AEP event are located on the corner of Henley and Hewson Street and on Yannathan Road respectively.

Resolving the flooding at these locations and the large number of properties subject to major flooding for the 1% AEP event and roads that are inundated are key issues to be addressed by the stormwater management strategy.

Figure 4.3, **Figure 4.4** and **Figure 4.5** show the 1% AEP flooding in the Walter Street, Yannathan Road and Follett Drive areas respectively. The figures also show properties affected by major flooding for the 1% AEP and 18% AEP events.

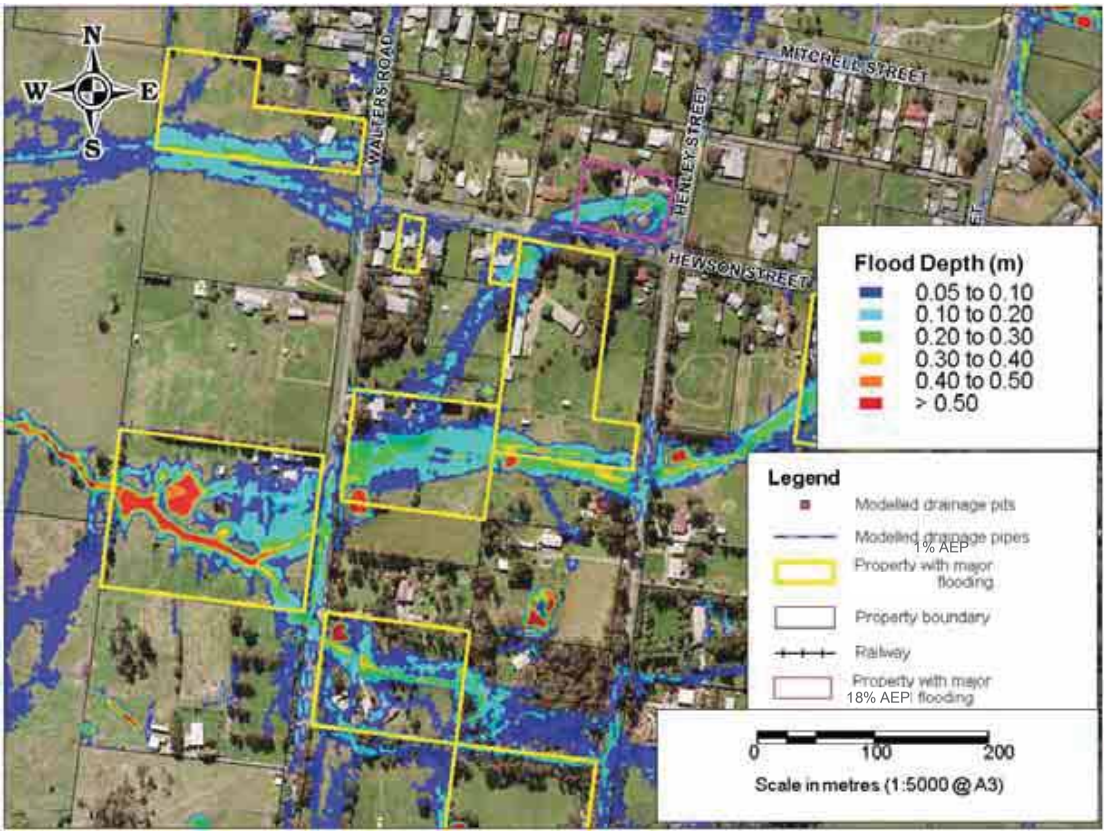

Figure 4.3 1% AEP flooding in the Walter Street area

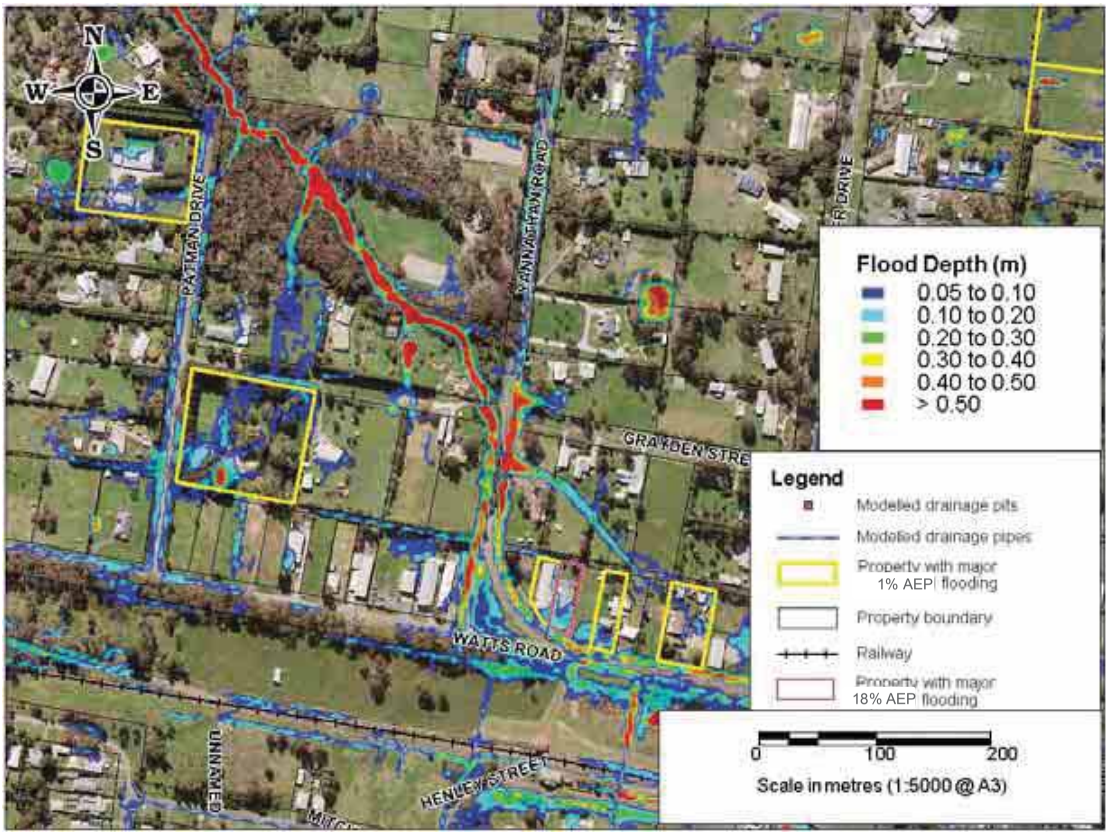

Figure 4.4 1% AEP flooding in the Yannathan Road area

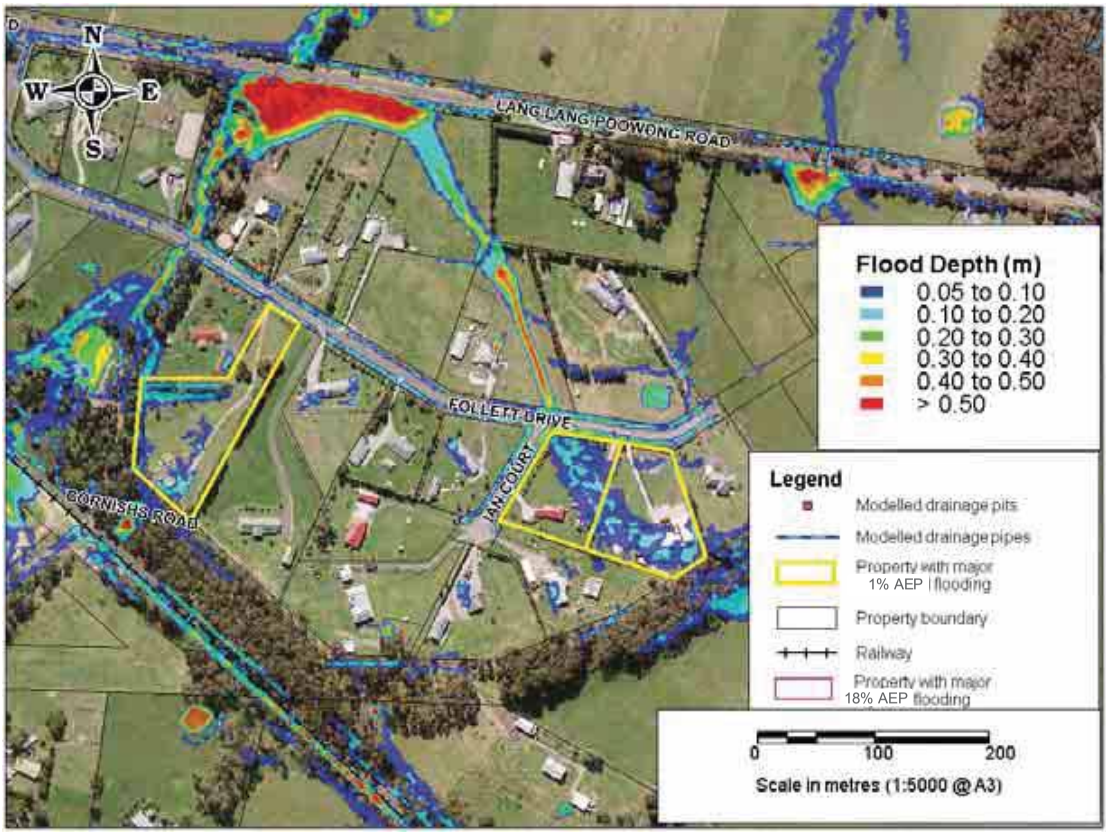

Figure 4.5 1% AEP flooding in the Follett Drive area

4.6.2 Pipe drainage system capacity

With the exception of the approximately 320 m long reach of pipe that starts at Mitchell Street and continues west before entering Walter Street and joining the Hewson Street pipe system, all underground pipe systems have a standard of less than the 18% AEP.

4.6.3 Open channel drainage system capacity

The modelling indicated that the open channel drainage system is generally able to convey the 18% AEP event with only minor local flooding occurring to road shoulders.

5. ISSUES AND OPPORTUNITIES

5.1 Strategic Opportunities

The stormwater management strategy for Nyora has the opportunity to address existing flooding problems and set a strategic direction for implementing best practice, multifunctional stormwater assets that achieve the primary water quality, drainage and flood mitigation objectives and also provide environmental, public amenity and other benefits to the community.

Liveability and resilience should be incorporated into all new developments. With respect to stormwater management, this involves utilising the stormwater as an asset for the community whilst ensuring fundamentals such as flood protection, safety with respect to flow management and water supply security are maintained. This can be achieved through incorporation of best planning practices for stormwater management during the development of the urban structure.

Nyora is located within Melbourne Water management zone and some of the stormwater assets proposed as part of the strategy may ultimately be managed and maintained by Melbourne Water. As a key stakeholder it is therefore intended that Melbourne Water is involved in the strategy development (please refer to Section 6 for further discussion).

5.2 Strategic Issues

A number of strategic stormwater issues have been identified and used as a basis for developing objectives for the stormwater management strategy:

- Existing flooding problems:
  - Resolve or identify flooding at all existing properties affected by major flooding for events up to the 1% AEP by upgrading the existing pipe system and implementing planning controls such as LSIO where appropriate.
  - Use structural measures such as pipe and road upgrades to resolve flooding at all roads affected by major flooding for events up to the 1% AEP and minor flooding for events up to the 18% AEP event.
  - Determine an appropriate planning mechanism that fairly apportions the cost of resolving existing flooding.

- Development in flood-prone areas:
  - Propose structural and non-structural measures to prevent future development being subject to flooding or increasing flooding elsewhere in the catchment.
  - Structural measures include appropriate planning for the major and minor drainage system to the standards required by Melbourne Water and the Infrastructure Design Manual (IDM).

- Non-structural measures include drainage easements, planning overlays and developer contribution schemes.

- Legal issues regarding drainage outlet permission:
  - Identify discharge locations for properties and parcels.
- Downstream impacts to existing landowners and the environment:
  - Determine appropriate discharge criteria to apply to future developments.
- Increased pollution in stormwater runoff from urbanisation:
  - Develop a water quality strategy that meets or exceeds the best practice environmental management water quality treatment objectives.
  - Propose assets that achieve best practice water quality requirements.
- Reduced annual rainfall due to climate change resulting in increased pressure on the potable water supply:
  - Build in resilience against climate change by investigating opportunities for stormwater and rainwater harvesting.
- Increased rainfall intensity due to climate change resulting in increased flooding:
  - Propose further investigations to identify the impact of increased rainfall intensity on climate change.
- Poor public amenity due to intrusive drainage infrastructure development:
  - Strategy should propose stormwater assets that are in keeping with and enhance public amenity and the natural environment.
- Damage to the environment as a result of future drainage infrastructure:
  - Protect key waterways and locations where the Giant Gippsland Earthworm and other protected species exist. Piping existing open channels and constructing other drainage infrastructure in locations where Giant Gippsland Earthworms are known to exist could have a detrimental impact to their survival. This should be carefully considered as part of the final drainage strategy.

5.3 Precinct based issues and opportunities

5.3.1 Precinct A – Town Centre

- The station area could be utilised to construct a detention storage to provide attenuation for development flows from the catchment located approximately east of Henley Street that discharges north across the railway. Depending on the future development plan for this area, the detention storage could be underground or an

above ground retarding basin. There is potential that the storage could be sized to attenuate existing catchment flows to provide some flood relief for properties on the north side of the railway. However further investigation is required to determine the effectiveness of this solution given the relatively small upstream catchment area. There is also potential that a storage located here could be utilised for stormwater harvesting.

- Back of kerb bioretention basins and tree pits could be utilised on Mitchell Street to provide water quality treatment.
- Pipe upgrades on Henley Street and Mitchell Street are required to provide 18% AEP standard for existing and future development.
- Water quality treatment for the catchment draining south west could be provided by an end of line wetland located in Precinct C or vegetated swales, bioretention basins and treepits depending on the development timing of the Precinct C development.
- Rainwater harvesting opportunities to be considered as part of redevelopment strategy to contribute towards the water quality objectives in this area.

5.3.2 Precinct B – Nyora Central

- Future road alignments or a drainage corridor should be aligned to convey the two main overland flowpaths if possible.
- Main trunk drains should be sized to convey the future 18% AEP fully developed flow and located under the main overland flow paths.
- Preferred water quality treatment and flow control is by end of line wetland and retarding basin located in Precinct C. However given precinct is likely to be developed after Precinct B locations for vegetation swales and bioretention basins adjacent to road sides and within public open spaces should be considered.

5.3.3 Precinct C – Nyora West

- Future major and minor drainage system to service development area.
- Water quality treatment by end of line wetland which could potentially be used to treat flows from the upstream precinct areas.
- Establish a waterway corridor with appropriate buffers around existing waterway.
- Look for opportunities for stormwater and rainwater harvesting.

5.3.4 Precinct D – Nyora North

- Isolated catchment that can be constructed at any time and independently to other precincts.
- Future major and minor drainage system to service development area.
- End of line wetland and retarding basin
- Look for opportunities for stormwater and rainwater harvesting.

5.3.5 Precinct E – Low Density Residential 1

- Drainage easement to convey flows into Precinct F at the north east corner of Hatchs Road.
- Underground pipe network construction to replace open channels with priority given to upgrading the underground pipe drainage system on Yannathan Road and the Lang-Lang Poowong Road.
- No end of line option is available within the development area therefore treatment provided in vegetated roadside swales and bioretention basins.
- Stormwater harvesting/detention storage should be considered at the Pony club as an alternative to mandating onsite detention.
- Consider implementation of an LSIO on Adam's creek.

5.3.6 Precinct F – Nyora East

- End of line retarding basin and wetland subject to proposed Wallis Watson subdivision

5.3.7 Precinct G – Low Density Residential 1

- Opportunity to mitigate flooding in precinct G and harvest stormwater for use on the Nyora Primary School by converting the existing storage located north of the railway and formalising the upstream flowpath. Modification to this storage could be undertaken provide at least a partial offset of the increase inflows resulting from future infill development
- Additional attenuation of development flows could be undertaken by formalising the defacto storage upstream of the Lang-Lang Poowong Road. However it is noted that this this may impact the habitat of the Giant Gippsland Earthworm and may require the procurement of private property.
- Consider negotiating with Precinct F development to enlarge wetland and retarding basin to cater for fully developed flows and treatment requirements from this

precinct. This could potentially be undertaken in combination with an upgrade of the culvert capacity under the Lang Lang – Poowong Road which would alleviate flooding and increase the developable land in this location.

- Consideration should be given to constructing a retarding basin to mitigate future development flows either immediately upstream of the Lang Lang – Poowong Road or further up on the main drainage land. Both options could potentially

- Construct a drainage easement containing a shallow open channel on the east side of Ian Court to intercept upstream catchment flows causing flooding to existing properties.

- Depending on resolution regarding Precinct F water quality treatment, bioretention basins and vegetated swales could be adopted to provide water quality treatment.

5.3.8 Precinct H – Rural Lifestyle

- No change.

6. STORMWATER MANAGEMENT STRATEGY DEVELOPMENT

6.1 Drainage

The drainage system should be designed to ensure no flooding of private property occurs in events up to the 1% AEP and that the stormwater runoff can be safely conveyed through the development to the receiving waterway. To achieve this a minor / major drainage system philosophy is proposed.

The following provides a basis for the development of the stormwater management strategy Based on the further investigations undertaken will cement these strategies.

6.2 Minor Drainage System

The minor drainage system will consist of a subsurface pipe network designed to capture and convey all stormwater runoff generated from the catchment for rainfall events up to and including the 18% AEP design storm.

6.3 Major Drainage System

The primary objective of the major drainage system is to provide flood protection for the allotments from the 1% AEP storm event and to ensure the overland flow can be safely conveyed through the development. This will be via overland flow paths contained within road reserves prior to discharging into a drainage or waterway reserve.

6.4 Retarding Basins

In some locations retarding basins will be required to mitigate the increase in catchment flows that will occur with development.

Further discussion with Melbourne Water is recommended to determine whether flows estimated with or without the presence of the dams should be adopted.

6.5 Waterway Corridors

The preservation of existing waterway corridors will be driven by environmental, public amenity and other factors together with consideration of stormwater requirements such as the grade and flow capacity requirements.

Waterway corridors may need to be augmented to protect them against increased flows from the development that may enter the waterway before retardation can occur. Alternatively distributed measures such as on-site detention considered to reduce inflows to the waterway and reduce the need for protection works.

6.6 Water Sensitive Urban Design (WSUD)

The State Environment Protection Policy (Waters of Victoria) defines the required water quality conditions for urban waterways. Section 56.07-4 of the Victorian Planning Provisions set the stormwater treatment targets required for residential development in Victoria in order to comply with SEPP and the Planning Scheme. The aim of stormwater quality treatment is to reduce typical pollutant loads from urban areas to Best Management Practices as defined in the following targets:

Table 5.1 Best Practice Pollutant Reduction Targets

Pollutant	Performance Objective
Total Suspended Solids (TSS)	80% reduction from typical urban load
Total Phosphorous (TP)	45% reduction from typical urban load
Total Nitrogen (TN)	45% reduction from typical urban load
Gross Pollutants (GP)	70% reduction from typical urban load

Source: Urban Stormwater: Best Practice Environmental Management Guidelines – Victorian Stormwater Committee, 1999.

End of line wetlands are the preference for providing water quality treatment at Nyora. As well as providing the required water quality treatment, wetlands will provide habitat value, visual amenity and are considered to be more aligned with the existing environmental character than other treatment measures. However the viability of constructing a large online wetland that treats runoff from multiple precincts will depend on the suitability of the terrain and development timeframes. In many precincts, particularly the infill development areas such as precincts E, G and B distributed water quality measures such as bio-retention basins, swales is likely to form a key part of the strategy.

A summary of the water sensitive urban design elements that will be considered for the water quality strategy is presented in **Appendix B**.

7. WHERE TO NEXT

The following summarises the next steps for the development of the Nyora stormwater strategy:

- Meet with Melbourne Water to discuss the findings of the existing conditions modelling work and the proposed strategies for each precinct. Determine appropriate existing conditions flow attenuation parameters for each waterway.
- Adopt existing conditions flood modelling results subject to approval by Council.
- Workshop the results of the drainage investigation to determine an appropriate development strategy for each precinct including staging of development and works.
- Identify the appropriate mechanism for procuring funding for stormwater assets for each catchment.
- Model fully developed conditions to determine catchment flows for sizing of the major and minor drainage system and retarding basins.
- Undertake MUSIC water quality modelling to determine the redevelopment strategy.
- Develop a stormwater management plan in accordance with Infrastructure Design Manual requirements including preliminary cost estimates for proposed assets.

8. QUALIFICATIONS

a. In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

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9. REFERENCES

Alluvium, 2009, Nyora Development Services Scheme Summary Report

Beverage Williams, 2011, Nyora Structure Plan Submission

BMT WBM, 2009, Water Quality Report

CSIRO, 2006, Urban Stormwater: Best Practice Environmental Management Guidelines

Engineers Australia, 1987, Australian Rainfall and Runoff

Growth Areas Authority, April 2011, Engineering Design and Construction Manual

Melbourne Water, 2015, Planning and Building website page

Nott and More, 2010,Development forecasts for Nyora

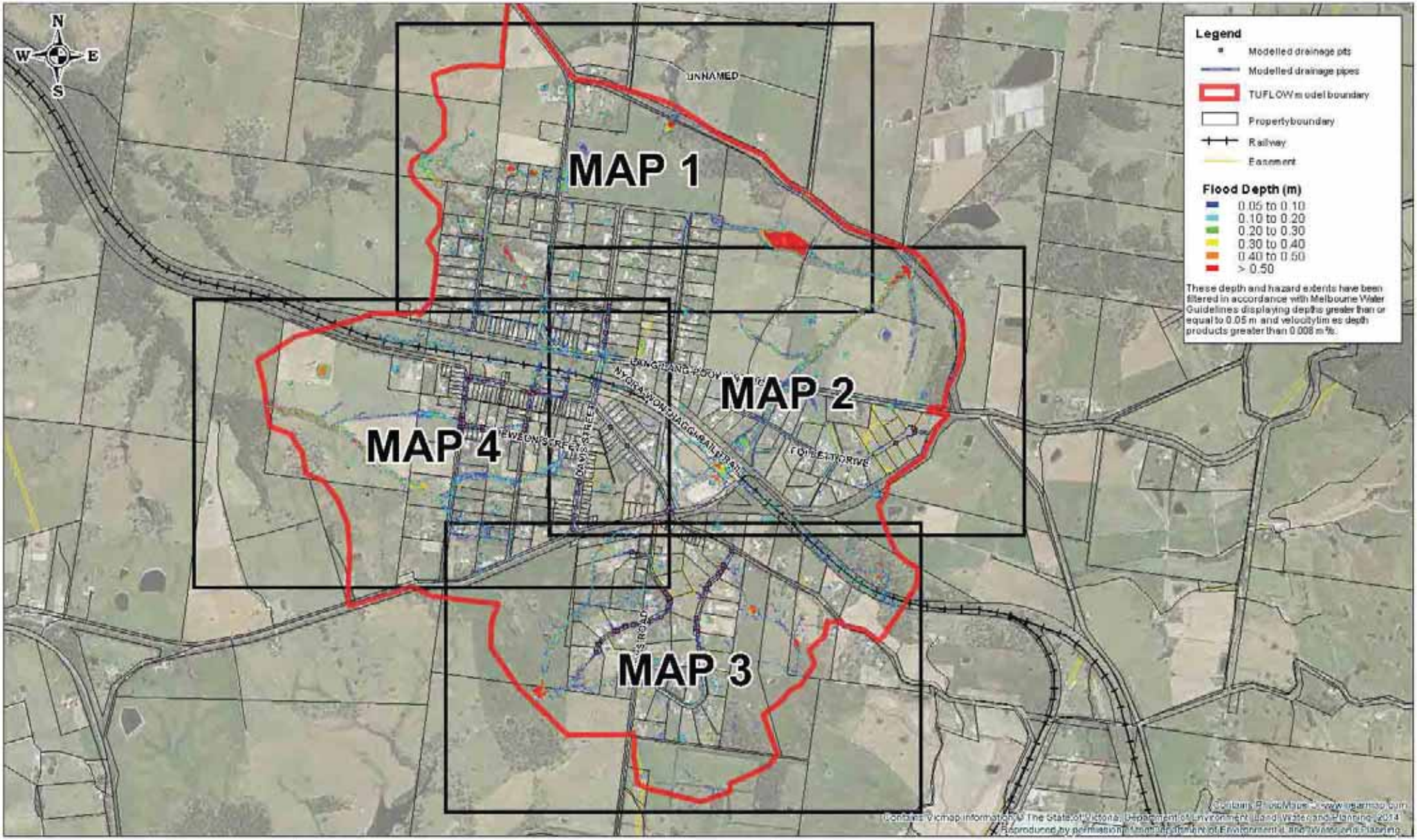
Planisphere, 2013, Nyora Structure Plan

South Gippsland Shire Council, Strategy & audit for social community infrastructure 2014 - 2029

South Gippsland Shire et al., 2013, Flood Management Plan for South Gippsland Shire Council, Melbourne Water and West Gippsland CMA (prepared in collaboration

APPENDIX A

Existing Conditions Flood Maps



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0 300 600
Scale in metres (1:15000 @ A3)

Map Projection: Transverse Mercator
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Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Nyora Development Strategy

18% AEP Existing Conditions Flood Map

Key Map

Job Number: V1128_001
Revision: 0
Drawn: MM
Checked: NEA
Date: 13 January 2016

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Map 1 of 4

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Map 2 of 4

Job Number: V1128_001
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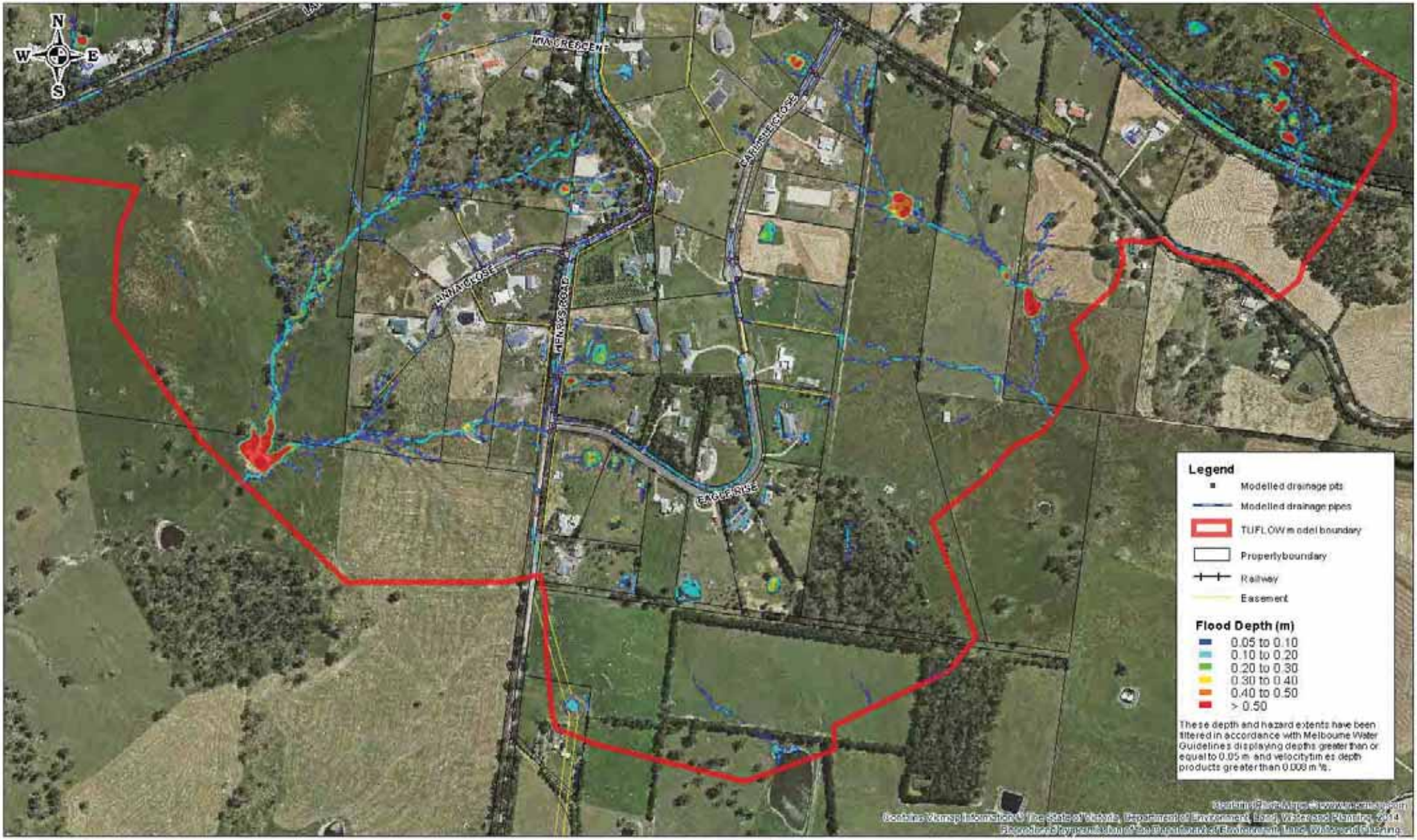

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18% AEP Existing Conditions Flood Map

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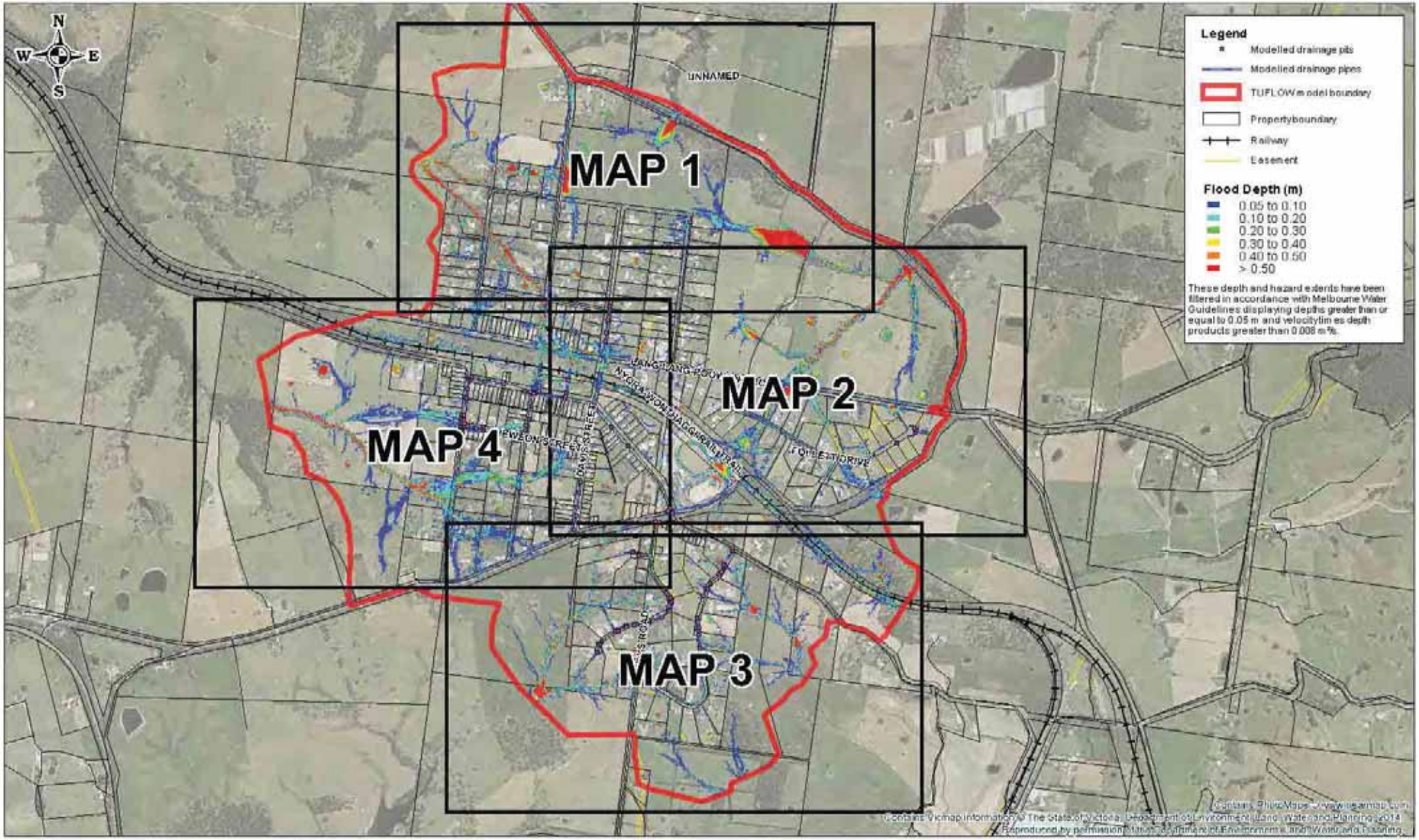

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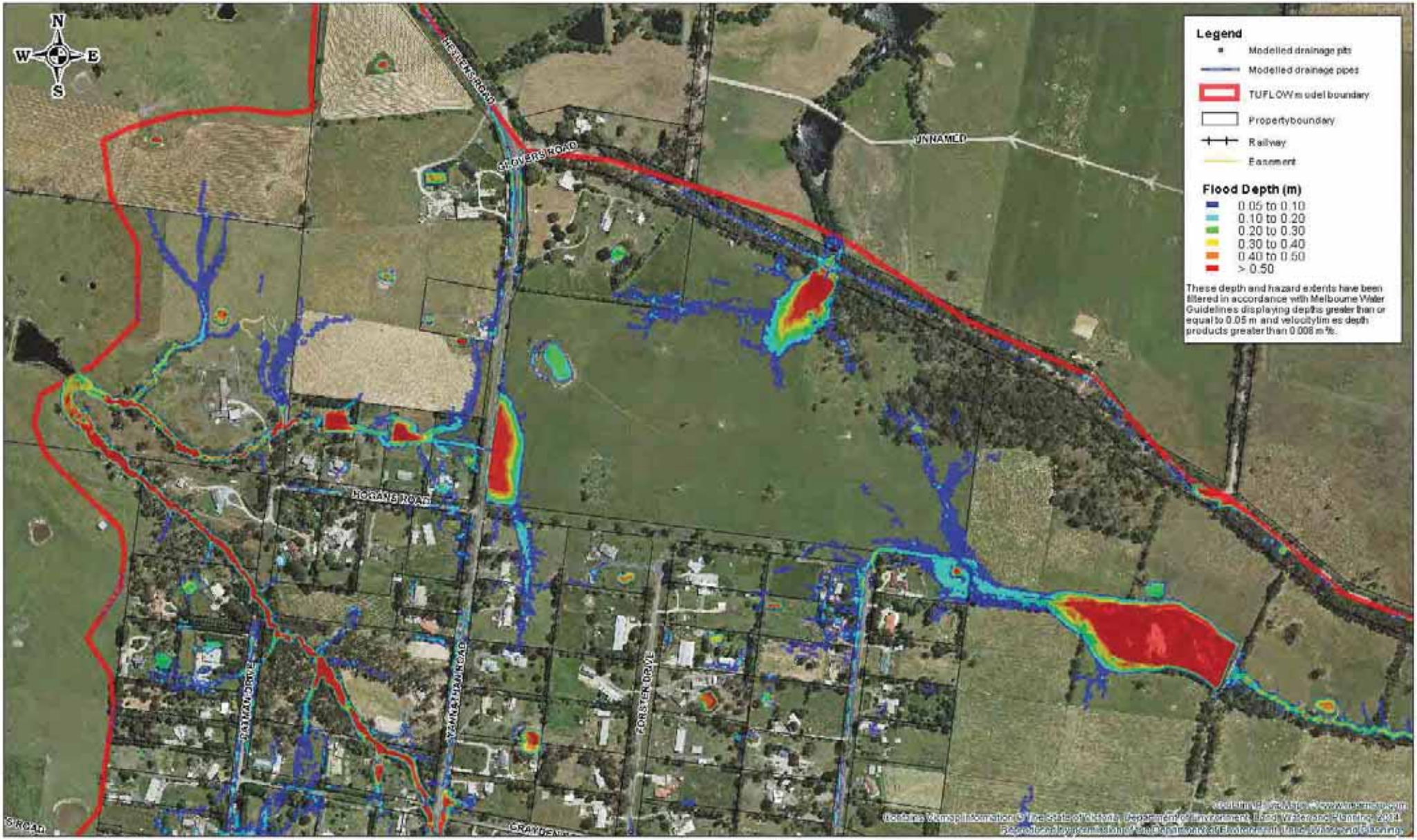

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1% AEP Existing Conditions Flood Map

Map 4 of 4

Job Number: V1128_001
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APPENDIX B

Water Sensitive Urban Design Elements

Rain Gardens

Rain gardens, otherwise known as bio-retention basins, are specifically designed to integrate gardens into the stormwater management systems of the site. Bioretention systems treat stormwater by percolation through a vegetated soil media (typically sandy loam). A rain garden will offer a landscape component to the site.

Bioretention Planter Box

Bioretention planter boxes are simply rain gardens, but in a planter box instead of flush with the ground. A planter box can create a nice aesthetic for a building, and can combine with a contemporary sculpture that conveys water from a downpipe to the box to add an architectural value.

Roof Garden

Roof gardens, also referred to as green roofs, are simply gardens or areas of greenery on roof tops. Since roof tops are 100% impervious area, roof gardens act to capture and filter stormwater, reducing the amount of runoff generated by a roof top and subsequently removing the pollutants associated with the stormwater.

Roof gardens can also assist to create a more energy efficient building. Reducing the amount of concrete or impervious area on a roof top effectively reduces the heat absorption and hence,

reducing the overheating effect of the roof top. The roof gardens provide a form of insulation for the building which may lead to substantial energy savings.

Implementation of roof gardens would need to be considered in the planning stage of buildings as the roof must be designed to cater for the additional loads generated by the gardens and the temporary storage of stormwater in these gardens.

Permeable Pavements

Permeable pavements promote infiltration of stormwater runoff to either the soil below or to a water storage reservoir below.

The structure of permeable pavements is relatively simple. They consist of the pavers, laid with a gap in between each paver, on a sand or fine gravel base with a layer of geotextile fabric between the base and a sub base of coarse aggregate. Pervious concrete and pervious gravel can also be considered a form of permeable pavements.

There are 2 main advantages of permeable pavements over traditional pavements; improved water quality through filtering, interception and biological treatment and flow attenuation through infiltration and storage.

The concept of permeable pavements is enticing, but careful design is required if the pavement requires vehicular traffic. Also, installation of permeable pavements alone will not meet the best practice targets for pollutant reductions as specified in the *Urban Stormwater: Best Practice Environmental Management Guidelines* (Victorian Stormwater Committee, 1999)

Rainwater Tanks

Rainwater tanks are used for harvesting stormwater for reuse. They capture stormwater runoff, primarily from roof tops, and store it for reuse. Applications of reuse include garden watering and toilet flushing. This effectively reduces the demand on reticulated potable water, while reducing the volume of stormwater runoff and the pollutants associated with the runoff.

Water reuse for a site is becoming increasingly popular with the uncertainties surrounding climate change. A rainwater tank can add value to this development, but alone will not meet the best practice targets for pollutant reductions.

Wetlands

Constructed wetland systems are an end of pipe solution to water quality. The primary function of wetland systems is to remove pollutants associated with fine particulates and dissolved contaminants. Wetlands are constructed to mimic a natural habitat and are generally located immediately upstream of a receiving waterway.

Whilst wetlands are effective at pollutant removal and provide an aesthetic water feature, they also have the largest footprint of all the above mentioned treatments.

Gross Pollutant Traps (GPT)

Gross pollutant traps (GPT) are used as a primary treatment measure to remove litter, debris and coarse sediments.

GPT's are advantageous in that they can be located underground in the form of a large drainage pit. They do, however, only remove a small portion of total phosphorous and total nitrogen from the runoff, only that which is attached to the coarse sediments being retained in the trap.

GPT's require regular manual maintenance to clean out the litter and debris, but are an ideal treatment for removal of unsightly gross pollutants as they have a very small footprint.

Vegetated Swales

Grass swale (Photo courtesy of Melbourne Water)

Vegetated swale conveying road runoff

(Photo courtesy of Melbourne Water)

Swales are linear depression of channels that provide for stormwater collection and conveyance. Swales may simply be grass-lined or more densely vegetated and/or landscaped. While swales provide for stormwater conveyance, they also lend to the screening or removal of gross pollutants, such as litter and coarse sediment, from stormwater runoff.

Swales are often used pre-treatment of stormwater at a streetscape level in lieu of the conventional piped drainage network. They are generally located in the nature strips or the central medians of roads. Swales are not a new concept however as they are often used instead of kerb and channel and can appear as a typical road verge in low density residential areas, on rural roads and highways.

Sedimentation Basins

Sedimentation basins are basins specifically designed to remove medium to coarse sized suspended solids via a settling process. Sedimentation basins use temporary detention to promote sediment settling and reduction of velocities. These basins can either be permanent or used as a temporary measure during construction.

Infiltration Trenches

Lynbrook Estate Infiltration Trench (Photo courtesy of Melbourne Water)

An infiltration trench is a shallow, excavated trench filled with gravel or rock, through which run-off drains. The purpose of infiltration trenches is to remove particulate and soluble contaminants from stormwater by passing the runoff through a filter medium. The effectiveness of the pollutant removal is determined by the type of filter medium used in the trench.

Infiltration trenches offer a recharge to ground water however are susceptible to clogging and do have the potential to cause ground water contamination.

APPENDIX B

TUFLOW model results

1% AEP developed conditions with **no** mitigation works

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Nyora Storm Water Management Plan

100yr ARI Developed Conditions Flood Map

Map 1 of 4

Job Number: V1128_001
Revision: 0
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Date: 22 Jun 2016

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Nyora Storm Water Management Plan

100yr ARI Developed Conditions Flood Map

Map 2 of 4

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Nyora Storm Water Management Plan

100yr ARI Developed Conditions Flood Map

Map 3 of 4

Job Number: V1128_001
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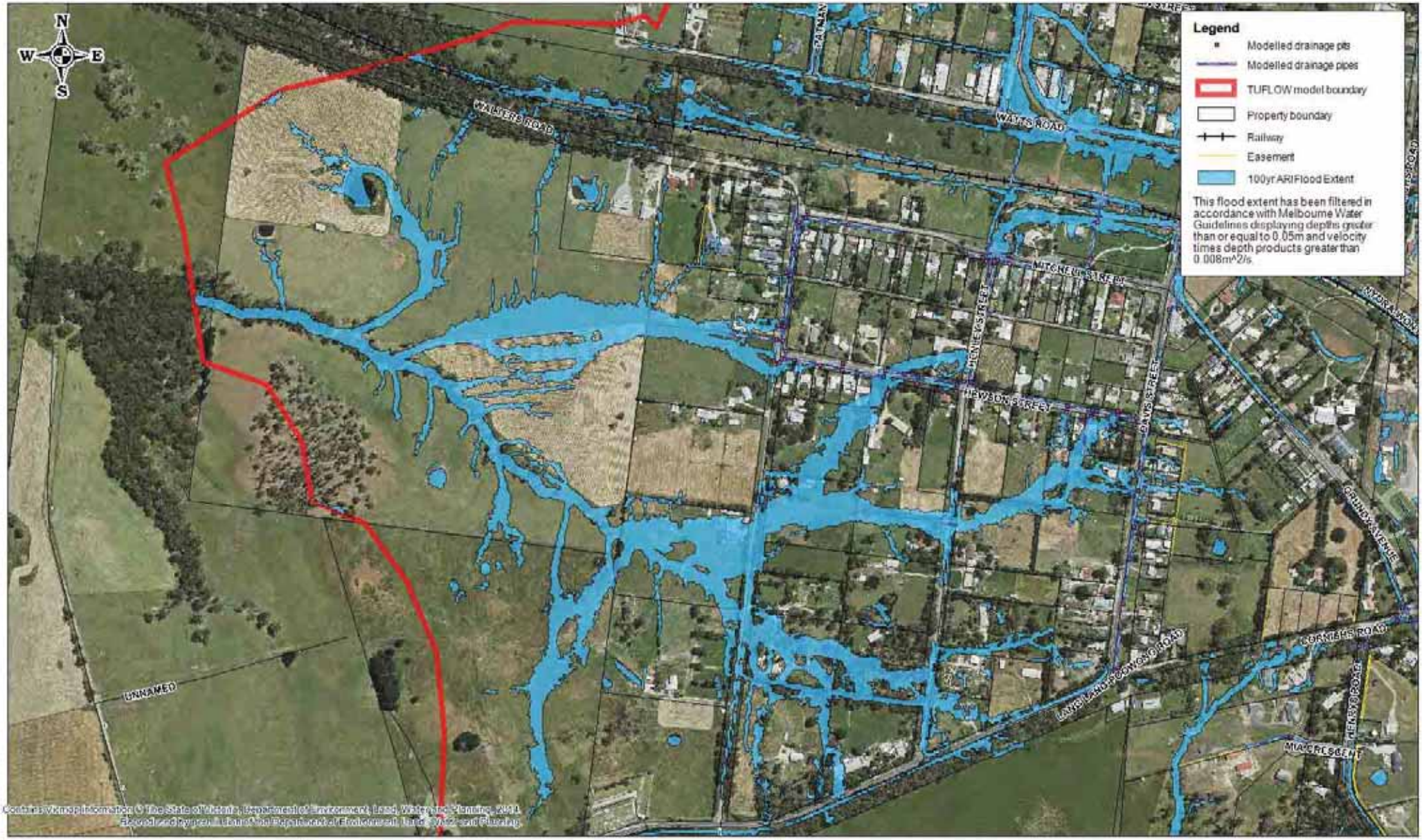

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Nyora Storm Water Management Plan

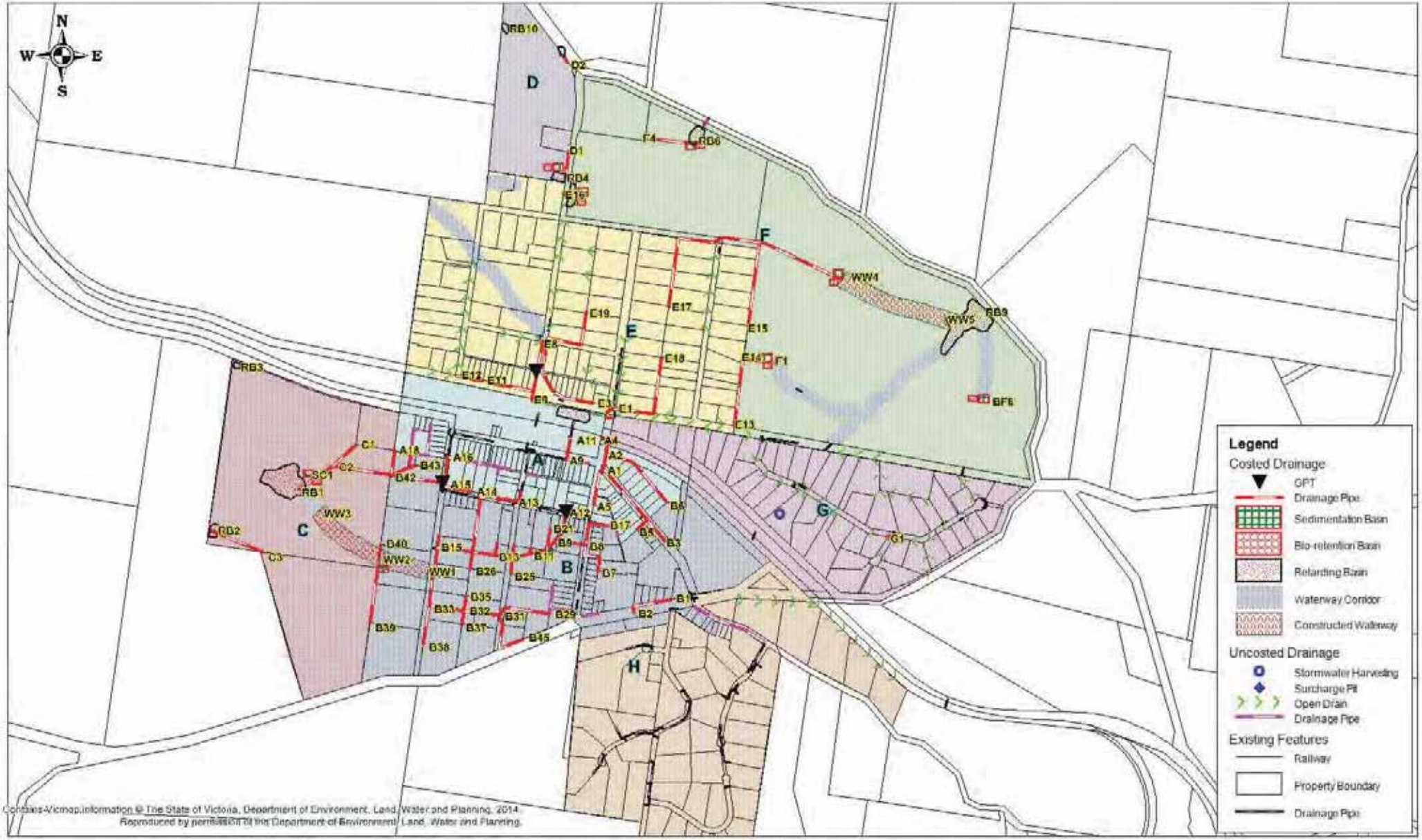
100yr ARI Developed Conditions Flood Map

Map 4 of 4

Job Number: V1128_001
Revision: 0
Drawn: NEA
Checked: AP
Date: 22 Jun 2016

APPENDIX C

Ultimate Stormwater Management Plan



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Nyora Storm Water Management Plan

OVERVIEW

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Revision: 0
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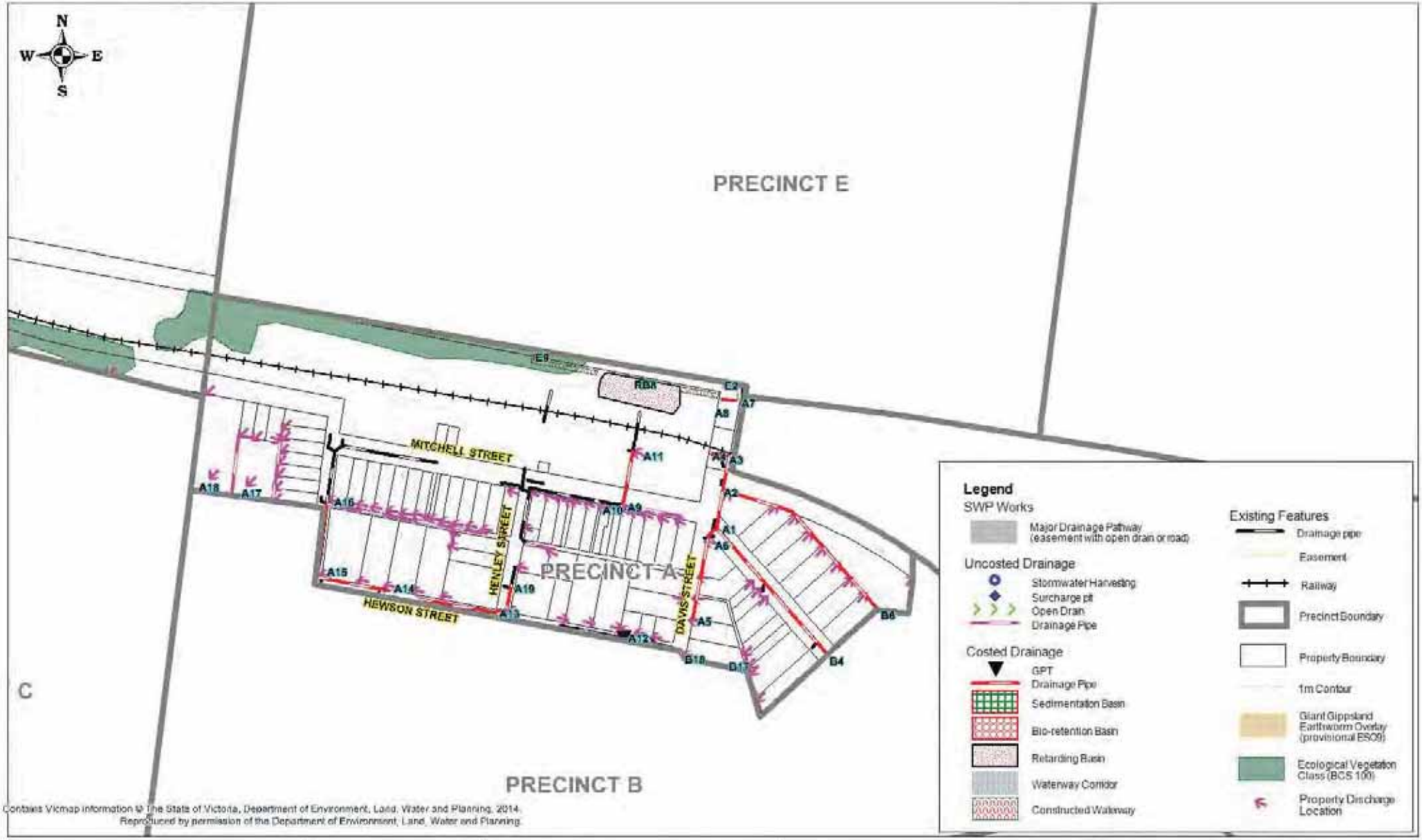
Date: 10 Jun 2016

APPENDIX D

Stormwater management by precinct



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Nyora Storm Water Management Plan

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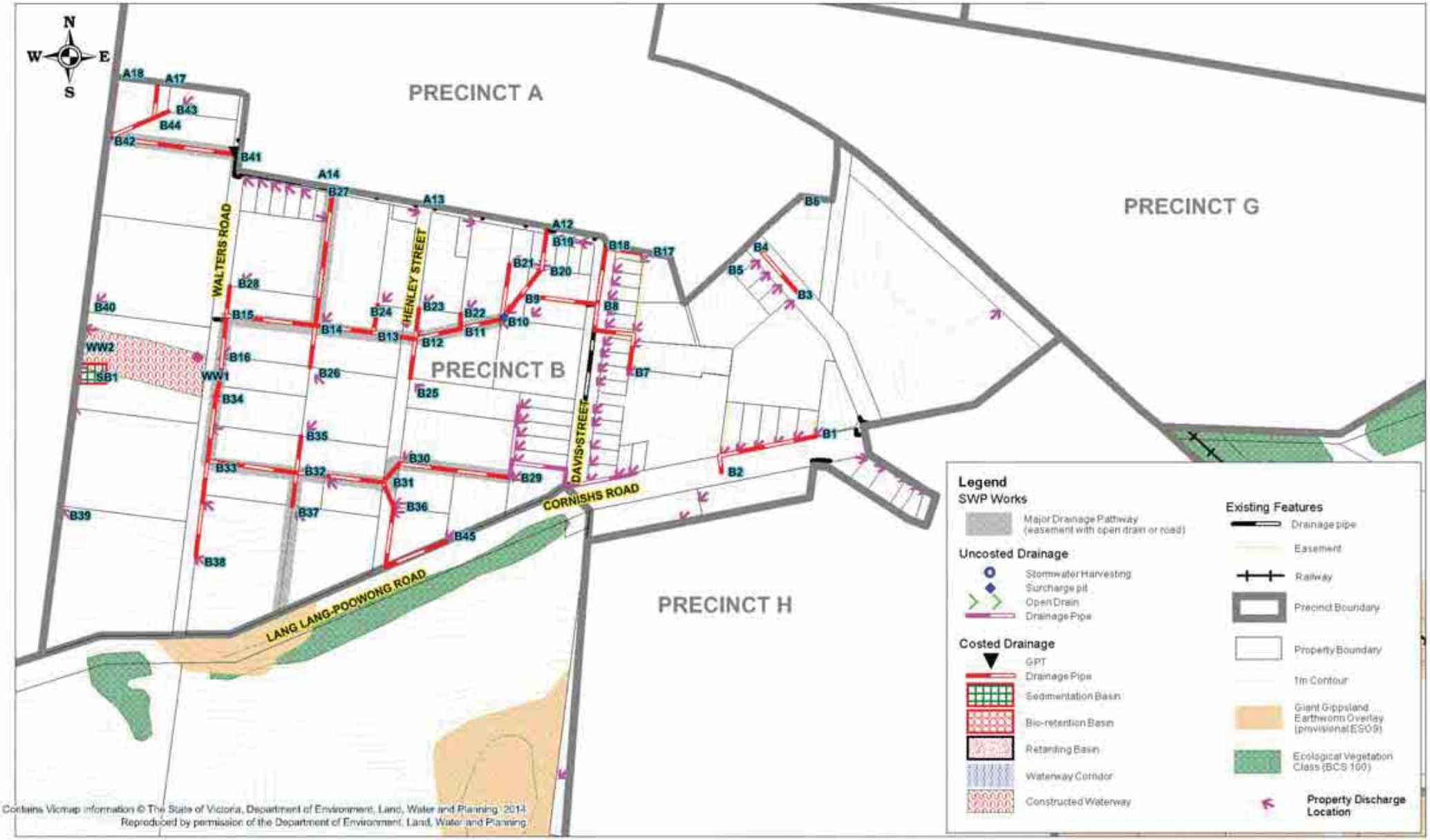

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Nyora Storm Water Management Plan

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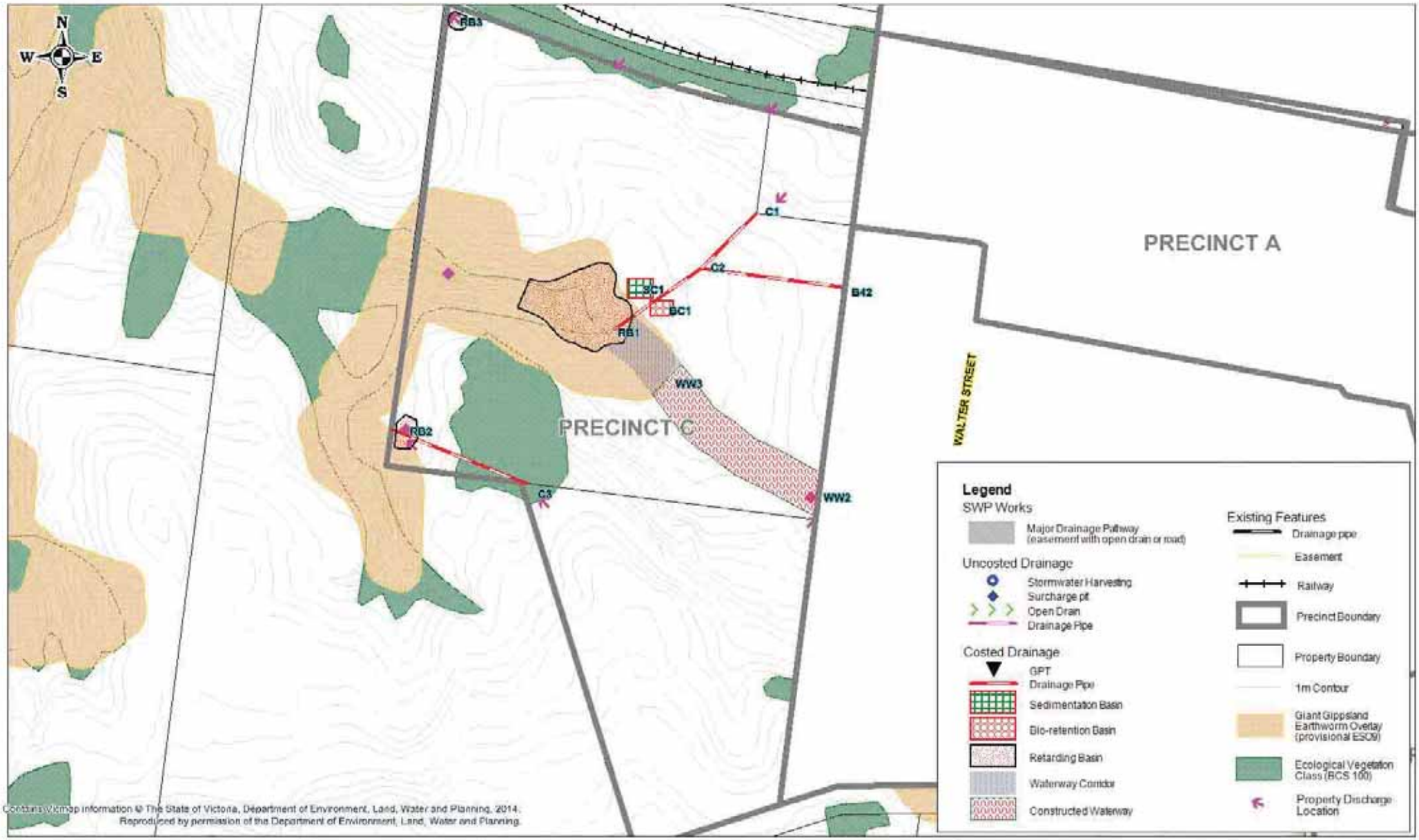

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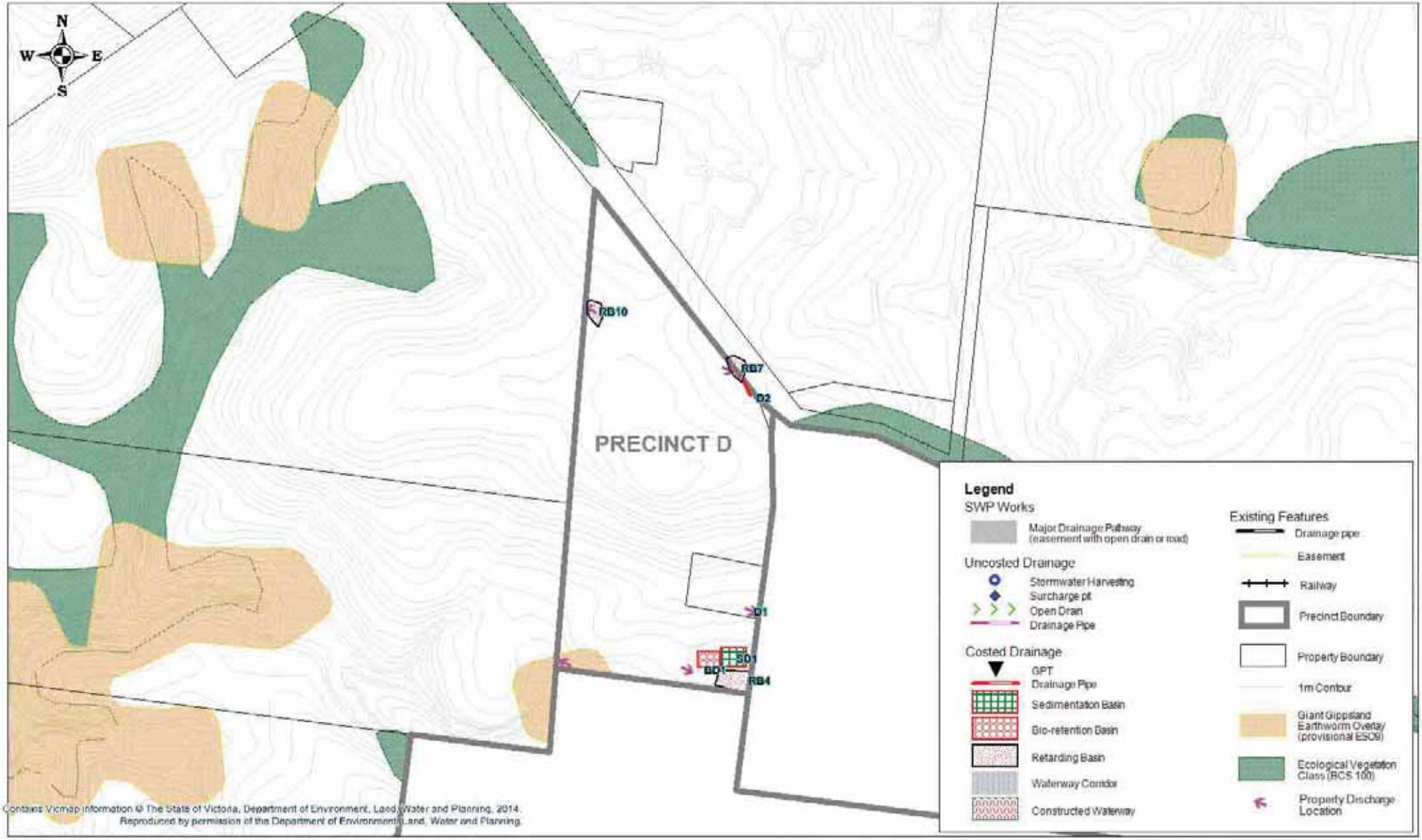

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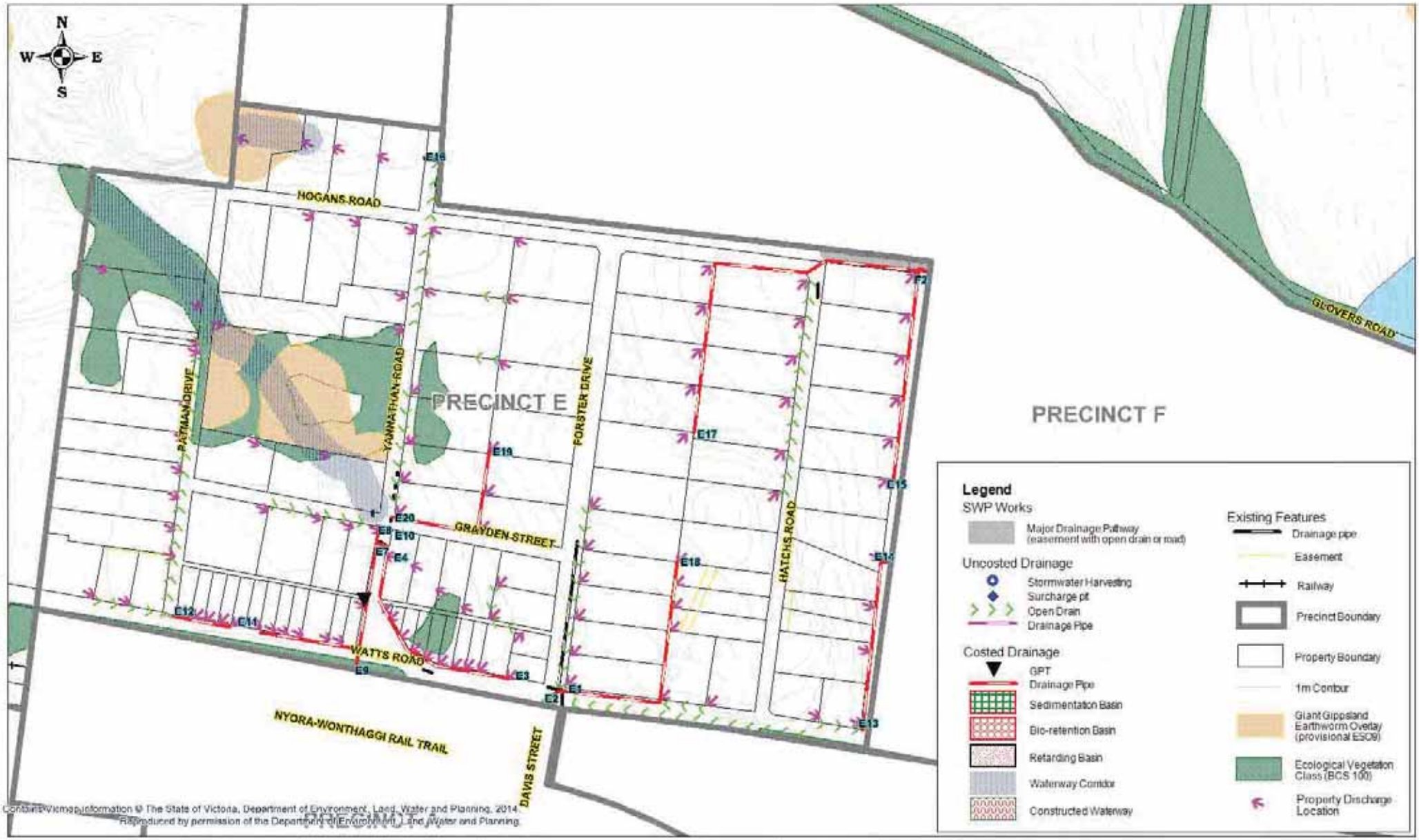

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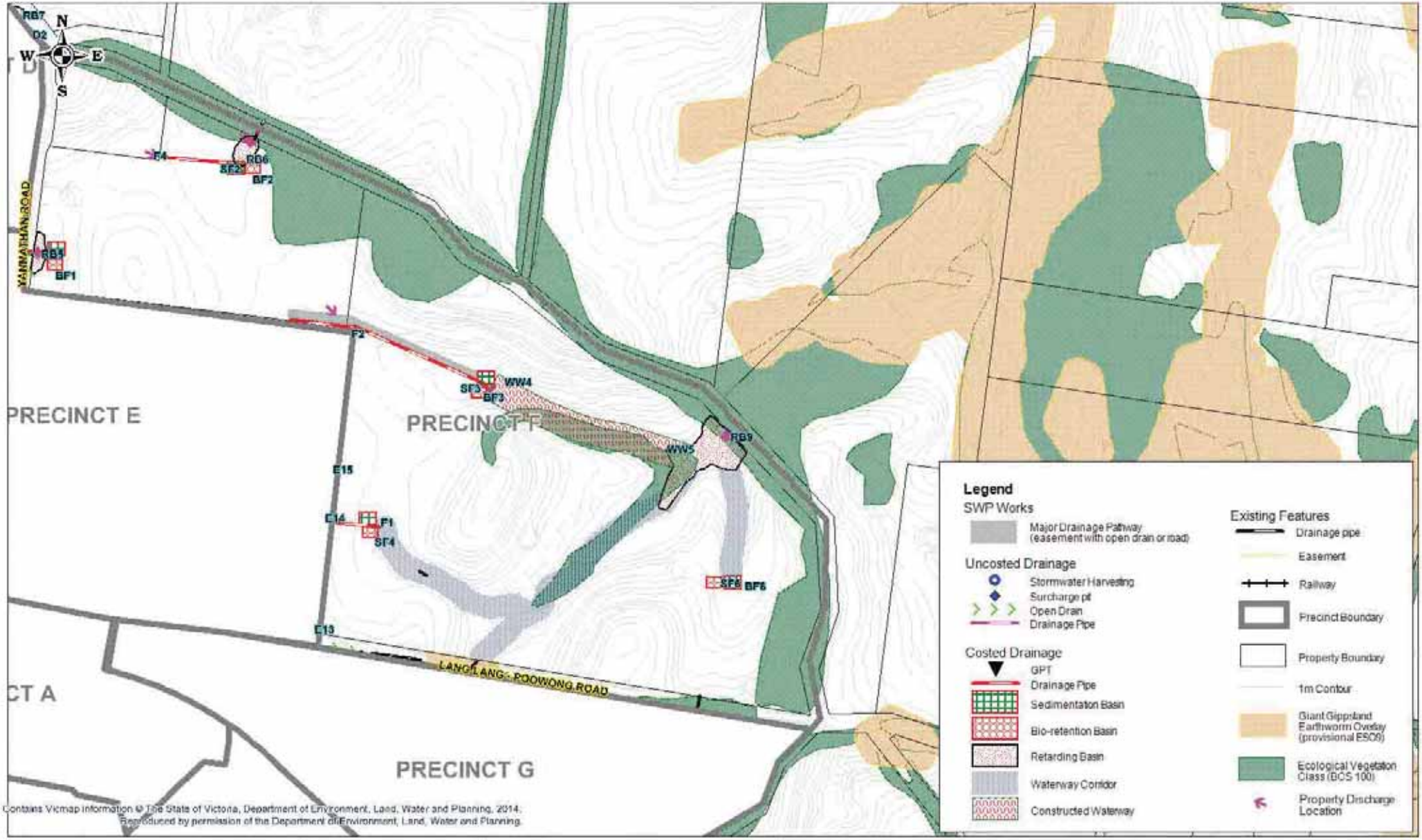

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Nyora Storm Water Management Plan

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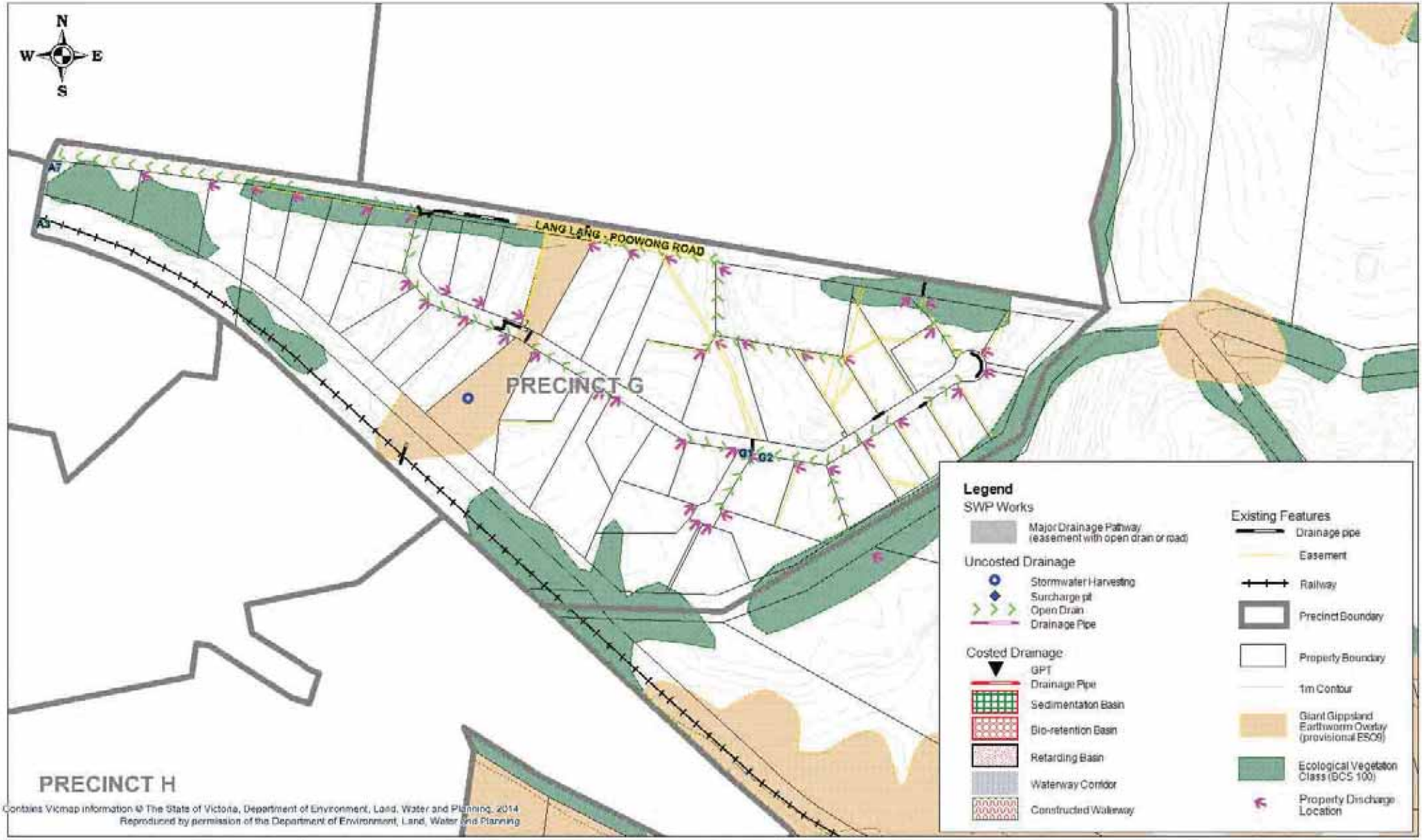

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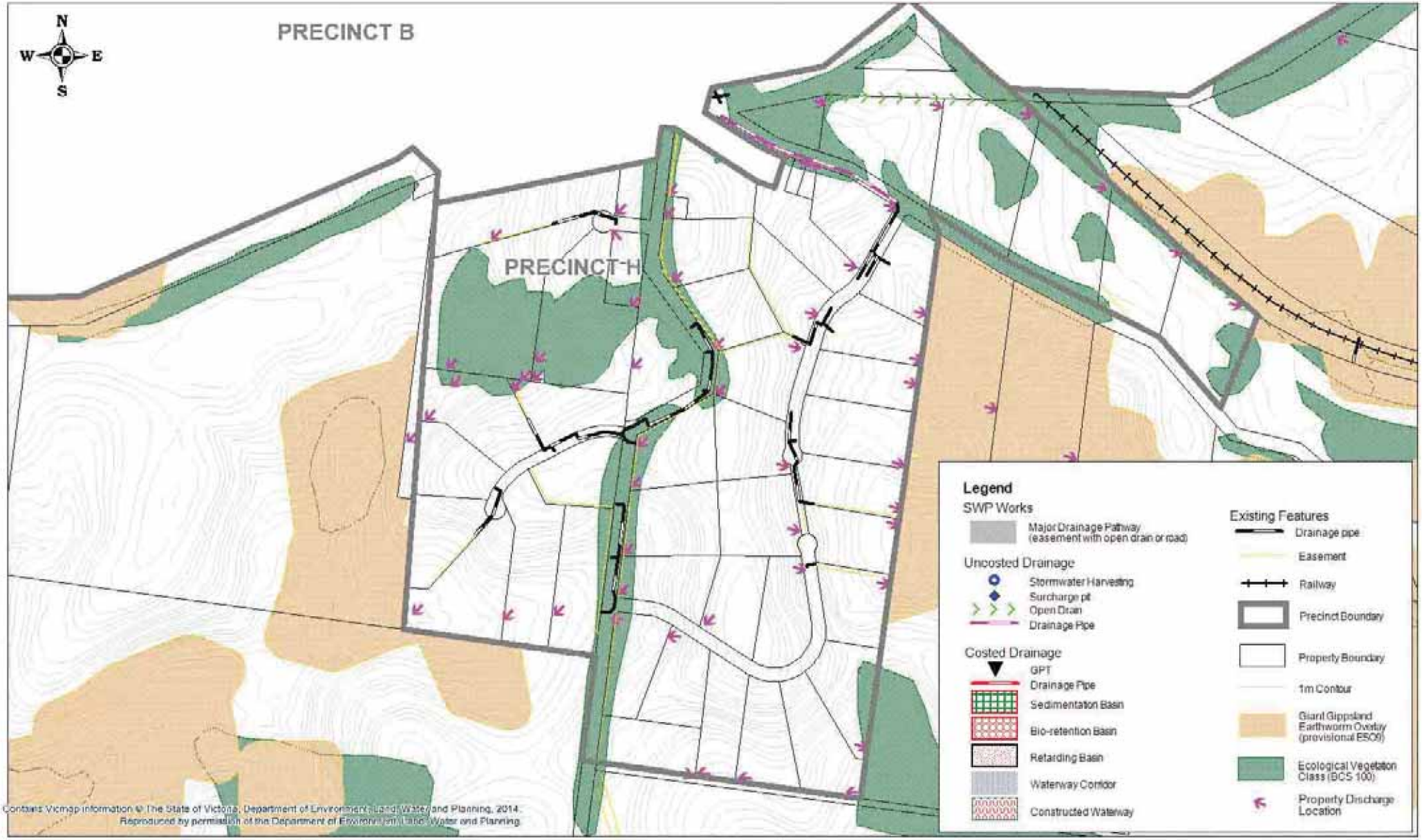

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0 100 200
Scale in metres (1:5000 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

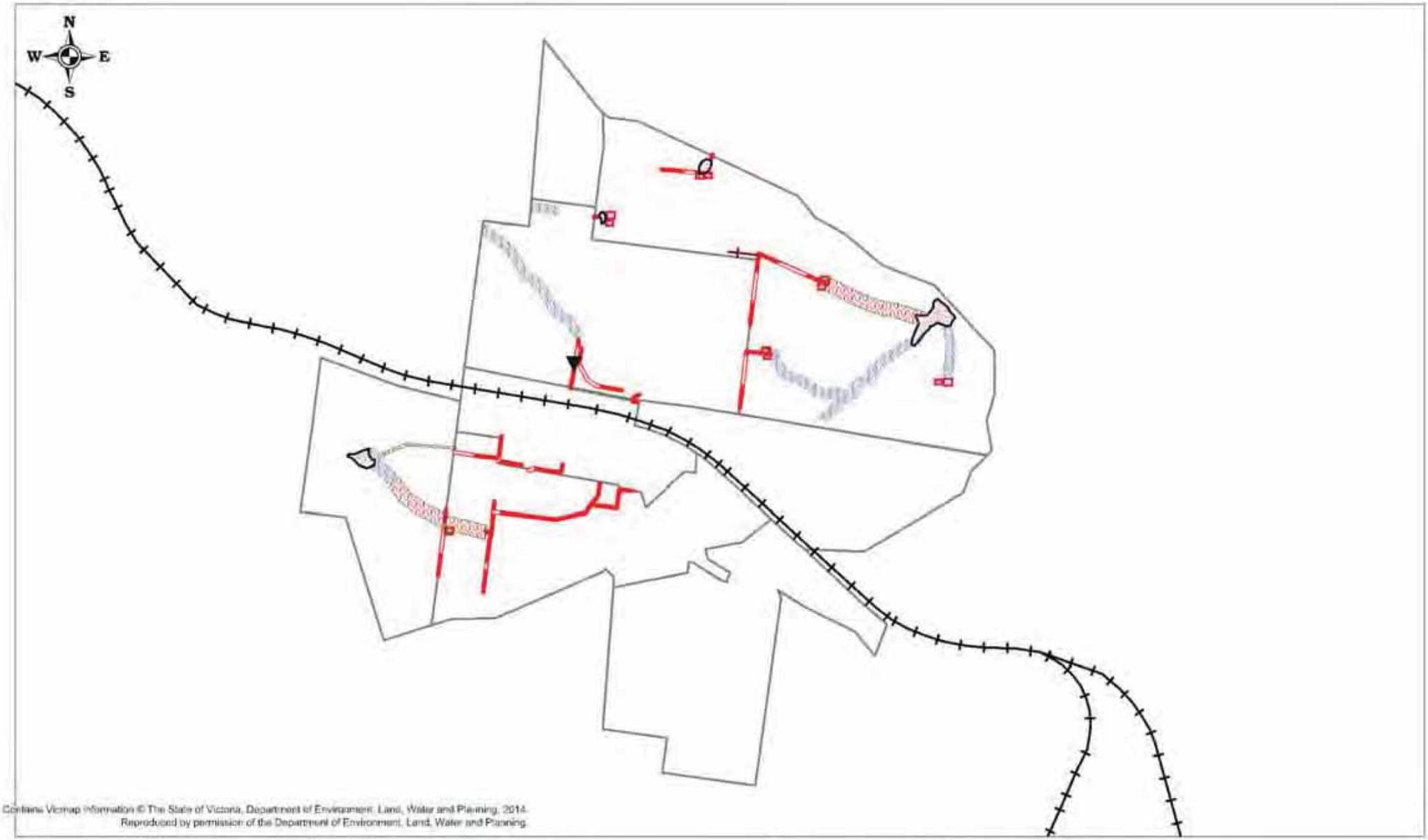
Nyora Storm Water Management Plan

PRECINCT H

Job Number: V1128_001
Revision: 0
Drawn: NEA
Checked: AP
Date: 10 Jun 2016

APPENDIX E

Staged stormwater management



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Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia_Zone 55

Nyora Storm Water Management Plan

SHORT TERM STORM WATER MANAGEMENT WORKS (5 -10 YEARS)

Job Number: V1128_001
Revision: 0
Drawn: NEA
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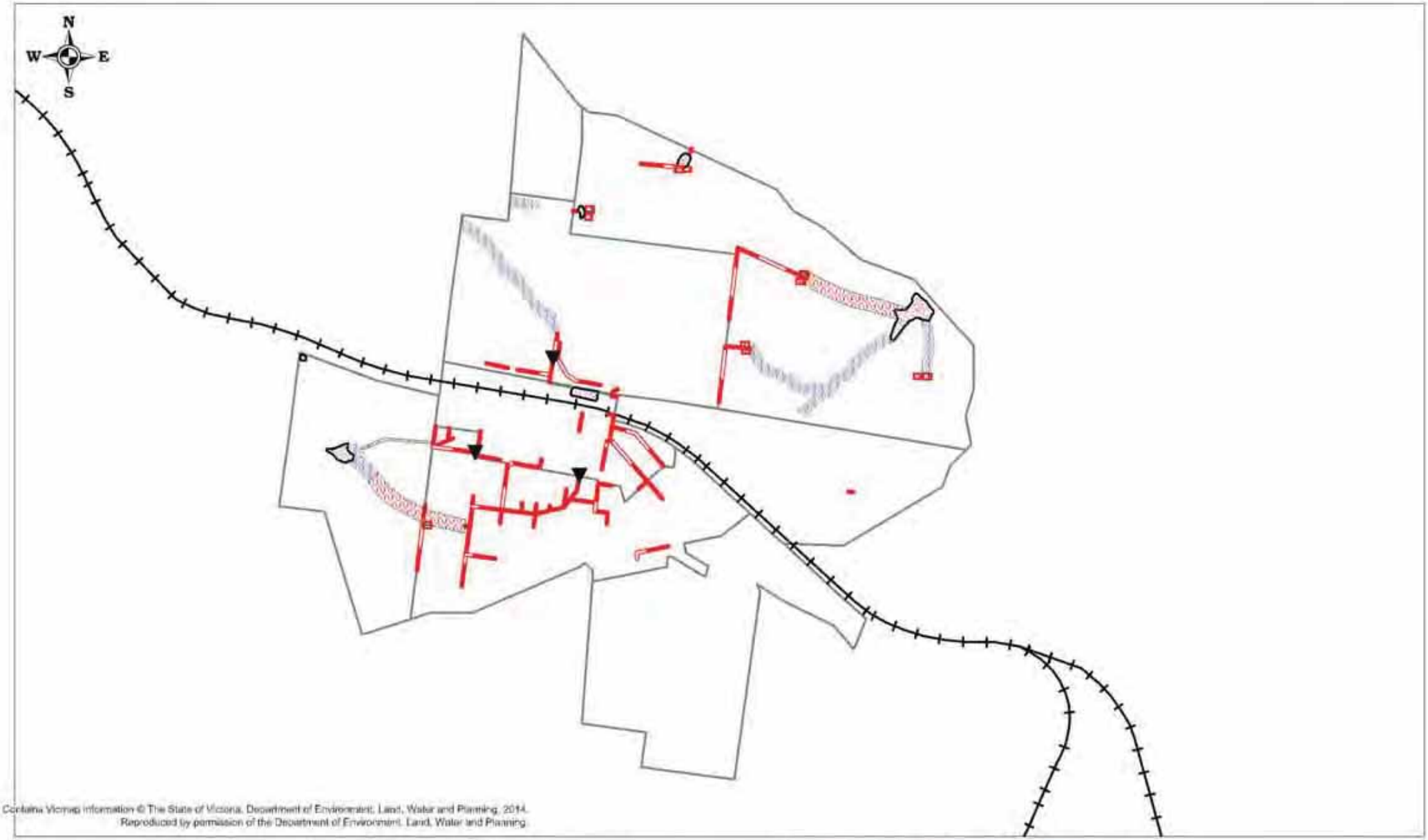
Date: 10 Jun 2016



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Scale in metres (1:15000 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Nyora Storm Water Management Plan

MEDIUM TERM STORM WATER MANAGEMENT WORKS (10 - 20 YEARS)

Job Number: V1128_001
Revision: 0
Drawn: NEA
Checked: AP
Date: 10 Jun 2016

F

APPENDIX F
PROPERTY & ECONOMIC REPORT

NYORA DEVELOPMENT STRATEGY

PROPERTY AND ECONOMIC ISSUES AND OPPORTUNITIES

SOUTH GIPPSLAND SHIRE COUNCIL AND PLANISPHERE

APRIL 2016

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1. INTRODUCTION

1.1. ENGAGEMENT

Urban Enterprise are engaged as a sub-consultant to Planisphere to provide economic and property analysis to inform the Nyora Development Strategy, a project undertaken for South Gippsland Shire Council (Council).

1.2. SCOPE

The scope of Urban Enterprise's input to the Development Strategy includes:

- A background review of relevant documents and information;
- A summary of the economic role of Nyora in the municipal and regional context;
- Preparing a business overview of the town centre;
- Prepare an analysis of competing activity centres;
- Review demand indicators for commercial land in Nyora;
- Supportable retail floorspace;
- Assessment of land area requirements;
- Assessment of strategic site options to meet floorspace requirements;
- Undertake discussions with land owners and Vic Track; and
- Town centre boundary and commercial layout assessment.

2. BACKGROUND DOCUMENTS

2.1. INTRODUCTION

This section includes a review of existing background documents relating to Nyora relevant to the property and economic considerations for the Development Strategy.

2.2. NYORA STRUCTURE PLAN

The Nyora Structure Plan was prepared by Planisphere in June 2013 for Council and Regional Development Victoria. The Structure Plan is the most important document in setting out the current planning and development context for this Development Strategy.

Key findings relevant to this project are as follows.

POPULATION AND GROWTH

- Nyora had approximately 900 residents in 2006. The growth rate between 2001 and 2006 was 1.7% per annum. The Structure Plan projected that the population by 2030 will be 1,460 residents based on a growth rate of 2.1% per annum. *Note: population and demographic data has been updated in this report to include 2011 Census results*;
- The increase of 500 residents would mean an additional 213 households by 2030 at an average of 2.6 people per household;
- The Structure Plan identifies large areas at the fringes of the township that could support residential growth. The key growth area is currently subject to a Planning Scheme Amendment process to rezone 119 hectares of land to allow lots in the order of 750sqm at to yield an estimated 700 – 800 lots.

RETAIL AND TOWN CENTRE

- The Structure Plan identifies a small existing commercial centre comprising of post office and a general store of approximately 120 sqm. Along with these sites are a vacant hotel at the corner of Mitchell Street and Lang Lang - Poowong Road, and a pizza restaurant on Lang Lang - Poowong Road;
- Nyora has no clear 'town centre', forcing residents to shop outside of the township;
- In 2010, it was estimated that Nyora residents spent approximately $11.5 million on retail products, which could support a retail floorspace of 2,000 sqm, at a rate of 2.1 sqm per person. Actual retail floorspace is 120sqm which highlights the lack supply, forcing residents to spend outside the township;
- Approximately 1000 sqm to 2000 sqm of retail floorspace (or 4000 sqm of zoned land) will be required in Nyora by 2030;
- The Structure Plan recommended to remove the Township Zone (**TZ**) and provide a Commercial 1 Zone (**C1Z**) along the south side of Mitchell Street, including the triangle site of the former hotel on the corner of Mitchell Street and Davis Street. This recommendation has since been implemented.

INDUSTRIAL AND EMPLOYMENT

- The Structure Plan notes that Nyora has a significant amount of industrial land and activity for the town's relatively small scale. The existing industrial activities include:
  - Farm supplies and animal feed;
  - Construction materials and earthmoving;
  - Engineers;
  - Septic tank supplies; and
  - Equine equipment and supplies.
- There are 10 industrial enterprises in Nyora, of which 8 are located in Industrial 3 Zone. There also appears to be 6 vacant lots, each of approximately 1,400sqm in the existing industrial zones;
- Nyora has a number of industrial businesses that serve national and international markets, however, local industrial businesses are not well represented (with the exception of the auto-mechanic on Davis Street), meaning that residents would be likely to use industrial businesses in surrounding towns.
- If Nyora is to have 1,460 residents by 2030, an additional 2.78 ha of industrial land will be required, based on 0.15 ha per small industrial lot.

2.3. DEVELOPMENT FORECASTS FOR NYORA

The Development Forecasts for Nyora report (**Development Forecasts**) was prepared in 2010 by Tim Nott and Matters More for Council.

The report noted that Nyora residents are increasingly being able to access jobs 'locally', with more also travelling further, mostly to inner Melbourne. Residents are generally travelling north and north-west to access jobs in the southern suburbs of Melbourne, while there are no residents of Nyora that work in the Latrobe Valley.

Table 1 reproduces the Development Forecasts estimate of the scale and type of retail activity centres that would be supported by five population growth scenarios for Nyora, as well as the scenario of no further land release. *Note: the data and assumptions used by Tim Nott to prepare these projections have been updated in this report (Section 3).*

TABLE 1 RETAIL ACTIVITY CENTRES UNDER FIVE GROWTH SCENARIOS, NYORA, 2030

Development scenarios	No further land	Existing conditions continued	State Government forecast	Commuter town	Rapid growth	Explosive growth
Population in each scenario by 2030	1,040	1,350	1,460	1,640	2,110	5,000
People in surrounding rural areas	500	500	500	500	500	500
Total catchment population	**1,540**	**1,850**	**1,960**	**2,140**	**2,610**	**5,500**
Support for local centre	Yes	Yes	Yes	Yes	Yes	Yes
Support for small neighbourhood centre	Yes	Yes	Yes	Yes	Yes	Yes
Support for neighbourhood centre	No	No	No	No	No	Yes

Source: Tim Nott - Development Forecasts, 2010

For the 'Explosive growth' scenario, the report estimates that Nyora would require a Neighbourhood Centre, including a medium to large supermarket (around 3,000sqm).

All other scenarios would require a small neighbourhood centre, including a small supermarket (up to 1,000sqm in the case of the Rapid growth scenario).

In addition to the retail space required, space for other activities would also be needed, such as doctors, other health practitioners, veterinarians, professional services and real estate agents. Non-retail demand was assumed to be 30% of the total floorspace.

The Development Forecasts include the following land requirement estimates for the two higher growth scenarios as follows:

- Allowing for retail space of 1,500 sqm under the **Rapid Growth** scenario, total floorspace in the activity centre would be needed in the order of 2,200 sqm. Assuming single storey development, the total area needed for the activity centre would be approximately 0.5 ha. However, taking into account the existing pattern of allotment; 0.5 ha is likely to be a minimum size; and
- Under the **Explosive Growth** scenario, the retail floorspace requirement would be 4,400 sqm (0.8sqm per person for 5,500 people). 50% of the centre would be non-retail space since this sized centre could also accommodate a higher level of community services. Providing for car-parking, the total area required for the centre would be 1.9 ha.

2.4. NYORA COMMUNITY INFRASTRUCTURE PLAN

The Nyora Community Infrastructure Plan was prepared by Council in 2014. The purpose of the Plan was to:

- Guide the development, timing, design and location of community infrastructure over the next 20 years;
- Identify and prioritise services and facilities required for an emerging population;
- Present key recommendations for community infrastructure that will address needs over the short, medium and long term;
- Develop a plan of possible locations and facilities for identified priorities; and
- Support funding submissions and timing.

The Plan builds on the findings of the Nyora Structure Plan and the Development Forecasts report, and identifies the following property and economic issues relevant to this Development Strategy:

- A number of home based businesses are located in Nyora, including massage, dog and cat grooming, a driving school and book keeping;
- Sand mining industries are located within 7km of the township of Nyora with many transport trucks operating around the area;
- A survey of Nyora residents indicated that residents shop in 13 different suburbs or towns on a regular basis, with some residents accessing up to 4 different towns for shopping in a typical week. The majority of respondents shop in Pakenham (48). Many residents access services in neighbouring towns where they shop, especially where there are supermarkets such as in Poowong, Lang Lang and Korumburra;
- The Nyora Urban Design Framework, 2005, provides conceptual plans and sketches of urban design improvements near the town centre including a retail facility and community centre on the northern side of Mitchell Street.
- In the first instance the provision of a small supermarket, pharmacy and petrol station would increasingly service the needs of residents. Residents indicated interest in a supermarket, pharmacy and specialty shops to be located in the town, and supported retention of Toby's Paddock as parkland for recreation, leaving the area to the south of Mitchell Street for future retail development.
- The recommendations from the Nyora Structure Plan, Nyora Urban Design Framework and Nyora Community Plan are consistent in recognising the benefits that increased retail would contribute to increasing the character of the town centre and the needs of the local community.
- The central location of retail in the town centre enhances the village character. This town centre boundary includes: Mitchell Street, Henley Street, Davis Street, the strip along Davis Street, the former hotel and take away pizza store. Further retail shops should be located within this business zone area.

In respect of retail and commercial facilities, the Plan recommended:

- A supermarket development in Mitchell Street as an extension to the general store to cater for the needs of the current population with investigation of larger supermarket as demand increases;
- A pharmacy in the town with nurse practitioner would be a start to the provision of health services to the broader community. Further health consulting rooms in a community hub or similar multipurpose centre could be considered; and
- Support development of a fuel outlet if financially viable.

2.5. SOUTH GIPPSLAND HOUSING AND SETTLEMENT STRATEGY

The South Gippsland Housing and Settlement Strategy (the Settlement Strategy) was prepared for Council in 2012 by a consultant team including Urban Enterprise and led by Planisphere.

The Settlement Strategy outlines the strategic framework for urban development in the Shire, and identifies Nyora as a 'peri-urban settlement' with the following growth pressures:

- Demand for lifestyle properties and some standard density commuter lots;
- Demand on existing primary school associated with growth; and
- Limited service provision in comparison to high growth projection.

The Settlement Strategy includes the following findings and commentary relevant to the economic and property aspects of the development strategy:

- As designated settlements begin to grow there may be sufficient demand for additional full line supermarkets, particularly in the north-west of the Shire, such as Korumburra. Given the relatively low population in South Gippsland, a supermarket is currently a higher order retail facility, and careful consideration should be given to the locations of future supermarkets given the significant trade that can be expected to be drawn to this location as a proportion of existing expenditure in the Shire and impact on local businesses and amenity. As a general rule, higher order retail facilities should be located in District Towns or larger.
- There is low non-retail commercial demand across the Shire. This is largely due to the absence of larger regional centres which are typically the location for public and private sector regional offices. However, a small amount of non-retail commercial land use should be facilitated to support areas experiencing significant retail and residential growth. This is particularly important in retaining local employment and reducing environmental impact related to work travel. Further, new business opportunities

should be sought to support the principle of diversifying and strengthening the economy as directed by the Economic Development and Tourism Strategy 2012.

2.6. KEY FINDINGS AND IMPLICATIONS

The key findings relevant to this project are as follows:

- A population growth rate of 2.1% per annum was used to inform the Nyora Structure Plan. This data was based on information prior to the 2011 Census, meaning the data is in need of updating;
- Existing studies identify the lack of retail and commercial facilities in the town and the need for further services to be provided to reduce escape expenditure and support the significant growth that is projected to occur in the town over the next 20 years;
- Multiple studies identify that increased retail and commercial services could enhance the character of the town as well as meeting the needs of locals.
- Projections prepared in 2010 estimate that population growth scenarios could result in a 2030 population of between 2,610 and 5,500 in the Nyora catchment, resulting in demand for between 2,200 and 4,,400 sqm of retail floorspace in the town by 2030.

It is clear through existing studies that there is a very low provision of local retail and commercial facilities, as well as a relative lack of local industrial businesses to meet population-driven demand.

The majority of Nyora residents' retail expenditure currently 'escapes' to other towns. The projected strong population growth rates of in excess of 2% per annum will generate significant additional demand for retail and commercial land over time.

It will be important for the Development Strategy to update the data and analysis prepared in recent studies, and to investigate opportunities to improve the economic containment of the town for current and future residents. The current economic and property context is considered in the following sections.

3. PLANNING AND ECONOMIC CONTEXT

3.1. INTRODUCTION

The section provides an overview of the location and economic function of Nyora as influenced by the role of nearby towns and activity centres.

3.2. BUSINESSES AND ZONES

Nyora includes a range of planning zones, including a small section of Commercial 1 Zone in the centre of the township, and a section of Industrial 3 Zone to the north of the railway line. The planning zones are shown in Figure 1.

Nyora has a largely undefined town centre. There is approximately 400 sqm of retail floorspace in 3 premises dispersed across the Commercial 1 Zone, including a General Store, opportunity shop and pizza / takeaway shop. There is also a post office (150 sqm).

Table 2 shows land and floorspace area within each commercial and industrial zone. Although this is a relatively low provision of retail and commercial floorspace, residents of Nyora have a broad range of retail and employment options nearby, including in other townships, regional centres and the Melbourne metropolitan area), which is likely to have somewhat restricted past demand for floorspace growth in Nyora itself. The location and role of competing centres is discussed in Section 3.3.

TABLE 2 NYORA COMMERCIAL AND INDUSTRIAL ZONED LAND

Zone	Area (Ha)	Properties (no.)	Vacant properties (no.)	Occupied Business Floorspace (sqm)	Vacant Business floorspace (sqm)
C1Z	2.33	14	2	400 (retail) + 150 (commercial)	220
IN3Z	3.36	17	6	3,323	0

Source: Planning Maps Online, compiled by Urban Enterprise 2015.

In the Commercial 1 Zone there are:

- 2.33 ha in 14 properties;
- Only 4 properties are currently operating with a commercial or retail land use; and
- 2 vacant/unused properties, with 220sqm of vacant floorspace. One of these, the Nyora Hotel, is currently for sale. (It is understood that a Planning Permit has recently been approved for a pharmacy use on the hotel site).

In the Industrial 3 Zone, there are:

- 15 properties totalling 3.36 ha of land;
- 9 properties with active industrial operations; and
- 6 vacant sites totalling 1.00 ha.

There is also a motor mechanic operating within the General Residential Zone on Davis Street, with a floor area of approximately 220 sqm.

FIGURE 1 PLANNING ZONES - NYORA

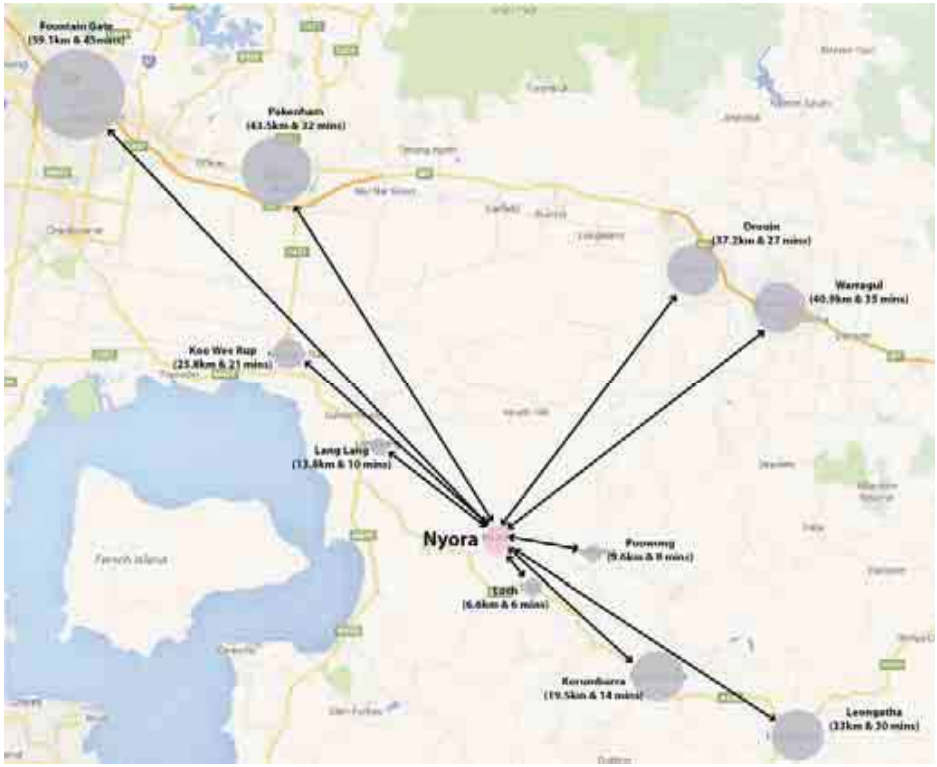
Source: Planning Maps Online.

3.3. COMPETING TOWNSHIPS AND ACTIVITY CENTRES

The economic role of Nyora is influenced by a number of small settlements in South Gippsland, activity centres in Cardinia Shire and regional centres in South Gippsland. Major activity centres in south-east metropolitan Melbourne such as Fountain Gate will also attract a significant share of retail expenditure.

Figure 2 shows the location of these surrounding towns in relation to Nyora. The retail supply and role of each centre is discussed in detail after Figure 2.

FIGURE 2 LOCATION OF SURROUNDING TOWNSHIPS AND COMPETING SUPPLY



Source: Google Maps, Urban Enterprise.

FOUNTAIN GATE

Fountain Gate is a regional shopping centre located in Narre Warren, approximately 45 minutes drive north-west of Nyora. The centre is located on the Princes Highway and is readily accessible to residents of the Nyora area by car, especially those commuting to work in metropolitan Melbourne.

Fountain Gate is one the largest shopping centres in Australia and has a wide range of major retailers, including a department stores (Myer), discount department stores Target, Kmart, Big W and Harris Scarfe, and other major retailers and entertainment facilities including Woolworths, Coles, Aldi, JB HiFi, Village Cinemas and an Apple Store.

Fountain Gate is expected a significant proportion of expenditure on higher order goods of residents in the Nyora area due to the range of major retailers available, particularly Myer, and the presence of Village Cinemas. The role of Fountain Gate will continue to be an important influence on the retail expenditure behaviour of the north-western section of South Gippsland Shire, due to the ongoing trend in peri-urban areas of former Melbourne residents purchasing housing in smaller towns and rural areas and commuting to the metropolitan area for work, and to access retail and other services.

PAKENHAM

Pakenham is located 44 km and a 32 minute drive from Nyora. A strong retail and commercial core is clearly defined in Pakenham in the areas on and surrounding Main Street. There is a significant commercial centre with two full line supermarkets and discount department stores. The two supermarkets also form two separate shopping centres with other stores attached, providing a range of goods and services.

Pakenham attracts trade from established suburbs in the south-eastern corridor, nearby growth areas and small towns, particularly to the east due to the size of the retail and commercial activity and the range of goods provided.

WARRAGUL

Warragul is located 41 km and a 35 minute drive from Nyora. There is a clear retail and commercial precinct in Warragul with a number of large retailers such as Target Country and Priceline. There are also two full line supermarkets, Woolworths and Coles.

Residents from surrounding towns and rural areas are attracted to Warragul due to the range of goods provided and excellent accessibility on the Princes Highway corridor. Although Nyora residents are unlikely to undertake shopping trips to Warragul, the availability of higher order retailers to the north will restrict any potential catchment area growth in the rural areas and small towns to the north of Nyora and Poowong.

LEONGATHA

Leongatha is the regional centre for South Gippsland, containing a range of civic, education, retail and commercial facilities. The town centre contains a significant range of independent specialty retailers and commercial offices, anchored by a full-line Woolworths Supermarket and a Supa IGA supermarket, and supported by a local cinema.

Leongatha is expected to continue to capture a proportion of expenditure from Nyora residents due to the strong civic, employment and regional connections, however a greater share of expenditure is likely to be captured by newer and larger retailers to the north-west of Nyora, such as Pakenham, Fountain Gate and Koo Wee Rup.

KOO WEE RUP

Koo Wee Rup is strategically located near the junction of the South Gippsland Highway and Koo Wee Rup Road providing a road connection to the Princes Freeway. The recent completion of the Koo Wee Rup Bypass has further improved the access to South Gippsland via the Princes Freeway, meaning that many Nyora residents will travel to and through Koo Wee Rup on a regular basis for employment, health, recreation and shopping trips.

Koo Wee Rup contains a relatively new full-line Woolworths supermarket, the closest modern full-line supermarket to Nyora (21 minutes drive). The town also includes a range of local specialty retailers, and non-retail attractors such as the Koo Wee Rup Health Service and a secondary college.

It is expected that Koo Wee Rup will attract a proportion of supermarket expenditure from the Nyora area, until such time that local supermarket floorspace is provided.

DROUIN

Drouin is located 37 km and a 27 minute drive from Nyora. It has a clear Town Centre defined largely by the strong retail and commercial activity on the main street. A variety of

businesses work in conjunction with a Woolworths to provide a Town Centre to the towns. It is noted that Nyora residents are unlikely to shop frequently at Drouin, however the proximity of a full line supermarket plays a role in defining the catchment to the north.

KORUMBURRA

Korumburra is located 20 km and a 14 minute drive from Nyora. Korumburra provides a strong main street of retail and commercial activity containing a variety of convenience and discretionary retailers, including a medium-sized SUPA IGA supermarket.

Korumburra services the local township and surrounding small towns and rural areas (including Nyora) for weekly supermarket and specialty shopping needs.

LANG LANG

Of the three smaller townships near Nyora, Lang Lang is located 14km and a 10 minute drive from Nyora. The population of Lang Lang was 1,347 residents in 2011. Lang Lang's main retail strip stretches between the Palace Hotel and a small IGA supermarket, and includes mainly local convenience retail stores.

POOWONG

Poowong (population 607 in 2011) is located 10km and an 8 minute drive from Nyora. Poowong has a clear town centre including the Poowong Hotel, a café, post office, a small IGA supermarket and a hardware store. The supermarket is likely to attract trade from surrounding rural areas and the smaller townships of Nyora and Loch.

LOCH

Loch is a small township (967 residents in 2011) located 7 km and a 6 minute drive from Nyora with a small but defined town centre. There are more than ten businesses operating in the centre, all of which are independent operators. The township primarily serves the convenience retail needs of the local residents, and also attracts an increasing number of tourists and local hospitality expenditure due to recent opening of a new brewery / distillery and cafes.

TABLE 3 COMPETING CENTRES HIERARCHY

Town	Hierarchy position and role	Major retailers	Travel time from Nyora	Relevance to Nyora catchment
Fountain Gate	Major Regional Centre	Myer, Kmart, Target, BigW, Woolworths, Coles, Aldi, Apple, JB HiFi.	45 minutes	High – comparison goods
Pakenham	Sub-Regional (Principal Activity Centre)	2 full line supermarkets (Coles & Woolworths), discount department stores.	32 minutes	High – comparison goods
Warragul	Sub-Regional Centre	2 full line supermarkets (Coles & Woolworths), Target Country, Priceline.	35 minutes	Low
Leongatha	Sub-regional Centre	Woolworths, Supa IGA, Target Country, wide range of independent specialties and commercial offices.	30 minutes	Medium – comparison goods, civic and commercial role.
Koo Wee Rup	Large Neighbourhood Centre	Full line Woolworths (new), smaller Foodworks, specialty shops.	21 minutes	High – supermarket
Drouin	Large Neighbourhood Centre	1 full line supermarket (Woolworths).	27 minutes	Low
Korumburra	Large Neighbourhood Centre	1 medium sized supermarket (SUPA IGA, 1,965sqm).	14 minutes	High – weekly and convenience supermarket and specialties
Lang Lang	Town Centre	1 small supermarket (IGA, 810sqm).	10 minutes	High – convenience
Poowong	Town Centre	1 express supermarket (IGA, 440sqm).	8 minutes	High – convenience
Loch	Local Centre	None (tourism and hospitality role, brewery and cafes)	6 minutes	High - hospitality
Nyora	Local Centre – convenience retail only.	None	-	

Source: Urban Enterprise, 2015.

3.4. RETAIL PROVISION

The retail provision per capita in Nyora and surrounding towns varies significantly. For example:

- The suburb of Lang Lang has a population of approximately 1,400 residents, and a retail provision of around 5,000 sqm, equating to around 3.6sqm per capita;
- The suburb of Poowong has a population of approximately 600 residents, and a retail provision of approximately 2,600 sqm, equating to more than 4 sqm per capita; and
- The suburb of Loch has a population of approximately 1,000 residents, and a retail provision of approximately 1,700 sqm, equating to 1.7 sqm per capita.

By comparison, the suburb of Nyora has a retail provision of just 0.3 sqm per capita, indicating that demand for convenience and local retail goods and services from Nyora residents is being met by retailers in nearby towns. This results in a very high level of 'escape' expenditure from Nyora that could be drawn to the town if new retailers were established.

The ability to reduce escape expenditure will rely on the attraction of a new anchor retailer such as a small supermarket, which will in turn rely on a sufficient population catchment to underpin its viability given that there are already a number of established smaller supermarkets in the area.

While there is clearly the opportunity to reduce escape expenditure in Nyora, the ultimate market share of retail in the town will remain low due to the high levels of competition from other towns, larger retailers (including full line supermarkets) in regional centres such as Leongatha and Koo Wee Rup), and major retailers in Pakenham and Fountain Gate.

A typical benchmark for the market share of a local retail centre is in the order of 20% of the expenditure available in the local retail catchment. Estimates of supportable floorspace in Nyora are provided later in this report.

3.5. KEY FINDINGS

The key findings relating to the economic context of Nyora are as follows:

- There is currently a low supply of retail floorspace in Nyora of approximately 400 sqm, and the town centre is not well defined;
- Nyora performs only a convenience retail role, with the majority of local retail expenditure undertaken in other towns such as Poowong, Lang Lang, Korumburra, Koo Wee Rup, Pakenham and Fountain Gate;
- The suburb of Nyora has a retail provision of just 0.3sqm per capita, indicating that demand for convenience and local retail goods and services from Nyora residents is being met by retailers in nearby towns. This results in a very high level of 'escape' expenditure from Nyora that could be drawn to the town if new retailers were established;
- Much of the Commercial 1 Zone in Nyora contains residential dwellings, a legacy of the previous Township Zone;
- There are 6 vacant industrial land parcels totalling 1ha as part of the 3.4ha Industrial 3 Zone.

4. DEMOGRAPHIC AND EMPLOYMENT PROFILE

4.1. INTRODUCTION

This section will provide an analysis of the current demographic of Nyora as well as the employment of residents within Nyora.

4.2. DEMOGRAPHIC PROFILE

The Nyora Community Infrastructure Plan, 2014, provides recent data relating to the demographics of the suburb of Nyora. A number of points relating population, growth and other demographic information are noted in the Community Infrastructure Plan as follows:

- Nyora is close to the Cardinia Shire which has had the second highest growth in Victoria in 2012 of 5.2%;
- Currently there are 1,332 people living in 450 households in Nyora with an average household size of 2.8 people, in comparison to South Gippsland where households average 2.4 people;
- According to 2001 data, there is a higher proportion of people aged 35 – 70 with 53% in Nyora compared to 47% in South Gippsland. There are less people aged over 75 years, 3.4% in Nyora compared with 6.6% in South Gippsland. There are considerably less people aged 20 – 35 in Nyora (22.8%) when compared to South Gippsland (28.5%);
- There are 450 families in Nyora with an average of 2 children per family. In Nyora in 2011 there were 175 couples with children, comprising 13% of households.
- In 2011 Nyora had the youngest median age of all towns in South Gippsland;
- 23.9% went on to complete Year 12 or equivalent, compared with 33.1% for the South Gippsland Shire.

4.3. EMPLOYMENT PROFILE

The Nyora Community Infrastructure Plan includes the following commentary on the employment profile of Nyora residents:

- 97.1% of the population (660 people) are employed and 3.2% (21 people) are unemployed. More people in Nyora work full time (59%) than in South Gippsland (55%) and less people work part time (30%) than in South Gippsland (39%);
- The majority of residents in South Gippsland West statistical local area (SLA) work within the area 1,668 (63%);
- A survey of Nyora residents undertaken during October 2013 found that respondents (n=159) worked in 44 different towns or suburbs. Most respondents work in Nyora and Dandenong (21). Many residents work in Melbourne (18) and the eastern suburbs, Korumburra (17), Leongatha, Pakenham (12) and Cranbourne (10).

ABS Census data on employment by industry and occupation of Nyora residents in 2011 is shown in Tables 4 and 5, indicating that compared with Regional Victorian averages:

- A greater proportion of Nyora residents are employed as Technicians and Trade workers and machinery operators and drivers (35%, compared with 22% across regional Victoria);
- A lower proportion of Nyora residents are employed as Managers or Professionals (21%, compared with 32% across regional Victoria); and
- A greater proportion of Nyora residents are employed in "industrial" sectors such as manufacturing, construction, wholesale trade and transport, postal and warehousing (45%, compared with 26% across regional Victoria).

TABLE 4 OCCUPATION OF NYORA RESIDENTS, 2011

Occupation	Nyora (Suburb)	% of total	Regional Vic. %
Managers	68	11%	15%
Professionals	63	10%	17%
Technicians and Trades Workers	136	22%	15%
Community and Personal Service Workers	54	9%	10%
Clerical and Administrative Workers	80	13%	12%
Sales Workers	53	8%	10%
Machinery Operators and Drivers	82	13%	7%
Labourers	87	14%	12%
Inadequately described	7	1%	1%
Total	630	100%	100%

Source: ABS Census 2011

TABLE 5 INDUSTRY OF NYORA RESIDENTS, 2011

Industry	Nyora (Suburb)	% of total	Regional Vic. %
Agriculture, Forestry and Fishing	45	7%	8%
Mining	7	1.1%	0.8%
Manufacturing	113	18%	10%
Electricity, Gas, Water and Waste Services	6	1.0%	1.5%
Construction	95	15%	9%
Wholesale Trade	36	6%	3.1%
Retail Trade	56	9%	12%
Accommodation and Food Services	39	6%	7%
Transport, Postal and Warehousing	35	6%	4.2%
Information Media and Telecommunications	0	0.0%	1.1%
Financial and Insurance Services	11	1.7%	2.0%
Rental, Hiring and Real Estate Services	3	0.5%	1.1%
Professional, Scientific and Technical Services	26	4.1%	4.0%
Administrative and Support Services	19	3.0%	2.6%
Public Administration and Safety	26	4.1%	6%
Education and Training	27	4.3%	8%
Health Care and Social Assistance	54	9%	13%
Arts and Recreation Services	6	1.0%	1.3%
Other Services	21	3.3%	3.6%
Inadequately described	6	1.0%	1.0%
Total	631	100%	100%

Source: ABS Census 2011

5. DEMAND FOR RETAIL AND COMMERCIAL FLOORSPACE

5.1. INTRODUCTION

This section includes an assessment of current and future demand for retail and commercial floorspace within Nyora based on a range of population growth scenarios.

5.2. POPULATION AND GROWTH

Previous assessments have noted the wide range of population growth rates that could be experienced in Nyora over the short to medium term. Projections published by the State government are generally only reliable at the regional level, and do not necessarily reflect the local conditions that will influence changes in population levels such as the recent availability for developments in Nyora to connect to reticulated sewerage.

The historical population growth rate in the Nyora region has been relatively low (in the order of 1% per annum over 10 years), and Victoria in Future (VIF 2015) projections for the region are for population growth of **1.2%** over the period 2011 to 2031.

Forecast ID provides population projections at smaller geographic areas, however these projections are often underpinned by a review of available land supply and therefore do not always take into account underlying demand and "step-changes" in population growth rates that could be stimulated by events such as infrastructure upgrades and rezoning. Forecast ID projects a growth rate of **2.5%** for the Nyora-Poowong area, including an allowance for 320 dwellings to be constructed within the Wallis Watson Nyora development between 2018 and 2036 (18 dwellings per annum), 100 dwellings to be constructed in "future urban areas" in Nyora between 2026 and 2036 (10 per annum), and a low to moderate level of infill development across the area of 3 to 12 dwellings per annum.

A summary of population growth indicators and projections is provided in Table 6. It is noted that the Nyora Community Infrastructure Plan (2014) allows for a population growth rate of between 2.5% and 3.6% per annum between 2016 and 2031 (average 2.8% per annum), based on Nyora accommodating 50% of the future growth in the Nyora, Poowong and Loch area projected by Forecast ID.

TABLE 6 POPULATOIN GROWTH INDICATORS AND PROJECTIONS

Geographic Area	Type	Period	Growth per annum	Source
Nyora Urban Centre Locality	Historical	2001 - 2011	2.6%	ABS Census
Korumburra Statistical Area 2	Historical	2004 - 2014	1.0%	ABS Regional Population Growth
Korumburra VIF Statistical Area	Projection	2011 - 2031	1.2%	Victoria in Future 2015
Nyora – Poowong region	Projection	2016 - 2036	2.5%	Forecast ID, 2015
Nyora	Projection	2010 - 2030	2.1%	Development Forecasts Report, 2010
Nyora	Projection	2016 - 2031	2.8%	Nyora Community Infrastructure Plan, 2014

Source: Compiled by Urban Enterprise, sources listed in table.

Other assessments of potential population growth include higher growth scenarios, including:

- The Development Forecasts report prepared in 2010, which included scenarios of:
  - 2.7% as a "commuter town" scenario;
  - 4% to reflect "rapid growth"; and
  - 8.6% to reflect "explosive growth".
- A residential assessment prepared by Spade Consultants for the Wallis Watson development which included upper population growth scenarios of 3.3% and 5% (if competitively priced new land supply was made available).

It is noted that the Wallis Watson development to the north of Nyora is expected to yield an estimated 700 – 800 lots if rezoned. The zoning of this land would most likely stimulate a

short to medium term increase in development activity and population growth given the strong levels of demand experienced in comparable peri-urban towns within 100km of Melbourne in recent years. This area could ultimately accommodate in the order of up to 2,000 new residents.

Due to the construction of the Sewerage Scheme in Nyora, as well as the proposed rezoning to create a significant residential growth area for the town, it is likely that population growth rates in Nyora will be higher than previous years and higher than the projected growth rates of surrounding areas in South Gippsland, at least in the short to medium term.

Based on the review of historical growth and various projections and scenarios for growth, it is considered prudent for the development strategy to assess the potential impact of four growth scenarios as shown in Table 7.

In practice, the growth rate would be expected to fluctuate somewhat within this broad range of 2.5% to 6.5% per annum as land is released, and the most likely short to medium term average growth rate would be expected to fall between 3% and 5% per annum.

After a likely short term spike in building activity as a result of rezoning of the Wallis Watson land, it is likely that demand rates will settle to a more steady medium to long term rate that reflects the regional and local projections in the order of 2% - 3% per annum.

TABLE 7 POPULATION GROWTH RATE SCENARIOS

Average annual population growth rate	
Low	2.5%
Medium	4.0%
High	6.5%

Source: Urban Enterprise, 2016.

5.3. RETAIL AND COMMERCIAL CATCHMENT

Based on the location and scale of competing retail centres outlined in Section 3, the primary catchment of Nyora for retail and commercial purposes is considered to largely align with the boundary of the Nyora suburb as shown in Figure 3. This catchment includes the township itself and the surrounding rural area.

Given that each of Poowong, Loch and Lang Lang include local retail services, these towns and their immediate surrounds are not considered to form part of the local catchment of Nyora. That is not to say that some expenditure will not transfer between the towns, however the majority of expenditure that could be captured within the township of Nyora in the future is expected to be generated by households within the catchment shown in Figure 3.

FIGURE 3 ESTIMATED RETAIL AND COMMERCIAL CATCHMENT AREA OF NYORA

Source: REMPLAN Map Builder, 2011.

The population of the catchment in 2011 was 1,397 persons according to the ABS Census. Population growth scenarios for the retail catchment are shown in Table 8, using the various scenarios outlined in this report.

TABLE 8 SUMMARY OF POPULATION GROWTH SCENARIOS IN THE CATCHMENT

Scenario		2011	2016	2021	2031	2036	2016-2036
Low	2.50%	1,397	1,468	1,661	1,879	2,126	+938
Medium	4.00%	1,397	1,468	1,786	2,173	2,644	+1,749
High	6.50%	1,397	1,468	2,012	2,756	3,776	+3,705

Source: Urban Enterprise.

5.4. RETAIL EXPENDITURE AND MARKET SHARE

In 2016, it is estimated that Nyora residents will spend an average of $12,764 per person on retail goods and services (based on Market Info data), resulting in a total catchment area retail expenditure of $18.7m.

There is currently only 400 sqm of retail floorspace in Nyora, generating an estimated $2m in turnover per annum (assuming an average turnover density of $5,000 per sqm). This equates to a current market share of approximately 11%, a very low share for a town of the size of Nyora, with 89% of expenditure 'escaping' to other towns.

Local retail centres typically capture around 20% of the total expenditure available from their immediate catchment, with the remaining 80% 'escaping' to higher order centres including full-line supermarkets, bulky goods centres and discount department stores.

Based on a 20% market share, the 2016 population of Nyora could support a local retail centre in the order of 700 sqm, almost twice the current retail floorspace in the town.

5.5. PROJECTED RETAIL DEMAND AND SUPPORTABLE FLOORSPACE

Over time as the catchment population grows, local retail expenditure - and therefore the supportable retail floorspace in Nyora - will increase. The impact of population growth on total retail expenditure and supportable floorspace is modelled in Table 9 on the following page under the low, medium and high growth scenarios.

The current and projected retail expenditure characteristics of Nyora residents are based on the following assumptions:

- Population growth at 2% for the period 2011 to 2016, and then at the designated scenario rate for the remainder of the study period;
- Real expenditure growth per capita of 1% per annum;
- Cost escalation of 2% per annum to bring values to 2015 dollars;
- Turnover density growth of 0.5% per annum;
- A consistent market share of 20% for the low and medium growth scenarios, increasing over time to 30% for the high growth scenario to reflect the elevation of the potential retail role of Nyora to a Neighbourhood Centre; and
- Passing trade generating 5% of total sales.

Based on the model findings as summarised in Table 9, it is estimated that at 2026 (10 years), the following retail conditions will exist:

- Supportable retail floorspace will range from approximately 1,000 to 1,500 sqm;
- In addition to the existing 400 sqm of convenience retail, a small supermarket could be supported under the high growth scenario;
- Under the medium growth scenario, a small supermarket may be supported, however this would only be a limited floorspace supermarket (in the order of up to 400sqm).
- A small number of specialty retailers could also be supported which primarily perform a convenience role, such as a chemist and hairdresser.

It is estimated that at 2036, the following retail conditions will exist:

- Under a low growth scenario, a small supermarket could be supported;
- Under a medium growth scenario, the supportable retail in the town could include a small supermarket and a range of other retail facilities;
- Under the high growth scenario, the significant catchment of in excess of 5,000 people would support in the order of 4,000sqm. This is a sufficient floorspace to support a larger independent supermarket (up to 2,000sqm) and a range of specialty shops and services.

Under each scenario, a small independent supermarket would be the first step towards reducing escape expenditure and improving the retail offer of the town. Attracting this type of anchor tenant (in the order of 400sqm to 600sqm) would most likely attract other smaller retailers to collocate with the supermarket.

TABLE 9 PROJECTED RETAIL DEMAND AND SUPPORTABLE FLOORSPACE

Growth Scenario	2011	2016	2021	2026	2031	2036	Change (2016-26)	Change (2016-36)
Catchment Population (persons)								
Low (2.50%)	1,397	1,468	1,661	1,879	2,126	2,406	+411	+938
Medium (4.00%)	1,397	1,468	1,786	2,173	2,644	3,217	+705	+1,749
High (6.50%)	1,397	1,468	2,012	2,756	3,776	5,174	+1,288	+3,705
Expenditure per person ($/p)								
All	$12,127	$12,764	$13,435	$14,142	$14,885	$15,668	+$1,377	+$2,903
Total Expenditure ($)								
Low (2.50%)	$16,941,106	$18,741,329	$22,318,833	$26,579,241	$31,652,912	$37,695,088	+$7,837,912	+$18,953,759
Medium (4.00%)	$16,941,106	$18,741,329	$24,000,421	$30,735,290	$39,360,062	$41,548,175	+$11,993,961	+$22,806,845
High (6.50%)	$16,941,106	$18,741,329	$27,027,147	$38,976,245	$56,208,216	$81,058,695	+$20,234,916	+$62,317,366
Nyora Market Share (%)								
Low (2.50%)	20%	20%	20%	20%	20%	20%	0%	0%
Medium (4.00%)	20%	20%	20%	20%	20%	20%	0%	0%
High (6.50%)	20%	20%	20%	22%	27%	30%	+ 2%	+ 10%
Supportable Floorspace (sqm)								
Low (2.50%)	659	**710**	823	**955**	1,108	**1,286**	+245	+576
Medium (4.00%)	659	**710**	885	**1,104**	1,378	**1,719**	+395	+1,009
High (6.50%)	659	**710**	997	**1,541**	2,640	**4,111**	+831	+3,402

Source: Urban Enterprise.

5.6. COMMERCIAL FLOORSPACE DEMAND OVER TIME

Data relating to employment within small areas such as Nyora is not available from the ABS Census. However, local employment within Nyora can be estimated through a range of methods, including the following:

- Surveys of the local population; and
- Applying employment benchmarks to existing business floorspace.

The survey of Nyora residents undertaken by Council in October 2013 found that of the 159 responses, 21 residents stated that they were employed in Nyora (13%). If this rate is extrapolated to the full working population of the township of 630, there would be 82 residents employed in the local area, some of whom would be expected to be employed in the rural area surrounding the town as opposed to township locations.

Existing floorspace within designated employment areas (Commercial and Industrial zones) within Nyora includes retail (400 sqm), a post office (150 sqm) and industrial (3,323 sqm). There is also a mechanic operating in the General Residential Zone (220 sqm), and other employment uses on farms in proximity to the township.

Using employment density benchmarks for each land use type, the total non-retail employment within Nyora is estimated at approximately 48 people, as shown in Table 10.

TABLE 10 EXISTING EMPLOYMENT IN NYORA

Land Use	Occupied Business Floorspace	Employment density (sqm per employee)	Estimated employment
Commercial	150	30	5
Industrial	3323	85	39
Other (mechanic)	220	55	4
Total	3693		48

Source: Urban Enterprise.

This level of employment results in a ratio of jobs per employed resident of approximately 1:13 (based on 630 employed residents as at the 2011 Census).

Assuming that 8% of residents are employed in the township (a conservative estimate) and that the employment profile of residents remains constant, population growth is likely to generate demand for between an additional 35 to 140 new employees in the township between 2016 and 2036. This is a broad approach to provide an indication of potential demand for commercial floorspace in the town.

Another way to measure commercial land demand over time in small centres is to apply a benchmark floorspace provision relative to retail floorspace. In smaller retail centres, non-retail commercial floorspace is typically limited to small offices such as accountants and lawyers, real estate agents and health services. These land uses would typically consume floorspace equivalent to between 25% and 50% of retail floorspace, resulting in the following floorspace requirements (adopting 35% for the purposes of this study):

- Medium growth retail requirement of 1,100sqm at 2026 and a supporting commercial requirement of 400sqm, and 1,700sqm at 2036 with a supporting 600sqm of commercial floorspace;
- High growth retail requirement of 1,500sqm at 2026 and a supporting 500sqm, and 4,000sqm at 2036 with 1,400sqm supporting commercial floorspace.

5.7. LAND REQUIREMENTS

It is considered prudent to plan for both the medium and high growth scenarios as part of this development strategy to ensure that sufficient land is made available for retail and commercial needs over the longer term, acknowledging that it is very difficult to project likely rates of growth in this context.

In principle, future retail and commercial floorspace needs should be met wherever possible within existing commercial zoned land, supplemented by new commercial land if required.

The current Commercial 1 Zone includes a number of parcels used for residential purposes which could be converted to small commercial uses over time (such as offices or medical centres), however their relatively small size means that more significant retail development (such as a supermarket) would require larger sites outside the main Mitchell Street strip.

Typically, retail and commercial floorspace that is newly developed has a site coverage in the order of 40%, meaning that the land requirements shown in Table 11 would be needed for retail and commercial use under each scenario.

TABLE 11 LAND REQUIREMENTS, RETAIL AND COMMERCIAL DEVELOPMENT TO 2036

Scenario	Retail floorspace (sqm)	Commercial floorspace (sqm)	Total Floorspace (sqm)	Land Area
Medium growth	1700	600	2300	0.6ha
High growth	4000	1400	5400	1.4ha

Source: Urban Enterprise.

It is noted that there is some capacity in the existing Commercial 1 Zone, such as vacant lots on Davis Street and residential properties on Mitchell Street that could be developed or converted for small to medium scale retail and/or commercial uses. Therefore, the land requirements shown in Table 11 would be an upper estimate of the area needed to be allocated for a stand-alone retail development given that some floorspace could be accommodated within existing buildings and vacant lots.

It should also be noted that the high growth scenario of 6.5% per annum is unlikely to be sustained over the entire period, and that population growth would be expected to settle somewhat to a rate in the order of 3% to 4%.

The following section investigates the potential sites in the town that could accommodate retail and commercial land requirements over time.

5.8. PROPERTY AND LOCATION CONSIDERATIONS

When planning for future retail and commercial land uses, the following location considerations should apply:

- Proximity to existing commercial uses – existing zoned land should be utilised as a priority;
- Proximity to existing community, recreation and education facilities;
- Proximity to major roads;
- Proximity to public transport; and
- Proximity to a significant proportion of current and future housing.

It is important for any future retail and commercial land uses in Nyora to be located to enable ready access for local residents, including existing dwellings and future dwellings (for example the Wallis Watson development). Equally important is facilitating a cluster of retail, commercial and community uses in a single location to encourage trip sharing, walking and community engagement.

In the context of Nyora, the central Commercial 1 Zone provides a clear town core from a planning perspective, however this area has only recently been included in this zone through the Nyora Structure Plan process and no new commercial activity has taken place since rezoning. While the Commercial 1 Zone is considered an appropriate location for commercial and retail land use, property within the zone is relatively fragmented and therefore more suitable to small businesses than an anchor retailer such as a supermarket.

The attractiveness of the central core of the town for retail uses is underpinned by the variety of supporting and complementary facilities adjacent to the commercial 1 Zone, including:

- Bus stops and an arterial road;
- Community facilities on Henley Street;
- Heritage and tourism value of the Nyora train station;
- Community open space and recreation facilities on VicTrack land immediately to the north; and
- Reasonable proximity to recreation and education uses along Grundy Avenue.

The existing town core is also easily accessible from the future Wallis Watson development to the north.

From a property development perspective, the following key considerations should be taken into account:

- Sites or precincts for retail and commercial use need to be sufficiently large to accommodate current and future floorspace requirements and ancillary land needs such as car parking, landscaping, loading and access;
- Ideally the chosen site or sites would be in single ownership, or a number of large adjacent lots which can be readily consolidated; and
- Sites are more 'development ready' if there is minimal value in improvements (eg. vacant or underutilised land, or low value improvements nearing the end of their economic life).

Based on the various location and property considerations, 6 areas of interest have been identified for future retail and commercial use in the town. These areas are shown in Appendix A.

- **Area A** has an area of 4,800 sqm and is comprised of 2 vacant land parcels in State government ownership. The sites are adjacent to existing public uses including a community centre and CFA base;
- **Area B** has an area of 1.32ha and comprises 4 parcels in separate private ownership. These sites are relatively underutilised, with some sites containing low value improvements. The area has one frontage to the Road Zone 1. An extension to Area B could annex the three smaller lots to the south-east if required;
- **Area C** has a combined area of 7,000 sqm across 3 parcels in separate ownership, including 2 parcels privately owned and one owned by the State government. The sites are separated by the Nyora Hotel site and the Grundy Avenue road reservation, and abut the Road Zone 1.
- **Area D** has a total area of approximately 5,100 sqm and includes three separately owned parcels in the Commercial 1 Zone, each 1,700 sqm in area. The sites are improved by established houses and gardens, and are located on the prime

commercial corner in the town abutting the Road Zone 1, opposite open space and bus stops, and between the existing retail facilities in the township;

- **Area E** covers an area of approximately 0.7 to 1ha on the existing rail reserve owned by the State government and managed by VicTrack. This site is not a separately disposable parcel of land, but appears unused and could provide a large site in single ownership central to the town and opposite the existing employment area. The site would have access to both major roads through Nyora; and
- **Area F** covers a total area of 1.5ha in two separately owned parcels in the Low Density Residential Zone. This area is located on the northern side of the rail reserve, closest to the new Wallis Watson development but still adjacent to the existing town core.

5.9. VICTRACK LAND

The rail reserve which bisects the town is owned by the State and managed by VicTrack. The rail line has not been in service for many years, other than for an occasional tourist train. The section of track through Nyora has not been used by the tourist train in recent times due to maintenance costs, and the tourist train association is understood to have recently dissolved.

Much of the rail reserve land within the Nyora town centre is leased to Council and community groups for community, recreation and tourist rail purposes. The former train station building is understood to be currently used by the local Op Shop.

The VicTrack land provides a strategic opportunity for development in Nyora, given that it is centrally located, includes large sections of unused or rarely used land, and adjoins the existing Commercial 1 and Industrial 1 Zones.

However, preliminary discussions with VicTrack revealed that it is unlikely that any parts of the rail reserve will be made available for private development. As such, the areas of interest held in private ownership should be investigated as a priority.

6. INFRASTRUCTURE FUNDING

6.1. OVERVIEW

The projections for significant residential growth in Nyora will give rise to the need for a range of infrastructure upgrades and new projects. Infrastructure requirements will vary depending on the location, scale and timing of development, as well as the mechanisms through which improvements can be funded.

6.2. DEVELOPMENT CONTRIBUTIONS

Council can collect development contributions through section 173 agreements with key developers, or, as of 2016, through an Infrastructure Contributions Plan (ICP) for new growth areas. These mechanisms provide for contributions to be collected towards the delivery of new infrastructure such as roads, intersections, drainage works, community facilities and open space.

It is understood that a section 173 agreement requires the developers of the Wallis Watson development to make a cash contribution to Council of $9,000 per lot, which will ultimately provide in the order of $6m to upgrade existing infrastructure in the town. Contributions are payable for each stage of subdivision, meaning that it may take a significant amount of time until a substantial infrastructure project can be delivered through these contributions.

6.3. SPECIAL CHARGE SCHEMES

It is understood that Council has longer term plans to implement a Special Charge Scheme to deliver infrastructure improvements to established areas of Nyora. Special charge scheme are an appropriate method to collect funds to contribute to infrastructure upgrades in areas of fragmented land ownership.

However, Special Charge Schemes can be challenging and time consuming to implement given that all owners that derive a benefit from the works are required to contribute to the cost, and an equitable apportionment needs to be struck between direct beneficiaries, indirect beneficiaries and Council.

Council's special charge scheme policy is available on the Council website, and identifies that Council will implement Special Charge Scheme if:

- "Council contributes a third (33.33%) or more of the cost of the Scheme without the support of affected property owners", or
- If there is a minimum of 70% of property owner support in writing to contribute financially to the works Scheme."

In the case of fragmented ownership and low rates of prospective development / change in parts of Nyora, it is considered that Special Charge Schemes could form part of the funding mix for localised road, drainage, footpath and shared path improvements (for example, in the Low Density Residential areas).

6.4. OPPORTUNITIES

An increased rate of development in Nyora – stimulated in the first instance by the Wallis Watson development if approved – will generate funds and additional demand for new infrastructure. In particular, demand for community and open space improvements will increase, and funds collected through development contributions can be used to upgrade existing facilities which will benefit both existing and new residents.

An important consideration for Council will be to investigate options for funding of key infrastructure projects in areas of fragmented ownership, and to ensure that an appropriate mechanism is considered for those projects that will be critical to the long term urban structure of the town. The new ICP system is expected to come into effect in 2016, allowing Councils to impose a standard levy to a development area to fund major roads,

7. ISSUES AND OPPORTUNITIES

7.1. INTRODUCTION

Based on a review of background information and key datasets, the following issues and opportunities are identified from an economic and property perspective.

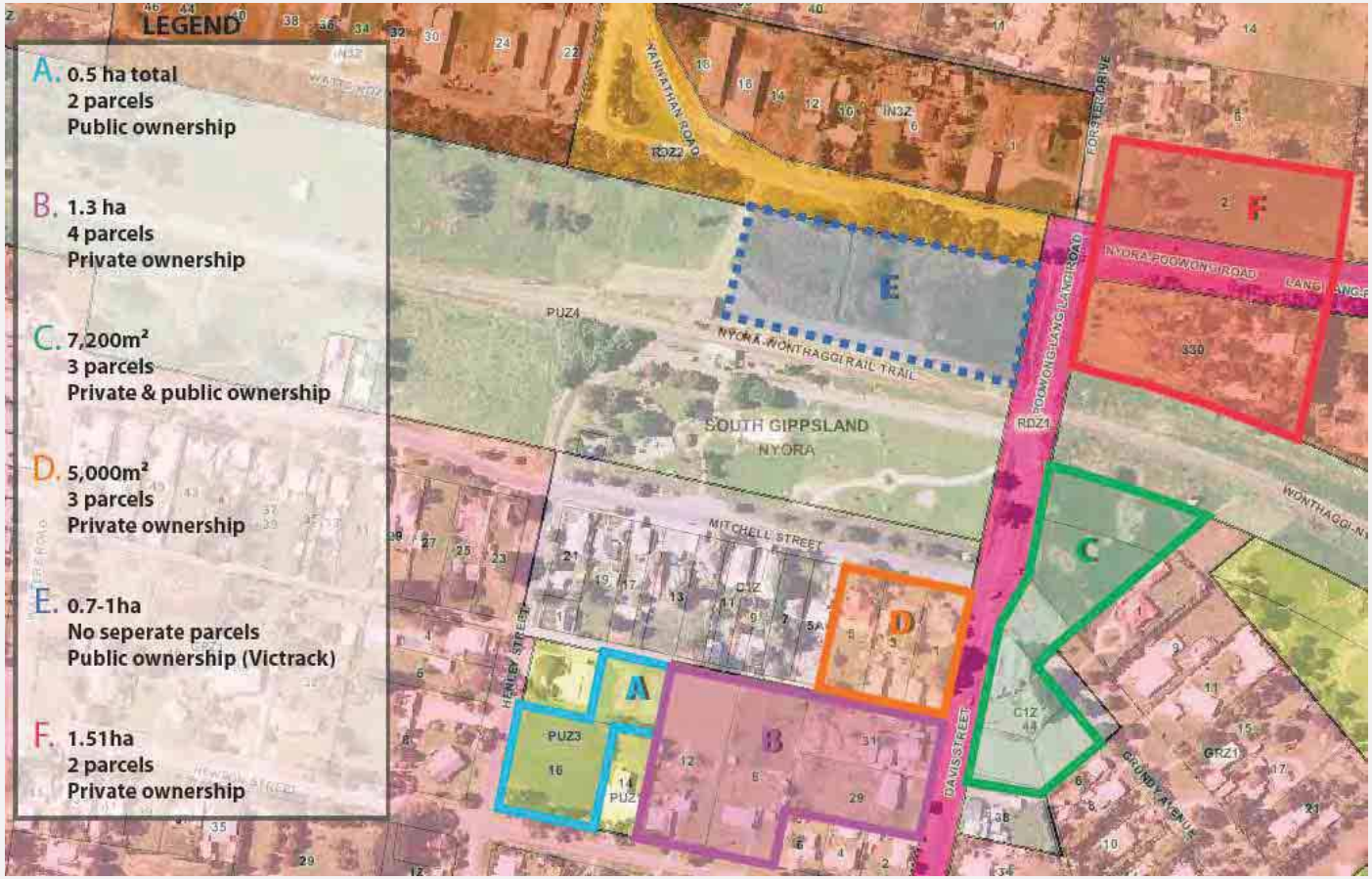
7.2. ISSUES

- There is no defined town centre and a significant under provision of retail and commercial floorspace. This results in expenditure and turnover escaping to other towns and municipalities;
- Recent connection to reticulated sewerage is expected to result in strong residential growth of the town which will increase the need for additional retail services and employment within the town;
- Nyora competes with a number of towns and regional centres for retail and commercial activity. The established pattern of retail expenditure in these competing centres will mean that a strong competitive framework will remain throughout the planning period;
- Without a retail anchor such as a supermarket, it will be difficult to attract other retails and commercial services to locate in the town. Supermarkets - including small supermarkets - generally require a significant population to be viable;
- Land ownership in the town centre is relatively fragmented and much of the Commercial 1 Zone has legacy residential use. There is likely to be the need to consolidate lots in order to create developable parcels for an anchor retail use;
- There is a lack of service industrial businesses meeting local population needs.

7.3. OPPORTUNITIES

- There is currently a high level of escape retail expenditure. There is a clear opportunity to establish additional retail floorspace in the short term to improve market share and generate additional economic activity in the town.
- Significant projected population growth will increase local retail expenditure and present the opportunity to support an anchor retailer by 2026 (small supermarket), especially if conventional density residential growth is permitted in the north-eastern growth area. Longer term growth to 2036 could support a larger independent supermarket in excess of 1,500sqm if strong population growth rates are achieved;
- Vacant land parcels exist in the industrial zone, presenting the opportunity for new locally oriented service businesses to establish. Research will need to ascertain whether these lots are likely to be made available to the market in the planning period.
- Changing demographics and employment profiles will generate opportunities for more employment to be located within Nyora. Evidence of many home based businesses located within the town points to existing demand for small businesses which is likely to increase over time with population growth. Existing dwellings in the Commercial 1 Zone along Mitchell Street present an opportunity for conversion and/or redevelopment to accommodate small businesses and medical services;
- There are a number of underutilised lots in or near the town centre which could be consolidated for retail and commercial development, subject to the intentions of owners and appropriate facilitation of development.
- New development will generate funds towards infrastructure improvements, many of which could benefit the broader community. Funds should be allocated towards key civil and community projects which will support the growth of the town from a local to a neighbourhood centre with commensurate commercial and community facilities. Catalyst infrastructure to support development in established areas, such as drainage works to the south of the town centre, should be investigated as a priority.

APPENDIX A AREAS OF INTEREST FOR TOWN CENTRE RETAIL AND COMMERCIAL DEVELOPMENT



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