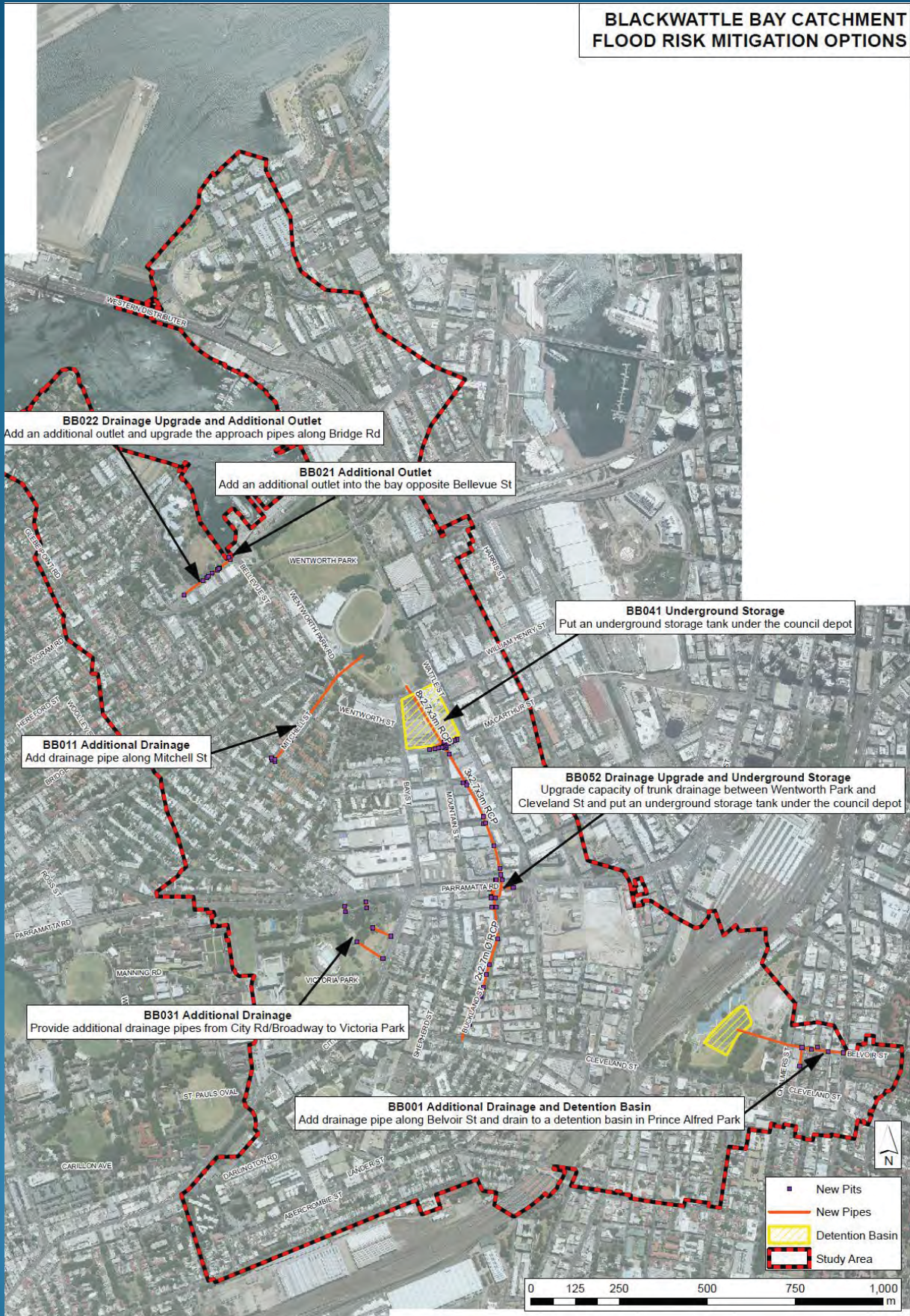


Preliminary Assessment of Flood Mitigation Measures – Blackwattle Bay Catchment





Blackwattle Bay Catchment Floodplain Risk Management Study and Plan



The City of Sydney is preparing a Floodplain Risk Management Study and Plan for the Blackwattle Bay catchment area and we would like your help.

The study will tell us about the type of flood mitigation solutions feasible for the catchment and help us plan for and manage any flood risks.

Good management of flood risks can help reduce damage and improve social and economic opportunities.



The City of Sydney has engaged WMAwater to assist with the preparation of the Blackwattle Bay Floodplain Risk Management Study and Plan.

The Blackwattle Bay Flood Study was completed by WMAwater in 2012, giving the City of Sydney a better understanding of the nature of flooding in your area. The next step in the NSW Government Flood Management Process is the preparation of a Floodplain Risk Management Study and Plan. The purpose of this study and plan is to identify and recommend appropriate actions to manage flood risks in the Blackwattle Bay area.

Stages of the NSW Government Flood Prone Land Policy

1. Formation of a Committee – complete
2. Data Collection – complete
3. Flood Study – complete
4. **Floodplain Risk Management Study**
5. **Floodplain Risk Management Plan**
6. Implementation of Plan.

Study area and flooding issues

The Blackwattle Bay study area includes parts of Glebe, Ultimo, Pyrmont, Chippendale and Darlington.

Much of the flooding in this catchment occurs due to natural depressions and low points. In the past, flooding has caused property damage and posed a hazard to people and property located near drainage areas. The Floodplain Risk Management Study and Plan currently being undertaken is to manage these flood risks.

Have your say

We want your comments about previous flood experiences and potential mitigation options.

The local knowledge of residents and business operators, including your personal experiences of flooding is a valuable source of information.

The information you provide in the accompanying questionnaire will help the City of Sydney determine how to manage the floods in your area.

For more information about this project, please contact the City of Sydney or WMAwater via the details provided.

Floodplain risk management options

The following list of floodplain risk management options are being investigated:

Flood modification options.

- Upgrading of drainage systems or construction of new pipes;
- Construction of detention/retarding basins to reduce downstream peak flows; and
- Provision of underground storage, e.g. at council depot; and
- Additional drainage outlet to Blackwattle Bay on Bridge Road.

Property modification options and planning control.

- Strategic planning and flood related development controls; and
- Flood-proofing measures, such as flood barriers.

Response modification options.

Examples include:

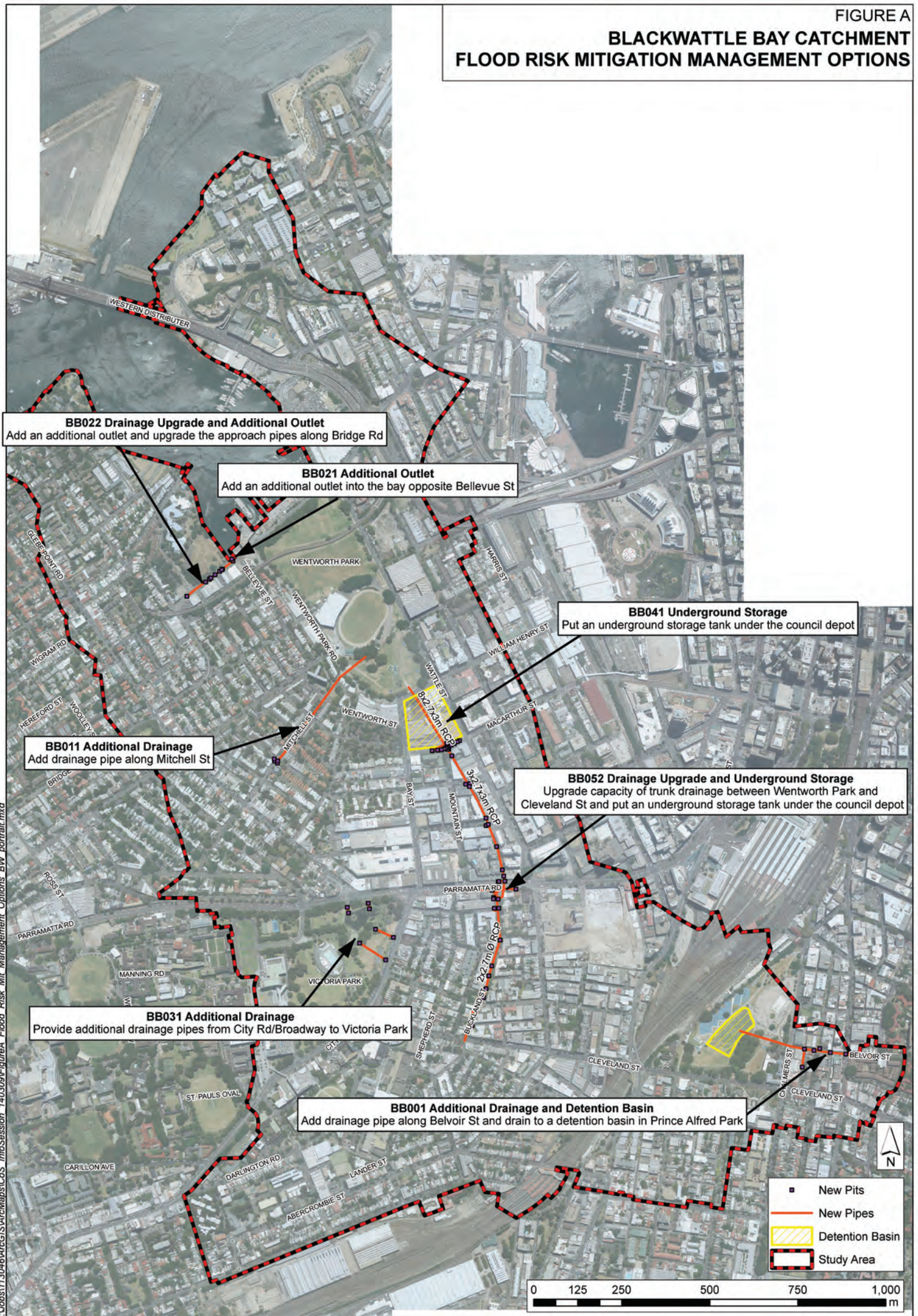
- Revision of the Local Disaster Plan;
- Public awareness and education – locality-based flooding information for residents;
- Public awareness and education – flooding information for schools;
- Flood depth markers at major (flood-affected) road crossings; and
- Data collection strategies for future floods.

For more information please contact:

WMAwater
Steve Gray
Phone 02 9299 2855
Fax: 02 9262 6208
gray@wmawater.com.au

City of Sydney
Shah Alam
Phone: 02 9288 5925
salam@cityofsydney.nsw.gov.au

**FIGURE A
BLACKWATTLE BAY CATCHMENT
FLOOD RISK MITIGATION MANAGEMENT OPTIONS**



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As a local resident who may have witnessed flooding/drainage problems, you may have your own ideas about how to reduce flood risks. Which of the following management options would you prefer for the Blackwattle Bay catchment (1=least preferred, 5=most preferred)?

Proposed option	Preference
Additional drainage along Belvoir Street and detention basin in Prince Alfred Park —	1 2 3 4 5
Drainage upgrade between Wentworth Park and Cleveland Street and an underground storage tank under the council depot —	1 2 3 4 5
Additional drainage pipes from City Road, Broadway to Victoria Park —	1 2 3 4 5
Additional drainage pipes along Mitchell Street —	1 2 3 4 5
Strategic planning and flood related development controls —	1 2 3 4 5
Education of the community, providing greater awareness of potential hazards —	1 2 3 4 5
Flood forecasting, flood warnings, evacuation planning and emergency response measures —	1 2 3 4 5

Other (please specify any options you think are suitable):.....

If you have any further comments that relate to the Blackwattle Bay Flood Management Study and Plan, please provide your name, address and phone number and any comments below and we will contact you.

Glossary

- Culvert** – a piped drain or covered channel that passes under a road or railroad.
- Levee bank/flood wall** – an embankment or wall, usually constructed from earth or concrete, built along the banks of a watercourse to help prevent overflow of its waters.
- Retarding/detention basin** – depression in the land surface that captures and holds stormwater runoff allowing it to slowly drain out of the basin into the adjoining natural drainage line or creek.
- ARI** – Average Recurrence Interval

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Table D1: Residential Tangible Damages - Option BB01

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	156	70	\$ 3,425,382	\$ 21,958
5Y ARI	186	80	\$ 4,016,065	\$ 21,592
10% AEP	195	95	\$ 4,504,265	\$ 23,099
5% AEP	205	102	\$ 4,852,307	\$ 23,670
2% AEP	210	117	\$ 5,327,838	\$ 25,371
1% AEP	225	126	\$ 5,982,537	\$ 26,589
PMF	248	201	\$ 9,723,208	\$ 39,206
Average Annual Damages (AAD)			\$ 2,920,198	\$ 11,775

Table D2: Commercial/Industrial Tangible Damages - Option BB01

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	40	23	\$ 5,265,056	\$ 131,626
5Y ARI	47	30	\$ 6,909,906	\$ 147,019
10% AEP	49	35	\$ 7,664,050	\$ 156,409
5% AEP	52	38	\$ 8,528,983	\$ 164,019
2% AEP	54	39	\$ 8,910,275	\$ 165,005
1% AEP	57	44	\$ 10,317,399	\$ 181,007
PMF	59	53	\$ 15,270,621	\$ 258,824
Average Annual Damages (AAD)			\$ 4,761,571	\$ 80,705

Table D3: Combined Tangible Damages - Option BB01

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	196	93	\$ 8,690,437	\$ 44,339
5Y ARI	233	110	\$ 10,925,971	\$ 46,893
10% AEP	244	130	\$ 12,168,315	\$ 49,870
5% AEP	257	140	\$ 13,381,290	\$ 52,067
2% AEP	264	156	\$ 14,238,113	\$ 53,932
1% AEP	282	170	\$ 16,299,936	\$ 57,801
PMF	307	254	\$ 24,993,830	\$ 81,413
Average Annual Damages (AAD)			\$ 7,681,769	\$ 25,022

Table D4: Residential Tangible Damages - Option BB02

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	153	66	\$ 3,267,665	\$ 21,357
5Y ARI	186	78	\$ 3,932,551	\$ 21,143
10% AEP	194	90	\$ 4,336,991	\$ 22,356
5% AEP	204	98	\$ 4,678,764	\$ 22,935
2% AEP	209	118	\$ 5,206,229	\$ 24,910
1% AEP	221	122	\$ 5,705,185	\$ 25,815
PMF	248	199	\$ 9,662,139	\$ 38,960
Average Annual Damages (AAD)			\$ 2,815,411	\$ 11,352

Table D5: Commercial/Industrial Tangible Damages - Option BB02

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	40	23	\$ 5,392,378	\$ 134,809
5Y ARI	48	31	\$ 7,166,777	\$ 149,308
10% AEP	49	35	\$ 7,695,297	\$ 157,047
5% AEP	53	39	\$ 8,628,624	\$ 162,804
2% AEP	56	43	\$ 9,234,431	\$ 164,901
1% AEP	57	44	\$ 10,275,357	\$ 180,269
PMF	59	53	\$ 15,367,428	\$ 260,465
Average Annual Damages (AAD)			\$ 4,876,750	\$ 82,657

Table D6: Combined Tangible Damages - Option BB02

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	193	89	\$ 8,660,043	\$ 44,871
5Y ARI	234	109	\$ 11,099,329	\$ 47,433
10% AEP	243	125	\$ 12,032,288	\$ 49,516
5% AEP	257	137	\$ 13,307,388	\$ 51,780
2% AEP	265	161	\$ 14,440,660	\$ 54,493
1% AEP	278	166	\$ 15,980,541	\$ 57,484
PMF	307	252	\$ 25,029,567	\$ 81,530
Average Annual Damages (AAD)			\$ 7,692,161	\$ 25,056

Table D7: Residential Tangible Damages - Option BB04

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	157	71	\$ 3,449,978	\$ 21,974
5Y ARI	188	81	\$ 4,064,278	\$ 21,618
10% AEP	197	95	\$ 4,547,427	\$ 23,083
5% AEP	206	102	\$ 4,897,217	\$ 23,773
2% AEP	212	121	\$ 5,392,425	\$ 25,436
1% AEP	227	127	\$ 5,971,083	\$ 26,304
PMF	248	200	\$ 9,713,152	\$ 39,166
Average Annual Damages (AAD)			\$ 2,945,839	\$ 11,878

Table D8: Commercial/Industrial Tangible Damages - Option BB04

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	36	23	\$ 5,354,956	\$ 148,749
5Y ARI	44	29	\$ 6,843,359	\$ 155,531
10% AEP	49	34	\$ 7,520,912	\$ 153,488
5% AEP	51	37	\$ 8,402,407	\$ 164,753
2% AEP	54	40	\$ 9,008,762	\$ 166,829
1% AEP	57	42	\$ 9,884,472	\$ 173,412
PMF	59	52	\$ 15,127,003	\$ 256,390
Average Annual Damages (AAD)			\$ 4,765,349	\$ 80,769

Table D9: Combined Tangible Damages - Option BB04

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	193	94	\$ 8,804,934	\$ 45,621
5Y ARI	232	110	\$ 10,907,637	\$ 47,016
10% AEP	246	129	\$ 12,068,340	\$ 49,058
5% AEP	257	139	\$ 13,299,624	\$ 51,750
2% AEP	266	161	\$ 14,401,188	\$ 54,140
1% AEP	284	169	\$ 15,855,556	\$ 55,829
PMF	307	252	\$ 24,840,155	\$ 80,913
Average Annual Damages (AAD)			\$ 7,711,188	\$ 25,118

Table D10: Residential Tangible Damages - Option BB06

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	152	71	\$ 3,429,959	\$ 22,566
5Y ARI	173	81	\$ 4,003,070	\$ 23,139
10% AEP	193	95	\$ 4,448,989	\$ 23,052
5% AEP	201	100	\$ 4,771,228	\$ 23,737
2% AEP	208	114	\$ 5,156,915	\$ 24,793
1% AEP	224	120	\$ 5,679,995	\$ 25,357
PMF	248	202	\$ 9,747,526	\$ 39,305
Average Annual Damages (AAD)			\$ 2,905,720	\$ 11,717

Table D11: Commercial/Industrial Tangible Damages - Option BB06

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	40	23	\$ 5,367,854	\$ 134,196
5Y ARI	47	30	\$ 6,925,411	\$ 147,349
10% AEP	49	35	\$ 7,667,317	\$ 156,476
5% AEP	51	39	\$ 8,574,753	\$ 168,132
2% AEP	51	43	\$ 9,210,232	\$ 180,593
1% AEP	52	44	\$ 10,219,075	\$ 196,521
PMF	59	53	\$ 15,288,863	\$ 259,133
Average Annual Damages (AAD)			\$ 4,812,975	\$ 81,576

Table D12: Combined Tangible Damages - Option BB06

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	192	94	\$ 8,797,813	\$ 45,822
5Y ARI	220	111	\$ 10,928,481	\$ 49,675
10% AEP	242	130	\$ 12,116,306	\$ 50,067
5% AEP	252	139	\$ 13,345,981	\$ 52,960
2% AEP	259	157	\$ 14,367,147	\$ 55,472
1% AEP	276	164	\$ 15,899,070	\$ 57,605
PMF	307	255	\$ 25,036,389	\$ 81,552
Average Annual Damages (AAD)			\$ 7,718,695	\$ 25,142

Table D13: Residential Tangible Damages - Option BB07

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	124	57	\$ 2,868,463	\$ 23,133
5Y ARI	140	61	\$ 3,183,481	\$ 22,739
10% AEP	156	73	\$ 3,557,137	\$ 22,802
5% AEP	164	78	\$ 3,828,434	\$ 23,344
2% AEP	176	91	\$ 4,122,622	\$ 23,424
1% AEP	191	98	\$ 4,610,017	\$ 24,136
PMF	248	200	\$ 9,499,150	\$ 38,303
Average Annual Damages (AAD)			\$ 2,379,982	\$ 9,597

Table D14: Commercial/Industrial Tangible Damages - Option BB07

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	22	8	\$ 1,958,618	\$ 89,028
5Y ARI	26	10	\$ 2,275,075	\$ 87,503
10% AEP	27	11	\$ 2,634,439	\$ 97,572
5% AEP	32	15	\$ 2,923,211	\$ 91,350
2% AEP	35	22	\$ 3,928,711	\$ 112,249
1% AEP	43	29	\$ 5,993,308	\$ 139,379
PMF	59	53	\$ 14,691,293	\$ 249,005
Average Annual Damages (AAD)			\$ 1,764,834	\$ 29,912

Table D15: Combined Tangible Damages - Option BB07

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	146	65	\$ 4,827,082	\$ 33,062
5Y ARI	166	71	\$ 5,458,556	\$ 32,883
10% AEP	183	84	\$ 6,191,576	\$ 33,834
5% AEP	196	93	\$ 6,751,645	\$ 34,447
2% AEP	211	113	\$ 8,051,333	\$ 38,158
1% AEP	234	127	\$ 10,603,325	\$ 45,313
PMF	307	253	\$ 24,190,443	\$ 78,796
Average Annual Damages (AAD)			\$ 4,144,816	\$ 13,501

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Table E1: Cost Estimate - Option FM-BB01: New Drainage and Detention Basin near Prince Alfred Park

Item No.	Description of work	Quantity	Unit	Rate	Cost
1	General Construction Costs				
1.1	Site establishment, security fencing, facilities and disestablishment	1	item		
1.2	Provision of sediment and erosion control	1	item		
1.3	Construction setout and survey	1	item		
1.4	Work as executed survey and documentation	1	item		
1.5	Geotechnical supervision, testing and certification	1	item		
	SUBTOTAL (Assumed as 15% of works cost)				\$ 549,021
2	Demolition and Clearing				
2.1	Clearing and grubbing	9,673	sq. m	11	104,467
2.2	Strip topsoil and stockpile for re-use (assuming 150mm depth)	1,451	cu. m	27	39,175
2.3	Dispose of excess topsoil (nominal 10% allowance)	145	cu. m	65	9,402
2.4	Pull up and dispose existing road surface	908	sq. m	38	34,322
	SUBTOTAL				\$ 187,366
3	Excavation and earthworks				
3.1	Excavation of detention basins and swales	20,467	cu. m	49	994,696
3.2	Disposal of excess cut (assuming 80% of total excavation)	16,374	item	65	1,061,009
	SUBTOTAL				\$ 2,055,705
4	Installation of Drainage				
4.29	Install new drainage/junction pit (assumed 1 pit per 50m of pipe)	9	each	4,320	38,880
4.31	Adjustment of existing services (nominal allowance) (assumed 10% of drainage installation cost)	71,936	item	74,547	71,936
	SUBTOTAL	791,297			\$ 791,297
	CONSTRUCTION TOTAL, exc. GST				\$ 6,313,740
	GST				\$ 631,374
	CONSTRUCTION TOTAL, inc. GST				\$ 6,945,114
	CONSTRUCTION TOTAL, rounded				\$ 6,945,100
11.1	Maintenance of mitigation option		item		\$ 14,540

Table E2: Cost Estimate - Option FM-BB02: New Drainage – Mitchell St to Wentworth Park

Item No.	Description of work	Quantity	Unit	Rate	Cost
1	General Construction Costs				
1.1	Site establishment, security fencing, facilities and disestablishment	1	item	0	0
1.2	Provision of sediment and erosion control	1	item	0	0
1.3	Construction setout and survey	1	item	0	0
1.4	Work as executed survey and documentation	1	item	0	0
1.5	Geotechnical supervision, testing and certification	1	item	0	0
	SUBTOTAL (Assumed as 15% of works cost)				\$ 262,708
2	Demolition and Clearing				
2.1	Clearing and grubbing	0	sq. m	11	0
2.2	Strip topsoil and stockpile for re-use (assuming 150mm depth)	0	cu. m	27	0
2.3	Dispose of excess topsoil (nominal 10% allowance)	0	cu. m	65	0
2.4	Pull up and dispose existing road surface	830	sq. m	38	31,374
	SUBTOTAL				\$ 31,374
4	Installation of Drainage				
4.1	Supply, excavate, bed, lay, joint, backfill and provide connections 0.45m dia. Pipe	11	lin. m	999	11,189
4.2	Supply, excavate, bed, lay, joint, backfill and provide connections 0.6m dia. Pipe	76	lin. m	1,053	79,923
4.3	Supply, excavate, bed, lay, joint, backfill and provide connections 0.9m dia. Pipe	9	lin. m	1,296	11,664
4.4	Supply, excavate, bed, lay, joint, backfill and provide connections 1.2m dia. Pipe	7	lin. m	1,782	11,761
4.7	Supply, excavate, bed, lay, joint, backfill and provide connections 1.8m dia. Pipe	312	lin. m	3,564	1,113,037
4.29	Install new drainage/junction pit (assumed 1 pit per 50m of pipe)	8	each	4,320	34,560
4.31	Adjustment of existing services (nominal allowance) (assumed 10% of drainage installation cost)	126,213	item	74,547	126,213
	SUBTOTAL				\$ 1,388,347
7	Footpath and Road Surfaces				
7.1	Reinstate disturbed road pavement, including demolition and disposal of additional material to provide good jointing	830	sq. m	130	107,568
	SUBTOTAL				\$ 107,568
9	Traffic Management				
9.1	Control of traffic during works (nominal allowance) (assumed \$500 per lin.m)	415	lin. m	540	224,100
	SUBTOTAL				\$ 224,100
	CONSTRUCTION SUBTOTAL				\$ 2,014,098
11	Contingencies				\$ -
11.1	50% construction cost				\$ 1,007,049
	CONSTRUCTION TOTAL, exc. GST				\$ 3,021,147
	GST				\$ 302,115
	CONSTRUCTION TOTAL, inc. GST				\$ 3,323,261
	CONSTRUCTION TOTAL, rounded				\$ 3,323,300
11	MAINTENANCE				
11.1	Maintenance of mitigation option		item		\$ 4,150

Table E3: Cost Estimate - Option FM-BB04: New Outlet to Blackwattle Bay & Drainage Upgrade – Bridge Rd

Item No.	Description of work	Quantity	Unit	Rate	Cost
1	General Construction Costs				
1.1	Site establishment, security fencing, facilities and disestablishment	1	item	0	0
1.2	Provision of sediment and erosion control	1	item	0	0
1.3	Construction setout and survey	1	item	0	0
1.4	Work as executed survey and documentation	1	item	0	0
1.5	Geotechnical supervision, testing and certification	1	item	0	0
	SUBTOTAL (Assumed as 15% of works cost)				\$ 148,527
2	Demolition and Clearing				
2.1	Clearing and grubbing	0	sq. m	11	0
2.2	Strip topsoil and stockpile for re-use (assuming 150mm depth)	0	cu. m	27	0
2.3	Dispose of excess topsoil (nominal 10% allowance)	0	cu. m	65	0
2.4	Pull up and dispose existing road surface	330	sq. m	38	12,489
	SUBTOTAL				\$ 12,489
4	Installation of Drainage				
4.2	Supply, excavate, bed, lay, joint, backfill and provide connections 2.4m x 2.4m culvert	165	lin. m	4,536	749,347
4.29	Install new drainage/junction pit (assumed 1 pit per 50m of pipe)	3	each	4,320	12,960
4.3	Install new outlet structure, including erosion protection as required	1	each	6,480	6,480
4.31	Adjustment of existing services (nominal allowance) (assumed 10% of drainage installation cost)	76,879	item	74,547	76,879
	SUBTOTAL				\$ 845,666
7	Footpath and Road Surfaces				
7.1	Reinstate disturbed road pavement, including demolition and disposal of additional material to provide good jointing	330	sq. m	130	42,820
	SUBTOTAL				\$ 42,820
9	Traffic Management				
9.1	Control of traffic during works (nominal allowance) (assumed \$500 per lin.m)	165	lin. m	540	89,208
	SUBTOTAL				\$ 89,208
	CONSTRUCTION SUBTOTAL				\$ 1,138,710
11	Contingencies				\$ 569,355
11.1	50% construction cost				\$ -
	CONSTRUCTION TOTAL, exc. GST				\$ 1,708,065
	GST				\$ 170,807
	CONSTRUCTION TOTAL, inc. GST				\$ 1,878,872
	CONSTRUCTION TOTAL, rounded				\$ 1,878,900
11	MAINTENANCE				
11.1	Maintenance of mitigation option		item	0	\$ 1,652

Table E4: Cost Estimate - Option FM-BB06: Underground Storage at Council Depot

Item No.	Description of work	Quantity	Unit	Rate	Cost
1	General Construction Costs				
1.1	Site establishment, security fencing, facilities and disestablishment	1	item	0	0
1.2	Provision of sediment and erosion control	1	item	0	0
1.3	Construction setout and survey	1	item	0	0
1.4	Work as executed survey and documentation	1	item	0	0
1.5	Geotechnical supervision, testing and certification	1	item	0	0
	SUBTOTAL (Assumed as 15% of works cost)				\$ 765,175
2	Demolition and Clearing				
2.1	Clearing and grubbing	0	sq. m	11	0
2.2	Strip topsoil and stockpile for re-use (assuming 150mm depth)	0	cu. m	27	0
2.3	Dispose of excess topsoil (nominal 10% allowance)	0	cu. m	65	0
2.4	Pull up and dispose existing road surface	100	sq. m	38	3,780
	SUBTOTAL				\$ 3,780
3	Excavation and earthworks				
3.1	Excavation of detention basins and swales	40,000	cu. m	49	1,944,000
3.2	Disposal of excess cut (assuming 80% of total excavation)	32,000	item	65	2,073,600
	SUBTOTAL				\$ 4,017,600
4	Installation of Drainage				
4.8	Supply, excavate, bed, lay, joint, backfill and provide connections 2.1m dia. Pipe	100	lin. m	4,212	421,200
4.29	Install new drainage/junction pit (assumed 1 pit per 50m of pipe)	2	each	4,320	8,640
4.31	Adjustment of existing services (nominal allowance) (assumed 10% of drainage installation cost)	42,984	item	74,547	42,984
	SUBTOTAL				\$ 472,824
6	Installation of Storage Tank				
6.1	Construction of storage tank (nominal allowance)	1	item	540,000	540,000
	SUBTOTAL				\$ 540,000
7	Footpath and Road Surfaces				
7.1	Reinstate disturbed road pavement, including demolition and disposal of additional material to provide good jointing	100	sq. m	130	12,960
	SUBTOTAL				\$ 12,960
9	Traffic Management				
9.1	Control of traffic during works (nominal allowance) (assumed \$500 per lin.m)	100	lin. m	540	100
	SUBTOTAL				\$ 54,000
	CONSTRUCTION SUBTOTAL				\$ 5,866,339
11	Contingencies				\$ 2,933,169
11.1	50% construction cost				\$ -
	CONSTRUCTION TOTAL, exc. GST				\$ 8,799,508
	GST				\$ 879,951
	CONSTRUCTION TOTAL, inc. GST				\$ 9,679,459
	CONSTRUCTION TOTAL, rounded				\$ 9,679,500
11	MAINTENANCE				
11.1	Maintenance of mitigation option		item	0	\$ 21,000

Table E5: Cost Estimate - Option FM-BB07: Drainage Upgrade – Cleveland St to Wentworth Park & Underground Storage at Council Depot

Item No.	Description of work	Quantity	Unit	Rate	Cost
1	General Construction Costs				
1.1	Site establishment, security fencing, facilities and disestablishment	1	item	0	0
1.2	Provision of sediment and erosion control	1	item	0	0
1.3	Construction setout and survey	1	item	0	0
1.4	Work as executed survey and documentation	1	item	0	0
1.5	Geotechnical supervision, testing and certification	1	item	0	0
	SUBTOTAL (Assumed as 15% of works cost)				\$ 2,866,623
2	Demolition and Clearing				
2.1	Clearing and grubbing	0	sq. m	10.8	0
2.2	Strip topsoil and stockpile for re-use (assuming 150mm depth)	0	cu. m	27	0
2.3	Dispose of excess topsoil (nominal 10% allowance)	0	cu. m	64.8	0
2.4	Pull up and dispose existing road surface	13,807	sq. m	37.8	521,905
	SUBTOTAL				\$ 521,905
3	Excavation and earthworks				
3.1	Excavation of detention basins and swales	40,000	cu. m	48.6	1,944,000
3.2	Disposal of excess cut (assuming 80% of total excavation)	32,000	item	64.8	2,073,600
	SUBTOTAL				\$ 4,017,600
4	Installation of Drainage				
4.3	Supply, excavate, bed, lay, joint, backfill and provide connections 0.9m dia. Pipe	98.5	lin. m	1296	127656.0
4.5	Supply, excavate, bed, lay, joint, backfill and provide connections 1.5m dia. Pipe	3.5	lin. m	2430	8505.0
4.7	Supply, excavate, bed, lay, joint, backfill and provide connections 1.8m dia. Pipe	15.2	lin. m	3564	54172.8
4.8	Supply, excavate, bed, lay, joint, backfill and provide connections 2.1m dia. Pipe	142.3	lin. m	4212	599367.6
4.1	Supply, excavate, bed, lay, joint, backfill and provide connections 2.4m dia. Pipe	8	lin. m	4536	37,649
4.12	Supply, excavate, bed, lay, joint, backfill and provide connections 2.7m dia. Pipe	302	lin. m	4860	1,468,692
4.13	Supply, excavate, bed, lay, joint, backfill and provide connections 3.0m dia. Pipe	126	lin. m	5184	653,184
4.16	Supply, excavate, bed, lay, joint, backfill and provide connections 2.1m x 1.2m culvert	3	lin. m	3240	9,072
4.21	Supply, excavate, bed, lay, joint, backfill and provide connections 3.0m x 2.7m culvert	547	lin. m	5400	2,952,180
4.23	Supply, excavate, bed, lay, joint, backfill and provide connections 3.0m x 3.0m culvert	76	lin. m	6156	467,856
4.24	Supply, excavate, bed, lay, joint, backfill and provide connections 3.3m x 2.1m culvert	153	lin. m	6264	959,645
4.25	Supply, excavate, bed, lay, joint, backfill and provide connections 3.0m x 0.9m culvert	6	lin. m	5940	35,640
4.29	Install new drainage/junction pit (assumed 1 pit per 50m of pipe)	28	each	4320	120,960
4.31	Adjustment of existing services (nominal allowance) (assumed 10% of drainage installation cost)	749,458	item	74547	42,984
	SUBTOTAL				\$ 8,244,037
6	Installation of Storage Tank				
6.1	Construction of storage tank (nominal allowance)	1		540,000	540,000
	SUBTOTAL				\$ 540,000

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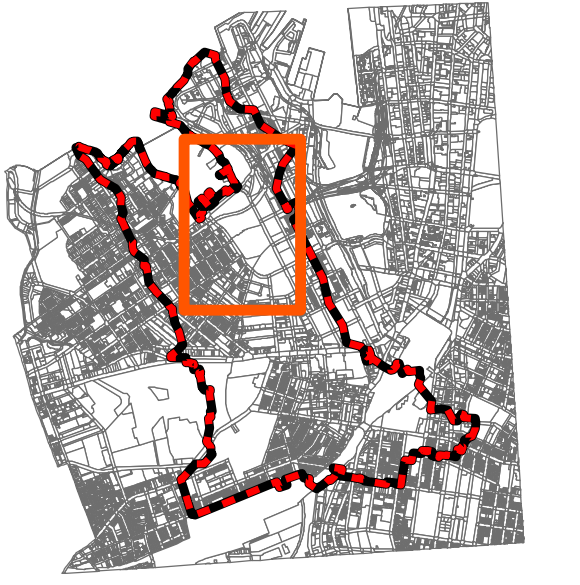
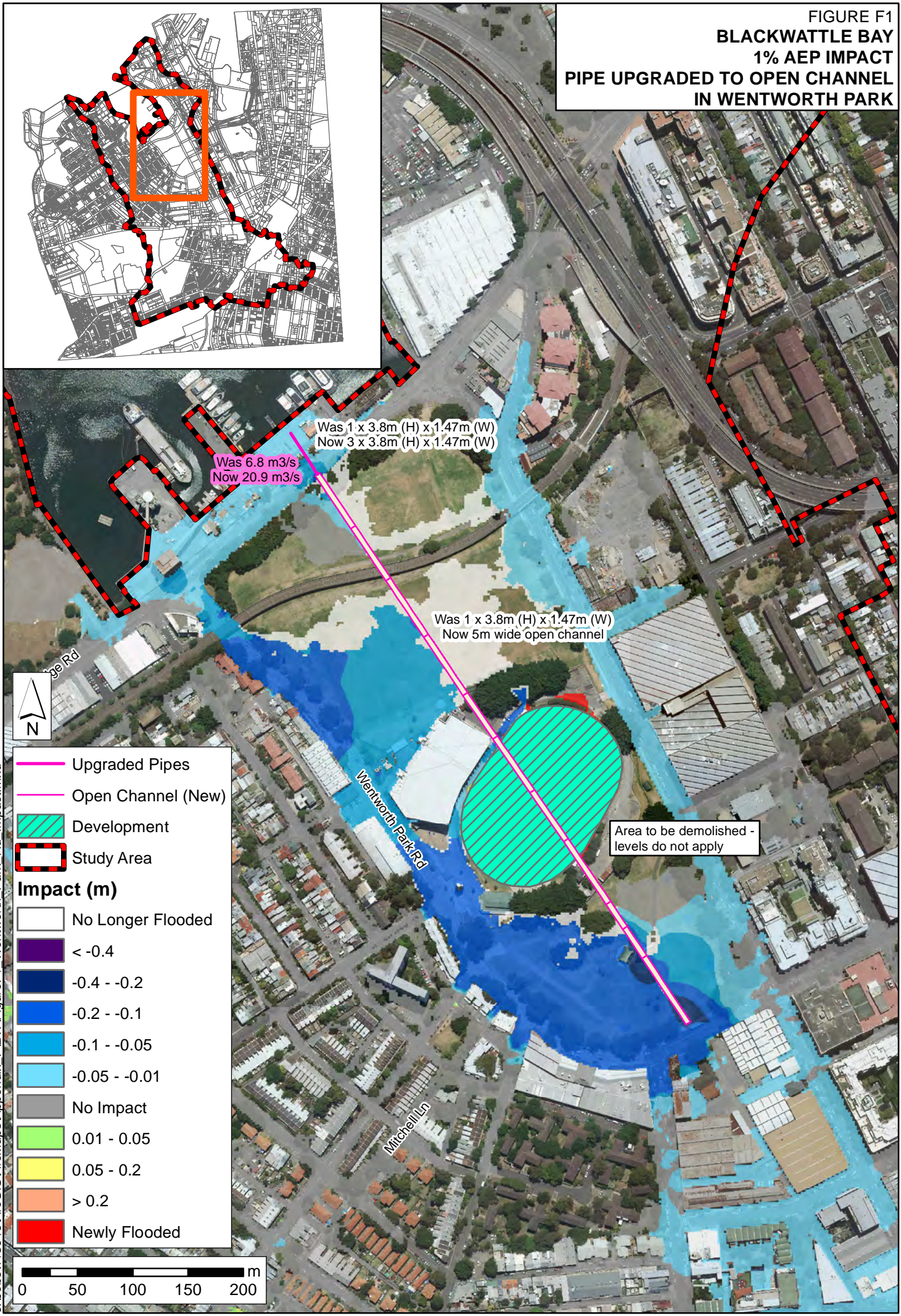


Blackwattle Bay - Mitigation Options Considered

Location	Description	Type of Measure	Impact	Outcome
Parramatta Rd/Buckland St - Wentworth Park	Double capacity of trunk drainage up to Parramatta Rd/Buckland St intersection	Drainage Upgrade	Drop of 0.1 m between low area between Parramatta Rd and Wentworth Park Rd, as well as along Wentworth Park Rd, in the 1% AEP event.	Comparative to it's limited benefits, there are issues with contaminated fill in Wentworth Park, and the high cost of a ~3 km long pipe upgrade. Discarded.
Wentworth Park	Open channel up to Wentworth Park Rd (see Figure F1)	Drainage Upgrade	Triples the peak flow at the outlet in the 1% AEP event, results in drop of around 0.2 m on Wentworth Park Rd and in the park.	Issues of contaminated fill in Wentworth Park outweigh the limited benefits to the area. Discarded
Mitchell St - Wentworth Park	Double capacity of trunk drainage up to Mitchell Ln East	Drainage Upgrade	Drop of 0.01 in 1% AEP event around flood affected properties near Mitchell St, on Wentworth Park Rd and on Wentworth Park.	Negligible drop in flood level. Refined to become FM - BB02
Pembroke St - Railway	Double capacity of drainage from railway line to Pembroke St	Drainage Upgrade	Drop of 0.1 m in 1% AEP event on Chalmers Street and in trapped depression. Increase from 0.5 m ³ /s to 0.8 m ³ /s at downstream end of Prince Alfred Park.	Negligible drop in flood level. Refined to become FM - BB01
Bridge Rd - Blackwattle Bay	Enhance pit and pipe capacity on Bridge Road where it is parallel to Bridge Lane.	Drainage Upgrade	Drop of 0.01 m in 1% AEP event on Bridge Rd, despite increase of flow at the outlet from 1.7 m ³ /s to 3.4 m ³ /s.	Negligible drop in flood level. Refined to become FM - BB03
Parramatta Rd/Buckland St - Wentworth Park	Double capacity of trunk drainage up to Parramatta Rd/Buckland St intersection (including the south side of Parramatta Road) and double pit capacity around the Parramatta Rd/Buckland St intersection.	Drainage Upgrade	Drop of 0.1 m in low area between Parramatta Rd and Wentworth Park Rd, as well as along Wentworth Park Rd, in the 1% AEP event.	Comparative to it's limited benefits, there are issues with contaminated fill in Wentworth Park, and the high cost of a ~3 km long pipe upgrade. Refined to become FM - BB07
Parramatta Rd/Buckland St	Same as above, but do not change the pipes in Wentworth Park (except the first one). Change the last pit so it surcharges (1528P)	Drainage Upgrade	Drop of 0.1 m in low area between Parramatta Rd and Wentworth Park Rd, slight increase at south end of Wentworth Park, in the 1% AEP event.	Negligible drop in flood level. Refined to become FM - BB07
Wattle St - Blackwattle Bay	Double capacity of trunk drainage along Wattle St, excluding the last two pipes before Broadway.	Drainage Upgrade	Drop of 0.02 m along Wattle St adjacent to Wentworth Park in the 1% AEP event.	Negligible drop in flood level. Issues with pipe upgrade along main road. Discarded
Talfourd St - Bridge Rd	2x 450 to drain Talfourd St up to Bridge Rd, double pit capacity at Talfourd depression.	Drainage Upgrade	Drop of 0.02 m along Talfourd St near Bridge Rd in the 1% AEP event.	Negligible drop in flood level. Discarded

Location	Description	Type of Measure	Impact	Outcome
Talfourd St - Bridge Rd	Same as above, with three 'humps' to divert flow away from the depression. Locations: Talfourd/Marlborough, Talfourd Ln/Marlborough, Talfourd Ln easement.	Flow Path Modification	Drop of 0.02 m along Talfourd St near Bridge Rd in the 1% AEP event. Slight increases upstream of the 'humps'.	Negligible drop in flood level. Discarded
Cleveland St - Parramatta Rd	Cleveland St. Upgrade pits and make pipes 450 at Cleveland low point, upgrade pipes from there until Broadway.	Drainage Upgrade	Drop of 0.01 m on some areas between Cleveland St and Parramatta Road in the 1% AEP event.	Negligible drop in flood level. Refined to become FM - BB07
Wentworth Park - Basin	Detention Basin in Wentworth Park SW corner, connected to deepest water on William Henry Dr with pipes (4 locations). Invert of basin 1.5 mAHD. (see Figure F2)	Detention Basin	Drop of 0.1 m on parts of Wentworth Park Rd at the south end of Wentworth Park. Drop of up to 0.1 m in parts of Wentworth Park.	Issues with loss public space and putting detention basin in area with contaminated fill. Not a significant drop in flood level. Discarded
Blackwattle Lane	Lower Blackwattle Lane by 0.5 m, including through council depot	Flow Path Modification	Drop of 0.1 m in low area between Parramatta Rd and Wentworth Park Rd, slight increase at south end of Wentworth Park, in the 1% AEP event.	Negligible drop in flood level and issues with significant re-landscaping of street. Discarded
Mitchell St	Re-grade the easements parallel to Mitchell St, including straightening and widening, to improve conveyance. (see Figure F3)	Flow Path Modification	Drop of between 0.1 and 0.4 m in the unrelieved low points on small streets perpendicular to Mitchell St. Impact of up to 0.1 m in areas downstream, before Wentworth Park (both in the 1% AEP event).	Significant drop in flood level, however, significant impact downstream would increase flood risk there, for current and future landholders. Discarded
Entire Catchment	Upgrade all pits and pipes to 3x existing capacity	Drainage Upgrade	Drop of up to 0.4 m, near Blackwattle Lane and along Wentworth Park Road in the 5% AEP event. Drop of around 0.1 m along Buckland Street	Not considered as an option per se, rather as a diagnostic tool to see which areas sensitive to pipe upgrades and by how much.

**FIGURE F1
BLACKWATTLE BAY
1% AEP IMPACT
PIPE UPGRADED TO OPEN CHANNEL
IN WENTWORTH PARK**


















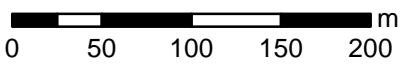
Was 1 x 3.8m (H) x 1.47m (W)
Now 3 x 3.8m (H) x 1.47m (W)

Was 6.8 m3/s
Now 20.9 m3/s

Was 1 x 3.8m (H) x 1.47m (W)
Now 5m wide open channel

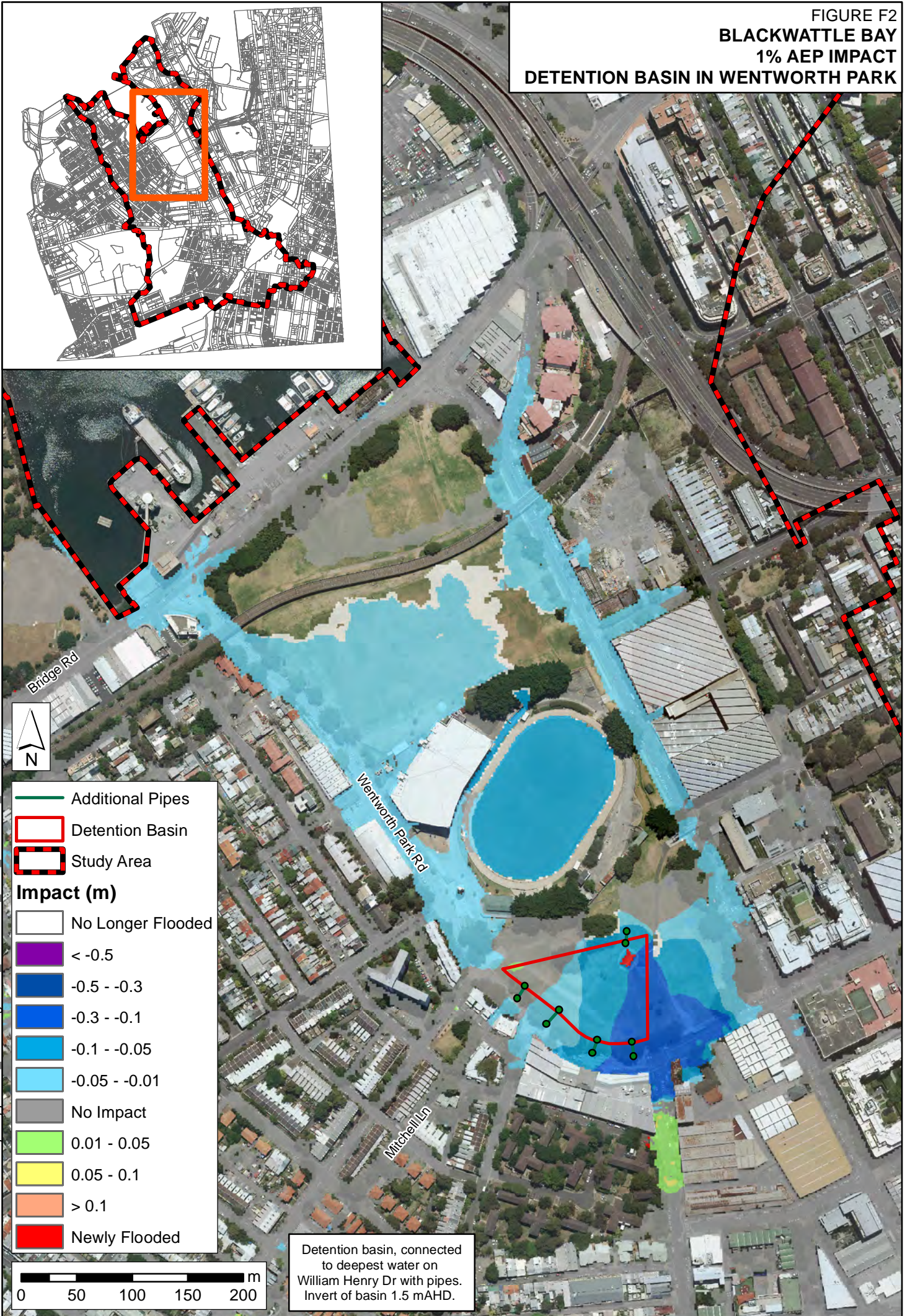
Area to be demolished -
levels do not apply

-  Upgraded Pipes
 -  Open Channel (New)
 -  Development
 -  Study Area
- Impact (m)**
-  No Longer Flooded
 -  < -0.4
 -  -0.4 - -0.2
 -  -0.2 - -0.1
 -  -0.1 - -0.05
 -  -0.05 - -0.01
 -  No Impact
 -  0.01 - 0.05
 -  0.05 - 0.2
 -  > 0.2
 -  Newly Flooded

















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FIGURE F2
 BLACKWATTLE BAY
 1% AEP IMPACT
 DETENTION BASIN IN WENTWORTH PARK



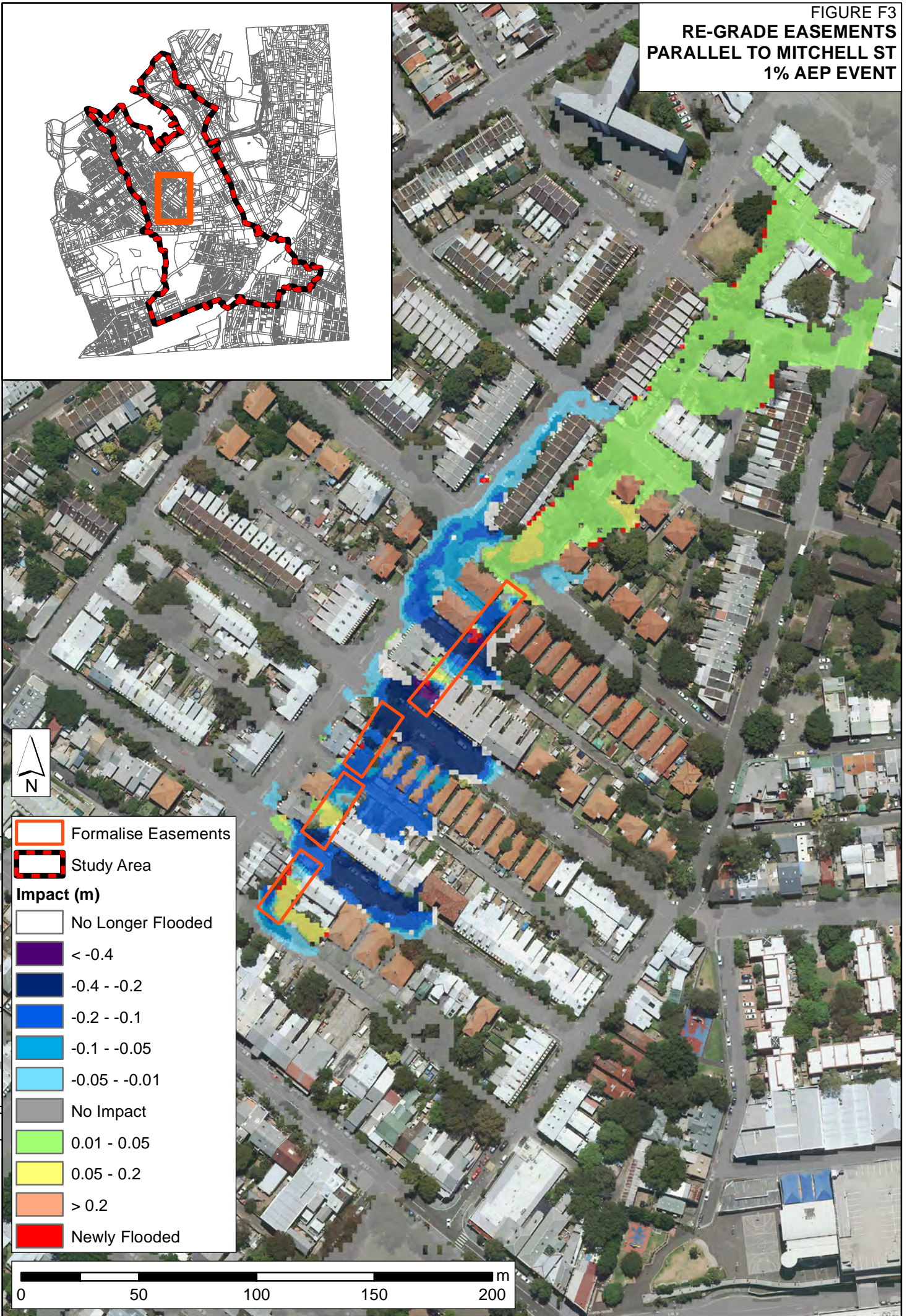
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-  Additional Pipes
 -  Detention Basin
 -  Study Area
- Impact (m)**
-  No Longer Flooded
 -  < -0.5
 -  -0.5 - -0.3
 -  -0.3 - -0.1
 -  -0.1 - -0.05
 -  -0.05 - -0.01
 -  No Impact
 -  0.01 - 0.05
 -  0.05 - 0.1
 -  > 0.1
 -  Newly Flooded

Detention basin, connected to deepest water on William Henry Dr with pipes. Invert of basin 1.5 mAHD.

0 50 100 150 200 m

FIGURE F3
 RE-GRADE EASEMENTS
 PARALLEL TO MITCHELL ST
 1% AEP EVENT



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APPENDIX G: EARLY CATCHMENT CONDITIONS

The Blackwattle Bay catchment has undergone extensive urbanisation over the past 200 years. Development has occurred uniformly across the area, with the suburbs of Glebe, Ultimo, Chippendale, Darlington and Redfern growing as Sydney expanded outward from what is now the Central Business District. Urbanisation of the catchment had a significant effect on flood behaviour, with watercourses and depressions being re-directed, blocked or sometimes removed, as streets and buildings were laid out and constructed. Understanding of the original catchment facilitates comprehension of the current flood liability and the general functioning of the catchment.

The following is a summary of what is known about the catchment features in the 19th century:

1. Blackwattle Creek was a significant watercourse. A map from Atlas of the Suburbs of Sydney (ca 1885) shows it flowing from Parramatta Road to Wentworth Park along the depression that is now Mitchell Lane.
2. The creek is known to have extended upstream of Parramatta Road, likely in the vicinity of what is now Buckland Street. The Francis Webb Sheilds Plan of Sydney (1844) shows the creek was dammed upstream of Parramatta, with the resultant reservoir used by the Brisbane Distillery.
3. Wentworth Park was previously an intertidal area that was filled to create a recreational area. The Atlas of the Suburbs of Sydney (ca 1885) shows a cricket and football grounds in the park. The Trigonometrical Survey of Sydney (1855-1865) labels the area as "Black Wattle Swamp Cove".

Figure G1 shows Blackwattle Creek and the shoreline as they were recorded in the Atlas of the Suburbs of Sydney (ca 1885), overlaid on the current 1% AEP peak flood depth. The figure shows that the concentration of flow in Mitchell Lane and the surrounding area is in fact where Blackwattle Creek was, before it was covered over and replaced with a stormwater drain. Although the map does not show it, the creek can be assumed to have continued upstream of Parramatta Road, likely in the vicinity of Buckland Street.

FIGURE G1
 19TH CENTURY CATCHMENT CONDITIONS
 CREEK LOCATIONS SHOWN WITH CURRENT
 1% AEP PEAK FLOOD DEPTH



Disclaimer:
 Inundation patterns and/or peak flood levels shown for design events are based on best available estimates of flood behaviour within the Catchment. Inundation from local overland flow may vary slightly to the displayed design rainfall inundation patterns. Council should be consulted to confirm flood affectation at individual allotments.

Note: Flood depths modelled as less than 0.1 m are not displayed

Legend

- Study Area
- (1899 Map) Creek
- (1899 Map) Shoreline

Depth (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

