

## Appendix D

### Economic Damages and Option Costing



## D1 Economic Flood Damages

### D1.1 Damage Categories

In order to quantify the economic impacts of flooding, a flood damage assessment has been undertaken. A property may suffer economic impacts from flooding through several ways. These are broadly grouped into three categories, as summarised in **Table 5-1**.

**Table D-1 Flood Damages Categories**

Type of Flood Damages		Description
Tangible	Direct	Building contents (internal) Structure (building repair and clean) External items (vehicles, contents of sheds etc.) Infrastructure
	Indirect	Clean-up (immediate removal of debris) Financial (loss of revenue, extra expenditure) Opportunity (non-provision of public services)
Intangible		Social – increased levels of insecurity, depression, stress General inconvenience in post-flood stage

Damage dealt directly to a property or its contents (direct damages) are only component of the total damages accrued during a flood event. Indirect costs, while also tangible, arise as a result of consequences of the flood event, such as clean-up costs, opportunity costs, and other financial impacts.

In addition to tangible damages, there are also a category of damages referred to as intangible damages. Intangible costs relate to social impacts, such as insecurity and depression, that arise as a result of major flood event, or general inconveniences that occur during the post-flood stage. The intangible costs are difficult to calculate in economic terms.

### D1.2 Property Survey

Detailed floor level survey was available for most properties within the Brisbane Water 1% AEP flood extent, as well as additional properties within the study area affected by the 1% AEP catchment flooding extent.

For properties above the 1% AEP extent but within the PMF extent, no property survey was collected. Property details were estimated based on surrounding property types and floor levels were estimated to be 0.15m above the ground level. The ground level was extracted from the LiDAR. Note that these were assumed to be residential single storey properties with a slab on ground foundation.

The Living Choice Alloura Waters retirement village is located at 1 Murna Road, Davistown and contains a range of units, houses, villas, and community spaces. Flood extents were analysed within the vicinity of these buildings and four strategically located points were used to assess the flood damages to the entire village.

Commercial properties within the study area include:

- Davistown RSL Club
- Brisbania Public School
- Empire Bay Public School.

Each inundated commercial property within the Davistown and Empire Bay study area has been assigned a 'low' value. Their floor area has been taken from survey information of approximated through the cadastre.

### D1.3 Economic Damage Assessment

The damage assessment undertaken for this study has examined the tangible damages only. Assessment of the tangible flood damages is based on a relationship between the depths of flooding on a property and the likely damage within the property.

Damage curves have been prepared for residential properties within the Davistown and Empire Bay catchment, including properties in the suburbs of Saratoga, Ettalong, and Bensville. The magnitude of damage attributed to a property is dependent upon its number of storeys and the depth of inundation experienced for all design flood events assessed.

#### D1.3.1 Residential Damage Curves

Residential damage curves were generated based on the curves prepared by the Department of Natural Resources (now DPIE) in 2007. The spreadsheet provides damage curves for three residential building types:

1. Single storey, high set
2. Single storey, slab on ground
3. Two storey, slab on ground.

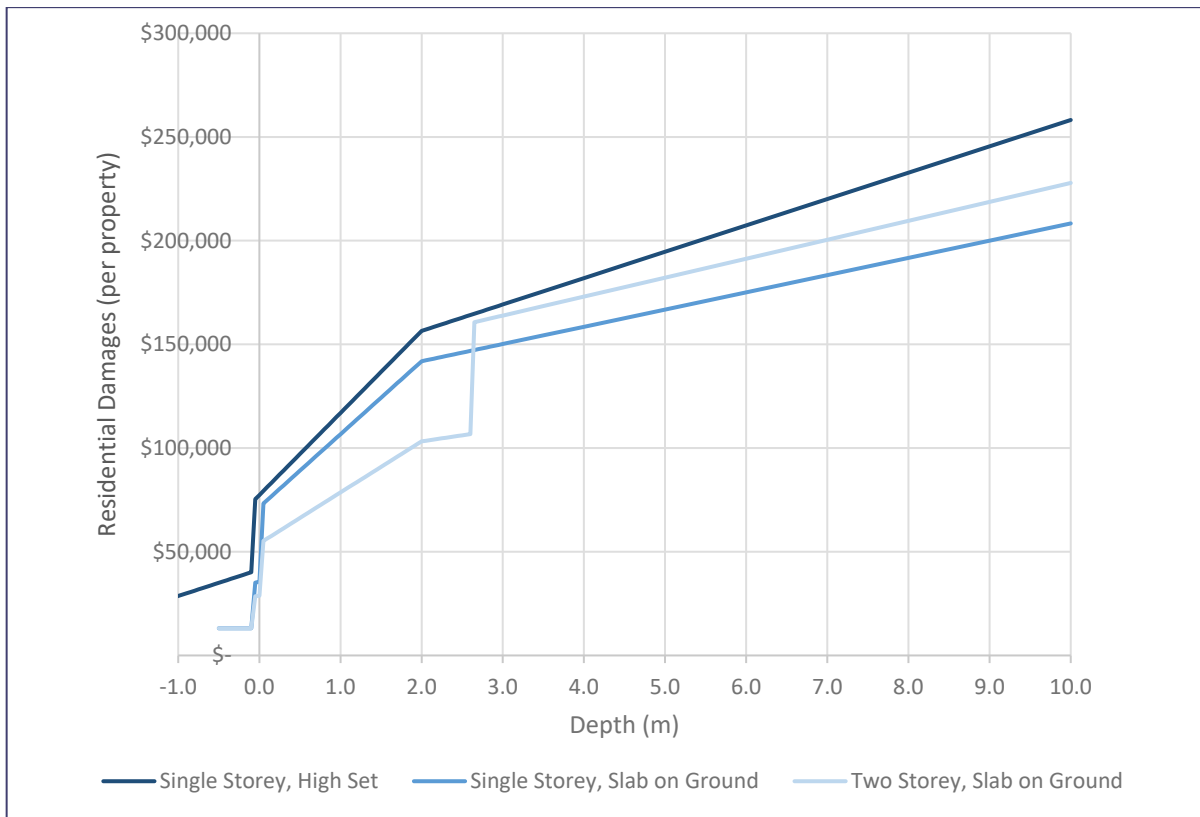
The damage curves are calculated based on an assumed floor area, and the warning time available. Single storey properties were classified as 'high set' if the difference between their floor level and ground level was greater than 0.3m. Consequently, the unsurveyed properties (i.e. those above the 1% AEP) were all conservatively classified as single storey slab on ground, as the difference between their floor level and ground level was set to a constant 0.15m.

An assessment of property size was undertaken from the aerial imagery. An average house size of 220m<sup>2</sup> was adopted for this damage assessment.

A warning time of zero hours was adopted.

The residential damage curves, adjusted to 2019 dollars, are shown in **Figure D-7**. The sudden jump in the two storey damage curve at a depth of 2.60m indicates that the flooding is starting to impact the upper storey, significantly increasing the damages incurred.

It should be noted that due to the nature of flooding in the study areas and to the relatively flat terrain, the damages were calculated based solely on the damage curves shown on **Figure D-7**, with no additional value accounting for "garden damages". This approach was adopted because a situation where the flood level at the property is simultaneously high enough to cause garden damages and too low to result in damages to the building foundation was considered unlikely.



**Figure D-7 Residential Damage Curves**

### D1.3.2 Catchment Flooding

The economic damages analysis for this FRMS have primarily assessed the damages associated with catchment flooding and utilise the flood model results from the Davistown and Empire Bay Flood Studies (2010). The existing case damages presented in **Section D1.4** are based solely on the catchment flood behaviour. Options that address catchment flood risks have also used catchment flood based damages.

### D1.3.3 Brisbane Water Flooding

The damages associated with Brisbane Water flooding were assessed as part of the Brisbane Water FRMS (2015). A similar approach adopted for the purposes of assessing options that address flood risk from Brisbane Water (e.g. foreshore barrier). These damages were only used for the comparison of options, not for input to the existing case damages presented in **Section D1.4**.

## D1.4 Existing Case Damage Assessment Results

The results from the damage assessment are summarised in **The average** annual damage (AAD) for the Davistown and Empire Bay study area under existing conditions is \$1,752,358. The ADD calculation takes into account the total damages associated with each analysed flood event, as well as the likelihood of that flood event occurring. This number provides a representation of the estimated amount of capital that Council would need to set aside every year to address damages caused by flooding (both frequent and rare).

Over a 50 year assessment period and under a seven per cent discount rate, this AAD is equivalent to a Net Present Value (NPV) of \$24.1M. This value is an estimate of the total expenses Council is expected to have due to flooding over 50 years, in today's dollar value.

Table 5-2.

The average annual damage (AAD) for the Davistown and Empire Bay study area under existing conditions is \$1,752,358. Over a 50 year assessment period and under a seven per cent discount rate, this is equivalent to a Net Present Value (NPV) of \$24.1M.

These damages were calculated based on the tangible damages only.

**Table D-2 Davistown and Empire Bay – Existing Damages Assessment Results**

	Properties with Over-Floor Flooding	Max Over-Floor Depth (m)	Avg Over-Floor Depth (m)	Flood affected properties	Total Damages (\$2019)
<b>PMF</b>	274	1.03	0.15	896	\$39,436,465
<b>0.5% AEP</b>	45	0.64	0.14	307	\$11,300,421
<b>1% AEP</b>	36	0.60	0.13	256	\$9,372,400
<b>2% AEP</b>	24	0.56	0.15	221	\$7,883,519
<b>5% AEP</b>	20	0.51	0.16	182	\$6,427,163
<b>10% AEP</b>	11	0.46	0.19	182	\$4,685,971
<b>20% AEP</b>	9	0.42	0.18	182	\$3,805,105
				<b>AAD</b>	<b>\$1,752,358</b>

The assessment showed that over floor flooding commenced in the 20% AEP event, with 9 residential properties affected. This affectation increased steadily for larger events with a total of 36 properties affected in the 1% AEP and 274 affected in the PMF. In all events, the average depth of over floor flooding is less than 0.2m.

#### *D1.4.1 Sensitivity Assessment*

The damages assessment is somewhat sensitive to the classification of single storey properties as ‘high set’ or ‘slab on ground’. The critical value that differentiates between these two classifications in the analysis is a difference of 0.3m between the floor level and ground level, resulting in an AAD of \$1,956 per property. If this criterion is increased to 0.5m or 1m, the AAD per property is \$1,553 or \$1,173 respectively, which is a decrease of up to 40 per cent. Furthermore, if every single storey property is classified as ‘high set’, the AAD is \$1,142,601 or \$2,365 per property, which is an increase of 21 per cent.

#### **D1.5 Flood Mitigation Option Damage Assessment Results**

The flood damages assessment is a useful tool for comparing the merits of various options, it is not a precise flood risk analysis tool and the limitation associated with the assessment should be considered when interpreting the results. The outcomes of the damages assessment for the six options that were assessed in detail are provided in the following sections.

The economic evaluation of each of these options was also assessed by considering the reduction in the amount of flood damages incurred for the design events and by then comparing this value with the cost of implementing the measure.

The indicator adopted to rank these measures on economic merit is the benefit-cost ratio (B/C or BCR), which is based on the net present worth (NPW) of the benefits (reduction in AAD) and the costs (capital and ongoing), adopting a 7% discount rate and an implementation period of 50 years.

The benefit-cost ratio provides an insight into how the damage savings from a measure, relate to its cost of construction and maintenance:

- Where the benefit-cost ratio is greater than 1, the economic benefits are greater than the costs of implementing the measure;
- Where the benefit-cost ratio is less than 1 but greater than 0, there is still an economic benefit from implementing the measure but the cost of implementing the measure is greater than the economic benefit;
- Where the benefit-cost is equal to zero, there is no economic benefit from implementing the measure; and
- Where the benefit-cost is less than zero, there is a negative economic impact of implementing the measure.

The following sections detail the damage assessment results for each of the six options and **Table D-** details some differing inputs for the damages calculation.

**Table D-3 Option list and associated inputs for the DECC Spreadsheet**

Options	Typical Duration of Immersion (hours)	Building Damage Repair Limitation Factor
Option FM DT1	3	0.90
Option FM DT2	3	0.90
Option FM EB6	1	0.85
Option FM EB7	1	0.85
Option FM EB4	3	0.90
Option FM EB5	1	0.85

#### D1.5.1 Option FM DT1 Davistown Foreshore Barrier

The damages associated with the scenario after implementation of Option FM DT1 are compared against the existing case (catchment flooding) damages in **Table D-**.

**Table D-4 Option FM DT1 Damages Assessment Results**

	Properties with Over-Floor Flooding		Flood affected properties		Total Damages (\$2019)		Reduction in Damages
	Existing	FM DT1	Existing	FM DT1	Existing	FM DT1	
PMF	455	455	596	596	\$37,930,047	\$37,930,047	\$0
0.5% AEP	270	270	512	512	\$23,447,003	\$23,447,003	\$0
1% AEP	203	54	454	78	\$18,429,371	\$4,160,187	\$14,269,184
2% AEP	146	41	382	61	\$14,318,581	\$3,331,977	\$10,986,604
5% AEP	88	27	277	40	\$9,561,328	\$2,366,178	\$7,195,150
10% AEP	52	21	185	31	\$6,311,259	\$1,804,398	\$4,506,861
20% AEP	27	14	115	25	\$4,074,298	\$1,388,100	\$2,686,197
AAD					\$2,307,002	\$817,191	\$1,489,811

The cost of implementing Option FM DT1 is compared against the reduction in AAD (compared to the existing case) to provide a benefit cost ratio (**Table D-**).

**Table D-5 Option FM DT1 Benefit Cost Ratio**

Capital Cost	Recurrent Cost	NPV of Cost	NPV of Reduction in AAD	Benefit Cost Ratio
\$12,343,100	\$5,000	\$11,604,611	\$20,560,503	1.77

*D1.5.2 Option FM DT2 Davistown Foreshore Barrier*

The damages associated with the scenario after implementation of Option FM DT2 are compared against the existing case (catchment flooding) damages in **Table D-**.

**Table D-6 Option FM DT2 Damages Assessment Results**

	Properties with Over-Floor Flooding		Flood affected properties		Total Damages (\$2019)		Reduction in Damages
	Existing	FM DT2	Existing	FM DT2	Existing	FM DT2	
<b>PMF</b>	455	455	596	596	\$37,930,047	\$37,930,047	\$0
<b>0.5% AEP</b>	270	270	512	512	\$23,447,003	\$23,447,003	\$0
<b>1% AEP</b>	203	2	454	3	\$18,429,371	\$164,862	\$18,264,508
<b>2% AEP</b>	146	2	382	2	\$14,318,581	\$122,254	\$14,196,327
<b>5% AEP</b>	88	0	277	0	\$9,561,328	\$36,381	\$9,524,947
<b>10% AEP</b>	52	0	185	0	\$6,311,259	\$36,381	\$6,274,878
<b>20% AEP</b>	27	0	115	0	\$4,074,298	\$36,381	\$4,037,916
<b>AAD</b>					\$2,307,002	\$226,895	\$2,080,107

The cost of implementing Option FM DT2 is compared against the reduction in AAD (compared to the existing case) to provide a benefit cost ratio (**Table D-**).

**Table D-7 Option FM DT2 Benefit Cost Ratio**

Capital Cost	Recurrent Cost	NPV of Cost	NPV of Reduction in AAD	Benefit Cost Ratio
\$19,454,050	\$8,000	\$18,291,761	\$28,707,034	1.57

*D1.5.3 Option FM EB6 Pomona Road Easement*

The damages associated with the scenario after implementation of Option FM EB6 are compared against the existing case (catchment flooding) damages in **Table D-**.

**Table D-8 Option FM EB6 Damages Assessment Results**

	Properties with Over-Floor Flooding		Flood affected properties		Total Damages (\$2019)		Reduction in Damages
	Existing	FM EB6	Existing	FM EB6	Existing	FM EB6	
<b>PMF</b>	184	184	383	383	\$19,514,862	\$19,507,012	\$7,851
<b>0.5% AEP</b>	36	36	148	146	\$6,151,352	\$6,113,124	\$38,228
<b>1% AEP</b>	30	30	133	134	\$5,414,027	\$5,353,321	\$60,706
<b>2% AEP</b>	20	19	113	113	\$4,423,651	\$4,362,413	\$61,238
<b>5% AEP</b>	17	16	99	96	\$3,791,010	\$3,668,139	\$122,871
<b>10% AEP</b>	8	8	99	96	\$2,870,564	\$2,645,085	\$225,479
<b>20% AEP</b>	8	7	99	96	\$2,443,948	\$2,108,566	\$335,382
<b>AAD</b>					\$1,064,000	\$973,208	\$90,793

The cost of implementing Option FM EB6 is compared against the reduction in AAD (compared to the existing case) to provide a benefit cost ratio (**Table D-**).

**Table D-9 Option FM EB6 Benefit Cost Ratio**

Capital Cost	Recurrent Cost	NPV of Cost	NPV of Reduction in AAD	Benefit Cost Ratio
\$737,100	\$2,000	\$716,480	\$1,253,006	1.75

#### D1.5.4 Option FM EB7 Empire Bay Drive Easement

The damages associated with the scenario after implementation of Option FM EB7 are compared against the existing case (catchment flooding) damages in **Table D-**.

**Table D-10 Option FM EB7 Damages Assessment Results**

	Properties with Over-Floor Flooding		Flood affected properties		Total Damages (\$2019)		Reduction in Damages
	Existing	FM EB7	Existing	FM EB7	Existing	FM EB7	
<b>PMF</b>	184	183	383	382	\$19,514,862	\$19,435,191	\$79,671
<b>0.5% AEP</b>	36	36	148	148	\$6,151,352	\$6,151,352	\$0
<b>1% AEP</b>	30	30	133	133	\$5,414,027	\$5,413,391	\$636
<b>2% AEP</b>	20	20	113	113	\$4,423,651	\$4,421,744	\$1,907
<b>5% AEP</b>	17	16	99	98	\$3,791,010	\$3,759,020	\$31,990
<b>10% AEP</b>	8	8	99	98	\$2,870,564	\$2,831,096	\$39,468
<b>20% AEP</b>	8	8	99	98	\$2,443,948	\$2,415,495	\$28,453
<b>AAD</b>					\$1,064,000	\$1,053,828	\$10,172

The cost of implementing Option FM EB7 is compared against the reduction in AAD (compared to the existing case) to provide a benefit cost ratio (**Table D-**).



**Table D-11 Option FM EB7 Benefit Cost Ratio**

Capital Cost	Recurrent Cost	NPV of Cost	NPV of Reduction in AAD	Benefit Cost Ratio
\$310,940	\$1,000	\$304,399	\$140,381	0.46

**D1.5.5 Option FM EB4 Empire Bay Foreshore Barrier**

The damages associated with the scenario after implementation of Option FM EB4 are compared against the existing case (catchment flooding) damages in **Table D-**.

**Table D-12 Option FM EB4 Damages Assessment Results**

	Properties with Over-Floor Flooding		Flood affected properties		Total Damages (\$2019)		Reduction in Damages
	Existing	FM EB4	Existing	FM EB4	Existing	FM EB4	
<b>PMF</b>	117	117	197	197	\$12,952,151	\$12,952,151	\$0
<b>0.5% AEP</b>	61	61	138	138	\$8,527,850	\$8,527,850	\$0
<b>1% AEP</b>	47	0	120	0	\$7,215,428	\$0	\$7,215,428
<b>2% AEP</b>	29	0	92	0	\$5,955,408	\$0	\$5,955,408
<b>5% AEP</b>	15	0	65	0	\$4,911,327	\$0	\$4,911,327
<b>10% AEP</b>	10	0	42	0	\$4,384,698	\$0	\$4,384,698
<b>20% AEP</b>	6	0	24	0	\$3,850,182	\$0	\$3,850,182
<b>AAD</b>					\$1,543,478	\$74,912	\$1,468,566

The cost of implementing Option FM EB4 is compared against the reduction in AAD (compared to the existing case) to provide a benefit cost ratio (**Table D-**).

**Table D-13 Option FM EB4 Benefit Cost Ratio**

Capital Cost	Recurrent Cost	NPV of Cost	NPV of Reduction in AAD	Benefit Cost Ratio
\$4,553,588	\$3,000	\$4,297,091	\$20,267,301	4.72

**D1.5.4 Option FM EB5 Myrtle Road Easement**

The damages associated with the scenario after implementation of Option FM EB5 are compared against the existing case (catchment flooding) damages in **Table D-**.

**Table D-14 Option FM EB5 Damages Assessment Results**

	Properties with Over-Floor Flooding		Flood affected properties		Total Damages (\$2019)		Reduction in Damages
	Existing	FM EB5	Existing	FM EB5	Existing	FM EB5	
<b>PMF</b>	184	177	383	376	\$19,514,862	\$19,056,736	\$458,126
<b>0.5% AEP</b>	36	32	148	140	\$6,151,352	\$5,648,291	\$503,061
<b>1% AEP</b>	30	23	133	120	\$5,414,027	\$4,789,975	\$624,052
<b>2% AEP</b>	20	16	113	101	\$4,423,651	\$3,875,787	\$547,864
<b>5% AEP</b>	17	15	99	89	\$3,791,010	\$3,342,871	\$448,139
<b>10% AEP</b>	8	7	99	89	\$2,870,564	\$2,394,975	\$475,589
<b>20% AEP</b>	8	6	99	89	\$2,443,948	\$1,958,732	\$485,215
<b>AAD</b>					\$1,064,000	\$894,069	\$169,931

The cost of implementing Option FM EB5 is compared against the reduction in AAD (compared to the existing case) to provide a benefit cost ratio (**Table D-**).

**Table D-15 Option FM EB5 Benefit Cost Ratio**

Capital Cost	Recurrent Cost	NPV of Cost	NPV of Reduction in AAD	Benefit Cost Ratio
\$6,481,400	\$4,000	\$6,112,586	\$2,652,569	0.43

Option DT1

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT excl GST
1	ESTABLISHMENT AND PRELIMINARIES				
1.1	Establishment	1	Item	\$ 20,000.00	\$ 20,000.00
1.2	Set out works	10	Item	\$ 3,000.00	\$ 30,000.00
1.3	Services location	1	Item	\$ 5,000.00	\$ 5,000.00
1.4	Traffic & Pedestrian Management Plan	1	Item	\$ 30,000.00	\$ 30,000.00
1.5	Stabilised site access and wash bay	10	Each	\$ 10,000.00	\$ 100,000.00
	SUBTOTAL				\$ 185,000.00
2	Levee				
2.1	Levee cost estimate	2900	m	\$ 1,800.00	\$ 5,220,000.00
2.2	Footpath - 1.5m wide	2900	m	\$ 150.00	\$ 435,000.00
2.3	Drainage				
2.3.1	DN 450 pipe with headwall through levee	12	Each	\$ 750.00	\$ 9,000.00
2.3.2	Backflow prevention device	12	Each	\$ 1,000.00	\$ 12,000.00
2.4	Floodgates				
2.4.1	Morton Cres Bridge	1	Item	\$ 100,000.00	\$ 100,000.00
2.4.2	Wetland	1	Item	\$ 15,000.00	\$ 15,000.00
	SUBTOTAL				\$ 5,791,000.00
3	Retaining walls				
3.1	Pine to Magnolia	100	m <sup>2</sup>	\$ 2,000.00	\$ 200,000.00
3.2	Kincumber to Magnolia	160	m <sup>2</sup>	\$ 2,000.00	\$ 320,000.00
	SUBTOTAL				\$ 520,000.00
4	Road Raising (footpath only)				
4.1	Davistown Road				
4.1.1	earthworks	230	m	\$ 1,800.00	\$ 414,000.00
4.1.2	footpath 1.5m wide	230	m	\$ 150.00	\$ 34,500.00
	SUBTOTAL				\$ 448,500.00
4.2	Murna Road				
4.2.1	earthworks	150	m	\$ 1,800.00	\$ 270,000.00
4.2.2	footpath 1.5m wide	150	m	\$ 150.00	\$ 22,500.00
	SUBTOTAL				\$ 292,500.00
4.3	Dilgara Ave				\$ 292,500.00
4.3.1	earthworks	90	m	\$ 1,800.00	\$ 162,000.00
4.3.2	footpath 1.5m wide	90	m	\$ 150.00	\$ 13,500.00
	SUBTOTAL				\$ 175,500.00
4.4	Lilli Pilli & Pine Street				
4.4.1	earthworks	320	m	\$ 1,800.00	\$ 576,000.00
4.4.2	footpath 1.5m wide	320	m	\$ 150.00	\$ 48,000.00
	SUBTOTAL				\$ 624,000.00
4.5	Kincumber Cres				
4.5.1	earthworks	80	m	\$ 1,800.00	\$ 144,000.00
4.5.2	footpath 1.5m wide	80	m	\$ 150.00	\$ 12,000.00
	SUBTOTAL				\$ 156,000.00
4.6	Morton Cres				
4.6.1	earthworks	320	m	\$ 1,800.00	\$ 576,000.00
4.6.2	footpath 1.5m wide	320	m	\$ 150.00	\$ 48,000.00
	SUBTOTAL				\$ 624,000.00
	SUBTOTAL				\$ 8,816,500.00
	design, management, geotechnical, survey (10%)				\$ 881,650.00
	contingency (30%)				\$ 2,644,950.00
	<b>TOTAL (ex GST)</b>				<b>\$ 12,343,100.00</b>

Option DT2

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT excl GST
1	ESTABLISHMENT AND PRELIMINARIES				
1.1	Establishment	1	Item	\$ 20,000.00	\$ 20,000.00
1.2	Set out works	16	Item	\$ 3,000.00	\$ 48,000.00
1.3	Services location	1	Item	\$ 5,000.00	\$ 5,000.00
1.4	Traffic & Pedestrian Management Plan	1	Item	\$ 50,000.00	\$ 50,000.00
1.5	Stabilised site access and wash bay	16	Each	\$ 10,000.00	\$ 160,000.00
	SUBTOTAL				\$ 283,000.00
2	Levee				
2.1	Levee cost estimate	4110	m	\$ 1,800.00	\$ 7,398,000.00
2.2	Footpath - 1.5m wide	4110	m	\$ 150.00	\$ 616,500.00
2.3	Drainage				
2.3.1	DN 450 pipe with headwall through levee	17	Each	\$ 750.00	\$ 12,750.00
2.3.2	Backflow prevention device	17	Each	\$ 1,000.00	\$ 17,000.00
2.4	Floodgates				
2.4.1	Morton Cres Bridge	1	Item	\$ 100,000.00	\$ 100,000.00
2.4.2	Wetland	1	Item	\$ 15,000.00	\$ 15,000.00
	SUBTOTAL				\$ 8,159,250.00
3	Retaining walls				
3.1	Pine to Magnolia	100	m <sup>2</sup>	\$ 2,000.00	\$ 200,000.00
3.2	Kincumber to Magnolia	160	m <sup>2</sup>	\$ 2,000.00	\$ 320,000.00
3.3	Additional retianing wall around peninsula	1209	m <sup>2</sup>	\$ 2,000.00	\$ 2,418,000.00
	SUBTOTAL				\$ 2,938,000.00
4	Road Raising (footpath only)				
4.1	Davistown Road				
4.1.1	earthworks	230	m	\$ 1,800.00	\$ 414,000.00
4.1.2	footpath 1.5m wide	230	m	\$ 150.00	\$ 34,500.00
	SUBTOTAL				\$ 448,500.00
4.2	Murna Road				
4.2.1	earthworks	150	m	\$ 1,800.00	\$ 270,000.00
4.2.2	footpath 1.5m wide	150	m	\$ 150.00	\$ 22,500.00
	SUBTOTAL				\$ 292,500.00
4.3	Dilgara Ave				\$ 292,500.00
4.3.1	earthworks	90	m	\$ 1,800.00	\$ 162,000.00
4.3.2	footpath 1.5m wide	90	m	\$ 150.00	\$ 13,500.00
	SUBTOTAL				\$ 175,500.00
4.4	Lilli Pilli & Pine Street				
4.4.1	earthworks	320	m	\$ 1,800.00	\$ 576,000.00
4.4.2	footpath 1.5m wide	320	m	\$ 150.00	\$ 48,000.00
	SUBTOTAL				\$ 624,000.00
4.5	Kincumber Cres				
4.5.1	earthworks	80	m	\$ 1,800.00	\$ 144,000.00
4.5.2	footpath 1.5m wide	80	m	\$ 150.00	\$ 12,000.00
	SUBTOTAL				\$ 156,000.00
4.6	Morton Cres				
4.6.1	earthworks	420	m	\$ 1,800.00	\$ 756,000.00
4.6.2	footpath 1.5m wide	420	m	\$ 150.00	\$ 63,000.00
	SUBTOTAL				\$ 819,000.00
	SUBTOTAL				\$ 13,895,750.00
	design, management, geotechnical, survey (10%)				\$ 1,389,575.00
	contingency (30%)				\$ 4,168,725.00
	<b>TOTAL (ex GST)</b>				<b>\$ 19,454,050.00</b>

Option DT3

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT excl GST
1	ESTABLISHMENT AND PRELIMINARIES				
1.1	Establishment	1	Item	\$ 20,000.00	\$ 20,000.00
1.2	Set out works	10	Item	\$ 3,000.00	\$ 30,000.00
1.3	Services location	1	Item	\$ 5,000.00	\$ 5,000.00
1.4	Traffic & Pedestrian Management Plan	1	Item	\$ 30,000.00	\$ 30,000.00
1.5	Stabilised site access and wash bay	10	Each	\$ 10,000.00	\$ 100,000.00
	SUBTOTAL				\$ 185,000.00
2	Levee				
2.1	Levee cost estimate	2900	m	\$ 2,200.00	\$ 6,380,000.00
2.2	Footpath - 1.5m wide	2900	m	\$ 150.00	\$ 435,000.00
2.3	Drainage				
2.3.1	DN 450 pipe with headwall through levee	12	Each	\$ 750.00	\$ 9,000.00
2.3.2	Backflow prevention device	12	Each	\$ 1,000.00	\$ 12,000.00
2.4	Floodgates				
2.4.1	Morton Cres Bridge	1	Item	\$ 100,000.00	\$ 100,000.00
2.4.2	Wetland	1	Item	\$ 15,000.00	\$ 15,000.00
	SUBTOTAL				\$ 6,951,000.00
3	Retaining walls				
3.1	Pine to Magnolia	80	m <sup>2</sup>	\$ 2,000.00	\$ 160,000.00
3.2	Kincumber to Magnolia	135	m <sup>2</sup>	\$ 2,000.00	\$ 270,000.00
	SUBTOTAL				\$ 430,000.00
4	Road Raising (footpath only)				
4.1	Davistown Road				
4.1.1	earthworks	230	m	\$ 1,500.00	\$ 345,000.00
4.1.2	footpath 1.5m wide	230	m	\$ 150.00	\$ 34,500.00
	SUBTOTAL				\$ 379,500.00
4.2	Murna Road				
4.2.1	earthworks	150	m	\$ 1,500.00	\$ 225,000.00
4.2.2	footpath 1.5m wide	150	m	\$ 150.00	\$ 22,500.00
	SUBTOTAL				\$ 247,500.00
4.3	Dilgara Ave				\$ 247,500.00
4.3.1	earthworks	90	m	\$ 1,500.00	\$ 135,000.00
4.3.2	footpath 1.5m wide	90	m	\$ 150.00	\$ 13,500.00
	SUBTOTAL				\$ 148,500.00
4.4	Lilli Pilli & Pine Street				
4.4.1	earthworks	320	m	\$ 1,500.00	\$ 480,000.00
4.4.2	footpath 1.5m wide	320	m	\$ 150.00	\$ 48,000.00
	SUBTOTAL				\$ 528,000.00
4.5	Kincumber Cres				
4.5.1	earthworks	80	m	\$ 1,500.00	\$ 120,000.00
4.5.2	footpath 1.5m wide	80	m	\$ 150.00	\$ 12,000.00
	SUBTOTAL				\$ 132,000.00
4.6	Morton Cres				
4.6.1	earthworks	320	m	\$ 1,500.00	\$ 480,000.00
4.6.2	footpath 1.5m wide	320	m	\$ 150.00	\$ 48,000.00
	SUBTOTAL				\$ 528,000.00
	SUBTOTAL				\$ 9,529,500.00
	design, management, geotechnical, survey (10%)				\$ 952,950.00
	contingency (30%)				\$ 2,858,850.00
	<b>TOTAL (ex GST)</b>				<b>\$ 13,341,300.00</b>

Option DT4

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT excl GST
1	replace pits with greater inlet capacity pits	100	each	\$ 4,000.00	\$ 400,000.00
2	upgrade pipes	1200	m	\$ 900.00	\$ 1,080,000.00
	SUBTOTAL				\$ 1,480,000.00
	design, management, geotechnical, survey (10%)				\$ 148,000.00
	contingency (30%)				\$ 444,000.00
	<b>TOTAL (ex GST)</b>				<b>\$ 2,072,000.00</b>

Option DT5

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT excl GST
1	remove illegal structures	1	item	\$ 100,000.00	\$ 100,000.00
2	construct culvert or swale	180	m	\$ 2,000.00	\$ 360,000.00
	SUBTOTAL				\$ 460,000.00
	design, management, geotechnical, survey (10%)				\$ 46,000.00
	contingency (30%)				\$ 138,000.00
	<b>TOTAL (ex GST)</b>				<b>\$ 644,000.00</b>

Option EB1

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT excl GST
1	Set out works	1	Item	\$ 5,000.00	\$ 5,000.00
2	Services location	1	Item	\$ 2,000.00	\$ 2,000.00
3	Traffic & Pedestrian Management Plan	1	Item	\$ 10,000.00	\$ 10,000.00
4	exhume existing pipes and dispose	250	m	\$ 80.00	\$ 20,000.00
5	supply and install new pipe and culvert (assume 1.5m dia RCP)	250	m	\$ 900.00	\$ 225,000.00
6	headwalls	1	each	\$ 3,000.00	\$ 3,000.00
	SUBTOTAL				\$ 265,000.00
	design, management, geotechnical, survey (10%)				\$ 26,500.00
	contingency (30%)				\$ 79,500.00
	<b>TOTAL (ex GST)</b>				<b>\$ 371,000.00</b>



Option EB4

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT excl GST
1	ESTABLISHMENT AND PRELIMINARIES				
1.1	Establishment	1	Item	\$ 20,000.00	\$ 20,000.00
1.2	Set out works	8	Item	\$ 3,000.00	\$ 24,000.00
1.3	Services location	1	Item	\$ 5,000.00	\$ 5,000.00
1.4	Traffic & Pedestrian Management Plan	1	Item	\$ 25,000.00	\$ 25,000.00
1.5	Stabilised site access and wash bay	8	Each	\$ 10,000.00	\$ 80,000.00
	SUBTOTAL				\$ 154,000.00
2	Levee				
2.1	Levee cost estimate	590	m	\$ 1,800.00	\$ 1,062,000.00
2.2	Footpath - 1.5m wide	590	m	\$ 150.00	\$ 88,500.00
2.3	Drainage				
2.3.1	DN 450 pipe with headwall through levee	3	Each	\$ 750.00	\$ 2,250.00
2.3.2	Backflow prevention device	3	Each	\$ 1,000.00	\$ 3,000.00
2.4	Private Seawall (EB3)	1555	m	\$ 200.00	\$ 311,000.00
	SUBTOTAL				\$ 1,466,750.00
3	Retaining walls				
3.1	Rickard to Myler	120	m <sup>2</sup>	\$ 2,000.00	\$ 240,000.00
3.2	Sorrento Rd west	108	m <sup>2</sup>	\$ 2,000.00	\$ 216,000.00
3.3	Sher Close	66	m <sup>2</sup>	\$ 2,000.00	\$ 132,000.00
3.4	Shelly Beach Rd / Kendall Rd	315	m <sup>2</sup>	\$ 2,000.00	\$ 630,000.00
	SUBTOTAL				\$ 1,218,000.00
4	Road Raising (footpath only)				
4.1	Sorrento Rd and Gordon Rd				
4.1.1	earthworks	150	m	\$ 1,800.00	\$ 270,000.00
4.1.2	footpath 1.5m wide	150	m	\$ 150.00	\$ 22,500.00
	SUBTOTAL				\$ 292,500.00
4.2	Kendall Rd				
4.2.1	earthworks	150	m	\$ 1,800.00	\$ 270,000.00
4.2.2	footpath 1.5m wide	150	m	\$ 150.00	\$ 22,500.00
	SUBTOTAL				\$ 292,500.00
	SUBTOTAL				\$ 3,423,750.00
	design, management, geotechnical, survey (10%)				\$ 102,712.50
	contingency (30%)				\$ 1,027,125.00
	<b>TOTAL (ex GST)</b>				<b>\$ 4,553,587.50</b>

Option EB5

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT excl GST
1	ESTABLISHMENT AND PRELIMINARIES				
1.1	Establishment	1	Item	\$ 10,000.00	\$ 10,000.00
1.2	Set out works	1	Item	\$ 10,000.00	\$ 10,000.00
1.3	Services location	1	Item	\$ 5,000.00	\$ 5,000.00
1.4	Traffic & Pedestrian Management Plan	1	Item	\$ 5,000.00	\$ 5,000.00
	SUBTOTAL				\$ 30,000.00
2	SITE WORKS				
2.1	Demolition (allowance)	6.0	each	\$ 25,000.00	\$ 150,000.00
	SUBTOTAL				\$ 150,000.00
3	Swale - rectangular, vertical sides				
3.1	Swale cost estimate	6000	m2	\$ 25.00	\$ 150,000.00
3.2	Retaining walls	710	m2	\$ 800.00	\$ 568,000.00
	SUBTOTAL				\$ 718,000.00
4	Road culvert crossings				
4.1	3 x 2.7 x 0.6 RCBC	73	m	\$ 3,000.00	\$ 219,000.00
4.2	3 x 2.7 x 0.6 Headwall	6	each	\$ 10,000.00	\$ 60,000.00
4.3	DN450 RRI Class 3	36	m	\$ 250.00	\$ 9,000.00
4.4	Pit (900x900)	2	each	\$ 2,500.00	\$ 5,000.00
4.5	DN450mm Headwall	2	Item	\$ 1,500.00	\$ 3,000.00
	SUBTOTAL				\$ 296,000.00
5	SOIL AND WATER MANAGEMENT				
5.1	Soil and water management	350	m	\$ 20.00	\$ 7,000.00
	SUBTOTAL				\$ 7,000.00
6	Property Purchase	6	each	\$ 800,000.00	\$ 4,800,000.00
	SUBTOTAL				\$ 6,001,000.00
	design, management, geotechnical, survey (10%)				\$ 120,100.00
	contingency (30%)				\$ 360,300.00
	<b>TOTAL (ex GST)</b>				<b>\$ 6,481,400.00</b>

Option EB6

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT excl GST
1	ESTABLISHMENT AND PRELIMINARIES				
1.1	Establishment	1	Item	\$ 10,000.00	\$ 10,000.00
1.2	Set out works	1	Item	\$ 15,000.00	\$ 15,000.00
1.3	Services location	1	Item	\$ 5,000.00	\$ 5,000.00
1.4	Traffic & Pedestrian Management Plan	1	Item	\$ 5,000.00	\$ 5,000.00
	SUBTOTAL				\$ 35,000.00
2	SITE WORKS				
2.1	Site clearance (allowance)	1.0	ha	\$ 60,000.00	\$ 60,000.00
	SUBTOTAL				\$ 60,000.00
3	Swale - trapezoidal, grassed				
3.1	excavation	600	m3	\$ 250.00	\$ 150,000.00
3.2	grassing	10600	m2	\$ 10.00	\$ 106,000.00
3.3	retaining wall	50	m2	\$ 800.00	\$ 40,000.00
	SUBTOTAL				\$ 296,000.00
4	Drainage				
4.1	DN1500 RRJ Class 3	130	m	\$ 900.00	\$ 117,000.00
4.2	Pit (900x900)	3	each	\$ 2,500.00	\$ 7,500.00
4.2	DN1500mm Headwall	1	Item	\$ 3,000.00	\$ 3,000.00
	SUBTOTAL				\$ 127,500.00
5	SOIL AND WATER MANAGEMENT				
5.1	Soil and water management	400	m	\$ 20.00	\$ 8,000.00
	SUBTOTAL				\$ 8,000.00
	SUBTOTAL				\$ 526,500.00
	design, management, geotechnical, survey (10%)				\$ 52,650.00
	contingency (30%)				\$ 157,950.00
	<b>TOTAL (ex GST)</b>				<b>\$ 737,100.00</b>

Option EB7

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT excl GST
1	ESTABLISHMENT AND PRELIMINARIES				
1.1	Establishment	1	Item	\$ 10,000.00	\$ 10,000.00
1.2	Set out works	1	Item	\$ 8,000.00	\$ 8,000.00
1.3	Services location	1	Item	\$ 7,000.00	\$ 7,000.00
1.4	Traffic & Pedestrian Management Plan	1	Item	\$ 7,000.00	\$ 7,000.00
	SUBTOTAL				\$ 32,000.00
2	SITE WORKS				
2.1	Site clearance (allowance)	0.2	ha	\$ 50,000.00	\$ 10,000.00
	SUBTOTAL				\$ 10,000.00
3	Swale - trapezoidal, grassed				
3.1	excavation	650	m3	\$ 250.00	\$ 162,500.00
3.2	grassing	1320	m2	\$ 10.00	\$ 13,200.00
	SUBTOTAL				\$ 175,700.00
5	SOIL AND WATER MANAGEMENT				
5.1	Soil and water management	220	m	\$ 20.00	\$ 4,400.00
	SUBTOTAL				\$ 4,400.00
	SUBTOTAL				\$ 222,100.00
	design, management, geotechnical, survey (10%)				\$ 22,210.00
	contingency (30%)				\$ 66,630.00
	<b>TOTAL (ex GST)</b>				<b>\$ 310,940.00</b>

Option EM02

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT excl GST
1	Davistown Road Raising				
1.1	Malinya Road	3040	m2	\$ 250.00	\$ 760,000.00
1.2	Malinya Road (North-west)	800	m2	\$ 250.00	\$ 200,000.00
1.3	Paringa Avenue	1280	m2	\$ 250.00	\$ 320,000.00
1.4	Davistown Road	1700	m2	\$ 250.00	\$ 425,000.00
1.5	Lilli Pilli Street	3280	m2	\$ 250.00	\$ 820,000.00
1.6	Kincumber Crescent	400	m2	\$ 250.00	\$ 100,000.00
	SUBTOTAL				\$ 2,625,000.00
2	Empire Bay Road Raising				
2.1	Gordon Road	2080	m2	\$ 250.00	\$ 520,000.00
2.2	Boongala Avenue	3200	m2	\$ 250.00	\$ 800,000.00
2.3	Sorrento Road	1280	m2	\$ 250.00	\$ 320,000.00
2.4	Rickard Road	2240	m2	\$ 250.00	\$ 560,000.00
2.5	Greenfield Road	3200	m2	\$ 250.00	\$ 800,000.00
2.6	Empire Bay Drive	7000	m2	\$ 250.00	\$ 1,750,000.00
2.7	Pomona Road	4880	m2	\$ 250.00	\$ 1,220,000.00
2.8	Pomona Road (West)	480	m2	\$ 250.00	\$ 120,000.00
2.9	Palmers Lane	2800	m2	\$ 250.00	\$ 700,000.00
2.10	Rosella Road	400	m2	\$ 250.00	\$ 100,000.00
2.11	Shelly Beach Road	640	m2	\$ 250.00	\$ 160,000.00
	SUBTOTAL				\$ 7,050,000.00
	SUBTOTAL				\$ 9,675,000.00
	design, management, geotechnical, survey (10%)				\$ 967,500.00
	contingency (30%)				\$ 2,902,500.00
	<b>TOTAL (ex GST)</b>				<b>\$ 13,545,000.00</b>

Option EM03

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT excl GST
1	Set out works	1	Item	\$ 5,000.00	\$ 5,000.00
2	Services location	1	Item	\$ 2,000.00	\$ 2,000.00
3	Traffic & Pedestrian Management Plan	1	Item	\$ 20,000.00	\$ 20,000.00
4	exhume existing pipes and dispose	15	m	\$ 80.00	\$ 1,200.00
5	supply and install new RCBC	15	m	\$ 6,000.00	\$ 90,000.00
6	headwalls	2	each	\$ 5,000.00	\$ 10,000.00
	SUBTOTAL				\$ 128,200.00
	design, management, geotechnical, survey (10%)				\$ 12,820.00
	contingency (30%)				\$ 38,460.00
	<b>TOTAL (ex GST)</b>				<b>\$ 179,480.00</b>