

Floodplain Risk Management Study

APPENDIX B
FLOOD DAMAGES METHODOLOGY

B Damage Methodology

Residential Damage Curves

The draft DNR (now OEH) Floodplain Management Guideline No. 4 Residential Flood Damage Calculation (NSW Government, 2005) was used in the creation of the residential damage curves. These guidelines include a template spreadsheet program that determines damage curves for three types of residential buildings, namely:

- Single storey, slab on ground,
- Two storey, slab on ground,
- Single storey, high set.

Damages are generally incurred on a property prior to any over floor flooding. The OEH curves allow for a damage of \$11,100 (March 2015 dollars) to be incurred when the water level reaches the base of the house, with the base of the house assumed to be 0.3m below the floor level for slab on ground. We have assumed that this remains constant until over floor flooding occurs. A nominal \$3,000 has been allowed to represent damage to gardens where the ground level of the property is overtopped and the depth of flooding is at least 0.3m below the floor of the house. This may occur on steeper properties and larger properties where the garden and fences may be impacted, but the flood waters do not reach the house.

There are a number of input parameters required for the OEH curves, such as floor area and level of flood awareness. The following parameters were adopted:

- A value of 150m² was adopted as a conservative estimate of the floor area for residential dwellings in the floodplain. With a floor area of 150m², the default contents value is \$62,300 (May 2014 dollars),
- The effective warning time has been assumed to be zero due to the absence of any flood warning systems in the catchment. A long effective warning time allows residents to prepare for flooding by moving valuable household contents and hence reduce the potential damages of household contents,
- The area is a small part of the regional area, and as such is not likely to cause any post flood inflation. These inflation costs are generally experienced in regional areas where re-construction resources are limited and large floods can cause a strain on these resources.

Average Weekly Earnings

The OEH curves are derived for late 2001 and were updated to represent March 2015 dollars. General recommendations by OEH are to adjust the values in residential damage curves by Average Weekly Earnings (AWE) rather than by the inflation rate as measured by the Consumer Price Index (CPI). OEH proposes that AWE is a better representation of societal wealth, and hence an indirect measure of the building and contents value of a home. The most recent data from the Australian Bureau of Statistics at the time of this study was for May 2014. Therefore, all ordinates in the residential flood damage curves were updated to May 2014 dollars. In addition, all damage curves include GST as per OEH recommendations.

The OEH guidelines were derived in November 2001, which allows us to use the November 2001 AWE statistics (issued quarterly) for comparison purposes. May 2014 AWE values were taken from the Australian Bureau of Statistics website (ABS, 2014).

Consequently, damages have been increased by 66% and GST has been included compared to 2001 values.

Average Weekly Earnings (AWE) Statistics for Residential Damage Curves

Month	Year	AWE
November	2001	\$676.40
March	2015	\$1,123.00

Commercial Damage Curves

Commercial damage curves were adopted from the FLDamage Manual (Water Studies Pty Ltd, 1992). FLDamage allows for three types of commercial properties:

- Low value commercial,
- Medium value commercial,
- High value commercial.

In determining these damage curves, it has been assumed that the effective warning time is approximately zero, and the loss of trading days as a result of the flooding has been taken as 10.

These curves are determined based on the floor area of the property. The floor level survey provides an estimate of the floor area of the individual commercial properties. These have been used to factor these curves.

The Consumer Price Index (CPI) was used to bring the 1990 data to March 2014 dollars, using data from the Australian Bureau of Statistics (ABS, 2014). It was assumed that the FLDamage data was in June 1990 dollars.

Consequently, commercial damages have been increased by 84% and GST has been included compared to 1990 values.

CPI Statistics for Commercial Damage Curves

Month	Year	CPI
June	1990	\$102.50
March	2015	\$188.43

Industrial Damage Curves

Cardno, as part of a previous floodplain management study (Cardno, 1998) conducted a survey of industrial properties in 1998 for Wollongong City Council. The damage curves derived from this survey are more recent than those presented in FLDamage and have been used in a number of previous studies. We therefore have used these damage curves for this study.

The curves were prepared for three categories:

- Low value industrial,
- Medium value industrial,
- High value industrial.

Within the catchment, there are no properties considered to be representative of high value industrial properties, and hence these curves were not used.

The floor areas for the industrial properties were estimated during the floor level survey. To normalise the damages for property size, the curves have been factored to account for floor area.

The survey conducted only accounts for structural and contents damage to the property. Clean-up costs and indirect financial costs were estimated based on the FLDamage Manual (Water Studies Pty Ltd, 1992). Actual internal damage could be estimated, along with potential internal damage, using various factors within FLDamage. Using both the actual and potential internal damages, estimation of both the clean-up costs and indirect financial costs could be made.

Consequently, damages have been increased by 56.0% and GST has been included compared to the 1998 values.

CPI Statistics for Industrial Damage Curves

Month	Year	CPI
June	1998	\$121.00
March	2015	\$188.43

Adopted Damage Curves

The adopted damage curves are shown in **Figure B-1** to **Figure B-3**. For purposes of illustration, the commercial and industrial damage curves are shown for a property with a floor area of 100m², although the size would be individually determined for each commercial and industrial property when calculating catchment damages. The residential damage curves are shown for a property with a floor area of 150 m² (the adopted floor area for residential dwellings in the damages analysis).

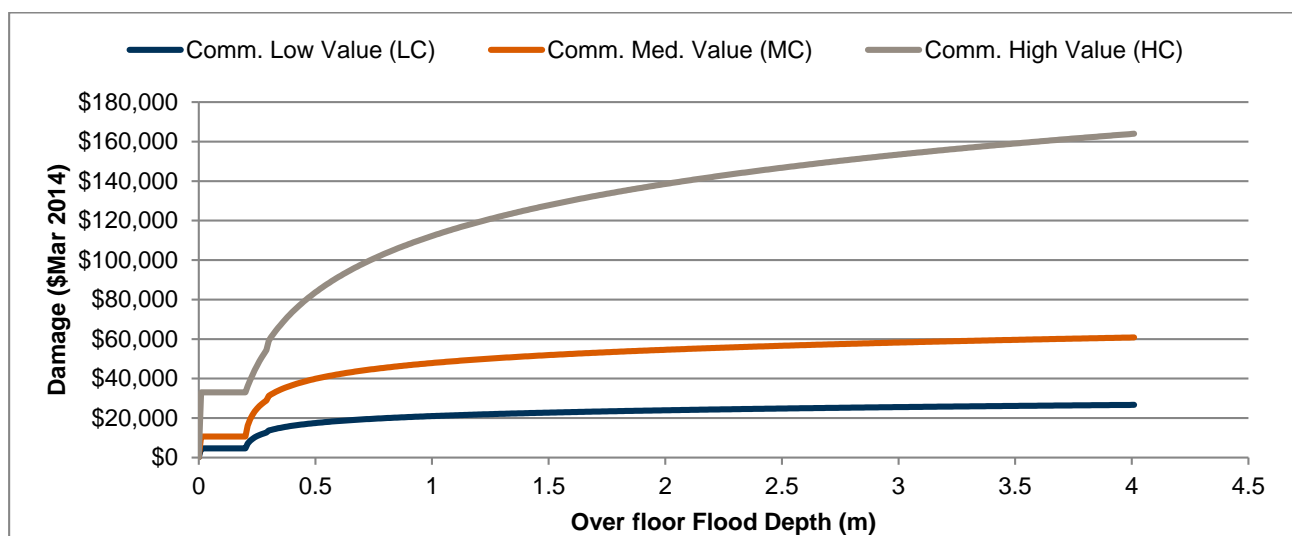


Figure B-1 Commercial Damage Curves for a property with 100 m² floor area (\$March 2015, including GST)

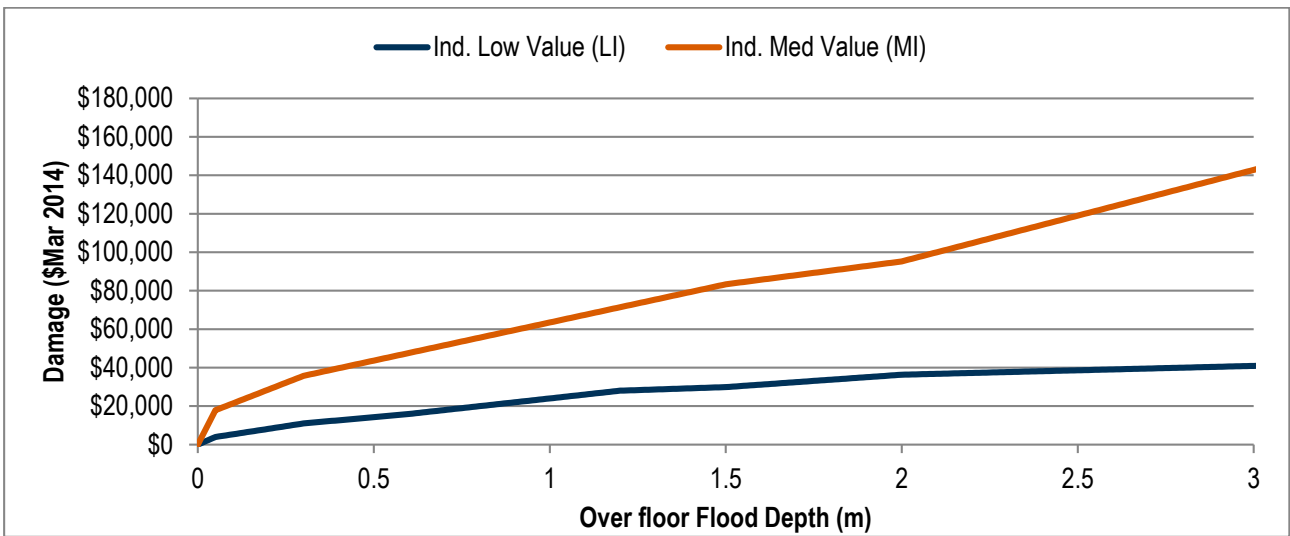


Figure B-2 Industrial Damage Curves for a property with 100 m² floor area (\$March 2015, including GST)

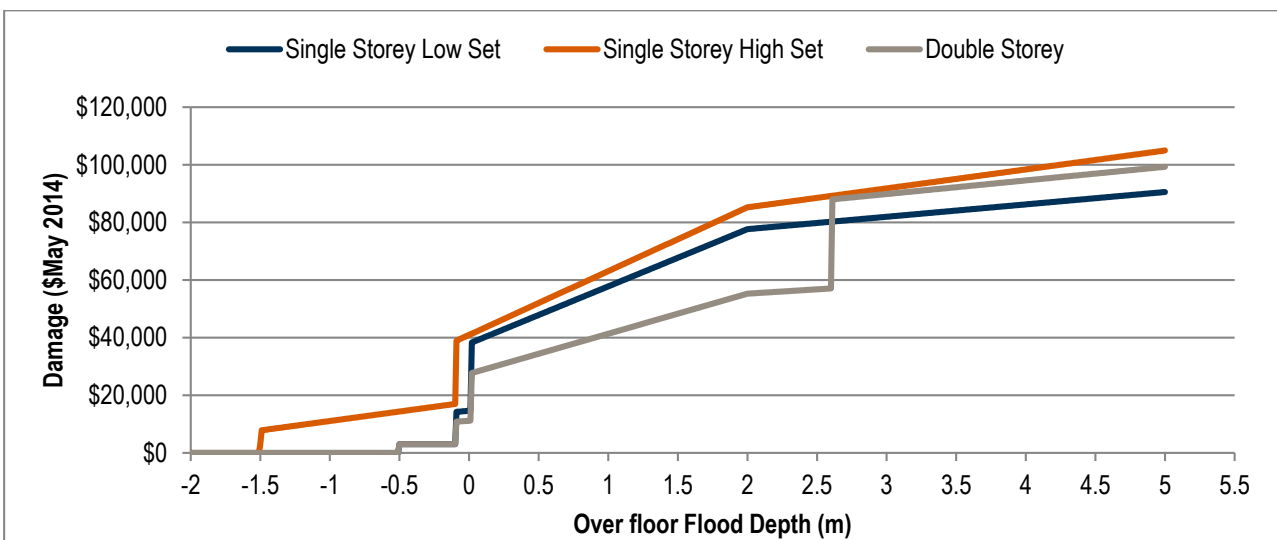


Figure B-3 Residential Damage Curves for a property with 150 m² floor area (\$March 2015, including GST)

Floodplain Risk Management Study

APPENDIX C
THREATENED FLORA AND FAUNA

C Threatened Flora Fauna

Table C-1: Flora Records within the Nowra and Browns Creeks Catchment Area

Family Name	Scientific Name	Common Name	TSC Act Status	EPBC Act Status
Fabaceae (Mimosoideae)	<i>Acacia pubescens</i>	Downy Wattle	V, P	V
Proteaceae	<i>Banksia spinulosa</i> var. <i>spinulosa</i>		P	
Cyperaceae	<i>Caustis flexuosa</i>	Curly Wig	P	
Orchidaceae	<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V, P	V
Cyperaceae	<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge	P	
Myrtaceae	<i>Kunzea ambigua</i>	Tick Bush	P	
Zamiaceae	<i>Macrozamia communis</i>	Burrawang	P	
Proteaceae	<i>Persoonia linearis</i>	Narrow-leaved Geebung	P	
Proteaceae	<i>Persoonia mollis</i> subsp. <i>caleyi</i>		P	
Proteaceae	<i>Persoonia mollis</i> subsp. <i>leptophylla</i>		P	
Proteaceae	<i>Petrophile pedunculata</i>		P	
Orchidaceae	<i>Pterostylis gibbosa</i>	Illawarra Greenhood	E1, P	E
Orchidaceae	<i>Pterostylis vernalis</i>		E4A, P	CE
Myrtaceae	<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E1	V
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion				TEC

P = Protected, V = Vulnerable, E1 = Endangered under the TSC Act, E = Endangered under the EPBC Act, CE = Critically Endangered, TEC = Threatened Ecological Community

Table C-2: Fauna Records within the Nowra and Browns Creeks Catchment Area

Family Name	Scientific Name	Common Name	TSC Act Status	EPBC Act Status
Acanthizidae	<i>Acanthiza lineata</i>	Striated Thornbill	P	
Acanthizidae	<i>Acanthiza nana</i>	Yellow Thornbill	P	
Acanthizidae	<i>Acanthiza pusilla</i>	Brown Thornbill	P	
Meliphagidae	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	P	
Accipitridae	<i>Accipiter fasciatus</i>	Brown Goshawk	P	
Agamidae	<i>Amphibolurus muricatus</i>	Jacky Lizard	P	
Dasyuridae	<i>Antechinus stuartii</i>	Brown Antechinus	P	
Meliphagidae	<i>Anthochaera carunculata</i>	Red Wattlebird	P	
Burhinidae	<i>Burhinus grallarius</i>	Bush Stone-curlew	E1,P	
Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	P	
Cacatuidae	<i>Cacatua tenuirostris</i>	Long-billed Corella	P	
Cuculidae	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	P	
Cuculidae	<i>Cacomantis pallidus</i>	Pallid Cuckoo	P	
Cacatuidae	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V,P,3	
Cacatuidae	<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	P	
Cacatuidae	<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V,P,2	
Alcedinidae	<i>Ceyx azureus</i>	Azure Kingfisher	P	
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	P	
Vespertilionidae	<i>Chalinolobus morio</i>	Chocolate Wattled Bat	P	
Chelidae	<i>Chelodina longicollis</i>	Eastern Snake-necked Turtle	P	
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck	P	
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	P	
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	P	
Campephagidae	<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	P	
Corcoracidae	<i>Corcorax melanorhamphos</i>	White-winged Chough	P	
Climacteridae	<i>Cormobates leucophaea</i>	White-throated Treecreeper	P	
Corvidae	<i>Corvus coronoides</i>	Australian Raven	P	
Artamidae	<i>Cracticus tibicen</i>	Australian Magpie	P	
Artamidae	<i>Cracticus torquatus</i>	Grey Butcherbird	P	
Myobatrachidae	<i>Crinia signifera</i>	Common Eastern Froglet	P	
Alcedinidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	P	
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird	P	

Family Name	Scientific Name	Common Name	TSC Act Status	EPBC Act Status
Cacatuidae	<i>Eolophus roseicapillus</i>	Galah	P	
Petroicidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin	P	
Cuculidae	<i>Eudynamys orientalis</i>	Eastern Koel	P	
Scincidae	<i>Eulamprus quoyii</i>	Eastern Water-skink	P	
Coraciidae	<i>Eurystomus orientalis</i>	Dollarbird	P	
Acanthizidae	<i>Gerygone albogularis</i>	White-throated Gerygone	P	
Psittacidae	<i>Glossopsitta concinna</i>	Musk Lorikeet	P	
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark	P	
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow	P	
Ardeidae	<i>Ixobrychus flavicollis</i>	Black Bittern	V,P	
Scincidae	<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink	P	
Scincidae	<i>Lampropholis guichenoti</i>	Pale-flecked Garden Sunskink	P	
Meliphagidae	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	P	
Myobatrachidae	<i>Limnodynastes peronii</i>	Brown-striped Frog	P	
Hylidae	<i>Litoria aurea</i>	Green and Golden Bell Frog	E1,P	V
Hylidae	<i>Litoria dentata</i>	Bleating Tree Frog	P	
Hylidae	<i>Litoria fallax</i>	Eastern Dwarf Tree Frog	P	
Hylidae	<i>Litoria jervisiensis</i>	Jervis Bay Tree Frog	P	
Hylidae	<i>Litoria peronii</i>	Peron's Tree Frog	P	
Hylidae	<i>Litoria tyleri</i>	Tyler's Tree Frog	P	
Hylidae	<i>Litoria verreauxii</i>	Verreaux's Frog	P	
Accipitridae	<i>Lophoictinia isura</i>	Square-tailed Kite	V,P,3	
Macropodidae	<i>Macropus giganteus</i>	Eastern Grey Kangaroo	P	
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren	P	
Maluridae	<i>Malurus lamberti</i>	Variiegated Fairy-wren	P	
Meliphagidae	<i>Manorina melanocephala</i>	Noisy Miner	P	
Meliphagidae	<i>Meliphaga lewinii</i>	Lewin's Honeyeater	P	
Meliphagidae	<i>Melithreptus lunatus</i>	White-naped Honeyeater	P	
Phalacrocoracidae	<i>Microcarbo melanoleucos</i>	Little Pied Cormorant	P	
Monarchidae	<i>Myiagra cyanoleuca</i>	Satin Flycatcher	P	
Meliphagidae	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater	P	
Strigidae	<i>Ninox strenua</i>	Powerful Owl	V,P,3	
Vespertilionidae	<i>Nyctophilus sp.</i>	long-eared bat	P	

Family Name	Scientific Name	Common Name	TSC Act Status	EPBC Act Status
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon	P	
Acanthizidae	<i>Origma solitaria</i>	Rockwarbler	P	
Oriolidae	<i>Oriolus sagittatus</i>	Olive-backed Oriole	P	
Pachycephalidae	<i>Pachycephala pectoralis</i>	Golden Whistler	P	
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler	P	
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote	P	
Petauridae	<i>Petaurus australis</i>	Yellow-bellied Glider	V,P	
Petauridae	<i>Petaurus breviceps</i>	Sugar Glider	P	
Hirundinidae	<i>Petrochelidon nigricans</i>	Tree Martin	P	
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing	P	
Meliphagidae	<i>Philemon corniculatus</i>	Noisy Friarbird	P	
Psittacidae	<i>Platycercus elegans</i>	Crimson Rosella	P	
Psittacidae	<i>Platycercus eximius</i>	Eastern Rosella	P	
Elapidae	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	P	
Pseudocheiridae	<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum	P	
Psophodidae	<i>Psophodes olivaceus</i>	Eastern Whipbird	P	
Ptilonorhynchidae	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird	P	
Muridae	<i>Rattus fuscipes</i>	Bush Rat	P	
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail	P	
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	P	
Rhipiduridae	<i>Rhipidura rufifrons</i>	Rufous Fantail	P	
Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V,P	
Vespertilionidae	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V,P	
Cuculidae	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	P	
Acanthizidae	<i>Sericornis frontalis</i>	White-browed Scrubwren	P	
Artamidae	<i>Strepera graculina</i>	Pied Currawong	P	
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	P	
Alcedinidae	<i>Todiramphus sanctus</i>	Sacred Kingfisher	P	
Psittacidae	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	P	
Phalangeridae	<i>Trichosurus sp.</i>	brush-tail possum	P	
Charadriidae	<i>Vanellus miles</i>	Masked Lapwing	P	
Vespertilionidae	<i>Vespadelus darlingtoni</i>	Large Forest Bat	P	
Vespertilionidae	<i>Vespadelus vulturnus</i>	Little Forest Bat	P	

Family Name	Scientific Name	Common Name	TSC Act Status	EPBC Act Status
Vombatidae	<i>Vombatus ursinus</i>	Common Wombat	P	
Macropodidae	<i>Wallabia bicolor</i>	Swamp Wallaby	P	
Timaliidae	<i>Zosterops lateralis</i>	Silvereye	P	

P = Protected, V = Vulnerable, E1 = Endangered under the TSC Act, E = Endangered under the EPBC Act, CE = Critically Endangered, TEC = Threatened Ecological Community

Floodplain Risk Management Study

APPENDIX D
PRELIMINARY COST ESTIMATES

**Vegetation Management
 Cost Estimate**

31.03.2014

ITEM NO.	DESCRIPTION OF WORK	QUANTITY	UNIT	RATE	COST
1.0 GENERAL AND PRELIMINARIES					
1.1	Site establishment, security fencing, facilities & disestablishment	1	item		
1.2	Provision of sediment & erosion control	1	item		
1.3	Construction setout & survey	1	item		
1.4	Work as executed survey & documentation	1	item		
1.5	Geotechnical supervision, testing & certification	1	item		
	SUBTOTAL (Assumed as 15% of works cost)				56,900
2.0 CLEARING AND WEEDING					
2.1	Removal of trees and debris from within river (nominal cost)	1	item	50,000	50,000
2.2	Weeding / clearing of creek sections with overgrown banks or invasive / exotic species.	5400	lin.m	20	108,000
	SUBTOTAL				158,000
3.0 PLANTING					
3.1	Plant species as listed by ecologist, at stocking densities as defined by landscape architect to stabilise banks and channel	5,400	lin.m	40	216,000
	SUBTOTAL				216,000
4.0 MINOR LANDSCAPING					
4.1	Repair disturbed bank areas in accordance with landscape architects requirements (nominal allowance)	500	sq. m	10	5,000
	SUBTOTAL				5,000
CONSTRUCTION SUB-TOTAL					435,900
5.0 CONTINGENCIES					
5.1	50% construction cost				217,950
CONSTRUCTION TOTAL, excluding GST					653,850
GST					65,385
CONSTRUCTION TOTAL, including GST					719,235
CONSTRUCTION TOTAL, rounded					719,300

DISCLAIMER:

1. This estimate of cost is provided in good faith using information available at this stage. This estimate of cost is not guaranteed. Cardno (NSW) will not accept liability in the event that actual costs exceed the estimate.

NOTES:

1. Estimate does not include Consultant's fees, including design or project management
2. Assume existing drainage at sufficiently deep level to remain undisturbed.
3. Estimate / rates in 2010 dollars and does not allow for inflation

**Culvert Augmentation
 Cost Estimate**

11.05.2015

ITEM NO.	DESCRIPTION OF WORK	QUANTITY	UNIT	RATE	COST
1.0 GENERAL AND PRELIMINARIES					
1.1	Site establishment, security fencing, facilities & disestablishment	1	item		
1.2	Provision of sediment & erosion control	1	item		
1.3	Construction setout & survey	1	item		
1.4	Work as executed survey & documentation	1	item		
1.5	Geotechnical supervision, testing & certification	1	item		
	SUBTOTAL (Assumed as 15% of works cost)				59,100
2.0 DEMOLITION, CLEARING AND GRUBBING					
2.1	Clearing & grubbing (nominal allowance)	225	sq. m	10	2,250
2.2	Strip topsoil & stockpile for re-use (assuming 150mm depth)	33.75	cu. m	20	675
2.3	Dispose of excess topsoil (nominal 10% allowance)	3.375	cu. m	50	169
2.4	Pull up and dispose of existing road surface	450	sq.m	50	22,500
	SUBTOTAL				25,594
3.0 EARTHWORKS					
3.1	Minor, local earthworks (nominal cost)	1	item	10000	10,000
	SUBTOTAL				10,000
4.0 DRAINAGE					
4.1	Supply, excavate, bed, lay, joint, backfill and provide connections for Ø1.8m RCP including demolition and disposal of existing pipe, and installation of headwalls and erosion protection as required	20	lin.m	4200	84,000
4.1	Supply, excavate, bed, lay, joint, backfill and provide connections for Ø2.4m RCP including demolition and disposal of existing pipe, and installation of headwalls and erosion protection as required	40	lin.m	5100	204,000
	SUBTOTAL				288,000
5.0 PAVEMENTS					
5.1	Reinstate removed pavements including subgrade, surface and connection to existing	450	sq. m	150	67,500
	SUBTOTAL				67,500
6.0 MINOR LANDSCAPING					
6.1	Repair disturbed areas in accordance with landscape architects requirements (nominal allowance)	225	sq. m	10	2,250
	SUBTOTAL				2,250
CONSTRUCTION SUB-TOTAL					452,444
7.0 CONTINGENCIES					
7.1	50% construction cost				226,222
CONSTRUCTION TOTAL, excluding GST					678,666
GST					67,867
CONSTRUCTION TOTAL, including GST					746,532
CONSTRUCTION TOTAL, rounded					746,600

DISCLAIMER:

1. This estimate of cost is provided in good faith using information available at this stage. This estimate of cost is not guaranteed.
 Cardno (NSW) will not accept liability in the event that actual costs exceed the estimate.

NOTES:

1. Estimate does not include Consultant's fees, including design or project management
2. Assume existing drainage at sufficiently deep level to remain undisturbed.
3. Estimate / rates in 2015 dollars and does not allow for inflation

**Upstream Detention Basins
 Cost Estimate**

11.05.2015

ITEM NO.	DESCRIPTION OF WORK	QUANTITY	UNIT	RATE	COST
1.0 GENERAL AND PRELIMINARIES					
1.1	Site establishment, security fencing, facilities & disestablishment	1	item		
1.2	Provision of sediment & erosion control	1	item		
1.3	Construction setout & survey	1	item		
1.4	Work as executed survey & documentation	1	item		
1.5	Geotechnical supervision, testing & certification	1	item		
	SUBTOTAL (Assumed as 15% of works cost)				109,600
2.0 DEMOLITION, CLEARING AND GRUBBING					
2.1	Clearing & grubbing	3,600	sq. m	10	36,000
2.2	Strip topsoil & stockpile for re-use (assuming 150mm depth)	540	cu. m	20	10,800
2.3	Dispose of excess topsoil (nominal 10% allowance)	54	cu. m	50	2,700
	SUBTOTAL				49,500
3.0 EARTHWORKS					
3.1	Excavate basin - cut / fill & regrade to suit new design levels, including disposal / provision of cut / fill	18000	cu. m	35	630,000
	SUBTOTAL				630,000
4.0 DETENTION BASIN DRAINAGE					
3.1	Instal entry and exit weirs, construct drainage and conect to existing network (nominal cost)	1	item	15000	15,000
	SUBTOTAL				15,000
4.0 MINOR LANDSCAPING					
4.1	Repair disturbed areas in accordance with landscape architects requirements (nominal allowance)	3,600	sq. m	10	36,000
	SUBTOTAL				36,000
CONSTRUCTION SUB-TOTAL					840,100
5.0 CONTINGENCIES					
5.1	50% construction cost				420,050
CONSTRUCTION TOTAL, excluding GST					1,260,150
GST					126,015
CONSTRUCTION TOTAL, including GST					1,386,165
CONSTRUCTION TOTAL, rounded					1,386,200

DISCLAIMER:

1. This estimate of cost is provided in good faith using information available at this stage. This estimate of cost is not guaranteed. Cardno (NSW) will not accept liability in the event that actual costs exceed the estimate.

NOTES:

1. Estimate does not include Consultant's fees, including design or project management
2. Assume existing drainage at sufficiently deep level to remain undisturbed.
3. Estimate / rates in 2015 dollars and does not allow for inflation

Nowra and Browns Creek FRMSP



Channel Formalisation (Note: Basin costs not included)
Cost Estimate

11.05.2015

ITEM NO.	DESCRIPTION OF WORK	QUANTITY	UNIT	RATE	COST
1.0 GENERAL AND PRELIMINARIES					
1.1	Site establishment, security fencing, facilities & disestablishment	1	item		
1.2	Provision of sediment & erosion control	1	item		
1.3	Construction setout & survey	1	item		
1.4	Work as executed survey & documentation	1	item		
1.5	Geotechnical supervision, testing & certification	1	item		
	SUBTOTAL (Assumed as 15% of works cost)				369,900
2.0 DEMOLITION, CLEARING AND GRUBBING					
2.1	Clearing & grubbing	72,000	sq. m	10	720,000
2.2	Strip topsoil & stockpile for re-use (assuming 150mm depth)	10800	cu. m	20	216,000
2.3	Dispose of excess topsoil (nominal 10% allowance)	1080	cu. m	50	54,000
	SUBTOTAL				990,000
3.0 EARTHWORKS					
3.1	Formalise, shape and regrade channel, including disposal / provision of cut / fill	21600	cu. m	35	756,000
	SUBTOTAL				756,000
4.0 MINOR LANDSCAPING					
4.1	Repair disturbed areas in accordance with landscape architects requirements (nominal allowance)	72,000	sq. m	10	720,000
	SUBTOTAL				720,000
CONSTRUCTION SUB-TOTAL					2,835,900
5.0 CONTINGENCIES					
5.1	50% construction cost				1,417,950
CONSTRUCTION TOTAL, excluding GST					4,253,850
GST					425,385
CONSTRUCTION TOTAL, including GST					4,679,235
CONSTRUCTION TOTAL, rounded					4,679,300

DISCLAIMER:

1. This estimate of cost is provided in good faith using information available at this stage. This estimate of cost is not guaranteed. Cardno (NSW) will not accept liability in the event that actual costs exceed the estimate.

NOTES:

1. Estimate does not include Consultant's fees, including design or project management
2. Assume existing drainage at sufficiently deep level to remain undisturbed.
3. Estimate / rates in 2015 dollars and does not allow for inflation

**Industrial Precinct Works (Note: Basin costs not included)
 Cost Estimate**

11.05.2015

ITEM NO.	DESCRIPTION OF WORK	QUANTITY	UNIT	RATE	COST
1.0 GENERAL AND PRELIMINARIES					
1.1	Site establishment, security fencing, facilities & disestablishment	1	item		
1.2	Provision of sediment & erosion control	1	item		
1.3	Construction setout & survey	1	item		
1.4	Work as executed survey & documentation	1	item		
1.5	Geotechnical supervision, testing & certification	1	item		
	SUBTOTAL (Assumed as 15% of works cost)				93,900
2.0 DEMOLITION, CLEARING AND GRUBBING					
2.1	Clearing & grubbing	11,250	sq. m	10	112,500
2.2	Strip topsoil & stockpile for re-use (assuming 150mm depth)	1687.5	cu. m	20	33,750
2.3	Dispose of excess topsoil (nominal 10% allowance)	168.75	cu. m	50	8,438
	SUBTOTAL				154,688
3.0 EARTHWORKS					
3.1	Formalise, shape and regrade open channel through industrial precinct, including disposal / provision of cut / fill	9100	cu. m	35	318,500
3.1	Formalise, shape and regrade open drain along Central Avenue, including disposal / provision of cut / fill	1150	cu. m	35	40,250
	SUBTOTAL				358,750
4.0 MINOR LANDSCAPING					
4.1	Repair disturbed areas in accordance with landscape architects requirements (nominal allowance)	11,250	sq. m	10	112,500
	SUBTOTAL				112,500
CONSTRUCTION SUB-TOTAL					719,838
5.0 CONTINGENCIES					
5.1	50% construction cost				359,919
CONSTRUCTION TOTAL, excluding GST					1,079,756
GST					107,976
CONSTRUCTION TOTAL, including GST					1,187,732
CONSTRUCTION TOTAL, rounded					1,187,800

DISCLAIMER:

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NOTES:

1. Estimate does not include Consultant's fees, including design or project management
2. Assume existing drainage at sufficiently deep level to remain undisturbed.
3. Estimate / rates in 2015 dollars and does not allow for inflation

Floodplain Risk Management Study

APPENDIX E
MULTI CRITERIA ASSESSMENT

Nowra & Browns Creeks Floodplain Risk Management Study & Plan - Multi Criteria Assessment

No.	ID	Category of Measure	Description	Estimate of Capital Cost	Estimate of Recurrent Cost	Net Present Value (7%, 50 years)	Reduction in AAD	NPV of Reduction in AAD	Benefit - Cost Ratio	Score on Benefit Cost Ratio	Reduction in Risk to Property	Economic Score	Reduction in Risk to Life	Reduction in Social Disruption	Community Criteria	Council Support	Social Score	Water Quality and Flow	Fauna & Flora	Environmental Score	TOTAL SCORE	RANK on TOTAL SCORE
1	Opt1	Flood Modification	Vegetation Management	\$719,300	\$20,000	\$995,315	\$66,274	\$914,631	0.9	-1	2	0.0	1	0	2	2	1.3	0	0	0.0	1.3	6
2	Opt2	Flood Modification	Culvert Augmentation	\$746,600	\$5,000	\$815,604	-\$11,161	-\$154,030	-0.2	-2	-1	-1.7	-1	-1	-2	1	-0.8	0	0	0.0	-4.1	13
3	Opt3	Flood Modification	Upstream Basins	\$1,386,200	\$10,000	\$1,524,207	\$48,673	\$671,724	0.4	-1	1	-0.3	0	1	0	1	0.5	0	0	0.0	-0.2	11
4	Opt4	Flood Modification	Channel formalisation with upstream basins	\$6,065,500	\$20,000	\$6,341,515	\$14,581	\$201,229	0.0	-2	1	-1.0	0	0	1	1	0.5	0	0	0.0	-1.5	12
5	Opt5	Flood Modification	Industrial precinct drainage with upstream basins	\$2,574,000	\$15,000	\$2,781,011	\$99,444	\$1,372,401	0.5	-1	1	-0.3	1	2	2	2	1.8	0	0	0.0	1.1	7
16	P1	Property Modification	LEP Update	\$5,000	\$500	\$11,900	NC	N/A	N/A	2	2	2.0	1	1	0	1	0.8	0	0	0.0	4.8	2
17	P2	Property Modification	Building and Development Controls	\$15,000	\$500	\$21,900	NC	N/A	N/A	2	2	2.0	2	1	0	1	1.0	0	0	0.0	5.0	1
18	P3	Property Modification	House Raising	Not viable, refer report																		
19	P4	Property Modification	House Rebuilding	Not viable, refer report																		
20	P5	Property Modification	Voluntary Purchase	Not viable, refer report																		
21	P6	Property Modification	Land Swap	Not viable, refer report																		
22	P7	Property Modification	Council Redevelopment	Not viable, refer report																		
23	P8	Property Modification	Flood Proofing Guidelines	\$15,000	\$1,000	\$28,801	NC	N/A	N/A	2	1	1.7	1	0	2	1	1.0	0	0	0.0	4.3	3
24	EM1	Emergency Response Modification	Information transfer to the SES	\$3,000	\$0	\$3,000	NC	N/A	N/A	2	0	1.3	2	0	2	2	1.5	0	0	0.0	4.2	4
25	EM2	Emergency Response Modification	Local Flood Plans and update DISPLAN	\$30,000	\$2,000	\$57,601	NC	N/A	N/A	0	0	0.0	0	0	1	0	0.3	0	0	0.0	0.3	10
26	EM3	Emergency Response Modification	Flood warning system	Not viable, refer report																		
27	EM4	Emergency Response Modification	Public awareness and education	\$20,000	\$2,000	\$47,601	NC	N/A	N/A	0	1	0.3	2	1	2	1	1.5	0	0	0.0	2.2	5
28	EM5	Emergency Response Modification	Flood warning signs	\$5,000	\$200	\$7,760	NC	N/A	N/A	0	0	0.0	1	0	1	1	0.8	0	0	0.0	0.8	9
29	DC1	Data Collection Strategy	Data collection following a flood event	\$5,000	\$3,000	\$46,402	NC	N/A	N/A	0	0	0.0	0	0	2	2	1.0	0	0	0.0	1.0	8

* Indicates hydraulic model and detailed economic assessment used

NC - Not Costed