Hewitts Creek

Incorporating Slacky, Tramway, Woodlands & Thomas Gibson Creeks

Floodplain Risk Management Study & Plan

DECEMBER 2002

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WOLLONGONG
City of Innovation

FOREWORD

The State Government's Flood Policy is directed at providing solutions to existing flooding problems in developed areas and to ensuring that new development is compatible with the flood hazard and does not create additional flooding problems in other areas.

Under the policy, the management of flood liable land remains the responsibility of local government. The State subsidises flood management studies and works to alleviate existing problems and provides specialist technical advice to assist Councils in the discharge of their floodplain management responsibilities.

The policy provides for technical and financial support by the Government through the following five sequential stages:

1 Data Collection.	Involves collection and review of data with respect to flooding in the catchment including recorded flood levels, cross-section survey of creeks, and property survey (a Compendium of Data was prepared in September 2001 and used to support subsequent studies).
2. Flood Study:	Determines the nature and extent of the flooding problem in the catchment (completed study accompanies this report).
3. Floodplain Risk Management Study:	Evaluates management measures for the floodplain in respect to both existing and proposed developments (this study).
4. Floodplain Risk Management Plan:	Involves preparation and formal adoption by Council of a plan of management for the floodplain (integrated into this study).
5. Implementation of the Plan:	Involves management and implementation of the full range of measures outlined in the plan. Use of Local Environmental Plans and Policies (as amended by the outcomes of this study) to ensure new development is compatible with the flood hazard.

This present Floodplain Risk Management Study has been carried out for the Hewitt's Creek Floodplain Management Committee, established by Wollongong City Council for the purpose of investigating various floodplain risk management strategies to address flooding problems in Hewitt's Creek and its adjoining catchments. The findings of this study are based on consultation with the Floodplain Management Committee, the Community, Council officers and the Department of Land and Water Conservation.

Under the process set down in the Floodplain Management Manual, the study serves as input to the formulation by Council of a Floodplain Risk Management Plan for the floodplains of Hewitt's Creek and its adjacent catchments.

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GLOSSARY

Where the following abbreviations or technical terms occur in this report, they have the following meaning:

ABBREVIATIONS

AEP	-	Annual Exceedance Probability; The probability of a rainfall or flood event of given magnitude being equalled or exceeded in any one year.
AHD	-	Australian Height Datum: National reference datum for level
ARI	-	Average Recurrence Interval; The expected or average interval of time between exceedances of a rainfall or flood event of given magnitude.
ARR	-	Australian Rainfall and Runoff; National Code of Practice for Drainage published by Institution of Engineers, Australia, 1987.
AAD	-	Average Annual Damage
DCP	-	Development Control Plan
DLWC	-	Department of Land and Water Conservation
EPAA	-	Environmental Planning and Assessment Act (1979)
EPAR	-	Environmental Planning and Assessment Regulation (1994)
ESD	-	Ecologically Sustainable Development
FPDM	-	Floodplain Development Manual; Guidelines for Development in Floodplains published by N.S.W. State Government, 1986.
FPL	-	Flood Planning Level
FPMC	-	Floodplain Management Committee
FPMM	-	Floodplain Management Manual; The Management of Flood Liable Land published by N.S.W. State Government, 2001.
FRMS	-	Floodplain Risk Management Study
FRMP	-	Floodplain Risk Management Plan
FSL	-	Flood Surface Level
ha	-	Hectare (Area =10,000 m^2)
IFD	-	Intensity - Frequency - Duration; Rainfall parameters used to describe rainfall at a particular location.
IREP	-	Illawarra Regional Environmental Plan
IUDP	-	Illawarra Urban Development Program
km	-	Kilometre. (Distance = 1,000m)
LEP	-	Local Environmental Plan
LGA	-	Local Government Area
m^3	-	Cubic Metre. (Basic unit of volume)
m/s	-	Metres/Second (Velocity)
m^3/s	-	Cubic Metre per Second. (Flow rate)
m	-	Metre. (Basic unit of length)
mm	-	Millimetre. (Basic unit of length)
m^2	-	Square Metre. (Basic unit of area)
NPV	-	Net Present Value
NWC	-	Natural Water Course; A small creek or channel in its natural condition.
OSD	-	On Site Detention
PMF	-	Probable Maximum Flood; Flood calculated to be the maximum physically possible.
PMP	-	Probable Maximum Precipitation; Rainfall calculated to be the maximum physically possible.
RCP	-	Reinforced Concrete Pipe
RTA	-	Roads and Traffic Authority
SEPP	-	State Environmental Planning Policy
SES	-	State Emergency Service
s	-	Second (basic unit of time)
TDD	-	Total Direct Damages
VPS	-	Voluntary Purchase Scheme
WLEP	-	Wollongong Local Environmental Plan
yr	-	Year.

TECHNICAL TERMS

Afflux	-	Increase in depth of water in a channel or floodplain compared to natural conditions. Generally caused by a constriction downstream.
Alluvium	-	Material eroded, transported and deposited by streams.
Antecedent	-	Pre-existing (conditions e.g. wetness of soils).
Average annual damage	-	The average damage per year that would occur in a nominated development situation from flooding over a very long period of time.
Benefit Cost Ratio	-	A measure of the benefits attributable to a particular flood management measure. Calculated as the total sum of all benefits divided by the total sum of all costs
Catchment	-	Area draining into a particular creek system, typically bounded by higher ground around its perimeter.
Cover	-	Type and distribution of vegetation on catchment.
Critical Flow	-	Water flowing at a Froude No. of one.
Culvert	-	An enclosed conduit (typically pipe or box) that conveys stormwater below a road or embankment.
Debris Control Structure	-	A structure, typically made of steel, located at the inlet to an underground pipe system to collect waterborne debris before it has the chance to enter the pipe and cause blockage.
Direct Damages	-	Damage to personal property which can be directly attributed to contact with floodwaters.
Discharge	-	The flow rate of water.
Escarpment	-	A cliff or steep slope, of some extent, generally separating two level or gently sloping areas.
Freeboard	-	A factor of safety, usually expressed as a difference in height between the flood surface and a floor level, or embankment crest. 0.5m freeboard is typically incorporated into a FPL
Flood	-	A relatively high stream flow which overtops the stream banks.
Flood Liable Land	-	land susceptible to flooding by the probable maximum flood.
Flood storages	-	Those parts of the flood plain that are important for the storage of floodwaters during the passage of a flood.
Floodways	-	Those areas where a significant volume of water flows during floods. They are often aligned with obvious naturally defined channels and are areas which, if partly blocked, would cause a significant redistribution of flow.
Flood Fringes	-	Those parts of the flood plain left after floodways and flood storages have been abstracted.
Froude No.	-	A measure of flow instability - below a value of one, flow is tranquil and smooth, above one flow tends to be rough and undulating (as in rapids).
Geotechnical	-	Relating to Engineering and the materials of the earth's crust.
Gradient	-	Slope or rate of fall of land/pipe/stream.
Gully	-	Narrow ravine, small valley.
Hazard	-	Source of potential harm. Flooding which has potential to cause damage to the community.
Headwall	-	Wall constructed around inlet or outlet of a culvert.
Hydraulic	-	A term given to the study of water flow, as relates to the evaluation of flow depths, levels and velocities.
Hydrology	-	A term given to the study of the rainfall and runoff process.
Hydrograph	-	A graph of flood flow against time.
Hyetograph	-	A graph of rainfall intensity against time.
Indirect Damages	-	Flood damages which can be calculated in terms of a dollar cost but which are not directly the result of contact with floodwaters (e.g. loss of productivity and income)
Intangible Damages	-	Those costs attributable to flooding which cannot be easily quantified in terms of a dollar cost (e.g. ill health due to stress).
Isohyets	-	Lines joining points of equal rainfall on a plan.
Levee	-	A low wall usually made of earth, which is used to contain floodwaters within a defined floodplain

Management Measure	-	A measure put into place in order to reduce either the flood level or extent of flood damages at a particular site.
Manning's n	-	A measure of channel or pipe roughness.
Net Present Value	-	The value of a future series of payments or lump sum payment, discounted to an equivalent present day value.
Orographic	-	Pertaining to changes in relief, mountains.
Orthophoto	-	Aerial photograph with contours, boundaries or grids added.
Overflow Path	-	Area through which water flows when the capacity of the underground pipe drainage system is exceeded
Planning Control Matrix	-	A planning tool used by Council and developers in order to establish specific flood management requirements at a particular site.
Pluviograph	-	An instrument which continuously records rain collected
Retarding Basin	-	Large collection area which temporarily stores water during flood to reduce peak flow.
Risk	-	The chance of something happening that will have an impact. It is measured in terms of consequences and probability (likelihood). In the context of this study/plan, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
Runoff	-	Water running off a catchment during a storm.
Scour	-	Rapid erosion of soil in the banks or bed of a creek, typically occurring in areas of high flow velocities and turbulence.
Siltation	-	The filling or raising up of the bed of a watercourse or channel by deposited silt.
Stage Damage Curve	-	Mathematical relationship expressed as a curve describing the relationship between flood damage and above floor flow depth
Stratigraphy	-	The sequence of deposition of soils/rocks in layers.
Surcharge	-	Flow unable to enter a culvert or exiting from a pit as a result of inadequate capacity or overload.
Topography	-	The natural surface features of a region.
Urbanisation	-	The change in land usage from a natural to developed state.
Watercourse	-	A small stream or creek.
Zoning	-	Categorisation of land which sets out permissible uses for that land type. Usually determined by Council as part of a LEP.

EXECUTIVE SUMMARY

The Study Area

The Floodplain Risk Management Study area comprises the catchments of Slacky, Tramway, Woodlands, Hewitts and Thomas Gibson Creeks located in the suburbs of Bulli and Thirroul, north of Wollongong NSW. These catchments are drained by a series of small easterly flowing streams which have a combined catchment area of 790ha.

Existing landuse comprises natural escarpment forest on the steep western half of the catchment and a mix of residential, commercial and industrial development on the flatter eastern half. Urban expansion in the catchment has generally reached its limits, although there is ongoing redevelopment of industrial land along with intensification of densities in areas close to town centres.

Available Data

The study required the collection of a significant body of data on flooding and flood behaviour to assist with analysis of flood risk management options. The principle background documents used for the study include the 'Hewitts Creek Flood Study' and 'Hewitts Creek Compendium of Data'. The current study uses the modelling carried out for the Flood Study as a basis for further investigation.

The results of this modelling confirm the experience of most residents that overbank flooding occurs on a relatively frequent basis. In particular, several flooding 'hot spots' were identified throughout the study catchments including:

- *sites upstream of the rail line and other north-south orientated roadways and/or embankments;*
- *sites adjacent to culvert structures which are generally undersized and prone to blockage in larger events;*
- *sites that have poorly defined overflow paths such as the smaller tributaries of Hewitts Creek and in the older areas of Thomas Gibson Creek where creek systems have been piped; and*
- *sites downstream of uncontrolled flow diversions such as in Tramway Creek at the eastern end of Hobart Street.*

Consultation and Community Input

Consultation was an integral part of the study process from its inception. A series of meetings were held with the principal stakeholders including: Council; the Department of Land and Water Conservation; the Hewitts/Slacky Creek Floodplain Management Committee; Roads and Traffic Authority; BHP Billiton; and numerous private landowners. These meetings provided valuable information on flooding and flood behaviour and also provided an opportunity to discuss the study process and obtain feedback with regard to proposed management measures.

Existing Flood Risk

The study identified that the area generally suffers from:

- *significant inundation during large floods;*
- *rapid rate of rise of floodwaters;*
- *frequent occurrence of blockage resulting in unanticipated flooding and flow diversion;*
- *significant encroachment by development onto the floodplain;*
- *steep and erodible streams which contribute to structural damage and blockage downstream; and*
- *a general lack of controlled and well defined overflow paths.*

Areas experiencing high hydraulic hazard were identified as being generally limited to stream channel areas and areas subject to significant flow depth upstream of the rail embankment.

A large number of properties are inundated by floodwaters, resulting in significant damage. The table below summarises the modelling results for existing conditions for each catchment in

the study area. The total estimated average annual direct damage resulting from flooding is approximately $750,000 per year, equivalent to a Net Present Value of $10.4 million. During an extreme flood event, approximately 188 properties are flooded, 125 of which are flooded above floor level.

INUNDATED PROPERTIES AND DIRECT DAMAGES - EXISTING CONDITIONS

	No. of Properties with Yard and Above Floor Flooding											
	20% AEP		5% AEP		2%AEP		1% AEP		PMF			
Creek	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Direct Damage ($AAD)	Direct Damage ($NPV)
Slacky	0	0	27	1	27	1	28	1	35	6	38,000	520,000
Tramway	0	0	10	10	11	10	11	11	20	15	47,000	650,000
Woodlands	0	0	5	4	5	5	5	5	6	5	22,000	300,000
Hewitts	7	5	61	45	70	55	70	56	85	67	312,000	4,300,000
Hewitts (Stream 4)	3	1	4	2	4	2	4	2	4	3	70,000	970,000
Thomas Gibson	5	5	25	13	27	18	30	22	38	29	265,000	3,660,000
TOTAL	**15**	**11**	**132**	**75**	**144**	**91**	**148**	**97**	**188**	**125**	**754,000**	**10,410,000**

Planning and Policy Controls

The study identifies a number of existing policy controls which apply to floodplain management. These include a number of statutory controls which broadly govern the heads of consideration for Council when considering the approval and land use planning process for flood liable lands. More detailed guidance is given to Council for the development assessment process through strategic planning controls. However, these are often a subset of other planning instruments principally intended for other purposes. The need for an alternate control specifically related to flooding has therefore been identified and recommended.

The study proposes planning controls as a method of minimising future flood damages. The key document used as a basis for determining appropriate controls is the NSW Floodplain Management Manual (2001).

This management plan recommends that the Draft Development Control Plan (DCP) "Managing our Flood Risks" be used as Council's mechanism to ensure appropriate development controls are applied to future development on floodplains. The DCP will utilise a 'Planning Control Matrix' as a catchment specific tool to assist with decisions concerning floodplain development. The matrix will include specific requirements as to which property modification (minimum floor levels, building materials) and response modification (flood access, flood awareness) controls should be applied to each landuse within areas of equivalent flood risk.

The study has also identified flood planning control precincts where planning controls can be applied on the basis of estimated flood risk and hazard. More stringent controls and exclusions of development are proposed for the high flood risk precinct (to be applied using the matrix). Whereas lesser controls will be applied to those areas affected by less frequent floods. A minimum riparian set-back is also proposed for incorporation into the Wollongong Local Environmental Plan for high hazard areas.

Risk Management Schemes

In consultation with various stakeholders, over 200 measures for reducing flood risks were identified. Following a preliminary assessment, the more effective of these

measures were further developed into schemes for which detailed analysis was undertaken. A total of 15 Schemes were considered, generally two or three for each of the five main catchments in the study area. Each scheme represents an alternative method by which flood damage reductions could be structurally achieved.

A range of non-structural measures were also considered for adoption on a catchment wide basis. These include flood awareness campaigns, and expansion of the present SES Local Flood Plan. These measures are generally low cost, yet have the potential to significantly reduce flood damages.

Scheme Assessment

The benefits of the various schemes were then assessed through a process of:

- *Hydrologic and hydraulic modelling of each scheme for a range of flood events, including consideration of the impact of blockages and diversions;*
- *Calculation of direct flood damages which occur after implementation of each scheme. This involved calculation of the depth of flooding at each flood effected dwelling and comparing this depth against the adopted stage damage relationship to derive an equivalent dollar damage. This was then annualised to derive an equivalent Average Annual Damage (AAD) value;*
- *The indirect and intangible damages which occur after implementation of each scheme were then calculated using a standard multiplier applied to the direct damages. This multiplier was factored using multi-criteria analysis to take into account the performance of each scheme against a range of economic, social and ecological objectives;*
- *The construction cost of each scheme was then estimated;*
- *The direct benefits (reduction in damages) and construction cost estimates were then used to calculate the direct benefit cost ratio for each scheme.*
- *The overall benefit cost values derived for each scheme then allowed selection of a preferred scheme for each catchment and recommendations to be made.*

Floodplain Risk Management Plan

The study provides recommendations with respect to the preferred floodplain management scheme for each catchment to form a key component of the Floodplain Risk Management Plan. The overall scheme comprises a combination of structural and non-structural measures.

For floodplains in the study area generally, non structural measures such as planning and development controls and response modification measures have been recommended including development controls (consistent with flood hazard); education programmes to improve public awareness of flood behaviour; and expansion of the SES Local Flood Plan to incorporate catchment specific data including location of residents at greatest risk. A Riparian Management Study is also recommended for the study area to identify potential sources of erosion and their appropriate management.

Within each catchment the following are some of the specific management recommendations made:

- *The flood mitigation scheme SB was recommended for Slacky Creek, involving formalisation of the existing diversion down Hobart St to Tramway Creek. This scheme was selected in recognition of its economic performance and reduced disruption to existing flood behaviour. In addition, specific planning controls were identified for the upper reaches involving minimum set backs and retention of open space.*
- *The flood mitigation scheme TB1 was recommended for Tramway Creek, involving formalisation of the existing diversion, but providing for controlled management of overflows along*

Hobart Street into the main watercourse east of the Princes Highway. This option is compatible with scheme SB and was selected for similar reasons. It was preferred over other Tramway Creek options as it is both relatively economic and provides reliable performance. Identified planning controls include minimisation of development in flood prone areas between the railway and highway, and setting aside of land along the south side of Hobart Street to formalise the overflow path.

- *The flood mitigation scheme WA was recommended for Woodlands Creek, involving construction of an enlarged culvert beneath the rail and re-establishment of the natural connection between lower Woodlands and Tramway Creek. This option was selected on the basis of economic and environmental performance. It was also noted that this option provides significant benefits to residents within the Hewitts Creek catchment as it removes a significant diversion which presently exists. Given the relatively large areas of open space along this creek, no catchment specific planning controls were identified other than application of standard flood management controls.*

- *The flood mitigation scheme HA was recommended for Hewitts Creek involving construction of a small levee at Corbett Ave. This scheme was selected on the basis of its economic performance. This catchment also requires the strict application of planning controls within the upper reaches, particularly upstream of Lachlan Street where minor developments close to the creek should be closely assessed. Intensification of development of flood prone areas immediately upstream of the rail should also be discouraged due to the nature of flooding experienced in this location.*

- *For the tributary of Hewitts Creek referred to as Stream 4, the recommended flood mitigation scheme is scheme HS4A, involving culvert and property modification measures. Riparian setbacks and provision of overflow paths as part of future redevelopment are also considered to be important controls for this area.*

- *No flood mitigation works are proposed in the Stream 3 tributary of Hewitts Creek. However, planning and development controls similar to Stream 4 should be applied.*

- *The flood mitigation scheme TGB was recommended for Thomas Gibson Creek. This scheme involves a focus on overflow paths in preference to underground drainage and is therefore considerably less costly to implement, yet provides reduction in flood damage. Planning controls are considered important for this catchment due to the intensity of existing pressure for re-development. In particular, provision of more formalised overflow paths along natural low points (such as along the rear of properties in Bath Street) are considered necessary.*

The following table schedules the number of properties protected by each scheme. Implementation of the recommended structural works will protect 48 residential properties from above floor flooding in the 1% AEP flood event in the study area.

SUMMARY OF PROPERTIES PROTECTED– RECOMMENDED SCHEME

Creek	No. of Properties Protected									
	20% AEP		5% AEP		2%AEP		1% AEP		PMF	
	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor
Slacky	0	0	27	1	27	1	27	1	25	1
Tramway	0	0	10	10	11	10	11	11	8	3
Woodlands	0	0	5	4	5	5	5	5	1	0
Hewitts	6	4	48	35	47	39	27	29	8	5
Hewitts (Stream 4)	0	0	0	1	0	1	0	0	0	0
Thomas Gibson	2	2	1	6	2	3	1	2	0	3
TOTAL	**8**	**6**	**91**	**57**	**91**	**59**	**71**	**48**	**42**	**12**

Based on combined reduction in damages resulting from the implementation of the schemes, the total benefits of scheme implementation are estimated to be $11.1 million. This compares against a total scheme cost of $8.9 million, giving an overall benefit cost ratio of 1.2.

SUMMARY OF FINANCIAL BENEFITS – RECOMMENDED SCHEME

Creek	Scheme	Total Damages ($AAD)	Total Benefits		Scheme Cost ($)	Benefit Cost Ratio
			$AAD	$NPV		
Slacky/ Tramway	SB/TB1	8,750	80,000	2,072,458	3,990,000	0.5
Woodlands/ Hewitts	WA/HA	162,750	241,000	6,290,070	2,800,000	2.2
Hewitts (Stream 4)	HS4A	54,250	39,000	994,378	260,000	3.8
Thomas Gibson	TGB	343,000	69,000	1,745,001	1,850,000	0.9
TOTAL		**$568,750**	**$429,000**	**$11,101,907**	**$8,900,000**	**1.2**

The recommended measures which make up the scheme were prioritised into three categories according to their contribution to the benefits provided. The three categories were:

- *High – these are high benefit options which should be considered for immediate implementation. These options also target areas where houses suffer frequent and hazardous flooding primarily above habitable floor areas. Implementation of the high priority measures will yield most of the identified scheme benefit but for half of the total scheme cost.*
- *Medium – these are worthwhile options that are provide good flood damage reductions but should only be constructed once the high priority items have been constructed.*

- *Low – these options provide valuable damage reductions but at significant cost. Low priority measures should not be pursued immediately but are to be retained within the scheme for possible future implementation when funding is available.*

HEWITTS CREEK
FLOODPLAIN RISK MANAGEMENT STUDY
(INCORPORATING SLACKY, TRAMWAY, WOODLANDS & THOMAS GIBSON CREEKS)

1. INTRODUCTION

1.1 BACKGROUND

The catchments of Slacky, Tramway, Woodlands, Hewitts and Thomas Gibsons Creeks are located in the northern suburbs of the City of Wollongong. They are situated on a narrow strip of coastal land backed by the Illawarra Escarpment to the west and the coastline to the east. The combined creek system drains an area of some 7.5km^2 of mixed residential, retail, light industrial and forested land. (Refer location plan **Appendix 1.1**)

Slacky Creek discharges to the ocean across Bulli Beach, south of Sandon Point. Tramway, Hewitts and Woodlands Creeks discharge to the ocean across McCauley's Beach, north of Sandon Point. Thomas Gibson Creek discharges to the ocean across Thirroul Beach, north of the Hewitts Creek outfall.

Urban development since European settlement has involved extensive intervention and modification to natural stream patterns including the construction of many instream structures such as culverts and bridges, stream straightening, diversions, and extensive clearing of riparian vegetation. These modifications have changed both in channel and floodplain flows throughout the catchment. In addition, encroachment of development onto floodplains has in several locations reduced the effective width (and waterway area) of flood flows. Consequently, much of the lower lands adjacent to creeks in the study area suffer flooding on a recurrent basis, resulting in significant flood risk. Blockages of structures during a flood further increases this risk.

In accordance with the State Government's policy for managing flood prone land, this study investigates and seeks to identify existing flood risks and appropriate options for their management. Management measures considered include a combination of site specific structural and non-structural measures as well as catchment wide planning controls for managing future flood risks.

1.2 OBJECTIVES

The primary objectives of this study are:

- To acquire and assemble data on flood behaviour, flood damages and properties in the catchment that are subject to periodic inundation.
- Using the previously prepared hydrologic and hydraulic models from the Flood Study, develop and analyse various floodplain management measures
- To examine existing flood planning policies and controls and recommend modifications to improve their efficacy.
- In consultation with various stakeholders, develop a range of measures to reduce the impact of flooding risk and assess these measures on the basis of their measured performance against a range of economic, social and ecological objectives.

- To make recommendations for floodplain management policies and controls for the Slacky, Tramway, Woodlands, Hewitts and Thomas Gibson Creek catchments.

1.3 METHODOLOGY

In order to describe the flood risks and develop appropriate methods for managing these risks, the following series of sequential activities occurred:

1) **Data Collection, Collation & Assessment**	*To assemble the required data*
2) **Community Consultation and Review**	*To obtain local flood knowledge on flood behaviour and suggestions for floodplain management options. To obtain feedback on recommended flood management measures and facilitate community involvement and ownership of the solutions.*
3) **Assessment of Flood Risk**	*To identify the extent of existing flood risk. Incorporates consideration of appropriate policies and procedures including blockages and their impact on flooding.*
4) **Review of Existing Policies and Controls**	*To identify the existing planning and legislative mechanisms which are used for floodplain management and recommend amendments where required.*
5) **Development of New Policies and Controls**	*To establish local planning and legislative mechanisms for floodplain management that are specific to the study area and suited to its particular characteristics.*
6) **Identification of Floodplain Management Measures**	*To identify and review appropriate floodplain management measures and facilitate input from stakeholders on the development of proposed schemes.*
7) **Selection of Floodplain Management Schemes**	*To combine the more appropriate management measures into a scheme(s) to allow a hydrologic and hydraulic assessment to be made.*
8) **Assessment of Management Schemes**	*To assess the performance of the management schemes against a range of objectives and allow selection of a preferred scheme on the basis of the schemes social, economic and environmental impacts.*

Following on from this process, a series of recommendations have been made as to the preferred measures appropriate measures for each specific creek system within the overall study catchment. This selection is made on the basis of estimated financial benefits through reduced flood damages and social and environmental considerations. This methodology has closely involved the Floodplain Management Committee and will involve public exhibition for wider community involvement in establishing the final management plan.

1.4 SCOPE

This study addresses the existing, residual and future flood risks, and appropriate measures to reduce the impact of these risks within the study area as follows:

Lower Slacky Ck	The main stream of Slacky Creek from the ocean outfall up to the coal haulage embankment below Hobart Street.
Upper Slacky Ck	The main stream of Slacky Creek from the coal haulage embankment up to the bend in National Avenue.
Tramway Ck	The main stream of Tramway Creek from the ocean outfall up to the Princes Highway and including the overland flow link to Slacky Creek along Hobart Street.
Hewitts (Stream 1)	The main stream of Hewitts Creek from the ocean outfall up to the western end of George Street.
Hewitts (Stream 2)	The main stream of Woodlands Creek from the junction with Hewitts Creek up to Yenda Avenue.
Hewitts (Stream 3)	A northern tributary of Hewitts Creek; (Fords Road Arm) from it's junction with the main stream of Hewitts Creek up to Fords Road
Hewitts (Stream 4)	A northern tributary of Hewitts Creek. (Nardoo Crescent Arm) from it's junction with the main arm of Hewitts Creek up to Nardoo Crescent.
Thomas Gibson (North)	The main stream of Thomas Gibsons Creek from the ocean outfall up to Mt Gilead Road.
Thomas Gibson (Middle)	A tributary of Thomas Gibson Creek from its junction with the mainstream of Thomas Gibson Creek up to Mason Street.
Thomas Gibson (South)	An unnamed small creek to the south of the main stream of Thomas Gibson Creek, from its ocean outlet up to Lawrence Hargrave Drive

The figure over the page shows graphically the extent of these reaches while further detail is provided on the Study Area Catchment Plan (**Appendix 1.2**).

FIGURE 1.1 THE STUDY AREA

Assessment of proposed flood management measures in each of these reaches, was for the full range of AEP from the 50% (2 yr ARI) through to the PMF flood event. Assessment has also incorporated Council's Blockage Policy with various combinations of blockages and diversions modelled to establish the design flood flow and design flood profiles in each reach.

2. THE STUDY AREA

2.1 GENERALLY

The Slacky, Tramway, Woodlands, Hewitts and Thomas Gibson Creek catchments lie within the Australian South East Coast Drainage Division -Wollongong Coastal Basin as shown in **Appendix 1.1.** These adjoining catchments are located approximately 10km to the north of the City of Wollongong, on a narrow coastal strip of land confined by the Tasman Sea to the east and the Illawarra escarpment to the west. For the most part these catchments are located in the suburbs of Bulli and Thirroul.

The headwaters of these small coastal catchments are steep and heavily forested, with the middle and lower sections grading from moderately steep down to relatively flat. Present residential development is for the most part confined to the middle and lower (eastern) sections of the study area.

Slacky Creek drains some 280ha of mixed residential, recreational and forested land, discharging over Bulli Beach to the sea, south of Sandon Point.

Tramway Creek drains some 53ha of mixed residential, retail and light industrial land discharging into the low lying rear dune area of McCauley's Beach some 200 m south of the outlet of Hewitts Creek. Some flow from the adjacent Slacky Creek catchment is diverted down Hobart Street, into Tramway Creek, in larger events.

The 380ha Hewitts Creek catchment is drained by two creeks which convey runoff from the escarpment, down into the rear dune area of McCauley's Beach, before discharging over the beach to the ocean, north of Sandon Point. (viz.);

- Hewitts Creek (The main arm draining the northern half of the catchment); and
- Woodlands Creek (The main arm draining the southern half of the catchment)

Woodlands Creek has been diverted into Hewitts Creek some 400 m above the beach in a gabion junction structure. A proportion of large to extreme flood flows still follow the natural flow path to enter Tramway Creek. The Thomas Gibson Creek system drains some 86ha of largely residential land, discharging over Thirroul Beach, north of the outfall of Hewitts Creek.

The Thomas Gibson system comprises three creeks that merge in an ill defined manner at the foot of the catchment before discharging to the sea at two locations across Thirroul beach.

The location and study area limits are shown in **Appendix 1.1** and **1.2**.

2.2 CHARACTERISTICS

The following is a brief overview of the study area and the particular characteristics which impact on flooding and drainage. For a more detailed description refer to the Hewitts Creek Flood Study (2002).

Rainfall Climate

Rainfall exhibits significant spatial variation in an east/west direction across the study area, with a distinct rainfall gradient generated by the orographic influence of the escarpment.

Average Annual Rainfall varies from 1500mm at Bulli Lookout to 1300mm at Sandon Point (Bureau of Meteorology 1979).

Seasonal variation in average rainfall is quite significant, with most rain occurring in the summer-autumn seasons.

TABLE 2.2.1 - SEASONAL RAINFALL (mm)

SUMMER (DEC - FEB)	*AUTUMN (MAR - MAY)*	*WINTER (JUN - AUG)*	*SPRING (SEPT - NOV)*
364	366	291	257

Source : Bureau of Meteorology (2001)

Physiography

Each of the study catchments is located within a tapering wedge of coastal land confined to the east by the Tasman Sea and to the west by the Illawarra coastal escarpment.

This coastal strip maintains a similar east-west profile, with the high (400 - 500 metres above sea level) escarpment to the west, falling sharply to around the 250 metre contour level, at which point the talus slopes commence. These slopes in turn run down at a 35 to 15% gradient to around the 100 metre contour level, below which residual soils and clays are typically encountered. In the residual soil/clay zone, surface gradients are typically in the 15 to 5% range. At around the 4 metre contour level, the profile again changes, to an overburden of recently transported sediments deposited on a relatively flat gradient (less than 5%).

The topographic and drainage features of catchments in the study area are shown in plan in **Appendix 1.2**.

Catchment Boundaries and Inter-catchment Flow

In general the overall boundary of the combined system (i.e. all the creeks in the study area) is well defined with little opportunity for flood flows to merge with or transfer from adjoining catchments to the south (Whartons Creek) or north (Flanagans Creek) (refer **Appendix 1.2**). However the various internal sub-catchment boundaries are not so well defined.

Culverts under Hobart Street and through the elevated coal haulage embankment parallel to Hobart Street, have created a restriction to flood flows in Slacky Creek at these points. These restrictions divert a substantial proportion of flow out of Slacky Creek eastwards down Hobart Street into the headwaters of Tramway Creek in major flood. In the event of a full blockage of the Hobart Street and/or the coal haulage embankment culverts, the `effective' catchment of the Tramway Creek system, increases by some 180 ha, as a consequence of this diversion of flood flows from Slacky Creek.

For larger events within the Hewitts Creek catchment, significant diversion of flow occurs from Woodlands into Hewitts Creek, above the Illawarra Rail embankment and from Woodlands Creek to Tramway Creek near the bend at the south eastern corner of BHP Refractories site.

An opportunity also exists for diversion of flow to occur in larger events, where the main arm of Hewitts Creek crosses Lachlan Street. A shallow rise in Lachlan Street to the east of this road crossing serves to redirect flow back into Hewitts Creek, in most smaller events, but would be overtopped in a major event (larger than the 2% AEP event). Any flow overtopping this slight rise would enter the southern arm of the Thomas Gibson system.

In the Thomas Gibson Creek system, surcharging of pipes and diversion of flows above the Illawarra rail line and the presence of underground systems to the east and west of the rail line, that do not follow surface flow paths, leads to ill-defined sub-catchment boundaries in this area.

On the escarpment face and in the steeper foothills, the east/west boundaries of subareas extending into these areas are also poorly defined. With little topographic relief between adjacent sub-catchments, minor landslip or rock falls have the potential to significantly change flow paths in these areas. Whilst such diversion could significantly alter minor flows in the uppermost reaches of the tributaries, it would not, in most circumstances, effect mainstream flood flow estimates downstream and has therefore not been considered further in the modelling described in this report.

Geology

The stratigraphy of the catchment generally comprises Triassic age, Narrabeen Group sandstone and siltstone (cliffs), overlying Permian age Illawarra Coal Measures (base of cliffs) with talus foothill slopes (mixture of the above). These in turn run down to residual soils and clays overlying the lower strata of the Illawarra Coal Measures. Quaternary deposits of alluvium, sands and silts are present on floodplains and in swamps. For the most part, surface soils are relatively impermeable. Areas in the upper catchment are also subject to land instability, particularly during prolonged wet weather.

Existing Cover and Landuse

The western half of the study area comprises escarpment and foothills that are predominantly forested with some of the more inaccessible areas in a relatively natural condition.

The eastern half of the study area is now almost fully urbanised with residential development slowly expanding into the foothills along the western fringe of present development. The shopping centre of Thirroul is located in the Thomas Gibson catchment and some industrial development is present adjoining the rail line in the Tramway Creek catchment.

Future Urban Development

While the eastern half of the study area is predominantly urbanised, it still contains some areas which are either available for new development or under pressure for redevelopment. Redevelopment typically includes the replacement of historic industrial uses with residential development or increased density within existing residential areas. The full impact of future development in the study area needs to be considered as part the development of this Floodplain Management Study and Plan. In practice this requires an analysis of full development of existing zoned land and an estimate of future development of other non-zoned (or differently zoned) lands over a 50 year timeframe.

In particular, the present zoning boundaries for land within the study area allows for significant residential development of land in the Hewitts and Tramway Creek catchments, at the rear of McCauley's Beach.

Also it is anticipated that increased densities will be achieved in and around Thirroul CBD (within the Thomas Gibson Creek catchment) and possibly within some of the hinterland areas currently zoned for environmental protection and mining purposes.

This future development scenario has been incorporated into the hydrologic modelling of the catchment used to model existing flood risks and damages. This was carried out principally via an assumed increase in impervious cover consistent with these future changes. It is noted that the magnitude of these changes are relatively small, as expected from a catchment with limited

available land for redevelopment (particularly in its headwaters). Nevertheless, future development needs to be carefully managed to ensure it is consistent with the recommendations given in this study, noting that the study accounts for these future changes.

3. AVAILABLE DATA

3.1 GENERALLY

The analysis carried out as part of the Hewitts Creek Floodplain Risk Management Study (FRMS) is based largely upon the data and previous modelling carried out for the Hewitts Creek Flood Study (2002). A brief summary of the general flood behaviour as described by the Flood Study is given in **Section 3.2** below. Copies of the data used as input to the Flood Study is reproduced in the Hewitts Creek Compendium of Data (September, 2001).

Additional data collected specifically for the Hewitts Creek FRMS includes:

- Details of property within flood prone land
- Stage damage data to estimate the change in flood damages with depth

This additional data is described further in **Sections 3.3** and **3.4**.

3.2 FLOOD BEHAVIOUR

Flood behaviour in the study area was quantified in the Hewitts Creek Flood Study (2002). This study involved data collection, preparation and validation of hydrologic and hydraulic models and estimation of design flood levels for the 5%, 2%, 1% AEP and 'Probable Maximum floods.

As well as forming the basis of flood modelling carried out as part of the FRMS, these models and subsequent results identify those areas which require particular attention when considering various floodplain management options management.

Hydrologic modelling for the Flood Study was undertaken using WBNM and PSxRM using regional calibration parameters. Recorded rainfall intensities from the historic 1988, 1991 and 1998 storms and synthesised rainfall for the four design events were input to the hydrologic models to determine runoff in these storms.

Hydraulic modelling for the Flood Study was undertaken using the US Army model HECRAS v3.0. Flows from the hydrologic model were input to the HECRAS hydraulic model and the model roughness parameters and blockage factors adjusted to provide the best fit for the 1988 and 1991 historic flood level data. The calibrated hydrologic/hydraulic models were then run for the August '98 flood event to validate the calibrations obtained from the earlier 1988 and 1991 events.

These calibrated and validated models were then used to determine 5%, 2%, 1% AEP and "Probable Maximum" Design Flood flows, levels and velocities in the creeks, under existing conditions, incorporating Wollongong City Council's Blockage Policy.

The Flood Study was able to confirm the experience of most residents that overbank flooding develops in the middle and lower stream reaches of the study area on a relatively frequent basis. In addition the study identified:

- Above the rail line, design flood levels are locally elevated due to raised embankments,, culverts or bridges. This afflux is further increased by Council's Blockage Policy, which for any structure with less than 6m diagonal opening, typically elevates the upstream flood level to be a few hundred millimetres above rail level. Whilst often a major increase relative to the unblocked flood level estimate, such blockages are real and do occur. The net result is that during

significant events (typically 1% AEP or greater) large areas upstream of the rail line are flooded, sometimes at significant depth.

- Above the Princes Highway, most streams flow through fully developed residential or retail areas where flooding is the result of the limited capacity of road culverts, piped segments and overflow paths. Historic realignments to suit development and intrusion of development into the streams and flood flow paths at some locations has exacerbated flooding at these locations.
- In the middle to upper reaches, several streams have been impacted by extensive scour and deposition in the August 1998 event. As a consequence, the middle (flatter) reaches have been infilled and the upper (steeper) reaches scoured out, leading to reduced conveyance and increased flooding in the middle reaches and increased conveyance and decreased flooding in the upper reaches.
- The lower reaches of Slacky Creek are currently isolated from larger flood events by the diversion caused by the limited capacity of the Hobart Street and coal haulage embankment culverts. This has potentially reduced peak flows in this reach for the last fifty years, permitting most flows to be contained within bank. Low lying development at the eastern end of Hutton Avenue is however impacted by flood waters backed up by the raised Blackall Street road embankment.
- Tramway Creek is, presently largely undeveloped in the reach downstream of the railway. However upstream of the rail line there is some development currently at risk of inundation during frequent events when culvert blockage occurs. Peak flows in Tramway Creek are also increased by the diversion of flow into Tramway Creek from Slacky Creek at the coal haulage embankment.
- The Woodlands Creek catchment is largely undeveloped, however the limited capacity and blockage of the railway culvert causes a significant diversion of flood flow into Hewitts creek upstream of the rail line which directly impacts on properties in the Hewitts Creek floodplain.
- The lower reaches of Hewitts Creek are less affected by development, with the exception of residential development on the northern floodplain. This can become flooded by both larger floods or oceanic storm events. The artificial diversion of Woodlands Creek exacerbates catchment flooding in this area also.
- Below the rail crossing the Thomas Gibson system flows through an older area of residential development in which the creeks have been filled and the watercourses piped. Given the limited pipe capacity, surface flows develop through these residential areas on a frequent basis.

3.3 PROPERTY DATA

In order to quantify direct damages associated with above floor flooding, a detailed property survey was carried out. This survey included details of:

- Property Address/Identification
- Landuse type (e.g. commercial, residential, vacant residential, rural)
- Building type (e.g. single detached dwelling, block of flats)
- Age of building (e.g. old, medium, new)
- Type of construction (e.g. full brick, brick veneer, weatherboard)
- Number of storeys
- Minimum habitable floor level

- Yard level (upslope and downslope of dwelling)

The above survey was carried out for those properties identified during visual inspection as being possibly inundated during a PMF event. A copy of this survey has been included in the Hewitts Creek Compendium of Data (September, 2001).

The data collected was used to calculate the depth of over floor and over yard flooding at each property, for the spectrum of ARI events between the 50% AEP (2yr ARI) and PMF flood events. This depth of flooding was then converted into an approximate dollar value of direct damage using the 'stage-damage curves' described in **Section 3.4** below.

3.4 STAGE DAMAGE DATA

'Stage damage curves' provide a relationship between flood level ('stage') and flood 'damage' for an individual property. While the shape of this curve will vary depending on the nature of the property, a single curve has been found to provide a reasonable estimate of stage damages for typical 'residential' type properties. Floodplain Management Studies in the Illawarra generally utilise stage damage curves based on data obtained from various floods throughout NSW and Australia as described in standard stage damage procedures set out in FLDAMAGE or ANUFLOOD.

Following the August 1998 Wollongong floods, it was decided to undertake a review of this earlier data and investigate the possibility of using a more site specific stage damage relationship. A dataset consisting of approximately 110 claims for flood damage resulting from the August 1998 flood was obtained from QBE insurance. A report was subsequently prepared by Forbes Rigby describing the preliminary analysis of this data. This report suggested that residential flood damage in the Northern Illawarra was much greater than flood damages used in other parts of NSW and Australia.

The Forbes Rigby analysis of August 1998 QBE claims based data implied damages far higher than those used for previous floodplain management studies. However it was decided that this study should use a stage damage analysis approach consistent with other studies undertaken throughout the state.

It was therefore resolved to adopt the stage damage relationship used by the flood damage model FLDAMAGE, with damages scaled upwards by a factor of 2. This scaling factor was applied to account for the recent trend for insurers to offer new for old replacement costs for items rather than the actual value of the item, which most likely is one of the principle reasons for the high damage estimates that were derived from the QBE claims based data.

4. CONSULTATION AND COMMUNITY INPUT

4.1 MEETINGS OF STAKEHOLDERS

Throughout the flood study and floodplain management study process, efforts have been made to involve the various parties that have a stake in the floodplain and its management. These include government authorities, residents and landowners. Meetings have been held with:

- Wollongong City Council
- The Department of Land and Water Conservation (DLWC)
- The Hewitts/Slacky Creek Floodplain Management Committee
- Roads and Traffic Authority (RTA)
- BHP Billiton
- Numerous private landowners

The general purpose of these meetings has been:

Data Collection - Including flood levels and historic flood damages.

Provision of Information - Inform stakeholders about the Floodplain Risk Management Study process and its recommendations.

Obtain Feedback - Obtain feedback as to the acceptability of proposed management schemes.

Several of these meetings that are otherwise not discussed in this chapter yet are worthy of note, are described below.

On 18 November 1999 a public meeting was held at the Thirroul Senior Citizens Centre to discuss the proposed remediation of those creeks that were heavily scoured as a result of the August 1998 Storm. At this meeting an update on the Floodplain Risk Management Study progress was also presented. The community was asked at this meeting for general information on flood behaviour (e.g. flood levels), and for input into possible flood management measures.

On 3 and 6 December 2001 site meetings were held with residents of Lachlan St, George St, Jennifer Cres and Virginia Terrace to discuss proposed flood management measures in these particular areas. These meetings were held in order to gauge responses to the recommended schemes that in these locations involved significant works within private land. Because of these meetings, changes were made to the recommended schemes to incorporate residents' comments.

On 5 December 2001 a meeting was held with the RTA to discuss the integration of possible future road works with the flood management works recommended as part of the Floodplain Risk Management Study. This meeting resolved that most of the works were compatible and that they could be further integrated at the time of detailed design.

4.2 COMMUNITY SURVEYS

General community surveys were carried out to obtain information with regard to flood behaviour in the catchment. These surveys included:

- 'mail out' of questionnaires to all residents in the study area asking for general flooding information and suggestions for improvements to flooding problems,
- targeted advertising in local newspapers requesting information, and calls for interest in membership of the floodplain management committee, and
- mail outs to residents along watercourses to obtain specific flood information as required.

Numerous letters were received in reply to these requests for information. These letters are on Council's file and were used as background data for the study.

It should also be noted that where possible, informal community feedback was obtained by members of the Hewitts/Slacky Creek Floodplain Management Committee within their neighbourhood. This information being then passed on to Council and its consultants through the committee meeting process.

4.3 INTEREST GROUP MEETINGS

Resident interest groups have called numerous site meetings and more localised resident groups concerned about flooding in their particular area. Many of these meetings occurred immediately following the August 1998 flood.

These meetings have been attended by Council and/or its representatives and have been used as a source of information contributing to the final recommendations of the study.

4.4 FLOODPLAIN MANAGEMENT COMMITTEE MEETINGS

The Hewitts/Slacky Creek Floodplain Management Committee (FPMC) has membership including Ward Councillors, Council's staff, DLWC, Roads and Traffic Authority, State Rail, State Emergency Service, local residents, flood affected landholders and other interested stakeholders. Residents on the committee include representatives of the major catchments in the study area, in particular Hewitts, Slacky and Thomas Gibson creeks. Advertising and direct mailouts, calling for community members interested in joining the committee, have been carried out several times throughout the study process.

Council coordinates the Floodplain Management Committee with meetings held on a regular basis (generally every quarter). This committee steers the development of the floodplain management study and plan.

Some of the committee's other roles in the Floodplain Risk Management Study process are

- to assist with the dissemination of knowledge and provide community, industry and interest group feedback as required by study;
- provide advice on local flooding problems; and
- Consider the implications of matters which may impact on the local community.

Further detailed advice with respect to the committees role in the study can be sourced from Appendix D of the NSW Floodplain Management Manual (2001)

All proposals for floodplain management including recommendations for proposed works are put to the committee for consideration and support. The study is then guided by the concurrence and determinations of the committee.

4.5 PUBLIC EXHIBITION OF STUDY & PLAN

A formal public consultation process involving exhibition of the draft FRMS was undertaken during September and October 2002.

The public was notified of the exhibition via newspaper articles and hand delivered newsletters. Public comment on the study document was invited via a feedback form. Overall a high level of feedback response was obtained including 48 written submissions.

During the exhibition period, two information sessions were held on separate days, one at Bulli and the other at Thirroul, to enable residents to discuss particular issues with members of the project team.

Public consultation was undertaken to obtain comments on the various flood management proposals and to provide a general review of the study document. Comments received were then assessed and the study amended accordingly.

Table 4.5.1 provides a summary of some of the more common feedback provided and the changes which have been made to the study document to reflect this feedback. Several other minor issues were raised which were either addressed by the study or for which changes to the study were considered not required.

TABLE 4.5.1 – SUMMARY OF PUBLIC EXHIBITION FEEDBACK

	Issue Raised	Description	Recommended Action for Study	Where addressed in this report
1	**Opposition to Voluntary Purchase - Princes Highway Bulli**	*Owners are opposed to the voluntary purchase of their properties.*	*It is recommended this option not be changed since there is a clear threat to life for occupants of these properties. Voluntary Purchase is considered to be a beneficial option which, although may not be acceptable at this time, could be accepted by the land owner in the future, particularly when valuations have been carried out and an offer can be made.* *Other schemes/options have been explored but found to be unfeasible and could not be implemented in an acceptable timeframe.* *Changes to the study were limited to the clarification of the basis for cost estimates.*	*Section 8.7*
2	**"Concerned about beach opening"**	*Several respondents were concerned about the potential environmental impacts of undertaking regular beach bar opening. They also perceived this as being of limited flooding benefit.*	*The FRMS flagged the need for environmental investigations to be carried out before the adoption of any beach opening policy. Nevertheless, the study needs to clarify this issue and more strongly recommend that these investigations are carried out. The FRMS should also flag the opportunity to integrate with the estuary management policy being developed for the Illawarra.* *Although it is acknowledged that for some events the opening of the beach bar may be of limited flooding benefit (since the opening will naturally scour with lead up rain), it could provide benefits for intense storms without lead up rain.*	*Section 9.1* *Appendix 4*
3	**"Environmental Impact of proposed works"**	*Some people believed that there was insufficient consideration given to the potential environmental impacts of the proposed flood mitigation works. For some people this was a general comment but for others it was related to specific works proposed.*	*The FRMS has undertaken a broad environmental assessment which was used to rank the various options considered. Those options which were assessed as having a high environmental 'benefit' were given a higher weighting and were therefore more likely to be selected. A more detailed environmental assessment is unwarranted at this stage given the conceptual nature of designs.* *The environmental impacts of the adopted scheme are likely to be small and easily managed. Nevertheless the FRMS should be amended to more strongly recommend that environmental investigations be undertaken for each scheme at the detailed design stage once the project scope becomes clearer.*	*Section 9.1*

Table 4.5.1 Continued

4	**Formalisation of Diversion of upper Slacky Creek major flows to Tramway Creek**	*A number of comments were received regarding the issue of the formalization of the major flow diversion from upper Slacky to Tramway. Some agree to the diversion and formalisation of upper Slacky flow to Tramway. Some would like to see the upper Slacky diverted back to lower Slacky (and removal of the old rail embankment)*	*The comments received conflict some what, but the majority of comments received support the formalisation of the existing major flow diversion from upper Slacky to Tramway Creek.* *The option of full diversion from upper Slacky to lower Slacky for the full range of events has been explored but found unfeasible due to the impacts on Lower Slacky (eg Hutton Ave) and the high cost (and therefore time delay) for implementation.* *No change to the FRMS is proposed*	-
5	**"Concerned about flooding issues associated with future proposed developments"**	*Several respondents were concerned about various flood management aspects of developments throughout the study area and felt that the FRMS should address these issues.*	*The FRMS is not intended to be a detailed investigation into water management for proposed developments. The FRMS is a document which seeks to establish appropriate flood management principles across the entire catchment (including planning controls for future development).* *Detailed investigations including analysis of environmental and flooding impacts at the site are the responsibility of land developers and the merits of the development proposal will be assessed on the basis that it is not contrary to the outcomes of the FRMS.*	-
6	**" The creeks need cleaning out"**	*Some residents felt that the creeks were in need of more maintenance and cleaning out to improve the channel capacity*	*Where land is owned by Council there is currently a process by which complaints are investigated and efforts made to remove excessive debris. This cannot be carried out on privately owned land. There are also environmental issues to consider.* *The FRMS should more strongly recommend a riparian management study be undertaken to investigate opportunities for controlling debris entering the creek system and the methodology by which this could be monitored and policed including a focus on education campaigns.*	*Section 9.3* *Appendix 7.1*

Table 4.5.1 Continued

7	**"Ban all filling on floodplains"**	*Several respondents called for a ban on filling on floodplains as they felt this was the reason for many existing flooding problems.*	*Filling on floodplains is discouraged by current Council policy. The FRMS discourages filling in the upper catchment as it can increase peak flows (by reducing flood storage). In the lower catchment it can be demonstrated that in areas of existing development, filling and redevelopment at a higher level can be a method of achieving long term flood mitigation (provided local hydraulic effects do not cause problems).* *This aspect of the study (already contained within the FRMS document) should be expanded to clarify the concerns raised particularly associated with environmental effects of filling.*	*Section 6.2.5*
8	**Integration required between the 'local flood plan' and 'SES flood plan'**	*The SES raised the issue of the 'local flood plans' proposed by the FRMS and how theses would integrate into the existing 'SES flood plans'.*	*The FRMS should more clearly explain the proposed role of the local flood plan. It is envisaged that the local flood plan will be a subset of the SES plan dealing with catchment specific issues including the identification of areas which may require evacuation due to potential for significant above floor flooding.*	*Section 7.2* *Section 9.2.5* *Appendix 7.1*
9	**Various detail design issues**	*Various concerns were raised about potential negative impacts of some proposals in particular levee banks proposed at Hutton Avenue and Corbett Avenue.*	*Based on conversation with people attending the manned public displays it has become apparent that there is a general misconception that the study represents a final document and that no further investigations will be carried out prior to construction. The study text should be modified to clearly require detailed design investigations be undertaken including more detailed consultation with those residents potentially impacted by options, to address concerns. Conceptually, it is felt that problems raised can be addressed. However, if this could not be demonstrated with the detailed designs, the option may not be able to proceed.*	*Section 9.1*
10	**Pass Avenue/ High Street**	*Residents in the Pass Avenue and High Street area were concerned that their flooding issues were not addressed by the FRMS*	*This tributary of Hewitt's Creek was not part of the study area. While some options have been identified for improving flooding in the lower reach of this tributary it does not recommend any specific options for dealing with issues further upstream.* *The report will recommend that Council undertake further investigations in this reach as a separate future study.*	*Section 9.6.1* *Appendix 7.1*

5. EXISTING FLOOD HAZARD

5.1 GENERALLY

The Slacky, Tramway, Woodlands, Hewitts and Thomas Gibson Creek systems have in the past experienced significant flooding and flood damages, most notably in August 1998. With regard to this existing flood hazard, the study area exhibits the following general characteristics:

- Significant sections of the study area are flood prone, particularly in areas upstream of the railway and low lying areas behind the coastal dunes.
- The rate of rise of floodwaters is very quick as a result of the limited catchment size and steep terrain. This presents a high hazard to occupants of the floodplain generally as flood warning is too short to allow safe evacuation or for appropriate damage reduction measures to be implemented. Access roads are also severed by floodwaters on a frequent basis.
- Blockages frequently occur due to the high debris load from the upper catchment which is both unstable and heavily forested. These blockages cause flow diversions, leading to unexpected flow redirections and elevated floodwaters.
- Encroachment of low lying development and a lack of defined overflow paths greatly increases damages and hazard in some areas.
- The steepness of the upper slopes and erodibility of stream bed and bank material creates further risk of damage to structures in some areas (as well as increasing blockage downstream).
- There is a lack of defined overflow paths to accommodate higher flows when the piped drainage system becomes blocked or its capacity exceeded.

A plan has been included in **Appendix 2.1** showing the areas subject to varying degrees of provisional hydraulic hazard as defined by the Flood Plain Management Manual 2001.

Two things should be noted with regard to **Appendix 2.1**:

- It should not be confused with **Appendix 6.1** showing 'Planning Control Precincts', which although similar in appearance, are different in their definition.
- The hazard categories are provisional only and reflect purely hydraulic characteristics. In order to establish true hazard at a particular site, a number of other factors need to be considered in accordance with the methodology set out in Appendix G of the FPMM (2001).

As a result, where hazard is referred to in this section, it should be taken to mean provisional hydraulic hazard as per the mapping in **Appendix 2.1** and the definitions within Appendix G of the FPMM (2001). It is noted that, no attempt was made to categorise each flood liable property with respect to 'actual' hazard as this would be a significant undertaking beyond the scope of this study. Notwithstanding this fact, provisional hazard is often a good indicator of actual hazard and is therefore relevant for general discussion purposes.

Appendix 2.1 shows that for the study catchment, areas subject to a high provisional hydraulic hazard generally lie within the stream channel. The exception to this, is the land above large structures, such as major road and rail crossings, where depth of inundation is the major contributing factor to the provisional hydraulic hazard. It is noted that very few areas are subject to a moderate provisional hazard. This is because of the relatively steep

and incised nature of floodplains and the limited depth range over which moderate hazard conditions occur.

A total of 194 properties were identified as subject to above floor flooding within the study area. The cumulative distribution of these across a range of flood frequencies is given in **Table 5.1.1** below.

TABLE 5.1.1 - ABOVE FLOOR FLOODING IN ALL CATCHMENTS

No. of Properties with Above Floor Flooding				
20% AEP	***5% AEP***	***2% AEP***	***1% AEP***	***PMF***
11	75	91	97	125

5.2 SLACKY CREEK

Existing flood hazard in the Slacky Creek catchment is relatively low when compared to other catchments. This is a result of the more modern subdivision standards that have been applied in this catchment including set backs and public reserves along the main channel.

A further factor influencing flood hazard in Slacky Creek is the limited peak flows in the reach downstream of the Hobart St diversion. This has the effect of reducing flood hazards in this area. The removal of this diversion as part of any flood management strategy would require careful consideration as significant areas downstream benefit from this diversion.

Areas of high hazard within Slacky Creek are generally limited to stream channels and areas immediately upstream of major structures where flow depths are high (refer **Appendix 2.1**). There are very few dwellings or structures within this high hydraulic hazard zone.

The number of properties that are subject to above floor flooding within Slacky Creek are listed in the table below.

TABLE 5.2.1 - ABOVE FLOOR FLOODING IN SLACKY CREEK

No. of Properties with Above Floor Flooding				
20% AEP	***5% AEP***	***2% AEP***	***1% AEP***	***PMF***
0	1	1	1	6

While there are a significant number of properties in the catchment that are subject to a low hydraulic hazard, the depth of inundation in these areas is generally quite low and is not above floor. Properties in Beacon Avenue for example are subject to shallow yard flooding as water that passes out of the northern rail culvert attempts to return to the main channel. Damages that result from this flooding are anticipated to be relatively low as most floor levels are elevated with respect to their yard.

5.3 TRAMWAY CREEK

Despite its small catchment, Tramway Creek contains a significant area of flood hazard upstream of the railway. This is a result of the diversion of flows in Upper Slacky Creek at Hobart St, which effectively trebles the Tramway Creek catchment area and results in a significant increase in peak flow in Tramway Creek. This is exacerbated by encroachment of development along the diversion path.

The area, which is subject to the greatest hydraulic hazard, is the area upstream of the rail embankment, which in larger events experiences a significant depth of flooding in the event of culvert blockage. Also at significant risk are several properties along the Princes Highway where flow down Hobart Street enters Tramway Creek.

Downstream of the rail embankment the land is currently vacant but under development pressure. Any new development of this area will need to consider the flow estimates in this reach as derived by this study and be designed accordingly.

The number of properties that are subject to above floor flooding within Tramway Creek are listed in the table below.

TABLE 5.3.1 - ABOVE FLOOR FLOODING IN TRAMWAY CREEK

No. of Properties with Above Floor Flooding				
20% AEP	***5% AEP***	***2% AEP***	***1% AEP***	***PMF***
0	10	10	11	15

Most of the properties that are affected by flooding are immediately upstream of the rail embankment. Due to the elevation of the rail embankment, the depth of above floor flooding at these properties is potentially up to 3m, should blockage of the rail culvert occur.

5.4 WOODLANDS CREEK

Woodlands Creek remains largely undeveloped and as a result does not contain significant areas of flood hazard. **Appendix 2.1** shows the greatest area of hazard is in the vicinity of the Princes Highway and railway embankments. Upstream of the Princes Highway the floodplain is well contained by an incised valley with no existing developments at risk of flooding.

Downstream of the rail the land is currently vacant thereby limiting the risk of flood damages. Proposed development of this area will need to consider the quantum of flow in this reach and be designed accordingly. It is noted that in this reach there is a significant area between Woodlands Creek and Hewitts Creek that is inundated at shallow depth because of break out of flow from the piped section of Woodlands Creek. This flow will require containment as part of any proposed channel upgrade works along Woodlands Creek.

The numbers of properties that are subject to above floor flooding within Woodlands Creek are listed in the table below.

TABLE 5.4.1 - ABOVE FLOOR FLOODING IN WOODLANDS CREEK

No. of Properties with Above Floor Flooding				
20% AEP	***5% AEP***	***2% AEP***	***1% AEP***	***PMF***
0	4	5	5	5

It is noted that while within the Woodlands Creek catchment there are only a handful of properties that are flood prone, there are several within Hewitts Creek that are directly impacted by the diversion of flow from Woodlands Creek into Hewitts immediately upstream

of the rail. These properties are included in the totals given for Hewitts Creek in **Section 5.5** below.

5.5 HEWITTS CREEK

Hewitts Creek is a relatively large catchment with a large number of properties encroaching onto the floodplain, increasing the level of hydraulic hazard for these properties.

In the upper reaches, the area of high hydraulic hazard is generally contained to within bank except at road culverts where there is significant disruption to watercourse geometry. This can cause flow to breakout of the channel, often causing damage as it re-enters the creek downstream. Where high hazard exists, damages are correspondingly high due to the velocity of flow. Yard damages can also be high for this same reason.

The floodplain in the upper reaches is generally narrow, limiting the area which experiences a moderate to low hydraulic hazard during a flood event.

In the middle reaches (Kelton Lane downstream to the rail line), the area subject to high hydraulic hazard is quite extensive. This is as a combined result of the large increase in peak flow attributable to the diversion from Woodlands creek and the afflux created by the railway bridge. In these areas, depth is the main factor leading to a high hazard categorisation. Properties most at risk are those adjoining the Lawrence Hargrave Drive culvert. The area subject to low hazard is also generally more extensive than the upper reaches. In particular the area in the vicinity of Lachlan St experiences significant channel break-out and diversion leading to flooding in areas, quite distant from the main channel.

Downstream of the rail, the stream enters a gabion-lined section within which floodwaters are generally well contained. It is noted that areas of low hazard on the southern bank, are a result of flow breakout from Woodlands Creek (refer **Section 5.4**). At the junction of Woodlands Creek downstream to the ocean outfall, the area of high hazard increases due to the additional flow from Woodlands Creek and generally poor channel capacity. It is noted that high hazard conditions are generally outside the developed areas along Corbett Ave and Hamilton Rd, however these areas are subject to low hazard flood flows.

The numbers of properties that are subject to above floor flooding in the Hewitts Creek catchment are given in **Table 5.5.1** below.

TABLE 5.5.1 - ABOVE FLOOR FLOODING IN HEWITTS CREEK

No. of Properties with Above Floor Flooding				
20% AEP	***5% AEP***	***2% AEP***	***1% AEP***	***PMF***
6	47	57	58	70

Most of the properties inundated in the Hewitts Creek catchment are those immediately upstream of the rail in Hewitts Avenue. There are also several properties in Corbett Ave and Hamilton Rd, which are inundated, though to a reduced depth. Properties in the upper reaches are generally well elevated with respect to flood levels and therefore do not contribute significantly to these totals.

It is noted that these totals do not include inundation due to local stormwater systems surcharging, or from major flow paths with inadequate capacity (other than those natural watercourses that have been modelled as part of this study).

5.6 THOMAS GIBSON CREEK

Thomas Gibson Creek is a very highly urbanised catchment with a high proportion of piped watercourses and very few well defined overflow paths.

Areas subject to high hydraulic hazard are limited to the southern arm of Thomas Gibson Creek, which receives diverted flow from Hewitts Creek in larger events (refer **Appendix 2.1**). Properties at significant risk from flooding include those immediately upstream of the rail and the church building upstream of Lawrence Hargrave Drive. There are also some areas of high hazard in the lower reach of the south arm to the rear of properties in Spray Street and along the diversion path, which follows Cliff Parade.

In the remaining areas of the catchment there are large areas of low hazard following valley depressions and roadways. The depth of flow in these areas is generally quite low leading to this hazard categorisation.

The number of properties that are subject to above floor flooding within Thomas Gibson Creek are listed in the table below.

TABLE 5.5.1 - ABOVE FLOOR FLOODING IN THOMAS GIBSON CREEK

No. of Properties with Above Floor Flooding				
20% AEP	***5% AEP***	***2% AEP***	***1% AEP***	***PMF***
5	13	18	22	29

Properties subject to above floor inundation are concentrated in the Bath Street, Cliff Parade and The Esplanade areas, all of which are downstream of the rail line.

5.7 SUMMARY OF EXISTING DAMAGES

Existing (direct) damages were calculated for the full spectrum of design flood events using the stage damage relationship described in **Section 3.4**. These were then converted into an equivalent Average Annual Damage (AAD).

AAD is calculated by multiplying the damages that occur in a given flood, by the probability of that flood occurring in a given year. It is often found that although the predicted PMF flood damage is high, the low frequency of its occurrence mean that its financial impact in real dollar terms on an annualised basis is also low. Conversely a storm of low magnitude but high frequency such as the 20% AEP (5 yr ARI) event may cause low damages but due to the frequency result in a very high annualised flood damage. The AAD calculation allows this reality to be incorporated into the financial assessment.

Once calculated, the AAD for each scheme can be converted into an equivalent Net Present Value (NPV). This is useful for financial comparison purposes and scheme assessment. The NPV calculation was based on a 50 year term, and an average interest rate over the term of 7%.

Table 5.7.1, summarises the existing damages which occur throughout the catchment.

TABLE 5.7.1 - INUNDATED PROPERTIES AND DIRECT DAMAGES (EXISTING CONDITIONS)

Creek	No. of Properties with Yard and Above Floor Flooding										Direct Damage ($AAD)	Direct Damage ($NPV)
	20% AEP		5% AEP		2%AEP		1% AEP		PMF			
	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor		
Slacky	0	0	27	1	27	1	28	1	35	6	38,000	520,000
Tramway	0	0	10	10	11	10	11	11	20	15	47,000	650,000
Woodlands	0	0	5	4	5	5	5	5	6	5	22,000	300,000
Hewitts	7	5	61	45	70	55	70	56	85	67	312,000	4,300,000
Hewitts (Stream 4)	3	1	4	2	4	2	4	2	4	3	70,000	970,000
Thomas Gibson	5	5	25	13	27	18	30	22	38	29	265,000	3,660,000
TOTAL	**15**	**11**	**132**	**75**	**144**	**91**	**148**	**97**	**188**	**125**	**$754,000**	**$10,410,000**

[a] Thomas Gibson damages exclude yard damages for events up to and including the 20% AEP event

From the above summary it can be concluded that the areas where the greatest direct damages can occur are the Hewitts Creek and Thomas Gibson Creek catchments, which together comprise almost 80% of the total damage in the study area. However, it is noted that a significant proportion of the damage in Thomas Gibson Creek catchment is related to external property damage (from shallow yard flooding). This is because Thomas Gibson Creek is predominantly served by an underground pipe system and does not have many areas adjoining open watercourses. For this reason, the stage damage calculations for Thomas Gibson Creek were modified to disregard yard damage for events up to and including the 20% AEP event. This is indeed closer to reality, as the extensive pipe system in Thomas Gibson Creek, despite being generally inadequate, is likely to be able to convey these smaller events without significant damage occurring. Indeed these type of events are so frequent that residents would typically 'flood proof' their yards to this extent. This same assumption for Thomas Gibson Creek was incorporated into the scheme assessment phase of the stage damage analysis described later in this report.

It should be noted that a distinction is often drawn between 'actual' and 'potential' damages. Actual damages are the damages which actually occur during a flood, while potential damages represent the damages which could occur if all the goods stored below flood level at the beginning of a flood event were damaged. This seemingly tedious distinction is necessary because in some areas where a significant warning time (hours or days) is available, residents have sufficient time to elevate their belongings (particularly high value items) thus protecting them from damage. Where warning time is short this opportunity is not available. In such areas, the actual damage therefore comes closer to parity with potential damage.

The stage damage relationship used for this study provides an estimate of potential damages. It has been assumed because of the very short warning times which are available in the study catchment that the potential damage is equivalent to actual damage i.e. that no residents have the opportunity to protect goods. This is a slightly conservative assumption but nevertheless very close to reality.

6. PLANNING AND POLICY CONTROLS

6.1 EXISTING PLANNING AND POLICY CONTROLS

This section identifies the various planning instruments and associated controls, which currently apply to the management of floodplains in the study area. Not all of these planning instruments or controls will be applicable in the future, but they are reviewed in this report for the purposes of completeness and to provide a general overview of planning controls and strategic planning direction for the area as they exist today.

6.1.1 Statutory Planning

Environmental Planning and Assessment Act 1979
The *Environmental Planning and Assessment Act 1979 (as amended) (EPAA)* institutes a system of environmental planning control and environmental assessment whereby applications for development consent can be assessed under a multitude of social, economic, engineering and environmental 'heads of consideration'. The EPAA is the principal act governing planning and environmental controls in the state. It sets up a range of environmental planning instruments and regulations that provide clear direction as to appropriate landuses and assessment procedures. These include:

- Environmental Planning and Assessment Regulation 1994 (EPAR)
- Section 117(2) Directions
- State Environmental Planning Policies (SEPP's)
- Regional Environmental Planning Policies (REP's)
- Local Environmental Planning Polices (LEP's)
- Development Applications
- Development Control Plans (DCP's)

The first six of these are described in more detail in the remainder of this section, while DCP's are dealt with separately in **Section 6.1.2**.

Environmental Planning and Assessment Regulation
Schedule 3 of the *Environmental Planning and Assessment Regulation 1994 (EPAR)* identifies those developments that are designated development by virtue of their processing capacity, site requirements or location near environmentally sensitive features. Developments such as certain industries, local works, extractive industries, mines and the like are permissible in the zoning of the study area and adjoining land. Some of these developments may be regarded as designated development when located within a certain distance of a natural water body or wetlands or on flood prone land or a floodplain.

Schedule 3 of the EPAR defines floodplain as:

> *"Floodplain means the floodplain level nominated in a Local Environmental Plan or those areas inundated as a result of a 100 year flood event if no level has been nominated."*

There are a number of potential outcomes of the floodplain management plan process that have implications in regard to the manner in which Development Applications are dealt with because the definition now differs from the FPMM (2001) definition of the 'Floodplain'.

The EPAR also prescribes certain matters that must be considered in dealing with development applications. For instance the regulations prescribe that Council's must take into account the NSW Coastal Policy (referred to below) in decision making under s.79(C) EPAA.

Section 117 Directions

Section 117 Direction G 25 - Flood Liable Land –is a generic direction given to all Council's, and applies to flood liable land. The direction requires that Council's do not rezone flood liable lands to a zoning which permits residential, industrial or commercial landuse (amongst others). Also Local Environmental Plan's should not contain provisions that:

- permit increased development on that land.
- are likely to result in increased requirements for flood management measures.
- permit development without development consent (except certain agricultural and minor developments).

Furthermore the directive requires that land defined in accord with the FPMM as 'high hazard' flood liable land or 'floodway' be appropriately zoned as floodway, rural, open space or environment protection (amongst other similar zonings).

State Environmental Planning Policies

State Environmental Planning Policies (SEPPs) are prepared by Planning NSW and are approved by the Minister of Planning. They deal with matters of significance for environmental planning for the State. The main SEPP that applies to the study area is SEPP No.1 - Development Standards, which provides flexibility in the application of planning controls operating by virtue of development standards in circumstances where strict compliance with those standards would, in any particular case, be unreasonable or unnecessary or tend to hinder the attainment of the objectives of the Act. It is noted that this SEPP does not apply to some environmental protection zone areas covered by this study such as the upper reaches of Woodlands Creek.

Some of the other sixty or so SEPPs apply to the study area including SEPP 11 - Traffic Generating Developments, SEPP 14 Coastal Wetlands, SEPP 19 - Bushland in Urban Areas, and SEPP 26 Littoral Rainforests and SEPP 35 – Maintenance Dredging of Tidal Waterways. It is noted with regard to SEPP 35 that this instrument is not intended to be used for the purpose of clearing sand build up from creek entrances for flood management purposes and that such activity, if proposed, should be subject to strict control.

The Coastal SEPP (SEPP 71) is currently in draft form and will have some implications for development along the coastal zone. Details of the SEPP are currently unavailable however it is not anticipated to dramatically impact on flood planning policy.

No SEPP has been prepared dealing specifically with the issue of flooding or management of risk on a floodplain.

Illawarra Regional Environmental Plan

The *Illawarra Regional Environmental Plan (IREP) No.1* was gazetted on 11 April 1986 and provides a broad framework for coordinated action between various state government authorities in respect to the development of the Illawarra region comprising the local government areas of Wollongong, Shellharbour, Kiama, Shoalhaven and Wingecarribee.

The objectives of IREP No.1 are, amongst other things, to:

- Place certain requirements on developments;
- Provide guidance to local councils in preparing local environmental plans and detailing development applications;
- Defining the extent of interest of Planning NSW; and

- Identifying Planning NSW's attitude and position on a wide range of environmental, social and environmental issues.

Under IREP No.1, the study area includes land that has been identified as:

- land potentially suitable for urban use;
- land with landscape or environmental attributes;
- land which supports rainforest vegetation species;
- committed industrial land;

Many of the clauses of IREP No.1 do not apply to the study area because of their insertion into Wollongong Local Environmental Plan (WLEP) 1990. The clauses of IREP No.1 that are relevant however are:

a) *Clause 28,* which requires that any draft LEP proposed to control development on rural land which has a history of flooding, requires Council to obtain sufficient information to introduce appropriate controls to minimise the affect of flooding on any potential development. This FRMS, prepared in accordance with State Government policy, would provide an appropriate basis for addressing the provisions of Clause 28 in the study area, if ever required.

b) *Clause 58,* which states that the objectives relating to living areas are to ensure that urban expansion is orderly and efficient having regard to the constraints of the natural environment and that sufficient land is available to prevent price rises resulting from scarcity of land; to ensure that new residential land or land for higher density development is only developed where there are adequate utility and community services available or there is a commitment from relevant authorities or developer to provide those services; to provide for a range of lot sizes, dwelling types and tenure forms to cater for varying household needs in all local government areas; to ensure that residential development does not take place on hazard-prone lands; and to minimise bush fire risks to urban development.

c) *Clause 65,* which stipulates that a draft LEP shall not rezone land from rural to urban unless Council has consulted with the DLWC, prepared a plan of management and is satisfied that the potential for flood losses is *"contained"*. Again, the ultimate outcome of this study is to produce a management plan for the various floodplains in the study area to minimise flood damages and risk to life. The FRMP will, therefore, be an important consideration for any future urban rezoning in the study area. Compliance with the ultimate FRMP will also be important for the purposes of maintaining Council's indemnity from liability pursuant to Section 733 of the Local Government Act, 1993.

d) *Clause 66*, which provides the following provisions in regard to the management of land subject to flooding:

> *"66.(1) A draft local Environmental Plan to control development on land in existing urban areas which has a history of flooding shall be prepared only when the consent authority has identified the flood behaviour on that land and associated flood risk.*
>
> *66.(2) A plan of management for the land referred in subclause (1) shall indicate appropriate controls or development standards relating to floor height, building materials, access, infill, land clearing and the like to ensure the effects of any flooding on the development shall be minimal."*

It is important to note that IREP No.1 does not define terms such as *"flood liable land", "land subject of flooding", "plan of management"*, etc. Consistent with the traditional flood planning approach, Council has to date adopted a designated flood (or flood planning level – FPL) to

be the 100 year average recurrence interval (ARI) event (basically the same as the 1% AEP) which results in the regulation of development in only a defined section of the floodplain. Floods greater than the 100 year ARI can occur, with the ultimate upper limit being the probable maximum flood (PMF). There is a fundamental change in this respect between the FPDM (1986) and more recently released FPMM (2001), with the FPMM defining the PMF as the limit of 'Flood Prone Land' as it defines the floodplain.

Wollongong Local Environmental Plan 1990

Wollongong Local Environmental Plan 1990 (as amended) is the principal planning instrument for the City of Wollongong and was gazetted on 19 December 1990. It defines zones, permissible uses within those zones and specific development standards and other special matters for consideration with regard to the use or development of land.

This LEP has no specific references to flooding. The objectives of the plan do not include any references to minimising flood risk, no definitions are provided which clarify terms associated with floodplain management, and no provisions are provided which specifically control development for the purposes of minimising damages and risk to life associated with flooding. Included as part of the current Floodplain Risk Management Study and Plan should be the introduction of additional provisions within the WLEP to clarify terms used, provide objectives which relates to floodplain management and outline specific matters for consideration when dealing with applications on flood affected land.

Notwithstanding the above, Clause 19 of WLEP indirectly provides a potential mechanism to minimise the impact of flooding. This clause provides the ability for Council to fix a foreshore building line from creeks, by way of a resolution. Due to the nature of flooding within the study area, this clause could be employed as an effective mechanism to restrict development within the more hazardous flood affected zone, bordering the numerous creeks traversing the study area. In addition Clause 10 (j) requires development consent for any works that involve filling of land forming part of a bed of a natural watercourse including any area subject to periodic inundation.

WLEP 1990 identifies a number of different zones within the subject floodplain, none of which are specific flood-related zones. These zones are:

- 2(a) Residential Low Density;
- 2(b) Residential Medium Density;
- 3(a) General Business;
- 3(b) Neighbourhood Business;
- 4(a) Industrial Light;
- 5(b) Special Uses – Railway;
- 6(a) Public Recreation;
- 6(b) Private Recreation;
- 7(a) Environmental Protection – Special;
- 7(b) Environmental Protection – Conservation;
- 7(c) Environmental Protection – Residential
- 8(b) State Recreation Areas;
- 9(b) Main Roads;
- 9(c) Local Roads.

The majority of the urban section of the study area is zoned 2(a) Residential Low Density, while the large proportion of the study area, being the non-urban escarpment, is mostly zoned 7(a) Environmental Protection – Special.

Any works associated with flood plain management would ordinarily be defined as utility installations. These uses are permissible within most zones within the study area with development consent.

A wholesale review of WLEP 1990 is currently underway and it is understood that Council are investigating ways to more pro-actively manage flood liable land through the LEP process. As part of this review it is recommended that Council update its terminology and definitions to ensure consistency with the NSW Floodplain Management Manual (2001).

Development Applications - "Matters for Consideration"
Prior to granting consent, Council must, amongst other things, consider the "Matters for Consideration" under section 79C EPAA. The matters to be addressed under section 79C are extensive, and include the provisions of any environmental planning instrument (including those described above). Accordingly, Council is required to have regard to the provisions of the applicable LEPs, which specify various matters to consider with respect to flood liable land.

6.1.2 Development Control Plans (DCP's)

Development Control Plans (DCP)s are prepared under Section 72 of the EPAA 1979 and provide detailed guidelines for the assessment of development applications. Section 79C(1)(a)(iii) requires that Council consider any DCP in force. While no DCP is presently in force, which deals specifically with the issue of flooding, such an instrument would provide a desirable mechanism for Council to comprehensively assess development applications with respect to the issue of flooding. For this reason a new DCP titled "Managing our Flood Risks" is currently being prepared and is expected to be adopted by Council in the near future. It is a recommendation of this study that this DCP be adopted to assist with floodplain management in the study area. Further discussion on this issue is presented in **Section 6.2**.

Notwithstanding the above, there are a number of relevant DCPs with references to the issue of flooding including:

Wollongong DCP 9 – Part 1 Residential Standards

- Conventional dwellings are required to have a maximum height of two storeys (or 7 metres to the topmost ceiling) while residential flats can have a height of between two storeys (or 7 metres to allow garages under dwellings on steep land) up to four storeys (including parking above ground level) depending upon the zoning of the land. The restrictions on height are important when considering the appropriateness of elevating structures as a means of minimising the impact of flooding.

- The issue of drainage generally is dealt with as follows (Page 13):

  "Surface and roof water must be disposed of to the satisfaction of Council and so designed that the rate of discharge off the site after the development has been completed does not exceed that currently discharging from the site. If drainage of the site needs to be across private property, proof of the owners consent must be furnished.

  Natural watercourses may be modified only with prior consent following a detailed hydrological study showing that there will be no adverse affect on any other properties."

In practice, modifications to watercourses are generally discouraged and only accepted if there are also no environmental consequences associated with the work. The Rivers and Foreshores Act, NSW State Rivers and Estuaries Policy and NSW Wetlands Management Policy also discourage modifications and alterations to natural watercourses. The modification of watercourses and the building on previous watercourse paths was a major issue of debate in the assessment of the impact of the 1998 floods (refer to Lustig & Irish, 1999), and also formed part of the terms of reference for the recent Commission of Inquiry into the management of the Illawarra Escarpment..

- The provisions for subdivision include the following requirements for the design of roads (Page 17):

  "Full crossfalls are appropriate in streets up to 5 metres in width. In all cases it must be demonstrated that downhill properties are protected from overflow drainage and that footpaths can be provided on through roads."

- Subdivision controls also include standard requirements for drainage, such as minimum width for easements (see Page 17).

- Further within the controls relating to subdivision, under the sub-heading *"Open Space"* (Page 18) the following is stated:

  "In all subdivisions on the foreshores of the ocean, lakes and inlets and major watercourses, a strip of at least 30 metres wide, or adequate width to carry maximum flood flow, is expected to be dedicated to Public Reserve unless there are special circumstances.

  Major watercourses within new development should be dedicated to Council."

  The situation in the study area is that the majority of the land has already been subdivided. Indeed, one of the issues within the study area is that earlier subdivisions have not provided for the identification and dedication of both major and minor watercourses as public open space or easements. This has resulted in some cases, in unrealistic expectations for the development of land upon which it is difficult to implement flood risk reduction works.

- The issue of drainage is again dealt with under the headings *"Sensitive Sites", "Environmental Zones"* and *"Drainage"* (Page 22). However, the provisions in this section are related primarily to water quality and not flooding.

- Under the heading *"Sensitive Sites", " Land Constraints", "Flood Control"* (Page 23), specific statements are made in regard to Council's policy in regard to floodplain management, being as follows:

  "Council has adopted the State Government's policy regarding development of flood affected land as set out in their "Floodplain Development Manual" - NSW Government. Where Council records show, or there is reason to suspect, that the land is susceptible to flood, then a detailed flood study prepared by a recognised consultant must establish the impact of the development on flooding."

This section then goes on to describe the six types of floodplain categories referred to within the FPDM (FPMM) and confirms that Council's current designated flood standard (FPMM) is the 100 year ARI flood event. Specific implications for development include the following:

- A detailed flood study may be required to determine the extent of flood affectation;

- The area of land classed as "floodway: or "high hazard flood fringe" (as per the FPDM (FMM) categories) should be excluded from gross site area when calculating FSR's;
- Habitable floor areas should be 0.5 metres above the designated flood;
- Garages should be at or above the designated flood;
- The level of parking areas should be determined based on the appropriate standard provided by the FPDM (FPMM) for the product of velocity and flood depth.
- New fences are limited to 'open' fences.

Wollongong DCP No. 6 – Commercial and Industrial Developments
Page 7 of this document outlines the information that Council will require to be submitted with a development application, which includes a flood study of any land, which could potentially flood. Page 50 of this document, under the headings Land Constraints and Flood, outlines the same controls as those contained within the Residential DCP under the same heading.

Wollongong Draft DCP No. 49 –Multi Dwelling Development
This document is a DCP to replace parts of DCP No. 9 that dealt with multi dwelling development. The thrust of the changes with DCP 49 are to provide better urban design outcomes, and accordingly flood related issues have not in the main been readdressed as would be expected.

The parts of the Draft DCP, which have any major relevance to the issue of flooding, are outlined as follows:

- A site analysis is to be required for development, which requires the identification of flood-affected areas, over land flow patterns, drainage and services (Page 36).
- Under the heading of Stormwater Management, the following provision is provided:

"Stormwater management

1. *All developments must provide for stormwater management in accordance with Council's drainage design code and on-site detention policy.*
2. *All developments on flood prone lands must comply with Council's flood policy.*
3. *Minimise Stormwater impacts through adopting such systems as:*
   - *On-site detention systems;*
   - *Porous paving;*
   - *Rainwater storage tanks to enable re-use of rainwater; and*
   - *On-site infiltration trenches (soil characteristics and water table permitting).*
4. *Any proposal to alter the existing Council drainage system will require the approval of Council's Works Division."*

Wollongong DCP No. 99/1 (Complying Development) and DCP No. 99/2 (Exempt Development)
All minor development which is ancillary or incidental to dwellings (including carports, garages, sheds and the like) has been excluded from being exempt developments, where located in an area marked "flood assessment" on a series of maps held by Council or located within the area affected by a 1% AEP storm event. For those ancillary developments, which fall within the ambit of complying development, some general criteria are specified, such as the need to ensure that fences do not prevent the natural flow of stormwater drainage and runoff. Certain minor development may be exempt development only if a Part 3A Permit

under the Rivers and Foreshores Improvement Act has been issued for development involving excavation in or within 40 metres of the bank of a watercourse. In many cases, this would preclude a proposal being exempt development.

The eventual recommendations of the FRMP should include a need to review the exempt and complying development provisions of Council, to ensure that they both remain consistent. Also, the FRMP may produce standard definitions of flood prone land and similar terms, which can be adopted by the above, described DCPs.

Controls on fencing within the floodplain are also a likely outcome of the FRMP, and therefore fencing on flood prone land should not be complying or exempt development, and the planning controls recommended by the FRMP could thereby provide the relevant criteria for the assessment of fencing applications in the floodplain.

6.1.3 Strategic Planning

Flood Plain Development Manual
The new "Floodplain Management Manual: The Management of Flood Liable Land" (January 2001) sets out state government policy in the management of flood liable lands. The Manual defines *flood prone land* as all land susceptible to flooding in the Probable Maximum Flood (PMF) event .

The Manual relates to all lands affected by:

- The full range of floods up to the PMF event, but recognises that it is generally not economically or physically possible to provide complete protection against this event.
- Local overland flooding (ie, in addition to 'mainstream' flooding). This is important in the Illawarra – in some catchments more damage was done in August 1998 as a result of local overland flooding (with floodwaters passing along roads and across private property) than as a result of creek flooding.

The Manual considers floodplain management to be primarily the management of risk associated with human occupation of the floodplain. This risk is dealt with in the hierarchy of :

- Avoidance
- Minimisation
- Mitigation

Local Council's have prime responsibility in the management of flood prone land, and are required to do this by developing and implementing Floodplain Management Plans. Floodplain Management Plans specify *'flood planning levels'* (FPLs) which are a combination of flood levels and freeboard (factor of safety). There may be a number of different FPLs at any given location, applying for instance to different types of land use.

There are not as yet any Floodplain Management Plans in place for Wollongong catchments. In the interim Wollongong City Council generally sets FPLs at 500 mm above the 100-year Average Recurrence Interval (ARI) flood event (the flood equalled or exceeded on average once in a 100 year period), or at the PMF level, whichever is the lower.

The Floodplain Management Plan also establishes other catchment specific planning and development controls to be administered by Council and applied generally at the re-zoning and/or development application stages.

NSW Government's Coastal Policy (1997)
The *NSW Government's Coastal Policy (1997) " A Sustainable Future for the NSW Coast"* was released in late October 1997, and circulated to relevant Councils in the state on 11

November 1997. The policy replaces *The New South Wales Coast - Government Policy* issued in 1990 and the *Draft Revised Coastal Policy for NSW* released in 1994. Wollongong LGA is part of the Greater Metropolitan Region and is therefore excluded from the policy. However, Council has adopted the spirit of the Coastal Policy and it would therefore be worth considering the implications of the policy if it was strictly to apply to the Wollongong LGA. The new Coastal Policy addresses critical issues of *water quality and biodiversity conservation in a more holistic way. It is also based on the* principles of ecologically sustainable development, which recognises that ESD provides the framework for making choices between, competing demands on the coastal zone. The policy also contains an Appendix that provides explanatory notes to assist in the implementation of the coastal policy by local councils.

Illawarra Urban Development Program

The Illawarra Urban Development Program (IUDP) coordinates the planning, servicing and development of new urban areas in the local government areas of Wollongong and Shellharbour. The main aim of the UDP is to ensure that sufficient serviced land is available to meet market demands over a five-year period. This is in part recognition, identified by consultants to the UDP in the 1970's, that the wider Wollongong metropolitan area will be the first major city in Australia to run out of land for urban expansion. This is principally because the development opportunities are constrained by the Pacific Ocean and the Illawarra Escarpment. The Sandon Point development is located within the study area and is included on the IUDP program.

Illawarra Coast Draft Planning Strategy - Discussion Paper (1993)

This document notes that the proposed Strategy is designed to provide a strategic framework to guide development on the coastal strip and would apply to the subject site. The Strategy would contain many of the revisions to be made to IREP No.1. The Strategy provides that specific criteria will be used to identify opportunities for future urban expansion including the protection of significant landscapes, wildlife habitats and water catchments.

Council Policies

In addition to formal regulations such as a DCP or an LEP, Council's may from time to time adopt specific local policies with regard to their long-term vision for development within the floodplain or to deal with specific matters such as flooding. Normally, such policies are in time translated, into DCP's or other planning instruments such as an LEP.

Wollongong City Council has adopted an interim Flood Prone Land Policy for the LGA which adopts the 1% AEP as the flood standard (with the Flood Planning Level being 0.5m above this).

Council is also considering the formal adoption of a policy regarding design flood levels and culvert blockages. Although not yet formally adopted, Council's development assessment team is applying this policy to all new developments. This policy requires that for the purposes of hydraulic design and flood level calculations certain criteria be adopted assuming blockages and obstructions and associated implications of such blockages. The need for this draft policy has arisen from data obtained during the major floods of August 17, 1998 and October 24, 1999 where the blockage of drainage structures and channels were found to contribute substantially to increase flood levels and flood impacts. Depending on Council's preference, such detailed specifications could be appended to the Draft DCP recommended in this report, for the purposes of having a complete comprehensive document dealing with the issue of flooding.

Adoption of an FRMP prepared in accordance with the FPMM (2001) provides Council with indemnity pursuant to the limitations provided by Section 733 of the Local Government Act 1993, and accordingly is very important to Council's overall risk management procedures. The eventual outcome of all FRMP's, including this FPMP will be to translate relevant

planning recommendations of these documents into the instruments available through the EPAA, principally the LEP and DCP. Recommendations for translating relevant recommendations of these documents into these instruments are made later, within this report.

Zoning Certificates

Zoning Certificates (previously referred to as s.149 Certificates) are prepared under the EPAA, and must be attached to a contract prepared for the sale of property. The matters to be contained within the Section 149(2) Certificate are prescribed within Schedule 4 of the Environmental Planning and Assessment Regulation, 1994, which includes the following specific matters in regard to flooding.

> *"12. Whether or not the Council has by resolution adopted a policy to restrict the development of land because of the likelihood of landslip, bushfire, flooding, tidal inundation, subsidence or any other risk". [Our emphasis]*

The wording of the above-prescribed matter is such that inconsistencies arise between local Council's in regard to the extent of information they provide on flooding. It has been argued that on literal interpretation, Council's are only required to provide a 'yes' or 'no' answer as to whether such a policy exists. Further, there is potential equivocation when a Council is aware of a flood risk and there are no policies restricting development subject to the risk.

A certificate issued under Section 149(5) of the Act simply requires that Council "include advice on such other relevant matter affecting the land of which it may be aware". While this certificate type would necessitate Council advising of all flood information it holds, it is a more expensive certificate and is not a mandatory attachment to property sale contracts.

Council has a number of standing notations for inclusion on Section 149 Certificates, which relate to lands that may be affected by flooding. The notations relating to land not known to be flood affected advise that Council's maps do not indicate flooding, however these may not be complete and where at any doubt exist the services of a suitable qualified engineer should be obtained.

Council has a number of notations for Section 149 Certificates on flood-affected land. These notations advise that Council's flood maps identify the land as being located in an area where flooding has occurred or is suspected. Advice is given that the services of a suitably qualified engineer should be sought to ascertain the likely affect, if any, on the land. There are notations, which also provide advice in regard to associated considerations such as existence of a piped watercourse and potential ponding.

These Section 149 notices should ultimately be reviewed upon adoption of the FRMP, to recognise the existence of the FRMP and any policies emanating from that document, as well as the findings of the flood study preceding the FRMP. Generally, the recommendations of this study are to advise all persons, using Section 149 Certificates (and other methods) of all potential flooding (i.e. up to the PMF).

Section 94 Contributions Plans

Section 94 Contributions Plans under the EPA Act provide a basis for the levying of development contributions to construct drainage and flood management works required as a result of future development. Section 94 contributions can generally only be applied to fund works associated with the new development and cannot be applied for purposes of rectifying past inadequacies. They could however be used to recoup the cost of undertaking studies such as this in areas of 'greenfield' development.

As structural flood management measures are limited and potential development growth is minimal, it is unlikely that a Section 94 Contributions Plan would be a feasible fund raising

mechanism in the study area but could nevertheless be considered by Council should there be a change in planning policies that allow significant re-development of some areas.

Other Strategic Planning Documents
The State of the Region - Review of Recent trends and their Strategic Implications for the Sydney-Newcastle-Wollongong Greater Metropolitan Region (1996);

The Metropolitan Strategy (DUAP (Planning NSW) Cities for the 21st Century);

The recently released Shaping Our Cities - The Planning Strategy for the Greater Metropolitan Region of Sydney, Newcastle, Wollongong and the Central Coast (1999) outlines the NSW Government's broad planning priorities for the Metropolitan Region. Planning NSW (Illawarra Regional Office) is currently preparing a separate Shaping Illawarra document, which will effectively supersede IREP No.1 (which itself is in very much in need of review).

6.2 PROPOSED PLANNING AND POLICY CONTROLS

6.2.1 A General Philosophy

Qualification of flood behaviour and development of acceptable controls for development on floodplains are very old issues dating back into antiquity.

It is therefore unlikely that any specific policies developed today will be the 'final' answer to these problems. It is important however, that whichever policies are adopted be cast in such a way as to permit progressive updating as experience develops in their implementation, highlighting their strengths and weaknesses.

The past two decades have seen some major changes in Governmental policies and regulations in respect to the management of Flood Prone Lands and the evolution of a number of policies from Federal and State Government Departments and Agencies, in respect to such land.

This study has for the most part adopted the New South Wales Flood Prone Lands Policy (as detailed in the Floodplain Management Manual (2001)) as the key document outlining desirable controls in this area.

It is the study's recommendations that the Draft Development Control Plan (DCP) entitled "Managing our Flood Risks" be implemented as the 'link' between Council's existing LEP and the policy and practice controls described in this study. In accord with the FPMM's guidelines, this DCP and supporting materials recognise the full spectrum of flood risk to the limit of possible flooding (as defined by the Probable Maximum Flood). This approach avoids the 'hard edge' in planning that occurred at the earlier 'designated' flood limit and eliminates altogether misinformation as to flood risk that the earlier 'designated' flood standard propagated in the community.

Since the city wide DCP must deal with all catchments (notwithstanding their differences) it is proposed to augment the DCP with a series of catchment specific 'Planning Control Matrices' to provide the flexibility needed in dealing with these differences.

The proposed DCP and the Hewitts Creek Planning Control Matrix are key components of the proposed risk management philosophy and are described further below.

6.2.2 Flood Planning Level(s) (FPL's)

One key component of any Floodplain Risk Management Study is consideration of the Flood Planning Level (FPL) for a given area. This FPL is the level below which Council adopts development controls to address flood risk. FPL is the current, FPMM (2001) terminology replacing the 'flood standard' or the 'designated flood', referred to commonly within the earlier FPDM (1986). The FPL also requires the integration of freeboard when setting this level.

There has traditionally been an approach where a singular FPL (or flood standard) has been chosen which creates significant limitations on a holistic approach to managing the flood risk in the floodplain. The reality is that various land uses are subject to different consequences (risks) from flood hazard (eg. the consequences of flooding to a hospital are much different to the consequences of the flooding of an amenities block in parkland). Accordingly, in assessing an appropriate FPL, there needs to be an approach developed, which reflects the different flood risk to different land uses within the floodplain, while maintaining an understanding that flooding can still occur, regardless of flood controls that may be imposed, up to the level of flooding in the Probable Maximum Flood.

6.2.3 THE PLANNING CONTROL MATRIX

Background & Objectives
Given the difficulty in addressing the associated variability in flood risks with simple rules, the use of the planning matrix approach developed by D. Bewsher and P. Grech, (1997) is recommended.

This approach distributes land uses within the floodplain and controls development to minimise the consequences of flooding on these developments.

Using this approach, a matrix of development controls, based on the flood risk and land use, can be developed which balances the risk exposure across the floodplain. This approach has been adopted as part of the Hawkesbury-Nepean Flood Management Strategy. It has also been previously applied within the Blacktown, Narrabri, Cabramatta Creek, Patterson River, North Wentworthville and Molong Floodplain Management Studies, and the resulting matrix has been pivotal in the new draft DCP's and LEP's recommended for implementation as part of these Floodplain Management Plans.

Categorising the Floodplain
The first stage in developing a "planning control matrix" is to identify each of the floodplains to which the overall policy document is to be applied, while the second stage is to divide the floodplains into areas subject to different levels of flood risk.

In regard to the first stage, it is noted that this FRMS relates only to the floodplains of the Slacky, Tramway, Woodlands, Hewitts and Thomas Gibson Creek systems. Notwithstanding potential differences between some catchments in the LGA it is likely that the planning control matrix for each will be similar and that once more experience is gained with regard to its application, Council may move towards a singular matrix, applying to all floodplains within its LGA.

Wollongong City Council's present proposal is to prepare a singular city wide DCP, which has a common preamble, objectives and general policies, while specific controls for each floodplain are reflected within the planning control matrix prepared each study area and annexed to the principal document. This approach has been adopted and recommended elsewhere for the management of floodplains jointly administered by more than one local Council (eg. Cabramatta Creek FPMS where its management is jointly the responsibility of

Fairfield and Liverpool City Council's), or where Councils have a number of floodplains with their LGA.

The second stage in the preparation of the planning control matrix is to identify different flood risk precincts (FRP's), reflective of the variable flood risk within each of the separate precincts and the development controls applicable to each precinct. In regard to the study area the following three FRP's are proposed:

- High Flood Risk — Being identified as land subject to a high hydraulic hazard in a 1% AEP event (in accordance with the provisional criteria outlined in fig G2 of the FPMM). In addition, the high risk precinct is to include all land within 10m of the top of creek bank as a setback for erosion risks.
- Medium Flood Risk — Being identified as land at a level below the 1% AEP flood level plus 0.5m freeboard , but outside of the High Flood Risk Precinct. In this precinct it is considered that there is a significant risk of flood damages without compliance with flood related building and planning controls.
- Low Flood Risk — All other land within the floodplain (i.e. within the limits of PMF flooding) but not identified as either in a high flood risk or medium flood risk precinct, where risk of damages are low for most land uses.

A plan showing the location of these precincts within the study area has been included in **Appendix 6.1**.

The FRP's described above have been formulated to provide a basis for strategic planning and development control having regard to the specific characteristics of the floodplains of Hewitts Creek and its adjacent catchments.

It should be noted that the Low Flood Risk Precinct is still subject to some flood-related risk and those uses that may be considered critical, such as essential community facilities are identified as undesirable land uses in this precinct. The other major purpose for this precinct is to identify and recognise the potential flood risk for all persons and properties affected by the PMF, regardless of whether any specific development controls are to be applied. This provides a basis for identifying the extent of targeted flood awareness programs, evacuation and emergency planning.

Prioritising Land Uses in the Floodplain

The next consideration in the preparation of the planning control matrix is to prioritise land uses within the floodplain. This is achieved by identifying discreet categories of land uses, each having similar flooding consequences. For Wollongong the following categories have been adopted:

- Essential community facilities
- Critical utilities
- New Residential Subdivisions
- Established Residential Areas
- Commercial
- Industrial
- Tourist related development

- Recreation or agriculture
- Minor development

Defined land uses, as specified by the relevant LEP's, are included within each of the above categories depending on relevance having regard to the issue of flooding. Many of these land uses are irrelevant to the floodplains of Hewitts Creek and its adjacent catchments but may be considerations for other floodplains in the Wollongong City LGA.

These categories are subsequently listed under each FRP in the planning matrix dependent upon the level of flood risk which is considered acceptable. This provides a basis for specifying whether certain categories are unsuitable land uses in different parts of the floodplain or whether they are suitable subject to varying degrees of development control. This approach is the application of the philosophy previously described within this report.

Property Modification
The next step in the preparation of the planning control matrix is to assign different planning controls to modify building form (property modification) and the ability of the residents occupying these new developments to respond in times of flooding (response modification), depending upon the type of land use and the location of that land use within the floodplain. Some of these of controls include:

- Floor levels (property modification)
- Flood compatible building components (property modification)
- Structural soundness (property modification)
- Flood effect on others (property modification)
- Evacuation/access (response modification)
- Flood awareness (response modification)
- Management and design (property and response modification)

There should be variance to the stringency of development controls reflecting the sensitivity of the land use category to the flood hazard, and the location of the land use within the floodplain.

6.2.4 The Hewitts Creek Planning Control Matrix
Based on the above procedures, a planning control matrix has been prepared for the Slacky, Tramway, Woodlands, Hewitts and Thomas Gibson catchments and is reproduced in **Appendix 6.2**.

6.2.5 Implementation of the Planning Control Matrix
As previously outlined a singular planning control matrix has been prepared as a component of this FRMS for the Slacky, Tramway, Woodlands, Hewitts and Thomas Gibson Creek floodplains.

In addition to the preparation of the DCP's, Council will need to undertake discreet changes to its LEP in order to ensure consistency with definitions, special flood development control clauses, and to modify boundaries, which establish appropriate setbacks from creeks using foreshore building line provisions.

A brief description of the specific controls as proposed for the study area is given below, while greater detail as to the specific application of these controls to different landuse categories is included in the matrix and associated DCP.

Land Use and Zoning

Ensure land use in flood prone areas is compatible with the inherent risks of flooding. Typical land uses which are not suitable for flood prone areas would typically include hospitals, critical utilities and other emergency facilities. In general, land within the low and medium planning risk precincts is considered suitable for most forms of development provided appropriate controls such as minimum floor levels are applied to minimise flood damages. Suitable land use within high risk precincts are limited to minor structures (that do not impede flow) and recreational /non-urban type developments.

Works (Set backs)

Ensure the provision of adequate setbacks for new development or re-development along creeks or overflow paths. In general where development adjoins a natural open watercourse, a minimum riparian set back should be integrated into the development. The set back is intended to provide a reduction in flood risk as well as reduced risk to structures located close to the top of steep eroding banks. The width of the set back should be between 10 and 40m (as measured from the top of the nearest bank with final width selection depending on site specific requirements of the Department of Land and Water Conservation (DLWC). Where the water course has been piped for a considerable distance, it is recommended that an overflow path that is sized to accommodate hydraulic and environmental needs be incorporated into the design, centred at the low point of the surface flow path. For small urban catchments such as Thomas Gibson Creek a minimum width of 10m is suggested although the adequacy of this should be confirmed at DA stage accounting for specific site conditions. Where an overflow path follows a common boundary, the developer should be encouraged to integrate the design (in consultation with adjoining owners) to create a flow path spanning the property boundary. Where possible, velocity and depth in these areas should be within safe limits.

Within the set back, it is recommended that no structures (including minor development) or fill encroachments be permitted unless appropriately designed and approved. Where a creek or overflow path crosses/follows a fenced boundary, the fence should be constructed using open type fencing for the full width of the riparian setback/overflow path. This is required in order to prevent blockage and reduce pondage on the high side of fences as much as possible. Where privacy is an issue, screening methods such as appropriate landscaping could be considered.

It is noted that a requirement for set backs is considered necessary to ensure that flood flows are adequately catered for and to prevent future damages which would invariably occur should any new development be constructed within a high risk precinct. In addition, the requirement for set backs along open channel systems should (in the long term) restore the viability of the riparian corridor and facilitate future riparian improvements.

Flood Access Enhancement

Ensure future development provides for enhanced access to, and egress from, existing flood prone property. This includes provision of safe evacuation access for pedestrians and vehicles in accordance with the requirements scheduled in the flood planning control matrix.

Filling

Limit the amount of filling on the floodplain. Any filling would need to be in accord with Council policy and it would need to be demonstrated that filling in the manner proposed, would have no adverse impact on flooding throughout the system.

No specific modelling has been carried out to assess the cumulative impact of any particular proposals for filling. However it is acknowledged that there will over time be significant pressure for filling of some areas.

Generally where loss of floodplain storage has no adverse impact on peak flows, filling as part of a site re-development (i.e. where there is an existing dwelling/structure to be removed) should be considered as a method by which an existing flood risk can be removed/reduced. It is noted however that filling of individual sites may result in local impacts such as increased flooding of adjoining properties that have not yet been filled. The short term impact of such filling will therefore need to be balanced against the long term benefits of lifting low lying areas above the floodplain.

It is therefore a recommendation of this study that filling within floodplain areas in the downstream part of the catchment be permitted, provided it can be demonstrated by the proponent that there are no local hydraulic impacts on any adjoining properties. This is seen as a positive long term strategy for encouraging redevelopment at higher elevations.

Within the upper parts of the catchment filling onto the floodplain should be discouraged due to its potential impacts on peak flows downstream.

The division between the two zones has been initially set at the north south rail embankment. Filling land to the east of the rail embankment could, with appropriate documentary support, be considered on its merits. However, land to the west of the rail embankment should generally not be filled. As with any proposed works in and around waterways, an assessment of the environmental impacts of the proposed filling should be undertaken including the effects of increased flow velocity and changes to stream morphology. Proposals should be modified to minimise these effects.

Minimum Freeboard
Ensure that an appropriate amount of freeboard is added to the design flood level used for planning purposes. This freeboard is required to account for uncertainties in the hydrologic and hydraulic modelling processes and surface waves. For the study area it is proposed to adopt a 500mm minimum freeboard for residential floors.

Minimum Floor Level
Ensure that all development complies with minimum floor levels to be set at the Flood Planning Level (FPL). The general FPL to be applied in the study area is the 1% AEP event flood level relevant to the site (incorporating the critical blockage pattern) plus 500mm minimum freeboard. Where this is impractical for minor additions or commercial premises, a reduced FPL may be considered provided flood proofing is carried out or consideration could be given to a minimum percentage of the floor area being constructed above the FPL for the storage of stock.

Building Materials
Require the use of appropriate building materials which are less prone to water damage (e.g. masonry, tiles) for all developments that may be subject to partial inundation. In general, flood compatible building materials should be used for all parts of the structure below the 1% AEP flood surface level plus freeboard (i.e. the Flood Planning Level).

Services
Ensure any proposed creek crossings by services e.g. sewer or water mains, do not impact on flooding. In this regard, services should be either well elevated above 1% AEP flood level or installed below the bed of the creek to minimise obstruction to flow. These service crossings should be constructed in an environmentally sensitive manner which does not impact on bed and bank stability.

Works (Structures)
Implement development controls on all proposed structures on flood prone land to ensure the proposed structure does not impact on flooding and is not itself impacted by flooding. It is noted that even minor development within the medium risk precinct has significant potential

for adversely impacting on flood levels. Any development in these areas, allowable in accordance with the proposed planning matrix, should be required to demonstrate no adverse impact on adjoining land. Any development involving structures within the high risk precinct should be discouraged.

Works (Construction sites)
Development controls to ensure building materials stored on construction sites and temporary works such as temporary cut-off drains, berms and soil and water management measures do not impact on flooding.

Works (Material Storage)
Ensure that any proposed usage of the floodplain as a material storage area does not impact on flooding as a result of stored materials being swept away, leading to increased debris and blockage downstream.

Structural Soundness
Ensure that structures proposed as part of developments which may be subject to inundation are not likely to collapse under load from floodwaters and are constructed from flood compatible materials. This would include internal flood proofing of new structures subject to inundation (refer comment on building materials above).

Fencing Type
Minimise the impediment to overland flow by ensuring that any fencing proposed within the riparian setback or overflow path is flood compatible i.e. large open pool fencing or similar.

7. RISK MANAGEMENT SCHEMES

7.1 INTRODUCTION

Over 200 risk management measures (structural and non-structural) were investigated for the Slacky, Tramway, Woodlands, Hewitts and Thomas Gibson Creek catchments. These measures were developed in consultation with Council, DLWC, the Hewitts Creek Floodplain Management Committee, feedback from community meetings and residents letters/submissions.

A "Management Measures Master List" (copy included in **Appendix 3.1**) was prepared documenting these measures including a preliminary subjective assessment of likely benefits and costs of each measure. In order to help identify the location of the various measures, a plan showing flood management zones (referred to in **Appendix 3.1**) accompanies this master list.

From the master list and feedback from the committee, selected measures were chosen for further development into Management schemes and subsequent modelling (refer **Sections 8 & 9**). These 'short listed' measures were initially selected on the basis of their estimated benefit cost ratio. A series of plans describing the schemes is included in **Appendix 4**.

Measures not included on the 'short list' include those measures which were technically, economically, socially or environmentally unfeasible. The Management Measures Master List (**Appendix 3.1**), gives a brief description of reasons for excluding each of these measures.

Each scheme represents an alternative combination of measures for mitigating flood damages in a particular stream reach. Due to the hydraulically isolated nature of the management measures, some measures are common to several schemes. The schemes only differ where two or more measures are proposed for a single zone that both have potential to reduce flood damages in that zone or reach, in a manner which cannot be modelled concurrently.

A generic scheme was also prepared describing measures most appropriately applied across all catchments in the study area.

For all catchments a 'do nothing' baseline scheme has been analysed to provide an indication of existing damages and for use as a benchmark against which other schemes are assessed. This is the system as it presently exists, as analysed in the companion Hewitts Creek Flood Study (2002).

7.2 A 'GENERIC' SCHEME FOR THE STUDY AREA

The measures considered for the various management zones are selected from three broad categories:

- Property modification measures;
- Response modification measures; and
- Flood modification measures.

A general description of the typical measures from each category is given in Appendix J of the Floodplain Management Manual (2001).

The first two of the categories given above are generally being implemented through the application of planning and development controls in accordance with the proposed planning control matrix. However a range of response modification measures, not suited to application via the matrix, have also been considered. These include a range of mostly non-structural management measures that can be applied to all floodplains in the study area as a generic scheme. These include:

Flood Education
Flood education programmes help to ensure that the local community is fully 'aware' that floods will occur and are likely to interfere with normal activities in the floodplain. A typical flood education programme could include:

- Meetings/workshops with residents/groups
- Articles in local newspapers
- Displays of flood photos/articles in centres
- Distribution of flood information leaflets
- School projects/addressing schools on flooding

This would need to be an ongoing program to accommodate loss of awareness with time and the addition of new members to the community.

Flood Signage
The provision of permanent flood signage to ensure that the local community remains constantly aware of flood risks. Signage could include:

- signs or markers of historic flooding
- signs or markers of the local Flood Planning Level in key areas
- signage showing evacuation routes

Flood Readiness
Establishment of a community education programme to provide information focussed on means of mitigating risks and damages, during a flood event thus ensuring that the community is as prepared for flooding as are reasonably practicable. This could easily be integrated with the Flood Education Program.

Flood Prediction and Warnings
It would be of considerable benefit if a flood prediction and warning system could be implemented that could maximise time available for residents to mitigate damages and if necessary evacuate their home prior to the onset of flooding site.

Unfortunately the short response time in all catchments makes few of the available measures practicable. In addition it would be at best confusing if each catchment in the City had a different approach to Flood Warning. No recommendations for catchment specific flood prediction and warning systems can therefore be made. It is however recommended that city wide flood warning schemes be further investigated.

Local Flood Plan
The NSW State Emergency Service (SES) is the designated combat agency for floods. Within this role, the SES is responsible for the preparation, maintenance and review of flood response plans at the local, district and state levels. A Local Flood Plan for the City of Wollongong has been prepared by the SES (April 1995 – currently under review).

The flood plan sets out procedures for 'Preparedness', 'Response' and 'Recovery' across the City and includes discussion on 'specific risk areas' in the Plan's annexures and is a sub-plan to the Wollongong Local Disaster Plan (DISPLAN).

The Floodplain Risk Management Study provides an opportunity for the SES to incorporate specific information on the effects of flooding within the study area in the review of the Wollongong City Local Flood Plan and to develop appropriate operational response procedures. In particular the Floodplain Risk Management process has identified dwellings within the floodplain subject to above-floor flooding during flood of differing severities.

From this information, properties where the depth of overfloor flooding could present a potential threat to life can be identified and appropriately provided for in the Local Flood Plan.

Given the value of data collected and processed in the present study, to the effectiveness of such a plan, it is most important that all data be made available to the State Emergency Service by Wollongong City Council once it has been collated into a format suitable for interpretation by the SES.

Recommendations as to the application of these response modification measures to the study area generally and to specific creek reaches are given in **Chapter 9**.

It is noted that the 'generic' all catchments scheme is not assessed in the same manner as the site-specific structural measures described later in this chapter. This is principally because of the difficulty of assessing the cost of these measures and the subjectivity of the benefits. Nevertheless it is important to note that investment in proper planning and development controls and introduction of public flood awareness and education campaigns has been found through past experience to be relatively low cost, yet highly effective at reducing flood damages.

7.3 SLACKY CREEK

The following two alternate management schemes are proposed for Slacky Creek identified as SA and SB.

7.3.1 Scheme SA (diversion to Tramway Creek removed)

The following measures have been incorporated into Scheme SA.

TABLE 7.3.1- SCHEME SA - PROPOSED MEASURES

Zone	*Location*	*Proposed Measure*
1.00	Ocean outfall	Develop opening policy
1.02	Footbridge to Blackall St	Flow training wall on south bank
1.04	Rail line to footbridge	Channel enlargement and stabilisation
1.04	Rail line to footbridge	Formalise overflow path in vicinity of Beacon Ave (immediately d/s of rail)
1.05	Rail line	Increase culvert capacity
1.06	Princes Highway to Rail line	Reconfigure basin outlet (to reduce nuisance flows into Beacon Ave)
1.08	Old mine rail to Princes Highway	Channel enlargement and stabilisation
1.08	Old mine rail to Princes Highway	Levee east bank

Table 7.3.1 cont'd

1.09	Old mine rail	**Remove diversion (at old rail)**
1.10	Hobart St	**Remove diversion (at Hobart)**
1.11	William St to Hobart St	Sediment basin
1.11	William St to Hobart St	Channel enlargement and stabilisation
1.12	William St	Formalise overflow path
1.13	Rex Ave to William St	Sediment basin
1.13	Rex Ave to William St	Restore pre Aug 98 capacity
1.13	Rex Ave to William St	Coarse debris trap
2.03	Southern Tributary - mine basin	Retarding basin

7.3.2 Scheme SB (diversion to Tramway Creek formalised)

The following measures have been incorporated into Scheme SB.

TABLE 7.3.2 - SCHEME SB - PROPOSED MEASURES

Zone	***Location***	***Proposed Measure***
1.00	Ocean outfall	Develop opening policy (as per SA)
1.02	Footbridge to Blackall St	Flow training wall on south bank (as per SA)
1.06	Princes Highway to Rail line	Reconfigure basin outlet (to reduce nuisance flows into Beacon Ave)
1.09	Old mine rail	**Formalise diversion (at old rail)**
1.10	Hobart St	**Formalise diversion (at Hobart)**
1.11	William St to Hobart St	Sediment basin (as per SA)
1.11	William St to Hobart St	Channel enlargement and stabilisation
1.12	William St	Formalise overflow path (as per SA)
1.13	Rex Ave to William St	Sediment basin (as per SA)
1.13	Rex Ave to William St	Restore pre Aug 98 capacity (as per SA)
1.13	Rex Ave to William St	Coarse debris trap
2.03	Southern Tributary - mine basin	Retarding basin (as per SA)

The key difference between the two schemes is that Scheme SA involves removal of the existing diversion of Slacky Creek into Tramway Creek upstream of Hobart Street. This by necessity will require additional flood management works in lower Slacky Creek due to the significantly increased flow in lower Slacky, in larger events.

Scheme SB requires less works in Lower Slacky Creek as the existing diversion currently protects lower Slacky Creek to the detriment of Tramway Creek. However, it is noted this arrangement has been in place for a significant length of time.

7.4 TRAMWAY CREEK

The following management schemes are proposed for Tramway Creek identified as TA1, TA2, TB1, TB2 and TB3.

Schemes TA1 and TA2 have been developed for the condition where it is determined that removal of the diversion of Slacky Ck at Hobart St should be carried out. Conversely, the TB1, TB2 and TB3 schemes have been developed for the condition where the diversion has been formalised.

7.4.1 Scheme TA1 (diversion to Tramway removed – culvert upgrade)

The following measures have been incorporated into Scheme TA1.

TABLE 7.4.1 - SCHEME TA1 - PROPOSED MEASURES

Zone	*Location*	*Proposed Measure*
3.01	Ocean outfall	Develop opening policy
3.03	Rail line	High flow culvert/bridge

7.4.2 Scheme TA2 (diversion to Tramway removed – debris control)

The following measures have been incorporated into Scheme TA2.

TABLE 7.4.2 - SCHEME TA2 - PROPOSED MEASURES

Zone	*Location*	*Proposed Measure*
3.01	Ocean outfall	Develop opening policy (as per TA1)
3.03	Rail line	Debris Control Structure

The key difference between TA1 and TA2 is that TA1 employs a culvert upgrade to reduce flood levels upstream of the rail while TA2 utilises a debris trap to reduce blockage of the culvert and therefore flood levels.

7.4.3 Scheme TB1 (diversion to Tramway formalised– culvert upgrade)

The following measures have been incorporated into Scheme TB1.

TABLE 7.4.3 - SCHEME TB1 - PROPOSED MEASURES

Zone	*Location*	*Proposed Measure*
3.01	Ocean outfall	Develop opening policy (as per TA1)
3.03	Rail line	High flow culvert/bridge
3.04	Princes Highway to Rail line	Formalise overflow path (inc along Hobart St)
3.04	Princes Highway to Rail line	Voluntary purchase offer (2 properties)

7.4.4 Scheme TB2 (diversion to Tramway formalised– debris control)

The following measures have been incorporated into Scheme TB2.

TABLE 7.4.4 - SCHEME TB2 - PROPOSED MEASURES

Zone	*Location*	*Proposed Measure*
3.01	Ocean outfall	Develop opening policy (as per TA1)
3.03	Rail line	Debris control structure
3.04	Princes Highway to Rail line	Formalise overflow path (as per TB1)
3.04	Princes Highway to Rail line	Voluntary purchase offer (2 properties) (per TB1)

7.4.5 Scheme TB3 (diversion to Tramway formalised– voluntary purchase)

The following measures have been incorporated into Scheme TB3.

TABLE 7.4.5 - SCHEME TB3 - PROPOSED MEASURES

Zone	*Location*	*Proposed Measure*
3.01	Ocean outfall	Develop opening policy (as per TA1)
3.04	Princes Highway to Rail line	Formalise overflow path (as per TB1)
3.04	Princes Highway to Rail line	Voluntary purchase offer (6 properties)
3.04	Princes Highway to Rail line	Voluntary purchase offer (2 properties)(per TB1)

The key difference between TB1 and TB2 is that TB1 employs a culvert upgrade to reduce flood levels while TB2 utilises a debris trap. TB3 incorporates flood proofing and voluntary purchase as a possible measure in this area.

7.5 WOODLANDS CREEK

Two management schemes are proposed for Woodlands Creek identified as WA and WB.

7.5.1 Scheme WA (high flow culvert at rail)

The following measures have been incorporated into Scheme WA.

TABLE 7.5.1 - SCHEME WA - PROPOSED MEASURES

Zone	*Location*	*Proposed Measure*
2.01	Diversion to Hewitts	Re-divert Woodlands Ck to Tramway Ck
2.01a	Near Sewer Pumping Station	Channel enlargement and stabilisation
2.03	Rail line	High flow culvert/bridge
2.04	Princes Highway to Rail line	Modify safety ramp and provide sag
2.04	Princes Highway to Rail line	Levee north bank
2.05	Princes Highway	Sediment basin/debris control structure

7.5.2 Scheme WB (retarding basin above highway)

The following measures have been incorporated into Scheme WB.

TABLE 7.5.2 - SCHEME WB - PROPOSED MEASURES

Zone	***Location***	***Proposed Measure***
2.01	Diversion to Hewitts	Re-divert Woodlands Ck to Tramway Ck (perWA)
2.01a	Near Sewer Pumping Station	Channel enlargement and stabilisation (per WA)
2.04	Princes Highway to Rail line	Modify safety ramp and provide sag (per WA)
2.04	Princes Highway to Rail line	Levee north bank (as per WA)
2.05	Princes Highway	Retarding basin
2.05	Princes Highway	Sediment basin/debris structure (as per WA)

The difference between these two schemes is that Scheme WA proposes to enlarge the capacity of the rail culvert to reduce rail overtopping, while Scheme WB proposes a large retarding basin upstream of the Princes Highway to attenuate peak flows (thereby reducing the need for an upgraded culvert downstream of the highway).

7.6 HEWITTS CREEK

Two management schemes are proposed for Hewitts Creek identified as HA and HB.

7.6.1 Scheme HA (levee at Corbett Ave)

The following measures have been incorporated into Scheme HA.

TABLE 7.6.1 - SCHEME HA - PROPOSED MEASURES

Zone	***Location***	***Proposed Measure***
1.00	Ocean outfall	Develop opening policy
1.02	Adjacent to Corbett Ave	Levee north bank
1.05	LHD to the Rail line	Voluntary purchase offer (1 property)
1.05	LHD to the Rail line	Rehabilitate creek channel
1.08	Lachlan St	Culvert inlet improvements
1.08	Lachlan St	Formalise overflow path
1.08	Lachlan St	Voluntary purchase offer (4 properties)
1.09	Kelton Ln to Lachlan St	Channel enlargement and stabilisation
1.10	Kelton Ln	Coarse Debris trap
1.11	Bangalow Rd to Kelton Ln	Restore pre Aug 98 capacity
1.11	Bangalow Rd to Kelton Ln	Coarse Debris trap

7.6.2 Scheme HB (property mods at Corbett Ave)

The following measures have been incorporated into Scheme HB.

TABLE 7.6.2 - SCHEME HB - PROPOSED MEASURES

Zone	***Location***	***Proposed Measure***
1.00	Ocean outfall	Develop opening policy (as per HA)
1.02	Adjacent to Corbett Ave	House raising
1.02	Adjacent to Corbett Ave	Flood proofing
1.05	LHD to the Rail line	Voluntary purchase offer (1 property (as per HA)
1.05	LHD to the Rail line	Rehabilitate creek channel (as per HA)
1.08	Lachlan St	Culvert inlet improvements (as per HA)
1.08	Lachlan St	Formalise overflow path (as per HA)
1.08	Lachlan St	Voluntary purchase offer (4 properties) (per HA)
1.09	Kelton Ln to Lachlan St	Channel enlargement and stabilisation (per HA)
1.10	Kelton Ln	Coarse Debris trap (as per HA)
1.11	Bangalow Rd to Kelton Ln	Restore pre Aug 98 capacity (as per HA)
1.11	Bangalow Rd to Kelton Ln	Coarse Debris trap (as per HA)

The difference between Schemes HA and HB is that HA proposes flood modification measures at Zone 1.02 while HB proposes property modification measures. All other measures are the same for each scheme.

7.7 HEWITTS CREEK STREAM 4

Two management schemes are proposed for Hewitts Creek 4, identified as HS4A and HS4B.

7.7.1 Scheme HS4A (culvert and property modification)

The following measures have been incorporated into Scheme HS4A.

TABLE 7.7.1 - SCHEME HS4A - PROPOSED MEASURES

Zone	*Location*	*Proposed Measure*
4.03	Stream 4 - Virginia Tce	Culvert mod's (to reduce surcharge freq'y)
4.03	Stream 4 - Virginia Tce	Property modification (flow deflectors)
4.04	Stream 4 - Deborah Ave	Coarse debris trap

7.7.2 Scheme HS4B (Voluntary purchase)

The following measures have been incorporated into Scheme HS4B.

TABLE 7.7.2 - SCHEME HS4B - PROPOSED MEASURES

Zone	*Location*	*Proposed Measure*
4.03	Stream 4 - Virginia Tce	Voluntary purchase offer (1 property)
4.04	Stream 4 - Deborah Ave	Coarse debris trap (as per HS4-A)

The key difference between these two schemes is that HS4A involves flood and property modifications, while HS4B involves purchase of property to remove flood risk and damage.

7.8 THOMAS GIBSON CREEK

Two management schemes are proposed for Thomas Gibson Creek identified as TGA and TGB.

7.8.1 Scheme TGA (Pipe upgrade)

The following measures have been incorporated into Scheme TGA.

TABLE 7.8.1 - SCHEME TGA - PROPOSED MEASURES

Zone	*Location*	*Proposed Measure*
1.00	Ocean outfall - North Arm	Develop opening policy
1.00	Ocean outfall - North Arm	Lower south bank
1.01	The Esplanade - North Arm	Upgrade Pipe Drainage
1.03	Macauley St to Cliff Pde - North Arm	Raise Kerb/Driveway
1.03	Macauley St to Cliff Pde - North Arm	Upgrade pipe drainage
1.04	Macauley St - North Arm	Investigate culvert inlet improvements
1.08	Rail Line - North Arm	Investigate culvert inlet improvements
1.08	Rail Line - North Arm	Debris Control Structure

Table 7.8.1 Cont'd

1.13	Phillip St to Sea Foam Ave - North Arm	Upgrade Pipe Drainage
1.13	Phillip St to Sea Foam Ave - North Arm	Re-shape roadway to improve capacity
2.03	Rail Line to Raymond Rd	Check condition and rehabilitate pipe drainage
2.03a	Station St diversion - Station St	Overflow path
2.04	Rail Line	Investigate culvert inlet improvements
2.07	Phillip St to LHD	Overflow path
3.00	Ocean outfall - South Arm	Develop opening policy
3.00	Ocean outfall - South Arm	Reduce diversion to north
3.01	Cliff Pde	Improve culvert capacity
3.02	Macauley St to Cliff Pde to Blackall St	Modify Existing Flood Gate
3.02	Macauley St to Cliff Pde	Debris Control Structure
3.02	Macauley St to Cliff Pde	Overflow path
3.03	Macauley St	Modify culvert inlet
3.05	Thomas Gibson Park outlet	Formalise existing detention basin
3.05	Thomas Gibson Park outlet	Debris control structure
3.10	Lachlan St to LHD	Overflow path

7.8.2 Scheme TGB (Overflow path)

The following measures have been incorporated into Scheme TGB.

TABLE 7.8.2 - SCHEME TGB - PROPOSED MEASURES

Zone	***Location***	***Proposed Measure***
1.00	Ocean outfall - North Arm	Develop opening policy
1.00	Ocean outfall - North Arm	Lower south bank
1.01	The Esplanade - North Arm	Expand floodway
1.03	Macauley St to Cliff Pde - North Arm	Raise Kerb/Driveway
1.04	Macauley St - North Arm	Investigate culvert inlet improvements
1.08	Rail Line - North Arm	Investigate culvert inlet improvements
1.08	Rail Line - North Arm	Debris Control Structure
1.12	Sea Foam Ave - North Arm	Raise Kerb/Driveway
1.13	Phillip St to Sea Foam Ave - North Arm	Culvert and Overflow path
2.03	Rail Line to Raymond Rd	Check condition and rehabilitate pipe drainage
2.03a	Station St diversion - Station St	Overflow path
2.04	Rail Line	Investigate culvert inlet improvements
2.07	Phillip St to LHD	Overflow path
3.00	Ocean outfall - South Arm	Develop opening policy
3.00	Ocean outfall - South Arm	Reduce diversion to north
3.01	Cliff Pde	Improve culvert capacity
3.02	Macauley St to Cliff Pde to Blackall St	Modify Existing Flood Gate
3.02	Macauley St to Cliff Pde	Debris Control Structure
3.02	Macauley St to Cliff Pde	Overflow path
3.03	Macauley St	Modify culvert inlet
3.05	Thomas Gibson Park outlet	Formalise existing detention basin
3.05	Thomas Gibson Park outlet	Debris control structure
3.10	Lachlan St to LHD	Overflow path

The difference between Schemes TGA and TGB is that TGA proposes flood modification measures at Zones 1.01 and 1.13 involving upgrades to pipe drainage while TGB proposes alternative measures at the same locations involving enhancements to the capacity of existing above ground overflow paths. In addition TGA proposes an upgrade of pipe drainage in bath St while TGB relies on planning and development controls in this reach to yield a reduction in damages. All other measures are the same for each scheme.

8. SCHEME ASSESSMENT

8.1 INTRODUCTION

This chapter describes the process by which the various schemes were assessed including:

- Hydrologic modelling of both existing conditions and proposed schemes (**Section 8.2**).
- Hydraulic modelling of both existing conditions and proposed schemes (**Section 8.3**).
- Calculation of direct flood damage from a stage damage analysis (**Section 8.4**).
- Calculation of a performance weighting for each scheme which incorporates the scheme's performance against a range of management objectives (**Section 8.5**).
- Derivation of multipliers used to calculate the indirect and intangible benefits of the scheme (also **Section 8.5**).
- Calculation of the total benefit attributable to each scheme (**Section 8.6**).
- Estimation of scheme construction costs (**Section 8.7**).
- Calculation of a benefit cost ratio for each scheme to provide a basis for scheme selection (**Section 8.8**).

8.2 HYDROLOGIC MODELLING

Estimation of peak flows was based on a modified version of the previous hydrologic model constructed for the Hewitts Creek Flood Study. This earlier model was constructed using the well known and regionally validated computer based software known as WBNM2001 developed by Boyd, Rigby & Van Drie, (2001). This model has been fully calibrated to account for catchment specific conditions as part of the Hewitts Creek Flood Study (2002).

Prior to its application to this Floodplain Risk Management Study, this base hydrologic model was modified to incorporate future development within the study catchment. This approach is followed to ensure economic analysis of each of the proposed flood management measures is based on catchment conditions that could reasonably be expected during the economic life of the proposed measures, usually taken as 50 years. The assumed extent of future development within the catchment was full development of existing zoned lands (e.g full development of the Sandon Point site) and likely development of other lands considered appropriate for some intensification of use (e.g increased residential densities in and around Thirroul CBD).

In addition, the adopted hydrologic model incorporates Wollongong City Council's Blockage Policy as described in detail in the Hewitts Creek Flood Study (2002). In practical terms this means that all management measures were assessed using three basic hydrologic models.

1. A 'clear' model, where all structures which could possibly cause diversion or attenuate flow are assumed to be clear.
2. A 'blocked' model, where all structures which could possibly cause diversion or attenuate flow are assumed to be blocked.
3. A 'critical blockage pattern' model, where some structures are assumed clear and some blocked such that the flow in a particular reach (that is sensitive to such blockage) is at a maximum for each design event.

This approach ensures that the performance of each risk management scheme is assessed against the design condition which incorporates a 'worst case' blockage pattern. It is noted that not all reaches have maximum design peak flow when the critical blockage pattern occurs. For example, some reaches downstream of a diversion out of the system will be at a maximum when the structure causing the diversion is assumed to be clear.

To assess the proposed management schemes, a model describing the existing conditions was constructed. The results of this model equate to a hypothetical scheme where no works are proposed and is referred to as a 'do nothing' scheme. Analysis of the 'do nothing' scheme is carried through all elements of the scheme assessment. This baseline model is used to determine the amount of flood damages which currently occur under existing conditions, and also to give a benchmark against which proposed schemes are compared.

Further models were then constructed for each 'real' scheme (where actual works are proposed), incorporating the specific hydrologic change anticipated as a result of the individual management measures. For example, where a management scheme proposes to upgrade a culvert such that attenuation and/or diversion is reduced, this reduction in attenuation/diversion has been calculated and incorporated into the model.

Peak flows obtained from the existing condition and proposed scheme models were then incorporated into the hydraulic models prepared for this study.

8.3 HYDRAULIC MODELLING

Estimation of flood surface levels was based on a modified version of the previous hydraulic model constructed for the Hewitts Creek Flood Study (2002). This previous modelling was carried out using computer based HecRAS v 3.0 hydraulic modelling software developed by the US army. In a similar manner to the hydrologic models described in **Section 8.2**, this model has been fully calibrated (as part of the Flood Study) to account for catchment specific conditions.

The basic hydraulic model was modified to include peak flows which incorporate the impacts of full development over a 50 year period. The model output was adopted as the existing condition, 'do nothing' scheme, and used to calculate existing flood damages.

In order to assess each of the proposed schemes, a series of hydraulic models was then created incorporating the proposed management measures. For example where a channel upgrade is proposed as a flood management measure, the hydraulic model was modified to incorporate the expanded channel geometry for the reach being considered.

Using these models a series of flood surface profiles were obtained for the full spectrum of design AR&R storm events ranging from the 50% AEP to the PMF. Profiles were also generated for the clear, blocked and 'critical blockage pattern' conditions.

Using these flood surface levels, the depth of over floor and over yard flooding was calculated for each dwelling adjoining the creek for which survey was obtained. This information was then used as input to the stage damage calculations and also used to identify those properties which should be targeted for flood management purposes.

8.4 STAGE/DAMAGE ANALYSIS

Stage damage analysis and subsequent financial modelling is required in order to assess the feasibility of a scheme in terms of its direct economic benefit. Stage damage analysis involves the estimation of direct flood damages for a given flood level. Direct damages

includes those damages that result from direct contact with flood waters. Direct damages can be further split into;

- Internal damages (furniture, flooring, electrical goods);
- Structural damages (damage to building structures);
- External damages (motor vehicles, contents of sheds, fencing).

While these damages can be influenced by other characteristics of the flooded property such as the number of storeys and velocity of flow, the principal factor leading to increased flood damages is depth of flooding. Properties inundated at great depth are more likely to experience damage than those with only shallow flooding. This is because less items are exposed to the flood waters.

As described in **chapter 3**, the stage (flood height) versus damage relationship that has been adopted for damage calculations, is based on the FLDAMAGE model, scaled upwards by a factor of two times. This scaling was done in order to account for the recent trend for insurers to offer 'new for old' replacement as well as the particular characteristics of flood behaviour and dwelling construction in the Northern Illawarra.

Using the calculated depth of flooding at each property, and the (factored) FLDAMAGE stage damage curves, the direct damages were calculated for each creek system after implementation of each scheme.

TABLE 8.4.1 - SUMMARY OF DIRECT DAMAGES

Creek	***Scheme***	***Direct Damages ($AAD)***
Slacky	Do Nothing [a]	38,000
	SA	3,000
	SB	2,000
Tramway	Do Nothing [a]	47,000
	TA1	0
	TA2	0
	TB1	3,000
	TB2	10,000
	TB3	3,000
Woodlands	Do Nothing [a]	22,000
	WA	1,000
	WB	2,000
Hewitts	Do Nothing [a]	312,000
	HA	92,000
	HB	95,000
Hewitts (Stream 4)	Do Nothing [a]	70,000
	HS4-A	31,000
	HS4-B	20,000
Thomas Gibson	Do Nothing [a]	265,000
	TGA	226,000
	TGB	196,000

[a] Based on existing conditions (refer Table in Section 5.7)

Detailed output showing results of direct damage calculations for each property has been included in **Appendix 5.3** and **5.4** for both existing conditions and proposed schemes.

The direct damages calculated for each flood event and each scheme were converted into an equivalent Average Annual Damage value (AAD) and Net Present Value (NPV). This approach allows a scheme to be assessed on the basis of the anticipated reduction in flood damages over the economic life of the works (when compared to the existing condition). This reduction in direct damages is taken to be the direct benefit of scheme implementation.

8.5 INDIRECT & INTANGIBLE DAMAGES

Indirect damages are classified as those calculable damages incurred as a consequence of flooding but not from direct contact with flood water. Typical indirect costs are the costs of cleaning up, disruption to services, and cost of emergency response. These damages can be calculated to some extent though are much more difficult to estimate than direct damages as they are dependant on many factors.

Intangible damages include all those damages against which it is difficult to give a dollar value. These typically include household disruption, reduced health, stress induced illness, and environmental damage.

In order to assess which of the schemes should be adopted, the reduction in indirect and intangible damages which each of the schemes provides needs to be considered in addition to reduced direct damage.

While the traditional approach has been to assume these indirect and intangible benefits are consistent for all schemes, this study has attempted to incorporate a more holistic and modern approach that utilises the individual scheme performance against a range of objectives to apply a weighting to the indirect and intangible benefits. This may influence the ranking of the schemes, for example a particular scheme may have a low benefit in terms of direct damage and cost but may perform highly against a range of social and ecological objectives.

This approach also provides a framework within which adoption of floodplain management measures can consider wider social and environmental aspects rather than simply a schemes performance with respect to direct flood damages.

This method is similar to the multi-criteria analysis methodology advocated by the Bureau of Transport Economics in their publication 'Economic Costs of Natural Disasters In Australia' (BTE, 2001) and is also in accordance with the methodology advocated by the Australian Risk Management Standard AS/NZS 4360:1999.

The steps used in applying this methodology to the management scheme assessment process are described further in the following sections.

8.5.1 Establishment of Risk Management Objectives (Step 1)

The study aims to recommend a number of floodplain risk management measures that where possible provide additional benefits in the form of enhanced social and environmental conditions in accordance with the general aspirations of the local community. In this regard, the proposed management measures have been assessed against their performance in meeting several risk management objectives. These objectives, which are based on the general philosophy described in the FPMM (2001), can be broadly categorised as:

- Economic,
- Social, or
- Ecological.

Economic Objectives

Specific economic objectives against which the proposed floodplain management measures are to be assessed include:

- *Reduction in floodplain management costs.* One of the key objectives of the NSW Flood Prone Land Policy is to achieve a reduction in the overall cost of occupation of flood prone land through the implementation of various risk management measures. This objective considers the overall costs associated with the implementation of these measures and compares these with the benefits obtained from reduced damages. While tangible damages are accounted for via derivation of a 'direct' benefit cost ratio, the intent of this objective can be extended to making allowance for the intangible component also.

- *Reduction in existing and/or future flood damages.* Whilst the preceding objective targets the 'overall' benefit of a risk management measure, it does not make clear the impact of a measure in respect to a reduction in direct flood damages. This second objective targets consideration of the absolute impact of a management measure on existing (as exists today) and future (as might exist in the future) flood damages.

- *Reduction in residual flood damages.* This objective deals with the level of flood damages that still remain after flood management measures have been implemented. Unless the management measure provides full protection up to the probable maximum flood level, there will always be some ongoing (residual) risk of flooding even after the measure has been implemented (i.e. for those events which exceed the design criteria of the specific measure).

Social Objectives

It is widely recognised that while flooding can cause tangible (monetary) damages, there are other indirect costs to the community associated with flooding. These include impacts on the emotional and physical well being of the community and the ongoing stress and emotional strain associated with living in a flood prone area. These effects can continue well after a flood event has occurred and can be most traumatic in some circumstances.

- *Reduced threat to life* This objective deals with the impact of a management measure on personal safety and in the extreme; it's impact on threat to life. Those measures that have a beneficial impact on personal safety and/or threat to life would typically remove a threat to life or potential for personal injury for a substantial proportion of residents on the floodplain. Where such a threat exists, elimination or management of such a threat becomes a key consideration in the risk management phase.

- *Reduced level of stress* This objective deals with the impact of a management measure on the level of stress and anxiety suffered by those occupying flood prone land.

- *Reduced disruption during flooding* This objective deals with the impact of a management measure on disruption during and after flooding. Meeting this objective may require enhancements to access, flood proofing and preparation of appropriate disaster recovery plans. A measure having a beneficial impact on flood disruption would typically minimise disruption to access, services, personal activities etc during flooding.

- *Reduced relocation and recovery costs* This objective deals with the impact a management measure would have on the relocation and recovery costs and related impacts of a flood event. Measures that would typically reduce such impacts include flood proofing of structures and provision of 'flood free' access to ensure people can be re-established in their homes as soon as possible following the event.

- *Reduced Property Constraints* This objective deals with the impact of a management measure on flooding constraints currently experienced on property in the study area and in particular the property devaluations which occur because of this constraint. A measure having a beneficial impact on this objective would typically lead to a substantial re-evaluation of property values throughout the floodplain (to be similar to adjoining properties which do not experience flooding) through a reduction in the need for flood planning controls.

- *Increased community growth* This objective deals with the impact of a management measure on growth of the local community. A measure may increase the amount of land available for development resulting in a significant increase in the number of persons and/or properties present in the local area.

Ecological Objectives

Any risk management measure proposed on the floodplain should consider the ecological characteristics of the floodplain and should avoid disruption to natural flow regimes or other fluvial geomorphologic processes. Where possible, specific measures should be incorporated into the management measures to enhance the ecology of the riparian zone. This may be through the provision of water quality controls, stabilisation of streambed and banks and/or enhancements to the habitat corridor through widening or native tree planting.

- *Streams stabilised* This objective deals with the impact of a flood management measure on the stability of a streambed, bank and changes to its plan or vertical alignment. A floodplain management measure having a beneficial impact on stream stability and morphology would typically lead to appropriate stream stabilisation and rehabilitation being carried out. It is noted however that in some intensely developed areas, it is not possible to maintain or recreate an entirely natural geomorphologic pattern and stream function. In these instances, benefits are assessed according to the likely improvements available for the existing, often highly disrupted, stream system.

- *Water quality enhanced* This objective deals with the impact of a management measure on stream water quality. Measures that improve water quality include: stream stabilisation works, sediment traps and detention basins with permanent wetland areas.

- *Riparian zone enhanced* This objective deals with the impact of a flood management measure on riparian zone vegetation. A measure having a beneficial impact on Riparian Zone vegetation would typically lead to a reinstated zone of natural vegetation along a substantial proportion of the banks of the stream system.

- *Stream ecosystem enhanced* This objective deals with the impact of a flood management measure on the stream ecosystem. A measure having a beneficial impact on the stream ecosystem might restore environmental flows and/or provide additional habitat for aquatic flora and fauna.

8.5.2 Objective Weighting (Step 2)

The second step was to weight each of the objectives in terms of their relative importance. This weighting was calculated by asking a randomly selected group of people to give a score to each objective, the score representing its relative importance when compared to each of the other objectives. The objectives were set out in a matrix, an example of which is given in **Table 8.5.1** below.

TABLE 8.5.1 - OBJECTIVE WEIGHTING MATRIX

MANAGEMENT OBJECTIVE	Economic			Social						Environmental			
	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	2.6	3.1	3.2	3.3	3.4
1. ECONOMIC BENEFITS													
1.1 Reduction in floodplain management costs	5												
1.2 Reduction in existing and/or future flood damages		5											
1.3 Reduction in residual flood damages			5										
2. SOCIAL BENEFITS													
2.1 Reduced threat to life				5									
2.2 Reduced level of stress					5								
2.3 Reduced disruption during flooding						5							
2.4 Reduced relocation and recovery costs/impacts							5						
2.5 Enhanced property values								5					
2.6 Increased community growth									5				
3. ENVIRONMENTAL BENEFITS													
3.1 Streams stabilised										5			
3.2 Water quality enhanced											5		
3.3 Riparian zone enhanced												5	
3.4 Stream ecosystem enhanced													5

Each person who filled out the matrix was asked to score each objective against each other objective in the list on a relative importance basis (1 to 9). Where:

1. Implies the row objective is **overwhelmingly less important** (< 0.3x less) than the column objective
2. Implies the row objective is **substantially less important** (0.3-0.5x less) than the column objective
3. Implies the row objective is **significantly less important** (0.5-0.8x less) than the column objective
4. Implies the row objective is **marginally less important** (0.8-1x less) than the column objective
5. Implies the row and column objective are considered of **equal importance**
6. Implies the row objective is **marginally more important** (1-1.2x more) than the column objective
7. Implies the row objective is **significantly more important** (1.2-2x more) than the column objective
8. Implies the row objective is **substantially more important** (2-3x more) than the column objective.
9. Implies the row objective is **overwhelmingly more important** (>3x more) than the column objective

The scores for each objective were added across each row and averaged for each participant within the group. These average totals were then used to rank the objectives in terms of their importance and to give each a weighting value.

TABLE 8.5.2 - SUMMARY OF OBJECTIVE WEIGHTINGS

MANAGEMENT OBJECTIVE	*Rank*	*Mean of Totals*	*Mean of Scores*	*High*	*Low*
1. ECONOMIC BENEFITS					
1.1 Reduction in flood damages	2	77	5.9	95	63
1.2 Reduction in floodplain management costs	8	58	4.5	82	26
1.3 Reduction in residual flood damages	6	67	5.1	86	47
2. SOCIAL BENEFITS					
2.1 Reduced threat to life	1	106	8.2	113	92
2.2 Reduced level of stress	3	74	5.7	95	59
2.3 Reduced disruption during flooding	5	67	5.1	86	58
2.4 Reduced relocation and recovery costs/impacts	4	71	5.5	87	50
2.5 Enhanced property values	12	43	3.3	71	17
2.6 Increased community growth	13	33	2.6	57	17
3. ENVIRONMENTAL BENEFITS					
3.1 Stream stabilised	7	62	4.8	71	45
3.2 Water quality enhanced	9	56	4.3	69	41
3.3 Riparian zone enhanced	10	54	4.1	79	39
3.4 Stream ecosystem enhanced	11	54	4.1	82	42

It is interesting to note from the above results summary that 'reduced threat to life' was considered (by a significant margin) the most important flood management objective, while increase community growth was the least important objective.

8.5.3 Management Scheme Performance (Step 3)

The next step in the process was to give each scheme a score for its performance against each of the objectives. This was done by giving each management measure (within a scheme) a 'performance score' between 1 and 5 where a score of:

1 - Implies the measure has a substantially adverse impact relative to that objective
2 - Implies the measure has a measurably adverse impact relative to that objective
3 - Implies the measure has no impact on that objective
4 - Implies the measure has a measurably beneficial impact relative to that objective
5 - Implies the measure has a substantially beneficial impact relative to that objective

The completed 'performance score' table showing the summation of scores for each scheme has been included in **Appendix 5.1**.

The 'performance scores' for each objective were then weighted by the corresponding objective weighting obtained from Step 2 to give a 'weighted performance score' for each scheme. This weighting accounts for the relative importance of each of the objectives.

The completed 'weighted performance score' table showing the summation of weighted scores for each scheme has been included in **Appendix 5.2**.

8.5.4 Management Scheme Performance Weighting (Step 4)

The 'weighted performance score' for each scheme was then normalised against the 'do nothing' scheme to give a 'management scheme performance weighting'.

The 'do nothing' scheme was assumed to have a neutral performance with respect to each objective and was given a performance weighting of 1.

Each of the actual schemes were scaled against this neutral result giving a final range of weightings between 1 and 1.2.

TABLE 8.5.3 - SCHEME PERFORMANCE WEIGHTINGS

Creek	*Scheme*	*Weighting*
Slacky	Do Nothing	1.00
	SA	1.16
	SB	1.12
Tramway	Do Nothing	1.00
	TA1	1.07
	TA2	1.09
	TB1	1.21
	TB2	1.21
	TB3	1.17
Woodlands	Do Nothing	1.00
	WA	1.17
	WB	1.17
Hewitts	Do Nothing	1.00
	HA	1.19
	HB	1.17
Hewitts (Stream 4)	Do Nothing	1.00
	HS4-A	1.13
	HS4-B	1.17
Thomas Gibson	Do Nothing	1.00
	TGA	1.07
	TGB	1.11

Due to the limited range of the weighting values (which is in part due to the methodology employed), the final benefit cost ratios will not be altered greatly. However, the fact that the values in **Table 8.5.3** are greater than 1 implies that each of the proposed schemes has a greater overall performance (with respect to the stated objectives) than that of the existing ('do nothing') condition, and furthermore that no scheme has an overall adverse impact compared to the existing ('do nothing') condition. This result is expected since no scheme would logically propose works which would not improve on existing conditions. The limited range of performance weightings is also as expected since the component measures which make up the schemes are derived from a range of measures with similar characteristics. Also, the various schemes for a particular creek often have a large number of common components.

8.5.5 Derivation of overall Indirect and Intangible Benefit Multipliers (Step 5)

The desired outcome of this analysis (Steps 1 through to 5) is to derive a reasonable estimate of indirect and intangible damages, taking into account the performance of each scheme. Ultimately it is the reduction in these indirect and intangible damages attributable to each scheme which forms part of the benefit cost ratio for that scheme.

While Steps 1 through to 4 provide a basis for establishing the relative performance of each scheme with respect to indirect and intangible damages, it does not provide a base multiplier that actually quantifies the dollar cost that can be attributed to these damages.

A considerable number of studies have been undertaken by various agencies in Australia, in order to determine a reasonable estimate for indirect and intangible damages from flooding and other natural disasters. The estimates provided often vary by a significant amount. In particular, intangible damage estimates (which by their very nature are difficult to quantify) have been proposed between 5 and 200% of direct damages.

For this study, the following multiplier values were adopted. While they should not be considered definitive, they have some basis in previous research. Similar values have also been applied to other floodplain management studies in the Illawarra.

TABLE 8.5.4 - INDIRECT AND INTANGIBLE DAMAGES AS PERCENTAGE OF DIRECT DAMAGES

Type of Damage	***As % of direct damages***	***Source***
Indirect - Residential	30	*Typical value used by previous studies as collated and described in the Bureau of Transport Economics in their publication 'Economic Costs of Natural Disasters In Australia' (BTE, 2001).*
Indirect - Public Infrastructure	30	*Value (modified) from the Draft Towradgi Creek Floodplain Management Study recently undertaken by Council.*
Intangible	15	*Value(modified) from the Draft Towradgi Creek Floodplain Management Study recently undertaken by Council.*

The outcome of this overall process (steps 1 – 5) is that the indirect and intangible benefit of a scheme can be modified by up to 20% from the standard multiplier depending on its performance against the stated economic, social and ecological objectives.

While application of this weighting methodology effectively increases the assumed benefit estimate, the maximum possible increase of 20% (noting some schemes will have a lesser value) is considered to be well within the likely accuracy of the original base multipliers from **Table 8.5.4**. It should also be noted that the benefit cost ratio for a scheme is only one of the decision making tools used in order to select a scheme for implementation. Other community and social issues may have equivalent influence over the ultimate decision making process.

It should be noted that damages to commercial properties are often dealt with separately from residential damage as the nature of damage to these properties is different and highly variable depending on the type of goods being stored at the premises. For this same reason, generalised commercial damage estimates are often unreliable.

Given there is only a handful of commercial properties in the catchment, and the uncertainty of damage estimates for this type of property, this study has assumed that commercial damages are equivalent to residential (I.e. each commercial property is assumed to be equivalent to one residential dwelling).

8.6 TOTAL SCHEME BENEFITS

The 'Total' scheme benefit was calculated as the difference between the Net Present Value of the 'Total' Average Annual Damage (AAD) of the scheme, compared to the Net Present Value of the 'Total' AAD of the 'do nothing' baseline. Where 'Total' AAD includes direct, indirect and intangible forms of damage.

Table 8.6.1 over-leaf summarises the results of this calculation. The table confirms that each scheme provides valuable benefits, with the Hewitts Creek schemes in particular yielding a Net Present Value benefit of approximately $6 million dollars in reduced damages over a 50 year period. This is equivalent to approximately $420,000 per year on an annualised basis.

TABLE 8.6.1 TOTAL SCHEME BENEFITS

		Direct Damages ($AAD)	Indirect and Intangible Damages ($AAD)				Total Damages ($AAD)	Total Benefits		
Creek	Scheme		Indirect (Residential)	Indirect (Public Infrastructure)	Intangible	Total		Direct $AAD	Indirect (weighted) $AAD	$NPV
Slacky	Do Nothing	38,000	11,400	11,400	5,700	28,500	66,500	-	-	-
	SA	3,000	900	900	450	2,250	5,250	35,000	30,450	903,259
	SB	2,000	600	600	300	1,500	3,500	36,000	30,240	914,161
Tramway	Do Nothing	47,000	14,100	14,100	7,050	35,250	82,250	-	-	
	TA1	0	0	0	0	0	0	47,000	37,718	1,169,165
	TA2	0	0	0	0	0	0	47,000	38,423	1,178,894
	TB1	3,000	900	900	450	2,250	5,250	44,000	39,930	1,158,297
	TB2	10,000	3,000	3,000	1,500	7,500	17,500	37,000	33,578	974,022
	TB3	3,000	900	900	450	2,250	5,250	44,000	38,610	1,140,080
Woodlands	Do Nothing	22,000	6,600	6,600	3,300	16,500	38,500	-	-	
	WA	1,000	300	300	150	750	1,750	21,000	18,428	544,129
	WB	2,000	600	600	300	1,500	3,500	20,000	17,550	518,218
Hewitts	Do Nothing	312,000	93,600	93,600	46,800	234,000	546,000	-	-	
	HA	92,000	27,600	27,600	13,800	69,000	161,000	220,000	196,350	5,745,941
	HB	95,000	28,500	28,500	14,250	71,250	166,250	217,000	190,418	5,622,666
Hewitts (Stream 4)	Do Nothing	70,000	21,000	21,000	10,500	52,500	122,500	-	-	
	HS4-A	31,000	9,300	9,300	4,650	23,250	54,250	39,000	33,053	994,378
	HS4-B	20,000	6,000	6,000	3,000	15,000	35,000	50,000	43,875	1,295,545
Thomas Gibson	Do Nothing	265,000	79,500	79,500	39,750	198,750	463,750	-	-	
	TGA	226,000	67,800	67,800	33,900	169,500	395,500	39,000	31,298	970,158
	TGB	196,000	58,800	58,800	29,400	147,000	343,000	69,000	57,443	1,745,001

8.7 SCHEME COST ESTIMATES

In order to assess the cost of each scheme, cost estimates were prepared for each management measure proposed as part of that scheme. A summary of these costs is included below, with a more detailed breakdown included in **Appendix 5.5**.

TABLE 8.7.1 - SCHEME CONSTRUCTION COST ESTIMATES

Scheme	*Construction Cost (2002$)*
Slacky - SA	4,180,000
Slacky - SB	1,400,000
Tramway – TA1	650,000
Tramway – TA2	80,000
Tramway – TB1	2,590,000
Tramway – TB2	2,090,000
Tramway – TB3	4,350,000
Woodlands - WA	1,400,000
Woodlands - WB	3,060,000
Hewitts - HA	1,400,000
Hewitts - HB	2,000,000
Hewitts –HS4A	260,000
Hewitts –HS4B	420,000
Thomas Gibson - TGA	3,090,000
Thomas Gibson - TGB	1,850,000

Each proposed measure within each scheme was broken down into a number of individual items with preliminary volume estimates made for each. Construction rates were then applied based on recently tendered rates for a range of projects in the local area. A contingency of between 10 and 20% was applied depending on the uncertainties in design for a particular measure.

Where a measure involves voluntary purchase of property, an average purchase cost of $300,000 per property was used. This average was applied across the study area and was used in the absence of property valuations. It should be noted however that the actual purchase price of any voluntary purchase arrangements that proceed will be determined on the basis of an agreed market rate at the time. It is clear that given the recent surges in property prices and the inherent variation in property values that there will be some disparity between the assumed average and the actual purchase costs. It is unlikely however that this price variation will have any material affect on the recommendations of this study.

8.8 SCHEME SELECTION

An overall benefit cost ratio was calculated using the estimated 'benefit' of each scheme (**Section 8.6**), and the schemes implementation cost (**Section 8.7**).

It is noted that for the purpose of scheme assessment the benefits and costs of the Slacky and Tramway schemes were combined. With these two creek systems, the selection of a particular scheme in one catchment will impact on flood damages in the adjacent system. As a result these two systems should be considered together to avoid the possibility of selecting two mutually exclusive schemes (e.g. SA and TB1). Combining the schemes ensures the best overall solution is found.

TABLE 8.8.1 - OVERALL BENEFIT COST RATIOS FOR EACH SCHEME

Creek	***Scheme***	***Overall Benefit Cost Ratio***
Slacky/Tramway	TA1/SA *(REMOVE DIV TO TRAM/ CULVERT ON TRAM AT RAIL)*	0.4
	TA2/SA *(REMOVE DIV TO TRAM/ DEBRIS TRAP ON TRAM AT RAIL)*	**0.5**
	TB1/SB *(FORMALISE DIV TO TRAM/ CULVERT ON TRAM AT RAIL)*	**0.5**
	TB2/SB *(FORMALISE DIV TO TRAM/DEBRIS TRAP ON TRAM AT RAIL)*	**0.5**
	TB3/SB *(FORMALISE DIV TO TRAM/ VP ON TRAM AT RAIL)*	0.4
Woodlands	WA *(HIGH FLOW CULVERT AT RAIL)*	**0.4**
	WB *(RETARDING BASIN ABOVE HIGHWAY)*	0.2
Hewitts	HA *(LEVEE AT CORBETT)*	**4.1**
	HB *(FLOOD PROOFING/RAISING AT CORBETT)*	2.8
Hewitts (Stream 4)	HS4-A *(PROPERTY MODS AT VIRGINIA)*	**3.8**
	HS4-B *(VP AT VIRGINIA)*	3.1
Thomas Gibson	TGA *(PIPE UPGRADE)*	0.3
	TGB *(OVERFLOW PATH)*	**0.9**

The bold values in the right hand column in the table above, represent those schemes with the highest overall benefit cost ratio for each creek system.

As can be seen from the table above, some schemes being considered have a benefit cost ratio significantly greater than 1. This high benefit is due to the combination of:

- high damages which are experienced within the study area (making any attempt to reduce them worthwhile);
- the blockage policy (which increases calculated flood surface levels); and
- the adopted stage damage curve (that is increased relative to standard values).

In general when carrying out a financial analysis, a proposed capital investment which has a benefit cost ratio of greater than 1, implies that the measure has greater benefit than cost and therefore has economic merit. While some of the benefit cost ratios determined for the proposed schemes are below this value, this should not be considered as a reason for not undertaking the work as there are likely to be other significant benefits achieved as part of the works. These 'other' benefits include social and environmental benefits which are difficult to quantify using the methodology employed.

Notwithstanding the above, preferred schemes were selected for each catchment on the basis of the scheme benefit cost ratio. Generally, the highest benefit cost in each system was adopted, however in the case of Slacky/Tramway Creek where three of the combinations of schemes had an equivalent benefit cost ratio, it was decided that TB1/SB (culvert upgrade at rail) was preferred over TB2/SB (debris trap at rail) due to the higher level of protection and increased reliability afforded by this scheme. Similarly the B scheme (TB1/SB) involving formalisation of the diversion to Tramway was selected in preference to the A scheme (TA2/SA), as it is least disruptive to existing flood behaviour in Slacky Creek, and the fact that no increase in flow to Tramway would occur as a result of this scheme.

It is noted that the Hewitts Creek Scheme HA has a very high benefit cost ratio however this value is partially inflated by the benefit which is attributable to works in Woodlands Creek (those works that remove diversion into Hewitts Creek), conversely, the Woodlands Creek

benefit cost ratio is low as the benefit is external to the catchment. For this reason the two schemes HA and WA should be considered for implementation as a single scheme and therefore the benefit cost ratio considered for the combined scheme.

A full description of each of the schemes recommended for implementation, including a detailed break down of financial benefits is included in **Chapter 9**.

9. FLOODPLAIN RISK MANAGEMENT PLAN

9.1 INTRODUCTION

The following risk management schemes are recommended as the basis of a Floodplain Risk Management Plan for the Slacky, Tramway, Woodlands, Hewitts and Thomas Gibson Creek systems. A plan showing recommended schemes is included in **Appendix 7.1**.

The recommended risk management schemes comprise a number of non-structural and structural flood management measures specifically developed for the study area.

The non-structural measures proposed within all catchments are described in **Section 9.2**, while the components of the structural management schemes recommended for each catchment along with site specific non-structural measures are described in **Sections 9.3** to **9.7**. A summary is provided in **Section 9.8** while implementation issues are discussed in **Section 9.9**.

It should be noted that the following plan, once adopted by Council, represents only the first step in the implementation process. It is recommended that there be an intensive design and consultation process undertaken for each measure prior to its construction and/or implementation. This would include an analysis of environmental impacts, detailed design and documentation using improved survey information, and consultation with effected land owners and the community. During the consultation phase, relevant reports and designs should be made available to the public for review. Should environmental and/or construction related concerns not be able to be addressed then it may be that the measure cannot be implemented.

9.2 FLOODPLAINS GENERALLY

The following measures are recommended for implementation across all floodplains within the study area. These measures are primarily non-structural and can be applied to all areas classified as flood prone. They are generally low cost yet can lead to significant improvement in the flood readiness of the community resulting in a corresponding drop in flood damages. All of the non-structural measures have been adopted without quantification of benefit cost ratio.

9.2.1 Planning & Development Controls

We recommend the establishment of planning and development controls to be implemented at the re-zoning/design development, and development application stage. It is intended that these controls will ensure appropriate development of flood prone land such that the development (both during and after construction) will not increase flood risk to those occupying the development, land adjacent to the development, or elsewhere in the catchment.

Application of planning and development controls is proposed through the use of the 'Managing our Flood Risks' Development Control Plan (DCP) and associated planning control matrix as described in **Chapter 6**. The matrix will be used as a tool by developers and development assessment officers to assign appropriate development controls, based on the flood risk at the site. A plan showing the distribution of various risk precincts within the study area is included in **Appendix 6.1**.

9.2.2 Flood Education

We recommend the provision of flood education programmes to ensure that the local community is fully 'aware' that floods will occur and are likely to interfere with normal activities in the floodplain. A typical flood education programme could include:

- Meetings/workshops with residents/groups
- Articles in local newspapers
- Displays of flood photos/articles in centres
- Distribution of flood information leaflets
- School projects/addressing schools on flooding

This would need to be an ongoing program to accommodate loss of awareness with time and the addition of new members to the community.

In consultation with the SES, it is further recommended that targeted education of residents within areas of greatest risk of above floor flooding be undertaken.

9.2.3 Flood Signage

We recommend the provision of permanent flood signage to ensure that the community remains constantly aware of flood risks. Signage could include:

- signs or markers of historic flooding
- signs or markers of the local Flood Planning Level in key areas
- signage showing evacuation routes

9.2.4 Flood Readiness

We recommend a community education programme be implemented, providing information focussed on means of mitigating risks and damages, during a flood event thus ensuring that the community is as prepared for flooding as is reasonably practicable. This could easily be integrated with the Flood Education Program.

9.2.5 Local Flood Plan

It is recommended that all data collected and processed in this study be provided to the State Emergency Service (SES) by Wollongong City Council in a format suitable for interpretation by the SES as soon as it is available, for incorporation into the 'Wollongong City Local Flood Plan'.

This data represents the best understanding of flood behaviour in the study area at the current time and will enable the sections of the Wollongong City Local Flood Plan dealing with specific risk areas, to be further detailed and expanded.

9.3 SLACKY CREEK

Specific non-structural measures which should be applied to the Slacky Creek system include minimum riparian setbacks in the upper reaches (upstream of William St) and the preservation of existing open space zonings adjoining the creek. In general the current zonings are not incompatible with the flood risks, being predominantly residential. It is noted that there are no essential utilities within the limits of flood prone land in Slacky Creek.

During the August 1998 flood Slacky Creek was impacted by significant debris flows from the upper catchment. While much of this material was natural in origin, there were also significant quantities of anthropogenic material and accelerated scour. As a general measure it is a recommendation of this study that a Riparian Management Study be undertaken within Slacky Creek and the other catchments within the study area to identify possible sources of sediment, areas of general channel and bank instability and opportunities for improving the overall riparian system with the associated benefit of reducing wherever possible the potential for future debris mobilisation. A key area for such investigation should be the now decommissioned Old Bulli mine site, which has been identified as having some areas of general instability which contributed to debris observed after the August 1998 flood event in Hobart Street. The mine owners should be requested to expedite as much as possible the rehabilitation of that site. This has been included in the scheme below.

The recommended structural management works programme for Slacky Creek is Scheme SB. Scheme SB involves the retention of the existing diversion into Tramway Creek at Hobart Street as well as several other proposed measures listed below.

TABLE 9.3.1 - SLACKY CREEK - RECOMMENDED SCHEME

Zone	*Location*	*Proposed Measures*
1.00	Ocean outfall	Develop opening policy and open as required
1.02	Footbridge to Blackall St	Flow training wall on south bank
1.06	Princes Highway to Rail line	Reconfigure basin outlet (to reduce nuisance flows into Beacon Ave)
1.09	Old mine rail	Formalise diversion to Tramway
1.10	Hobart St	Formalise diversion to Tramway
1.11	William St to Hobart St	Sediment basin
1.11	William St to Hobart St	Channel enlargement and stabilisation
1.12	William St	Formalise overflow path
1.13	Rex Ave to William St	Sediment basin
1.13	Rex Ave to William St	Restore pre Aug 98 capacity
1.13	Rex Ave to William St	Coarse debris trap
2.03	Southern Tributary - mine basin	Retarding basin
2.03	Southern Tributary - mine basin	Request mine owner to expedite rehabilitation of mine site (works to be carried out by owner)

As a result of the diversion of upper Slacky Creek into Tramway Creek during large flood events, properties in lower Slacky Creek (downstream of the old mine coal haulage embankment) are effectively protected from high flows during these flood events. Scheme SB takes advantage of this benefit, resulting in fewer management measures being required in the lower reach of Slacky Creek.

Proposed measures in lower Slacky creek are limited to the development of an opening policy and construction of a flow training wall on the southern bank of Slacky Creek to afford protection to properties in Hutton Ave. In addition, some minor modifications are proposed to the outlet of the Slacky Flat basin to protect residents in Beacon Ave.

In upper Slacky Creek (upstream of the old mine coal haulage embankment) measures proposed include construction of a sediment basin and provision of a debris control structure immediately above the coal haulage embankment. These measures are aimed at reducing blockage of the coal haulage and Hobart St culverts and ensuring that they are able to accept at least a proportion of the peak flow during a large flood. In addition it is proposed as part of Scheme SB that the large informal retarding basin on the south arm of upper Slacky Creek (created by the coal haulage embankment) be modified to improve its effectiveness as a management measure.

Scheme SB was selected on the basis of both economic performance and a need to minimise the amount of disruption to existing flooding behaviour. Scheme SA in contrast was considered to be a very significant alteration to existing flood behaviour (all flows would be contained within Slacky Creek). This increase could not be readily accommodated within lower Slacky Creek floodplain without increasing flood damages and possible disruption to residents (currently protected by the coal haulage embankment). Scheme SB does not increase the amount of flow diverted into Tramway Ck and therefore does not exacerbate downstream flooding. Nevertheless, the current lack of an overflow path along Hobart St and into the head of Tramway creek is clearly unacceptable and is addressed as part of the selected scheme for Tramway Creek.

9.4 TRAMWAY CREEK

Current landuse within Tramway creek is considered generally acceptable except for the area upstream of the rail where residential development has taken place in an area flooded to significant depth. It is also noted that the existing school upstream of the highway is, at least in part, at risk of flooding. While the extent and depth of flooding is not a serious threat, flooding issues should be considered as part of any future building works at the site. Immediately upstream of the rail, significant over floor flooding can result from blockage of the rail culvert. It is therefore recommended that no intensification of landuse be encouraged in this zone unless it can be demonstrated that the development will have minimum floor levels above the rail overtopping level.

It is suggested that land along the southern side of Hobart Street be set aside for the purpose of an overflow path (proposed as part of the structural management works), while riparian setbacks are required along the water course downstream of the rail.

The recommended structural management works programme for Tramway Creek is Scheme TB1. Scheme TB1 involves the retention of the existing diversion into Tramway Creek at Hobart Street as well as several other proposed measures listed below.

TABLE 9.4.1 - TRAMWAY CREEK - RECOMMENDED SCHEME

Zone	*Location*	*Proposed Measures*
3.01	Ocean outfall	Develop opening policy and open as required
3.03	Rail line	High flow culvert/bridge
3.04	Princes Highway to Rail line	Formalise overflow path (inc along Hobart St)
3.04a	Princes Highway to Rail line	Property Purchase (2 properties)

Scheme TB1 involves the retention of the existing diversion of Upper Slacky Creek into Tramway Creek but provides a controlled overflow path for this diversion. The overflow path would include: provision of a open channel alongside Hobart St (south side); a large culvert structure beneath the Princes Highway; purchase of 1 or 2 dwellings on the eastern side of the Princes Highway; construction of an overflow path through these properties connecting to Tramway Creek; and provision of a (large) high level culvert through the rail.

Scheme TB1 was selected on the basis of both economic performance and a need to minimise the amount of disruption to existing flooding behaviour (in the same way Scheme SB was selected for Slacky Creek).

It is noted that Scheme TB2 (debris control structure at the rail to reduce blockage) showed sightly better economic performance and costs significantly less ($550,000 approx) than the selected Scheme (TB1- high flow culvert at the rail) however TB2 was not selected as it was

decided that a debris control structure would be less reliable than provision of a larger culvert particularly for larger events where the ability of a debris control structure to reduce blockage is questionable.

TB3 (voluntary purchase of all potentially flooded homes) was not selected primarily due to its poor economic performance.

It is noted that the TA1 and TA2 schemes were quickly disregarded as being inappropriate solutions as they do not sufficiently provide for diverted flows from Slacky Creek (the TA schemes were developed for the scenario where the diversion to Tramway is removed and therefore did not need to provide for controlled overflows).

9.5 WOODLANDS CREEK

Woodlands creek is fortunate that it presently contains significant areas of open space and there is limited residential development in hazardous flood areas. Flood damages as a direct result of flood levels in Woodlands creek are therefore low and can be maintained as such provided planning and development controls are incorporated into its management. It is recommended that the opportunity be taken to incorporate wide riparian buffers as part of any development along this watercourse to reduce flooding and ensure potential habitat linkages are maintained and enhanced, consistent with the recommendations of the commission of Inquiry into the Illawarra Escarpment.

It is noted that the primary flooding impact of Woodlands Creek is its diversion into Hewitts Creek. This is to be addressed through structural measures outlined below. Any future development such as the proposed Northern Distributor Extension (to the bottom of Bulli Pass) will need to be designed so as to be compatible with these measures.

The recommended structural management works programme for Woodlands Creek is Scheme WA. Scheme WA includes: reinstatement of the original path of Woodlands Creek into Lower Tramway Creek; provision of a large culvert through the rail; and major works upstream of the rail to reduce blockage of culverts and flow diversion into Hewitts Creek. A listing of all proposed measures is given below.

TABLE 9.5.1 - WOODLANDS CREEK - RECOMMENDED SCHEME

Zone	*Location*	*Proposed Measures*
2.01	Diversion to Hewitts	Re-divert Woodlands Ck to Tramway Ck
2.01a	Near Sewer Pumping Station	Channel enlargement and stabilisation
2.03	Rail line	High flow culvert/bridge
2.04	Princes Highway to Rail line	Modify safety ramp and provide sag
2.04	Princes Highway to Rail line	Levee north bank
2.05	Princes Highway	Sediment basin/debris control structure

Scheme WA was selected as the preferred option on the basis of economic performance. Both WA (high flow culvert at rail) and WB (retardation basin above Highway) provide similar reductions in flood damages however the reduced construction cost of Scheme WA means that it has a higher benefit cost ratio than Scheme WB.

It is noted that this scheme provides significant benefits to properties in Hewitts Creek (namely properties in Hewitts Ave, Corbett Ave and Hamilton Rd), through reduction in diversion to Hewitts Creek. The benefits of WA to these properties have resulted in a higher benefit cost for the Hewitts Creek structural schemes.

9.6 HEWITTS CREEK

9.6.1 Main Arm

Specific non-structural measures recommended for adoption within the main arm of Hewitts Creek include: provision of riparian setbacks, particularly for areas upstream of Lachlan St; and the strict enforcement of minor development controls. These controls need to ensure minor structures (including small bridges) are not constructed within the high risk precinct without adequate consideration of the impacts of these structures on flooding including the impact on blockage if mobilised. It is noted that significant sections of Hewitts Creek are in private ownership. The application of these controls is therefore critical to the success of flood management in this system.

In general, the current zonings are not incompatible with the flood risks, being predominantly residential with no essential utilities within the limits of flood prone land. It is recommended that no intensification of landuse be encouraged in the area immediately upstream of the rail unless it can be demonstrated that the development will have minimum floor levels above the rail overtopping level.

The recommended structural management works programme for Hewitts Creek main arm is Scheme HA. Scheme HA includes: a levee to protect residents of Corbett Ave; creek rehabilitation works downstream of Lawrence Hargrave Drive; Voluntary purchase offer for one property; culvert and overflow path improvements at Lachlan St; channel improvement downstream of Kelton Lane and provision of a coarse debris trap at the upstream end to reduce blockage.

TABLE 9.6.1 - HEWITTS CREEK - RECOMMENDED SCHEME

Zone	*Location*	*Proposed Measures*
1.00	Ocean outfall	Develop opening policy and open as required
1.02	Adjacent to Corbett Ave	Levee north bank
1.05	LHD to the Rail line	Voluntary purchase offer (no 419 LHD)
1.05	LHD to the Rail line	Rehabilitate creek channel
1.08	Lachlan St	Culvert inlet improvements
1.08	Lachlan St	Formalise overflow path
1.09	Kelton Ln to Lachlan St	Channel enlargement and stabilisation
1.11	Bangalow Rd to Kelton Ln	Restore pre Aug 98 capacity
1.11	Bangalow Rd to Kelton Ln	Coarse Debris trap

Scheme HA was selected as the preferred option on the basis of economic performance. Scheme HB (flood proofing/house raising at Corbett Ave) was not selected as it is clear that the eventual redevelopment of this area (with future dwellings having higher floor levels and appropriate designs) would achieve similar outcomes to Scheme HA.

It is noted that the full diversion of Woodlands Creek into Tramway Creek (Scheme WA) will provide significant benefits to properties in Corbett Ave and Hamilton Rd and that because of this, the levee proposed as part of Scheme HA may be reduced in extent (possibly limited to a small flow training wall to the rear of no.17 Corbett).

In addition to the above selected measures for the main arm of Hewitts Creek, it is recommended that Council undertake further investigations within the tributary of Hewitts Creek in the vicinity of Pass Avenue and High Street. This reach was not part of the current study, however several flood/stormwater related issues were identified during the consultation phase. These issues are significant and warrant the formal analysis of this reach.

9.6.2 Stream 4 (Nardoo Cres Arm)

Stream 4 is similar in its flood behaviour to the upper reaches of the main arm and is also largely in private ownership. It is envisaged that riparian setbacks and overflow paths along with development controls will be the most important tools for flood management in this stream. A review of local road drainage is also considered necessary for this catchment to look at opportunities for reducing stormwater damage (from road drainage systems). This review was outside the scope of the Floodplain Risk Management Study.

The recommended structural management works programme for Hewitts Creek Stream 4 is Scheme HS4A. Scheme HS4A includes: culvert and property modifications in the vicinity of Virginia Terrace and provision of a coarse debris trap upstream of Deborah Ave to reduce blockage.

TABLE 9.6.2 - HEWITTS CREEK (S4) - RECOMMENDED SCHEME

Zone	*Location*	*Proposed Measures*
4.03	Stream 4 - Virginia Tce	Culvert modifications (to reduce surcharge frequency) and creek rehabilitation upstream
4.03	Stream 4 - Virginia Tce	Property modification (flow deflectors)
4.04	Stream 4 - Deborah Ave	Coarse debris trap

Scheme HS4A was selected on the basis of economic performance.

9.6.3 Stream 3 (Fords Road Arm)

Stream 3 is very similar in its behaviour to Stream 4 and will also benefit greatly from the general planning and development controls described in **Section 9.2**. In particular, provision of overflow paths and incorporation of flood compatible fencing into new development is required for this stream. Improvements to the local road drainage system will also yield significant benefits to properties in the catchment however a more detailed review of this issue is beyond the scope of this study.

No structural management works are proposed in this tributary of Hewitts Creek.

9.7 THOMAS GIBSON CREEK

Specific non-structural measures recommended for adoption within the Thomas Gibson Creek catchment include: provision of setbacks to defined overflow paths particularly in areas such as Bath St and the lower reaches of the south arm, downstream of Macauley St. Also minor development controls are important for this area given the limited width of overflow paths. As for Hewitts Creek, it is noted that significant sections of Thomas Gibson Creek are in private ownership. The application of these controls is therefore critical to the success of flood management in this system.

In general, the current zonings are not incompatible with the flood risks, being predominantly residential with no essential utilities within the limits of flood prone land. However, it is recommended that no intensification of landuse be encouraged for areas generally east of Macauley Street identified as being within the floodplain. The existing 2B zoning has already encouraged development which encroaches into floodways, restricting hydraulic conveyance.

The recommended structural management works programme for Thomas Gibson Creek main arm is Scheme TGB. Scheme TGB includes a large number of work items

some of which include: modifications and re-contouring alongside The Esplanade to encourage escape of floodwaters; investigation of improvements and provision of debris control structure to numerous critical pipe inlet structures; provision of overflow paths in critical locations where none presently exist; construction of a new culvert and overflow path to redirect flows away from The Lookout; Modifications to Cliff Parade near Harboard St to reduce the amount of diversion which occurs north to Bath St; and formalisation of Thomas Gibson Park as a detention basin to reduce peak flows downstream.

TABLE 9.7.1 - THOMAS GIBSON CREEK - RECOMMENDED SCHEME

Zone	*Location*	*Proposed Measure*
1.00	Ocean outfall - North Arm	Develop opening policy
1.00	Ocean outfall - North Arm	Lower south bank
1.01	The Esplanade - North Arm	Expand floodway
1.03	Macauley St to Cliff Pde - North Arm	Raise Kerb/Driveway
1.04	Macauley St - North Arm	Investigate culvert inlet improvements
1.08	Rail Line - North Arm	Investigate culvert inlet improvements
1.08	Rail Line - North Arm	Debris Control Structure
1.12	Sea Foam Ave - North Arm	Raise Kerb/Driveway
1.13	Phillip St to Sea Foam Ave - North Arm	Culvert and Overflow path
2.03	Rail Line to Raymond Rd	Check condition and rehabilitate pipe drainage
2.03a	Station St diversion - Station St	Overflow path
2.04	Rail Line	Investigate culvert inlet improvements
2.07	Phillip St to LHD	Overflow path
3.00	Ocean outfall - South Arm	Develop opening policy
3.00	Ocean outfall - South Arm	Reduce diversion to north
3.01	Cliff Pde	Improve culvert capacity
3.02	Macauley St to Cliff Pde to Blackall St	Modify Existing Flood Gate
3.02	Macauley St to Cliff Pde	Debris Control Structure
3.02	Macauley St to Cliff Pde	Overflow path
3.03	Macauley St	Modify culvert inlet
3.05	Thomas Gibson Park outlet	Formalise existing detention basin
3.05	Thomas Gibson Park outlet	Debris control structure
3.10	Lachlan St to LHD	Overflow path

Scheme TGB was selected as the preferred option on the basis of economic performance (being significantly less expensive to construct than TGA). It is also noted that there was a significant item in Scheme TGA for provision of underground drainage in Bath St. This particular item was considered inappropriate given eventual redevelopment of this area (which is active at the present time) will lead to reduced damages.

9.8 SCHEME BENEFITS SUMMARY

The following tables provide a numerical summary of the anticipated benefits arising from implementation of the structural management works outlined in the preceding sections of **Chapter 9**. These tables are intended to provide useful information to be utilised by Council at the funding application stage.

TABLE 9.8.1 - SUMMARY OF INUNDATED PROPERTIES - RECOMMENDED SCHEME

Creek	No. of Properties with Yard and Above Floor Flooding									
	20% AEP		5% AEP		2%AEP		1% AEP		PMF	
	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor
Slacky	0	0	0	0	0	0	1	0	10	5
Tramway	0	0	0	0	0	0	0	0	12	12
Woodlands	0	0	0	0	0	0	0	0	5	5
Hewitts	1	1	13	10	23	16	43	27	77	62
Hewitts (Stream 4)	3	1	4	1	4	1	4	2	4	3
Thomas Gibson	3	3	24	7	25	15	29	20	38	26
TOTAL	**7**	**5**	**41**	**18**	**53**	**32**	**77**	**49**	**146**	**113**

TABLE 9.8.2 - SUMMARY OF PROPERTIES PROTECTED - RECOMMENDED SCHEME

Creek	No. of Properties Protected									
	20% AEP		5% AEP		2%AEP		1% AEP		PMF	
	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor
Slacky	0	0	27	1	27	1	27	1	25	1
Tramway	0	0	10	10	11	10	11	11	8	3
Woodlands	0	0	5	4	5	5	5	5	1	0
Hewitts	6	4	48	35	47	39	27	29	8	5
Hewitts (Stream 4)	0	0	0	1	0	1	0	0	0	0
Thomas Gibson	2	2	1	6	2	3	1	2	0	3
TOTAL	**8**	**6**	**91**	**57**	**91**	**59**	**71**	**48**	**42**	**12**

TABLE 9.8.3 SUMMARY OF FINANCIAL BENEFITS- RECOMMENDED SCHEME

		Direct Damages ($AAD)	Indirect and Intangible Damages ($AAD)				Total Damages ($AAD)	Total Benefits			Scheme Cost ($)	Benefit Cost Ratio
Creek	Scheme		Indirect (Residential)	Indirect (Public Infrastructure)	Intangible	Total (unweighted)		$AAD	Indirect (weighted) $AAD	$NPV		
TOTAL		**325,000**	**97,500**	**97,500**	**48,750**	**243,750**	**568,750**	**429,000**	**375,443**	**11,101,907**	**8,900,000**	**1.2**
Slacky/ Tramway	SB/TB1	5,000	1,500	1,500	750	3,750	8,750	80,000	70,170	2,072,458	3,990,000	0.5
Woodlands/ Hewitts	WA/HA	93,000	27,900	27,900	13,950	69,750	162,750	241,000	214,778	6,290,070	2,800,000	2.2
Hewitts (Stream 4)	HS4A	31,000	9,300	9,300	4,650	23,250	54,250	39,000	33,053	994,378	260,000	3.8
Thomas Gibson	TGB	196,000	58,800	58,800	29,400	147,000	343,000	69,000	57,443	1,745,001	1,850,000	0.9

9.9 SCHEME PRIORITISATION

The timing of implementation for the Floodplain Risk Management Plan, including the schemes outlined above and the proposed planning and development controls outlined in **Chapter 6,** is contingent on the availability of funding from Council, State and Federal Governments and other bodies. Although a range of beneficial works have been identified, there are limited funds available for implementation of these works and those funds that are available are distributed across other floodplains in the Illawarra, the region and the state.

For this reason it is general practice that works be carried out on a progressive basis over a period of several years. It is therefore necessary, given the limited funding availability, for works to be prioritised according to their importance. Prioritisation of the options allows the clear standout 'performers' within each scheme to be given additional weighting when scheduling works and preparing funding submissions.

It is noted that although all the schemes include works considered worthwhile, some measures are more important than others. Similarly, there are some measures which do not contribute as greatly to the schemes overall benefit cost ratio as others.

Table 9.9.1 overleaf, gives a detailed listing of all schemes and their components with a priority of High, Medium or Low given to each component.

The selection criteria used for this categorisation are set out below:

Priority	***Selection Criteria (at least one of the following)***
High	• *Measure targets increased safety for dwelling occupants. Reduced threat to life is possibly the single most important objective for any flood mitigation works* • *Measure reduces, eliminates or controls diversion between creek systems. This is important as diverted flows can lead to unexpected and significant alterations to flood behaviour which are a potential threat to life and lead to significant damages.* • *The measure has a high benefit compared to cost. Although this has not been calculated numerically for each option, there has been sufficient information obtained with respect to the costs and benefits of each individual measure to gain an appreciation for its contribution to a schemes overall benefit cost.* • *The measure targets an area having significant above floor damage. Reduction in above floor damage is one of the key selection criteria adopted for funding allocation decision making. A measure that targets areas of significant above floor damage (as opposed to yard damage or improved trafficability) has been given a high priority.* • *The measure must be carried out prior to other works in order to offset potential impacts of other flood mitigation works. This is generally a construction sequencing issue and is not necessarily linked to reducing existing damages.*
Medium	• *These measures are those which still contribute significant benefits however the benefits are not as significant as those that were given a high priority.*

Low	• *These measures are those which still yield some benefits for reduced flood damages but come at a significant cost.* • *The measure principally targets yard flooding. Yard flooding is not considered to be a critical area that deserves allocation of significant flood mitigation funding. Particularly when compared to other High and Medium priority measures in the catchment.*

Measures that are given a High priority, generally contribute the most to a schemes benefit, and for this reason should be implemented as soon as funding is made available. It is anticipated that this may occur over a 1-5 year time frame.

Measures that are given a Low priority should not be pursed for funding application until all other higher priority works are completed. In reality this may mean that some Low priority works are not ultimately carried out. Notwithstanding this, it is important that these be retained in the recommended scheme for possible future implementation. These are still worthwhile works, and conditions may change that alter prioritisation or funding. For example:

- A significant change in funding availability may occur which makes all works readily achievable within a relatively short time frame.
- Other parties (such as other government authorities or developers) may be willing to carry out the work at no cost to Council as part of other works in the catchment.
- There could be a philosophical or political change in the way in which the community values a specific Low priority measure which elevates its priority status

TABLE 9.9.1 PRIORITISATION OF WORKS - RECOMMENDED SCHEME

S		***SCHEME SB***	*(DIVERSION TO TRAMWAY FORMALISED)*	**Estimated Cost**	**Priority Level**
S	1.00	Ocean outfall	Develop opening policy	$ 6,000	High
S	1.02	Footbridge to Blackall St	Flow training wall south bank	$ 231,000	Low
S	1.06	Princes Highway to Rail line	Reconfigure basin outlet (to reduce nuisance flows into Beacon Ave)	$ 29,000	High
S	1.09	Old mine rail	**Formalise diversion (at old rail)**	See TB1	High
S	1.10	Hobart St	**Formalise diversion (at Hobart)**		High
S	1.11	William St to Hobart St	Channel enlargement and stabilisation	$ 165,000	Low
S	1.11	William St to Hobart St	Sediment basin	$ 105,000	Med
S	1.12	William St	Formalise overland flowpath	$ 78,000	Med
S	1.13	Rex Ave to William St	Sediment basin	$ 105,000	Med
S	1.13	Rex Ave to William St	Restore pre Aug 98 capacity	$ 148,960	Low
S	1.13	Rex Ave to William St	Coarse debris trap	$ 17,000	High
S	1.03	Southern Tributary - mine basin	Retarding basin	$ 518,000	Low
S	2.03	Southern Tributary - mine basin	Request mine owner to expedite rehabilitation of mine site (works to be carried out by owner)	$ -	High
			Total Scheme Cost	**$ 1,402,960**	
T		***SCHEME TB1***	*(DIV' FORMALISED - CULVERT UPGRADE)*	**Estimated Cost**	**Priority Level**
T	3.01	Ocean outfall	Develop opening policy	$ 6,000	Low
T	3.03	Rail line	High flow culvert/bridge	$ 640,000	High
T	3.04	Princes Highway to Rail line	Formalise overland flowpath	$ 1,340,000	Med
T	3.04a	Princes Highway to Rail line	Voluntary purchase offer	$ 600,000	High
			Total Scheme Cost	**$ 2,586,000**	
W		***SCHEME WA***	*(HIGH FLOW CULVERT AT RAIL)*	**Estimated Cost**	**Priority Level**
W	2.01	Diversion to Hewitts	Re-divert Woodlands Ck to Tramway Ck	$ 172,000	High
W	2.01a	Near Sewer Pumping Station	Channel enlargement and stabilisation	$ 240,000	Low
W	2.03	Rail line	High flow culvert/bridge	$ 640,000	High
W	2.04	Princes Highway to Rail line	Modify safety ramp and provide sag	$ 70,000	High
W	2.04	Princes Highway to Rail line	Levee north bank	$ 103,000	High
W	2.05	Princes Highway	Sediment basin/debris control structure	$ 177,000	Low
			Total Scheme Cost	**$ 1,402,000**	
H		***SCHEME HA***	*(LEVEE AT CORBETT AVE)*	**Estimated Cost**	**Priority Level**
H	1.00	Ocean outfall	Develop opening policy	$ 6,000	High
H	1.02	Adjacent to Corbett Ave	Levee north bank	$ 196,000	High
H	1.05	LHD to the Rail line	Voluntary purchase offer	$ 300,000	High
H	1.05	LHD to the Rail line	Rehabilitate creek channel	$ 360,000	Low
H	1.08	Lachlan St	Culvert inlet improvements	$ 82,000	High
H	1.08	Lachlan St	Formalise overland flowpath		High
H	1.09	Kelton Ln to Lachlan St	Channel enlargement and stabilisation	$ 193,000	Med
H	1.11	Bangalow Rd to Kelton Ln	Restore pre Aug 98 capacity	$ 241,000	Med
H	1.11	Bangalow Rd to Kelton Ln	Coarse Debris trap	$ 17,000	High
			Total Scheme Cost	**$ 1,395,000**	
H		***SCHEME HS4-A***	*(FLOOD/PROPERTY MOD'S - VIRGINIA TCE)*	**Estimated Cost**	**Priority Level**
H	4.03	Stream 4 - Virginia Tce	Culvert mod's (to reduce surcharge freq'y)	$ 136,000	High
H	4.03	Stream 4 - Virginia Tce	Property modification (flow deflectors)	$ 107,000	High
H	4.04	Stream 4 - Deborah Ave	Coarse debris trap	$ 17,000	High
			Total Scheme Cost	**$ 260,000**	
TG		***SCHEME TGB***	*(PROVIDE OVERLAND FLOW PATHS)*	**Estimated Cost**	**Priority Level**
TG	1.00	Ocean outfall - North Arm	Develop opening policy	$ 6,000.00	High
TG	1.00	Ocean outfall - North Arm	Lower south bank	$ 79,000.00	High
TG	1.01	The Esplanade - North Arm	Expand floodway	$ 124,000.00	Low
TG	1.03	Macauley St to Cliff Pde - North Arm	Raise Kerb/Driveway	$ 14,000.00	High
TG	1.04	Macauley St - North Arm	Investigate culvert inlet improvements	$ 50,000.00	Low
TG	1.08	Rail Line - North Arm	Investigate culvert inlet improvements	$ 50,000.00	Low
TG	1.08	Rail Line - North Arm	Debris Control Structure	$ 94,000.00	Low
TG	1.12	Sea Foam Ave - North Arm	Raise Kerb/Driveway	$ 28,000.00	High
TG	1.13	Phillip St to Sea Foam Ave - North Arm	Culvert and Overland flow path	$ 315,000.00	High
TG	2.03	Rail Line to Raymond Rd	Check condition and rehabilitate pipe drainage	$ 32,000.00	Low
TG	2.03a	Station St diversion - Station St	Overland flow path	$ 90,000.00	Low
TG	2.04	Rail Line	Investigate culvert inlet improvements	$ 50,000.00	Med
TG	2.07	Phillip St to LHD	Overland flow path	$ 92,000.00	Med
TG	3.00	Ocean outfall - South Arm	Develop opening policy	$ 6,000.00	Low
TG	3.00	Ocean outfall - South Arm	Reduce diversion to north	$ 86,000.00	High
TG	3.01	Cliff Pde	Improve culvert capacity	$ 128,000.00	Med
TG	3.02	Macauley St to Cliff Pde to Blackall St	Modify Existing Flood Gate	$ 7,000.00	High
TG	3.02	Macauley St to Cliff Pde	Debris Control Structure	$ 94,000.00	Med
TG	3.02	Macauley St to Cliff Pde	Overland Flowpath	$ 127,000.00	Low
TG	3.03	Macauley St	Modify culvert inlet	$ 65,000.00	Med
TG	3.05	Thomas Gibson Park outlet	Formalise existing detention basin	$ 135,000.00	High
TG	3.05	Thomas Gibson Park outlet	Debris control structure	$ 94,000.00	Low
TG	3.10	Lachlan St to LHD	Overland flow path	$ 85,000.00	High
			Total Scheme Cost	**$ 1,851,000**	

Total Combined Scheme Cost	**$ 8,896,960**

10. ACKNOWLEDGEMENTS

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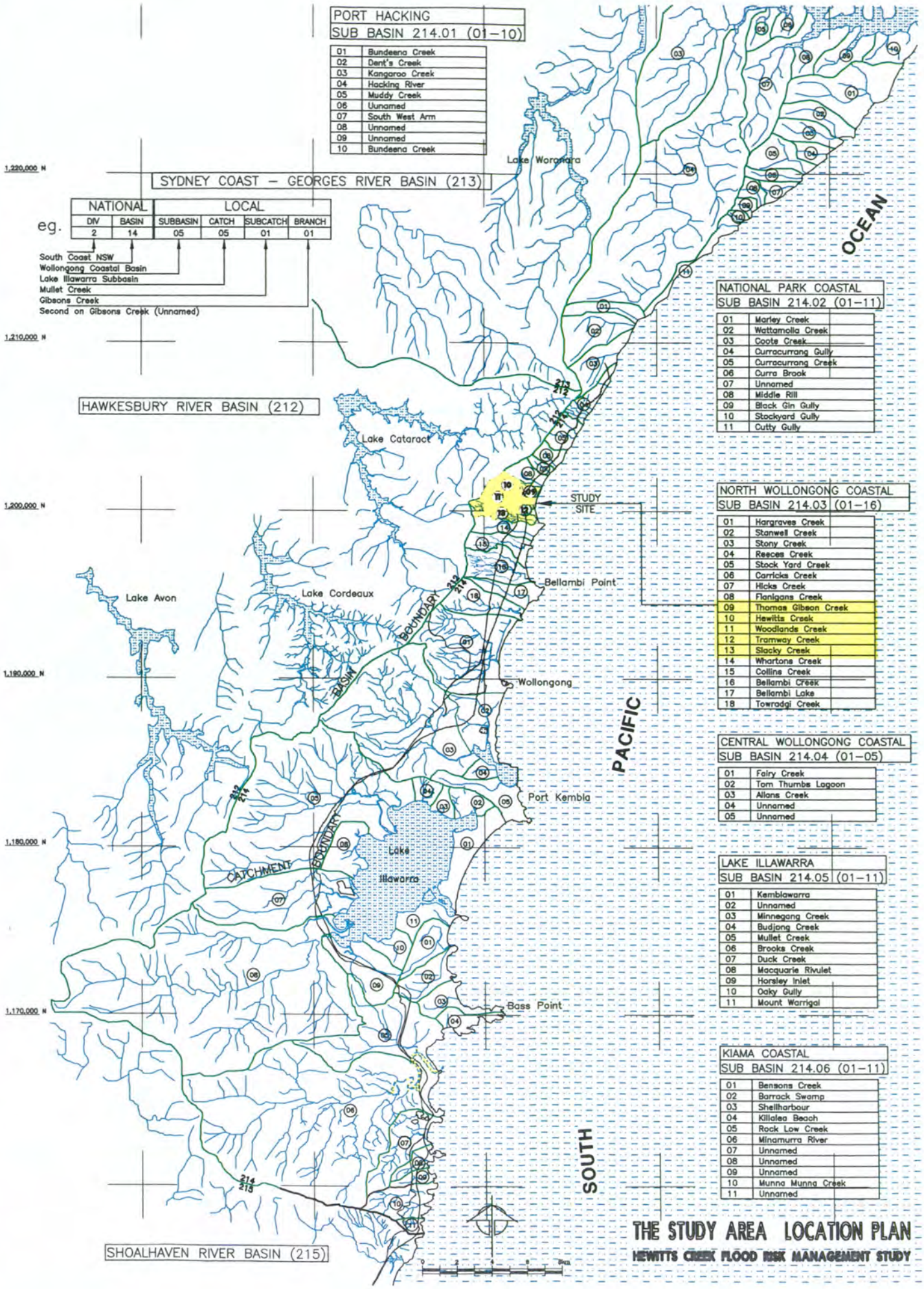
APPENDIX 1

THE STUDY AREA

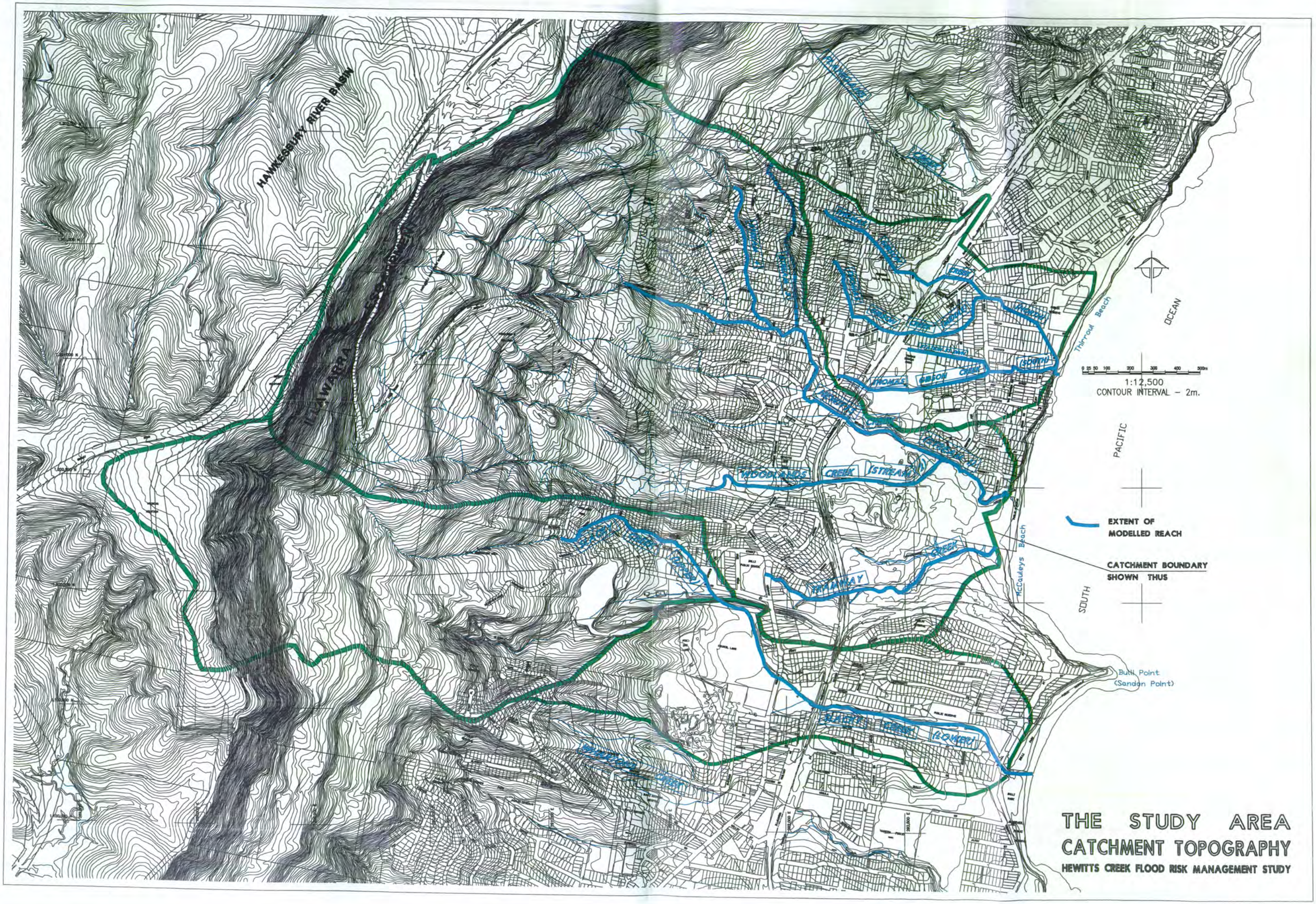
APPENDIX 1.1

Location Plan


PORT HACKING
SUB BASIN 214.01 (01–10)
01 Bundeena Creek
02 Dent's Creek
03 Kangaroo Creek
04 Hacking River
05 Muddy Creek
06 Unnamed
07 South West Arm
08 Unnamed
09 Unnamed
10 Bundeena Creek
1,220,000 N
SYDNEY COAST – GEORGES RIVER BASIN (213)
NATIONAL
LOCAL
DIV
BASIN
SUBBASIN
CATCH
SUBCATCH
BRANCH
eg.
2
14
05
05
01
01
South Coast NSW
Wollongong Coastal Basin
Lake Illawarra Subbasin
Mullet Creek
Gibsons Creek
Second on Gibsons Creek (Unnamed)
1,210,000 N
HAWKESBURY RIVER BASIN (212)
Lake Cataract
1,200,000 N
Lake Avon
Lake Cordeaux
BOUNDARY
BASIN
1,190,000 N
Wollongong
Bellambi Point
STUDY SITE
Port Kembla
CATCHMENT
BOUNDARY
Lake Illawarra
1,180,000 N
Bass Point
1,170,000 N
SHOALHAVEN RIVER BASIN (215)
Lake Woronora
OCEAN
PACIFIC
SOUTH
NATIONAL PARK COASTAL
SUB BASIN 214.02 (01–11)
01 Marley Creek
02 Wattamolla Creek
03 Coote Creek
04 Curracurrang Gully
05 Curracurrang Creek
06 Curra Brook
07 Unnamed
08 Middle Rill
09 Black Gin Gully
10 Stockyard Gully
11 Cutty Gully
NORTH WOLLONGONG COASTAL
SUB BASIN 214.03 (01–16)
01 Hargraves Creek
02 Stanwell Creek
03 Stony Creek
04 Reeces Creek
05 Stock Yard Creek
06 Carricks Creek
07 Hicks Creek
08 Flanigans Creek
09 Thomas Gibson Creek
10 Hewitts Creek
11 Woodlands Creek
12 Tramway Creek
13 Slacky Creek
14 Whartons Creek
15 Collins Creek
16 Bellambi Creek
17 Bellambi Lake
18 Towradgi Creek
CENTRAL WOLLONGONG COASTAL
SUB BASIN 214.04 (01–05)
01 Fairy Creek
02 Tom Thumbs Lagoon
03 Allans Creek
04 Unnamed
05 Unnamed
LAKE ILLAWARRA
SUB BASIN 214.05 (01–11)
01 Kemblawarra
02 Unnamed
03 Minnegang Creek
04 Budjong Creek
05 Mullet Creek
06 Brooks Creek
07 Duck Creek
08 Macquarie Rivulet
09 Horsley Inlet
10 Oaky Gully
11 Mount Warrigal
KIAMA COASTAL
SUB BASIN 214.06 (01–11)
01 Bensons Creek
02 Barrack Swamp
03 Shellharbour
04 Killalea Beach
05 Rock Low Creek
06 Minamurra River
07 Unnamed
08 Unnamed
09 Unnamed
10 Munna Munna Creek
11 Unnamed
0 2 4 8 kms
THE STUDY AREA LOCATION PLAN
HEWITTS CREEK FLOOD RISK MANAGEMENT STUDY

APPENDIX 1.2

Catchment Plan



THE STUDY AREA
CATCHMENT TOPOGRAPHY

HEWITTS CREEK FLOOD RISK MANAGEMENT STUDY

APPENDIX 2.1

FPMM Flood Hazard Zones

APPENDIX 2

EXISTING FLOOD HAZARD

Provisional Hydraulic Hazard Zones

Provisional Hydraulic Hazard Zones are as defined in the Flood Plain Management Manual 2001 by figure G2 of appendix G. They provide an initial representation of 'risk' based solely on hydraulic criteria.

In summary these provisional hydraulic hazard zones are defined as;

High Provisional Hazard:

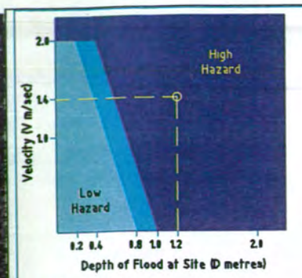
V + 3.33D = 3.33 in a 1% AEP flood event
or V > 2m/sec in a 1% AEP flood event
or D > 1m in a 1% AEP flood event

Moderate Provisional Hazard:

V + 3.33D < 3.33 in a 1% AEP flood event
and V + 3.33D > 2.66 in a 1% AEP flood event
and V < 2m/sec in a 1% AEP flood event
and D < 1m in a 1% AEP flood event

Low Provisional Hazard:

V + 3.33D = 2.66 in a 1% AEP flood event
and D = 0.8m in a 1% AEP flood event
and V = 2m/sec in a 1% AEP flood event



Note

The degree of hazard may be either –

reduced by establishment of an effective flood evacuation procedure.

increased if evacuation difficulties exist.

In the transition zone highlight by median colour, the degree of hazard is dependant on site conditions and the nature of the proposed development.

EXAMPLE

If the depth of flood water is **1.2 m**

and the velocity of floodwater is **1.4 m/sec**

then the provisional hazard is **high**.

Figure G2
Provisional Hydraulic Hazard Categories

PROVISIONAL HYDRAULIC HAZARD ZONES

HEWITTS CREEK FLOOD RISK MANAGEMENT STUDY

0 50 100 200
METRES

APPENDIX 3

RISK MANAGEMENT MEASURES

APPENDIX 3.1

Management Measures Master List

DO NOT SCALE IF IN DOUBT ASK

HEWITTS CREEK

WOODLANDS CREEK

SLACKY CREEK (Upper)

TRAMWAY CREEK

SLACKY CREEK (Lower)

WHARTONS CREEK

CATCHMENT BOUNDARY SHOWN THUS

1.14 1.13 1.12 1.11 1.10 1.09 1.08 1.07 1.06 1.05 1.04 1.03 1.02 1.01 1.00

2.03 2.02 2.01

3.07 3.06 3.05 3.04 3.03 3.02 3.01 4.02 4.01

1,200,500 N

1,200,000 N

1,100,500 N

1,100,000 N

290,500 E

291,000 E

291,500 E

292,000 E

292,500 E

0 250 500

SCALE 1:4,000

PRELIMINARY

REV	DATE	BY	APP.	DETAILS

DRAWING STATUS		
DESIGN BY	EH.RIGBY	OCTOBER'01
DRAWN BY	CE.DAVIS	OCTOBER'01
DRAFTING CHECK		
DESIGN CHECK		
FINAL APPROVAL		

SCALE: (on A1 Original) 1:4000

DATUM: AHD

FORBES RIGBY PTY LTD
Engineers Planners & Scientists
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PROJECT TITLE
FLOOD PLAIN MANAGEMENT
CONSOLIDATED HEWITTS CREEK
FOR
WOLLONGONG CITY COUNCIL

DRAWING TITLE
FLOOD MITIGATION ZONES
SHEET 1 OF 3
SLACKY & TRAMWAY CREEKS

Project No.	Drawing No.	REV
93073	11106	P0

File Plotted: U:\1993\93073-11 CONSOLIDATED FPMS\REPORTS\FPM STUDY\APPENDIX\BUILD\APP 3.2.1 PROPOSED WORKS ALL OPTIONS SLACKY & TRAMWAY CKS.DWG
August 23, 2002 2:45:51 p.m.

A1

DO NOT SCALE | IF IN DOUBT ASK

ILLAWARRA ESCARPMENT

HEWITTS CREEK

THOMAS GIBSON CREEK

WOODLANDS CREEK

SLACKY CREEK (Upper)

TRAMWAY CREEK

Thirroul Beach

1,202,000 N

1,201,500 N

1,201,000 N

1,200,500 N

290,500 E

291,000 E

291,500 E

292,000 E

292,500 E

293,000 E

3.5 3.04 3.03 3.02 3.01 4.04 4.03 4.02 4.01 5.01 6.01 1.10 1.09 1.08 1.07 7.01 1.06 1.05 1.04 8.01 8.02 8.03 1.03 2.01 2.02 2.03 2.04 2.05 2.01a 1.02 1.01 1.00

CATCHMENT BOUNDARY SHOWN THUS

0 250 500

SCALE 1: 4,000

PRELIMINARY

REV	DATE	BY	APP.	DETAILS

DRAWING STATUS		
DESIGN BY	EH.RIGBY	OCTOBER'01
DRAWN BY	CE.DAVIS	OCTOBER'01
DRAFTING CHECK		
DESIGN CHECK		
FINAL APPROVAL		

SCALE: (on A1 Original) 1:4000

DATUM: AHD

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PROJECT TITLE
FLOOD PLAIN MANAGEMENT
CONSOLIDATED HEWITTS CREEK
FOR
WOLLONGONG CITY COUNCIL

DRAWING TITLE
FLOOD MITIGATION ZONES
SHEET 2 OF 3
HEWITTS & WOODLANDS

Project No.	Drawing No.	REV
93073	11107	P0

A1

File Plotted: J:\99\93073-11 CONSOLIDATED FPMS\REPORTS\FPM STUDY\APPENDIX\BUILD\APP 3 2 2 PROPOSED WORKS ALL OPTIONS HEWITTS & WOODLAND.DWG
August 23, 2002 2:46:38 p.m.

DO NOT SCALE IF IN DOUBT ASK

ILLAWARRA ESCARPMENT

HEWITTS CREEK

WOODLANDS CREEK

SLACKY CREEK (Upper)

THOMAS GIBSON CREEK

TRAMWAY CREEK

1,202,000 N
1,201,500 N
1,201,000 N
1,200,500 N

290,500 E
291,000 E
291,500 E
292,000 E
292,500 E
293,000 E

1.00 1.01 1.02 1.03 1.04 1.05 1.06 1.07 1.08 1.09 1.10 1.11 1.12 1.13 1.14 1.15
2.01 2.02 2.02a 2.03 2.03a 2.04 2.04a 2.05 2.06 2.07 2.08 2.09 2.10 2.11
3.00 3.00a 3.01 3.02 3.03 3.04 3.05 3.06 3.07 3.08 3.09 3.10

PRELIMINARY

CATCHMENT BOUNDARY SHOWN THUS

0 250 500
SCALE 1: 4,000

REV	DATE	BY	APP.	DETAILS

DRAWING STATUS		
DESIGN BY	EH.RIGBY	OCTOBER'01
DRAWN BY	CE.DAVIS	OCTOBER'01
DRAFTING CHECK		
DESIGN CHECK		
FINAL APPROVAL		

PRELIMINARY

SCALE: (on A1 Original) 1:4000

DATUM: AHD

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PROJECT TITLE
FLOOD PLAIN MANAGEMENT
CONSOLIDATED HEWITTS CREEK
FOR
WOLLONGONG CITY COUNCIL

DRAWING TITLE
FLOOD MITIGATION ZONES
SHEET 3 OF 3
THOMAS GIBSON

Project No.	Drawing No.	REV
93073	11108	P0

File Plotted: U:\1993\93073-11 CONSOLIDATED FPMS\REPORTS\FPM STUDY\APPENDIX\BUILD\APP 3.2.3 PROPOSED WORKS ALL OPTIONS THOMAS GIBSON.DWG
August 23, 2012 2:44:56 p.m.

A1

Consolidated Hewitts Creek Floodplain Risk Management Study

Mitigation Measures Master List

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
ALL	ALL	ALL	Zoning controls	Property	Using zoning controls, limit occupation/development of flood prone land to those forms of occupation/development that are compatible with the inherent risks.	Potential elimination of future flood damages for events up to the Flood Planning Level. Will not reduce existing flood damages.		Reduced community growth	Y	(ALL)
ALL	ALL	ALL	DC - Flood access enhancement	Property	Enhance access to and from sites during flooding (mostly applies to future development)	No reduction in flood levels	Enhanced safety and emergency access/egress		Y	(ALL)
ALL	ALL	ALL	DC - Control filling	Property	Control of fill or excavation on the flood plain	No reduction in flood levels. Can eliminate potential adverse impact of development on flood behaviour.			Y	(ALL)
ALL	ALL	ALL	DC - Set Min' Freeboard	Property	Set minimum levels of free board (height difference between floor level and flood level) for new development.	No reduction in flood levels. Enhances flood security of future development for events greater than the flood used to set the flood planning level.			Y	(ALL)
ALL	ALL	ALL	DC - Set Min' Floor Level	Property	Set minimum floor levels for all new development to elevate floor levels above the flood levels and above levels of adjacent ground.	No reduction in flood levels. Can eliminate above floor flood damages for events up to the Flood Planning Level and flood damage from local overland flow.			Y	(ALL)
ALL	ALL	ALL	DC - Control Building Mat'	Property	Controlling acceptable building materials for new development. Limit use of building materials that are susceptible to water damage such as 'chip board'.	No reduction in flood levels. Will reduce building flood damages for future development.			Y	(ALL)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
ALL	ALL	ALL	DC - Services	Property	Reducing impact of flooding on services/services on flooding through relocation of existing services (e.g. water mains which cross creeks) and appropriate design of new services.	Generally limited benefits during large flood events due to the relative size of the services. Small flood level reductions could be achieved where existing services are relocated outside the channel waterway.			Y	(ALL)
ALL	ALL	ALL	DC - Works (Structures)	Property	Control the development of all structures including garages and non-permanent sheds in and around watercourses. Removal of existing illegal structures.	Generally only small reduction in flood levels are achieved (depending on size of structure and proximity to watercourse). However, could significantly reduce yard damage and potential structure blockages.			Y	(ALL)
ALL	ALL	ALL	DC - Works (Constructi on sites)	Property	Control construction activities within the flood plain to ensure that building activities (e.g. temporary earthworks, material stockpiles) do not ijmpact on flood levels or debris load	Generally only small reduction depending on nature of works			Y	(ALL)
ALL	ALL	ALL	DC - Works (Set backs)	Property	Apply minimum setbacks between the top of creek bank and all structures	Generally only a small reduction in flood levels. Reduced future flood damages.	May provide significant enhancement to the stream environment		Y	(ALL)
ALL	ALL	ALL	DC - Works (Material Storage)	Property	Control the use of the floodplain as a storage area for goods and equipment that could be swept into the floodplain	Reduce the potential for blockage of downstream structures.			Y	(ALL)
ALL	ALL	ALL	DC - Land use control	Property	Using development control, limit occupation/development of flood prone land to those forms of occupation/development that are compatible with the inherent risks.	Potential elimination of future flood damages for events up to the Flood Planning Level. Will not reduce existing flood damages.		Reduced community growth	Y	(ALL)

APPENDIX 3.1

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
ALL	ALL	ALL	DC - Structural Soundness	Property	Ensuring structural soundness of new dwellings through minimum requirements for construction type.	No reduction in flood levels. Will reduce structural damage to properties in areas where substantial flow depth could occur.			Y	(ALL)
ALL	ALL	ALL	DC - Fencing type	Property	Control fencing type and location. Ensure that all new fences which cross the floodplain are flood compatible (i.e. minimum opening size, maximum heights, anchor blocks, hingeing posts)	Potentially large reduction in flood levels in some circumstances. Reduced costs associated with yard damage.			Y	(ALL)
ALL	ALL	ALL	Flood Education - general	Response	Ensure the community is fully 'aware' that floods will occur and are likely to interfere with normal activities in the flood plain through: Meetings/workshops with residents/groups; Articles in local newspapers; Displays of flood photos/articles in centres; Distribution of flood information leaflets; School projects/addressing schools on flooding	No reduction in flood levels	Can result in significantly reduced public risk and possibly a small reduction in flooding as a result of a reduction in irresponsible behaviour such as storing equipment adjacent to creeks.		Y	(ALL)
ALL	ALL	ALL	Flood Education - signage	Response	Ensure the community is fully 'aware' that floods will occur and are likely to interfere with normal activities in the flood plain through: Construction of signs or markers of historic flooding; Construction of signs or markers of the Flood Planning Level; Construction of signing of evacuation routes	No reduction in flood levels	Improved community response during flood, enhanced safety	Increased stress levels	Y	(ALL)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
ALL	ALL	ALL	Flood Readiness	Response	To ensure that the community is as prepared for flooding as is reasonably practicable through education that is focussed on means of mitigating risks and damages, during a flood event.	No reduction in flood levels	Some reduction in flood damages could be achieved though this would be limited given available warning time.		Y	(ALL)
ALL	ALL	ALL	Flood prediction and warnings	Response	Flood prediction and warnings: To maximise time available for residents to mitigate damages and if necessary evacuate the site using: Sirens/Alarms; Ripple control warning devices; Coded visual signs; Laser lights; Door knocks; Tone alert radio; Fixed/Mobile PA's; Telephones; Paging; Variable message signs; Radio broadcasts; TV broadcasts; Push Internet; Informal personal networks	No reduction in flood levels	Enhanced public safety, reduced flood damages. Limited application in Hewitts Ck due to short response times.		Y	(ALL)
ALL	ALL	ALL	Local Flood Plan	Response	Preparation of a local flood plan which formalises the various measures to be undertaken before, during and after a flood, including warning, evacuation resupply and recovery procedures.	No reduction in flood levels	Improved community and emergency services response during and after flood, enhanced safety, reduced stress		Y	(ALL)
HEWITTS	1.00	Ocean outfall	Develop opening policy	Flood	Develop Procedure setting out the conditions under which sand should be cleared from the creek outlet	Reduced risk of floor inundation during small (2 to 3 times a year) storm events. Minimal benefit during large storm events.		Regular opening of sand bars may negatively impact on some species which depend on these estuarine areas. Some assessment of these risks should be undertaken	Y	(HA/HB)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	1.01	Cycleway bridge	Reconstruct higher footbridge	Flood	Remove and replace existing footbridge with a bridge at a higher level (or possibly lift the existing bridge)	May reduce flooding in large events when the bridge becomes blocked. Flooding benefit is limited (Possibly less <0.5m) because of the wide weir length available at overtopping.		Reduced amenity for cyclists using the bicycle track	N	Estimated low B/C ratio. Wide weir available at overtopping therefore benefits are low.
HEWITTS	1.02	Adjacent to Corbett Ave	Levee north bank	Flood	Construct a low wall (1-2 m in height) at rear of properties in Corbett Ave to restrict flood waters to within the creek banks. Remove invasive overgrowth on southern bank to improve the creek conveyance. May require relocation of a section of creek to provide room for the levee.	Height of levee can be easily manipulated to prevent flooding for most ARI events. Height chosen will be dependant on land availability. Height of wall may be restricted to what can be constructed within the limited space between homes and the bank.			Y	(HA)
HEWITTS	1.02	Adjacent to Corbett Ave	House raising	Property	Elevate habitable floors above flooding – normally only applicable in low hazard areas and for certain (site and construction) specific dwellings. Owner funded with government assistance. Both benefit and disbenefits need careful consideration. Homes along Corbett Avenue/Hamilton St.	Reduction in above floor flood damages for all events up to that used to set new floor levels.	Potential for less long term disruption to residents. Increased property values.	Does nothing to reduce damages in flood events rarer than the flood used to set floor levels.	Y	(HB)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	1.02	Adjacent to Corbett Ave	Flood proofing	Property	Refers to the design and construction of new buildings with appropriate water resistant materials such that flood damage to the building itself (structural damage), and possibly its contents, is minimised should the building be inundated. Does not reduce social or economic hardship. Only applicable as an adjunct to other measures.	No reduction in flood levels associated with flood proofing only reduction in building flood damages.			Y	(HB)
WOODLANDS	2.01	Diversion to Hewitts Ck	Re-divert Woodlands Ck to Tramway Ck	Flood	Close existing diversion of Woodlands Creek into Hewitts Creek and reinstate original Woodlands Creek.	Reduction in flows through Corbett Avenue area, particularly if carried out with expansion of the Woodlands Creek Rail Culvert	Restoration of Woodlands back to original course may have environmental benefits	Possible impact on SPS will need to be assessed	Y	(WA/WB)
HEWITTS	1.03	Rail line to Surfers Pde	Channel enlargement and stabilisation	Flood	Excavation to reduce the height of the floodplain adjacent to the southern bank. Height to be restricted to the top of the gabion wall to avoid the cost of their removal. Width of excavation anticipated is in the order of 10 to 15m. Rehabilitate/stabilise excavation area	No homes will directly benefit from this work (unless the railway culvert is improved in which case this excavation may be necessary)	Could be made part of the new development. May improve performance of Railway culvert	Loss of developable land	N	To be incorporated into designs for future development (by Stocklands)
HEWITTS	1.03	Rail line to Surfers Pde	Divert Hewitts Ck to Tramway Ck	Flood	Close existing Hewitts Creek Channel and divert into Tramway Ck via old path of Woodlands Creek	Almost complete protection from flooding for all homes in Corbett Ave and Hamilton St	Could be made part of the new development	Loss of Habitat	N	Potential environmental impacts due to alteration of natural riparian processes

APPENDIX 3.1

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	1.04	Rail line	Increase bridge capacity	Flood	Close the existing access road to the BHP refractory site and reduce the invert level of the bridge opening thereby improving its conveyance. Will require strict measures to ensure structural integrity of bridge is not compromised.	Drop in flood level immediately upstream of culvert will be roughly proportional to drop in culvert invert level. Up to 1m of excavation is possible. (depth of cut dependant on what is structurally feasible).	Improve the performance of the Lawrence Hargreave Drive culvert by decreasing tailwater levels	Loss of access to refractories site	N	Estimated low B/C ratio. Low benefit/ high cost of alterations to bridge (train shut downs etc). Some minor modifications have been incorporated into the creek rehabilitation measure for upstream zone.
HEWITTS	1.05	Lawrence Hargrave Dve to the Rail line	Rehabilita te creek channel	Flood	Close the existing access road to the BHP refractory site and excavate to restore the original waterway(natural rock protection, construct small wet ponds, rock drop structures and landscaping with native species). measure would need to incorporate some minor mods to rail bridge invert to 'match' creek bed invert levels across the structure.	Improved conveyance during small storms. In a larger event the culvert through the railway will provide a downstream control, limiting the potential benefit to flooding.		Loss of access to refractories site	Y	(HA/HB)
HEWITTS	1.05	Lawrence Hargrave Dve to the Rail line	Voluntary purchase offer	Property	Acquire property in areas of high hazard where it is impractical or uneconomic to mitigate flooding of existing properties. (d/s of LHD culvert)	Elimination of flooding risk for properties aqcuired. Reduced diversion to Thomas Gibson Creek	Removal of continuing flood risk		Y	(HA/HB)
HEWITTS	1.06	Lawrence Hargrave Dve	Debris trap/augm ent culverts	Flood	Provide debris trap upstream of LHD to reduce blockage and augment culverts with additional cells of similar dimension	Some reduction in flood level upstream of highway (0.5). Also will provide improved emergency access during flood. Limited improvement during large events when culvert is outlet controlled.	Debris trap will reduce need to expand culverts. Improved emergency Access	Maintenance would be high as trap is on a large creek	N	Does not target above floor flooding. (i.e no reduction in flood damages) Estimated low B/C ratio

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	1.06	Lawrence Hargrave Dve	Replace culvert with bridge >6m span	Flood	Upgrade culvert capacity by increasing the number of culvert cells or reconfiguration of headwalls. May require excavation and disruption to traffic on Lawrence Hargreave drive. Will need to be greater than 6m diagonal width to avoid blockage.	Some reduction in flood level upstream of highway (0.5-1.0m). Limited improvement during large events when culvert is outlet controlled.	Improved emergency Access	Disruption to Traffic during construction	N	Does not target above floor flooding. (i.e no reduction in flood damages) Estimated low B/C ratio
HEWITTS	1.06	Lawrence Hargrave Dve	Flood access enhance ment	Property	Enhance access to and egress from flood prone property – difficult to retrofit best implemented during development/ redevelopment under appropriate development control.	No reduction in flood levels. Could increase upstream flood levels if not appropriately designed.	Enhanced safety and emergency access/egress		N	Estimated low B/C ratio (i.e no reduction in flood damages)
HEWITTS	1.07	Lachlan St to Lawrence Hargrave Dve	Channel stabilisati on	Flood	Stabilise creek banks with gabion/rock protection in upper part of zone to protect property. May require some channel modifications.	Benefit proportional to degree of channel modification. Assuming maximum change applied, then this could reduce flood levels in immediate vicinity by up to 0.5m	Prevent erosion and loss of land		N	Does not target above floor flood damages as homes generally elevated
HEWITTS	1.07	Lachlan St to Lawrence Hargrave Dve	Remove small weir	Flood	Remove existing small weir in creek and increase the channel capacity in the immediate vicinity (relocate any services that may be buried beneath weir wall).	Minimal and localised. Flood levels at this point are controlled by culvert downstream.		Loss of creek habitat	N	Estimated low B/C ratio
HEWITTS	1.08	Lachlan St	Culvert inlet improvem ents	Flood	Design of a projecting centre wall or similar in front of the entrance to reduce the likelihood of the pillar collecting debris. Construct a sloping grate to collect debris (if room available). Construct tapered inlet to improve capacity	Reduction in risk of ground and floor level flooding for 10 - 15 properties. Restricted to the potential capacity improvement (ie. probably less than 0.5 m).		Maintenance would be high as trap is on a large creek	Y	(HA/HB)

APPENDIX 3.1

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	1.08	Lachlan St	Voluntary purchase offer	Property	Acquire property in areas of high hazard where it is impractical or uneconomic to mitigate flooding of existing properties. (No.s 11?, 6?, 8?, 10?)	Elimination of flooding risk for properties aqcuired. Reduced diversion to Thomas Gibson Creek	Removal of continuing flood risk		N	Originally included in scheme but later removed following consultation with owners
HEWITTS	1.08	Lachlan St	Reduce diversion by incorporating road sag	Flood	Reduce existing diversion to Thomas Gibson Creek through incorporation of sag at road crossing and possible aquisition of property to expand available overflow path	Benefits to homes fronting southern side of Lachlan St and townhouses upstream of Railway at head of Thomas Gibson Creek. Benefit limited to downstream of Thomas Gibson park due to attenuation available from informal basin within park		Reduced trafficability of Lachlan St during flood	N	Estimated low B/C ratio. High cost and reduced safety
HEWITTS	1.08	Lachlan St	Replace culvert with bridge >6m span	Flood	Upgrade culvert capacity at Lachlan St by increasing the number of culvert cells. Could require property acquisition. Would require culvert of greater than 6m diagonal width.	Reduction in flood level (up to 0.5m) immediately upstream and over culvert			N	Estimated low B/C ratio (high cost of construction)
HEWITTS	1.08	Lachlan St	Formalise overflow path	Flood	Provide improved overflowpath across Lachlan St. Modifications to railing, modifications to footpath(s), lowering of kerb. Raising of driveways (up to 14 Lachlan St).	Reduction in flood level (possibly up to 0.5m) immediately upstream and over culvert	Reduced diversion to Thomas Gibson	Reduced trafficabilty of footpath if lowered	Y	(HA/HB)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	1.09	Kelton Ln to Lachlan St	Channel enlargement and stabilisation	Flood	Restore original capacity of waterway by removing material deposited during Aug 98 event. Excavating material from banks of creek while still maintaining the existing creek bottom. Widen where practical. Creek banks can then be stabilised and landscaped. Private usage of land retained. Significant riparian enhancements anticipated. Work limited to downstream end of zone downstream of 19 Lachlan St. Stabilise eroding embankment at rear of 19 George St.	Dependant on amount of excavation considered appropriate. Homes generally elevated above channel except for lower part of zone (Lachlan St). Potential benefit is partially controlled by capacity of Lachlan St culvert.	Reduce erosion of embankment material and loss of property	Possible loss of some mature trees	Y	(HA/HB)
HEWITTS	1.09	Kelton Ln to Lachlan St	Channel modifications	Flood	Excavation and removal of northern creek bank at small bend immediately downstream of Kelton Lane bridge. Will require some gabions/rock as toe protection.			Possible increased depth of flooding in the vicinity of Lachlan St Culvert due to additional flow being kept within channel	N	Estimated low B/C ratio. Low benefit as houses generally elevated w.r.t creek
HEWITTS	1.10	Kelton Ln	Coarse Debris trap	Flood	Construct a 'bollard' type coarse debris trap u/s of bridge	Limited reduction in flood levels in creek but may reduce breakout of flows to Lachlans St	Improve the performance of any debris traps proposed downstream. Reduce potential for damage to bridge and services.	Possible increased depth of flooding in the vicinity of Lachlan St Culvert due to additional flow being kept within channel	N	Originally included in scheme but later removed following consultation with owners
HEWITTS	1.10	Kelton Ln	Relocate services above underside of deck	Flood	Support existing pipes above bridge deck level to improve capacity of channel under bridge.	Increase capacity of bridge.	Reduced risk of pipe burst which can contribute to total flow in creek and direct flow into properties		N	Estimated low B/C ratio. Bridge already has significant capacity.

APPENDIX 3.1

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	1.10	Kelton Ln	Remove bridge	Flood	Close Kelton Lane and remove existing bridge structure	Limited benefit as homes upstream are generally elevated above bridge level. May improve uncontrolled overflow through downstream properties.		Lost emergency access and public amenity. Services would need to be relocated or at least supported.	N	Estimated low B/C ratio. Loss of amenity if bridge removed.
HEWITTS	1.11	Bangalow Rd to Kelton Ln	Channel enlargement and stabilisation	Flood	Increase capacity of water way by excavating material from creek while still maintaining the existing creek bottom. Widen where practical and stabilise banks.	Minimal, however some properties will have there homes protected from further erosion if velocity and therefore scour is reduced by virtue of a larger waterway.	Can improve the look of the creek if carried out sensitively	Reduction in available land for some residents. Should be done in conjunction with scour protection.	N	Estimated low B/C ratio. Houses generally elevated w.r.t creek
HEWITTS	1.11	Bangalow Rd to Kelton Ln	Voluntary purchase offer	Property	Acquire property in areas of high hazard where it is impractical or uneconomic to mitigate flooding of existing properties. Property(s) along George St e.g. opposite Robinsville & Kanangra Dve intersections (no.s 51(part) & 75 already purchased. 61?)	Elimination of flooding risk for properties acquired	Removal of continuing flood risk		N	Partially carried out. Homes generally elevated w.r.t creek.
HEWITTS	1.11	Bangalow Rd to Kelton Ln	Channel stabilisation	Flood	Place large rock so as to dissipate energy and reduce scour/head cuts. Stabilise creek banks with gabion/rock protection.	Minimal, however some properties will have there homes protected from further erosion by these works	Can improve the look of the creek if carried out sensitively	Should be done in conjunction with any excavation work carried out to enlargen the waterway area.	N	Does not target 'stream' flooding. Above floor flood damages not reduced with this measure.
HEWITTS	1.11	Bangalow Rd to Kelton Ln	Boulder/Debris control structure	Flood	Construct sloping grate debris trap and stilling basin (above Bangalow Rd) to capture and store boulders and debris and reduce blockages of downstream culverts.	Can significantly reduce flooding of properties immediately adjacent to downstream culverts.		Maintenance costs may exceed cost of cleaning culverts during major events. As even debris from small events is captured.	N	Construction unfeasible due to access difficulties and space limitations.

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	1.11	Bangalow Rd to Kelton Ln	Coarse Debris trap	Flood	Construct a 'bollard' type coarse debris trap	Limited reduction in flood levels in creek but may reduce blockage of downstream structures	Improve the performance of debris traps proposed downstream. Reduce potential for damage to bridge and services.	Local increase in flood level adjacent to trap	Y	(HA/HB)
HEWITTS	1.11	Bangalow Rd to Kelton Ln	Retarding basin	Flood	Construct a retarding basin which captures runoff and contains it for a sufficiently long period of time to reduce the peak flowrate downstream of this point. Will also trap boulders and debris.	Can significantly reduce flooding and bed debris load for all properties downstream of the basin (dependant on size of basin). Given geotechnical constraints however only a small basin could be constructed therefore flooding benefit is limited.	Reduces need to construct mitigation measures downstream.	Potentially catastrophic if basin fails when full (Possible given geotech constraints). This limits the size of the basin and therefore its positive benefits.	N	Construction unfeasible - geotechnical constraints and space limitations
HEWITTS	1.11	Bangalow Rd to Kelton Ln	Restore pre-Aug 98 capacity	Flood	Restore original capacity of waterway by removing material deposited during Aug 98 event (already partially carried out)	Restore flood levels to pre Aug 98. No reduction in flood levels relative to these levels. It is noted that many properties in this zone are elevated with respect to creek.	Reduced bed load available for future transport downstream therefore potentially reduced blockage in future	Disruption to residents (access difficult).	Y	(HA/HB)
HEWITTS	3.01	Stream 3 - George St	Energy dissipator	Flood	Construct concrete training wall/flow deflector at pipe outlet as energy dissipator	Small flood level reduction. Reduce turbulence in main channel and therefore increase its conveyance. Reduce diversion of water into Lachlan St and the associated flooding.		Could reduce capacity of pipe system if not correctly designed.	N	Can be incorporated into designs for Zone 1.09

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	3.01	Stream 3 - George St	Improve culvert capacity	Flood	Replace or duplicate existing culverts beneath George St (near Soudan St). Improve inlet capacity. Replacement will require excavation of road along length of pipe (100m).	Complete reduction in flooding up to the 1 in 10 year event for which the pipes are designed. (Greater than 1 in 10 year is probably impractical). Minimal flood reduction in major events (>10 year). May increase flooding of properties downstream of pipe outlet.		Disruption to residents who have the drainage easement running through their property.	N	Estimated low B/C ratio. Construction difficult. Limited benefit in large floods.
HEWITTS	3.02	Stream 3 - Virginia Tce	Improve culvert capacity	Flood	Improve capacity at Virginia Terrace by constructing additional culvert cells or improving inlet configuration.	Reduce flooding of properties adjacent to culverts. Benefits mostly limited to yard flooding.		Increase flows downstream.	N	Estimated low B/C ratio. Limited benefit in large floods.
HEWITTS	3.03	Stream 3 - Palm Gve	Improve culvert capacity	Flood	Replace or duplicate existing piped drainage at Palm Grove. Requires excavation along length of pipe or improve inlet configuration.	Reduction in flooding for small events as flows are retained in stream. May increase flooding of properties downstream of pipe outlet to a small degree.		Significant disruption to residents as little room for excavation in this zone. Increased flows downstream.	N	Estimated low B/C ratio. Limited benefit in large floods.
HEWITTS	3.04	Stream 3 - Nardoo Cr	Improve culvert capacity	Flood	Replace or duplicate existing piped drainage at Nardoo Crescent. Requires excavation along length of pipe.	Reduction in flooding for small events as flows are retained in stream. May increase flooding of properties downstream of pipe outlet to a small degree.		Significant disruption to residents as little room for excavation in this zone. Increased flows downstream.	N	Estimated low B/C ratio. Limited benefit in large floods.
HEWITTS	3.05	Steeam 3 - Fords Rd	Improve culvert capacity	Flood	Replace or duplicate existing piped drainage at Fords Rd. Requires excavation along length of pipe.	Reduction in flooding for small events as flows are retained in stream. May increase flooding of properties downstream of pipe outlet to a small degree. Of limited benefit as catchment at this location is relatively small.		Significant disruption to residents as little room for excavation in this zone. Increased flows downstream.	N	Estimated low B/C ratio. Limited benefit in large floods.

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	4.01	Stream 4 - George St	Improve culvert capacity	Flood	Replace or duplicate existing box culverts by excavating road and laying additional culvert cells Approximately 100m of road needs to be excavated and a small section of front yard OR improve the inlet conguration.	Reduction of flooding due to overflow down George St. Level of protection is limited to the capacity of the culvert. No protection afforded if culvert blocked		Disruption to residents during construction	N	Estimated low B/C ratio. Construction difficult.
HEWITTS	4.01	Stream 4 - George St	Formalise overflow path	Flood	Provide a clear and safe passage for flood waters which exceed the capacity of the piped system to travel through properties. May require building restrictions; re-construction of fences as flow training walls; minor excavation to create a drainage swale.	Limited on this site because of relatively steep slope on George St which encourages water to flow down the road.		Disruption to residents during construction	N	Estimated low B/C ratio. Construction difficult.
HEWITTS	4.01	Stream 4 - George St	Re-align road sag	Flood	Lower the road level in the immediate vicinity of the creek crossing to allow floodwaters to overtop the road and return to the same creek immediately downstream of the road.	Limited on this site because of relatively steep slope on George St which encourages water to flow down the road and because the culvert runs parallel with the road for a short distance.		Disruption to residents during construction	N	Construction unfeasible
HEWITTS	4.02	Stream 4 - Jennifer Cr	Improve culvert capacity	Flood	Replace or duplicate existing culvert at Jennifer Crescent by excavating through the road and laying additional pipe drainage. This would have to be keyed into the upstream system draining from Virginia Terrace to be effective.	Limited benefit as the road sag is aligned with the road. Large events can currently overtop with relative safety.	Improved trafficability during medium storms for the duration of the flood peak.		N	Estimated low B/C ratio. Limited benefit in large floods.
HEWITTS	4.02	Stream 4 - Jennifer Cr	Formalise overflow path	Flood	Provide a clear and safe passage for flood waters which exceed the capacity of the piped system to travel through properties.	Of limited benefit as the creek channel is open and aligned with the natural low point as far as zone 4.1.			N	Estimated low B/C ratio.

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Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	4.03	Stream 4 - Virginia Tce	Formalise overflow path	Flood	Provide a clear and safe passage for flood waters which exceed the capacity of the piped system to travel through properties downstream of Virginia Terrace. May require building restrictions; re- construction of fences as flow training walls; minor excavation to create a drainage swale.	Reduce flooding damage to 2-3 homes			N	Construction difficulties. Significant disruption to residents. Alternative measures to be considered in-lieu of this measure.
HEWITTS	4.03	Stream 4 - Virginia Tce	Culvert modificati on (to reduce surcharge freq'y)	Flood	Reduce the length of the culvert to reduce surcharging of the downstream pit and/or improve headwall structures. Seal downstream stormwater pits to reduce surcharge and direct into new separate line. Provide debris control structure at inlet. Rehabilitate upstream watercourse to reduce scour and culvert blockage.	Reduce flooding damage to 2-3 homes. Benefits limited to smaller storms (10 Yr ARI).			Y	(HS4-A)
HEWITTS	4.03	Stream 4 - Virginia Tce	Voluntary purchase offer	Property	Acquire property in areas of high hazard where it is impractical or uneconomic to mitigate flooding of existing properties. Scope: Property(s) between Viriginia Tce and Jennifer Cres (no. 23?, 25?). May include partial purchase/easement over properties to provide safe overflow path.	Elimination of flooding risk for properties aqcuired	Removal of continuing flood risk		Y	(HS4-B)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	4.03	Stream 4 - Virginia Tce	Close road and reconstruct creek	Flood	Close road and re-create creek channel for the full width of the existing road. Key this channel into the existing pipe drainage. OR partial narrowing of road to allow the construction of a shorter culvert (reducing surcharge) and the integration of a training wall/speed hump to keep overflows within a defined overflow path.	Some benefit to 2-3 homes. Benefit limited to the capacity of the downstream pipes.		Some loss of traffic amenity	N	Estimated low B/C ratio. Disruption to residents.
HEWITTS	4.03	Stream 4 - Virginia Tce	Improve culvert capacity	Flood	Replace or duplicate existing piped drainage. To be effective also requires excavation/pipe replacement between Virginia Terrace and Jennifer Crescent through several properties.	Potential flooding benefit limited to capacity of pipes to be installed. This would be probably limited to 10 - 20 year ARI. Limited effectiveness if culverts block.		Disruption to residents during construction. May require removal of some sheds etc.	N	Construction unfeasible
HEWITTS	4.03	Stream 4 - Virginia Tce	Re-align road sag	Flood	Lower the road level in the immediate vicinity of the creek crossing to allow floodwaters to overtop the road and return to the same creek immediately downstream of the road.	Could prevent flooding of 2 to 3 homes downstream of this culvert.		Construction costs would be high. Increased flooding of property opposite any new low point	N	Construction unfeasible
HEWITTS	4.03	Stream 4 - Virginia Tce	Property modification (flow deflector)	Property	Modifications to front of building (no. 23 Virginia). May include: small levee/fence to redirect flow, structural improvements to walls/windows, modifications to driveway/footpath.	No reduction in flood levels, reduced damage to no 23.			Y	(HS4-A)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	4.04	Stream 4 - Deborah Ave	Re-align road sag	Flood	Lower the road level in the immediate vicinity of the creek crossing to allow floodwaters to overtop the road and return to the same creek immediately downstream of the road.	Reduce flooding of homes immediately downstream of the culvert.		May increase velocities in vicinity of driveway/road.	N	Increased impact on Virginia Tce residents if additional flow in kept within the stream (in current situation some flow may be diverted east along roadway).
HEWITTS	4.04	Stream 4 - Deborah Ave	Improve culvert capacity	Flood	Replace or duplicate existing culvert at Deborah Ave and or improvements to existing headwalls	Potential flooding benefit limited to homes immediately downstream of culvert.			N	Estimated low B/C ratio. Increased impact on Virginia Tce residents if additional flow in kept within the stream (in current situation some flow may be diverted east along roadway).
HEWITTS	4.04	Stream 4 - Deborah Ave	Formalise overflow path	Flood	Provide a clear and safe passage for flood waters which exceed the capacity of the piped system to travel through properties downstream of Deborah Avenue.	Limited benefit as the channel upstream and downstream of this point is open and generally at the low point.			N	Estimated low B/C ratio. Low benefits. Construction difficulties.
HEWITTS	4.04	Stream 4 - Deborah Ave	Coarse Debris trap	Flood	Construct a 'bollard' type coarse debris trap. Final location may be 2-300m upstream of Deborah avenue.	Limited reduction in flood levels in creek except near structures where blockage may be reduced.	Improve the performance of any debris traps proposed downstream. Reduce potential for damage to bridge and services.	Local increase in flood level adjacent to trap	Y	(HS4-A/HS4-B)
HEWITTS	5.01	Stream 5 - Cnr Kanangra Dve and George St	Improve pipe drainage (within roadway)	Flood	Replace existing pipe drainage in Kanangra Dve with pipes of larger capacity	Provide some flood reduction during small events (up to 10 year ARI)		disruption to residents	N	Upgrade to pipe drainage does not target 'stream' flooding. Any benefits would be limited to small storms only (< 10-20yr ARI).
HEWITTS	6.01	Stream 6 - Cnr Robinsville Cr and George St	Improve pipe drainage (within roadway)	Flood	Replace existing pipe drainage in Robinsville Crescent with pipes of larger capacity	Provide some flood reduction during small events (up to 10 year ARI)		disruption to residents	N	Upgrade to pipe drainage does not target 'stream' flooding. Any benefits would be limited to small storms only (< 10-20yr ARI).

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	7.01	Stream 7 - Pass Ave to Lawrence Hargrave Dve	Improve pipe drainage (within roadway)	Flood	Replace existing pipe drainage at bottom of High St with pipes of larger capacity	Provide some flood reduction during small events (up to 10 year ARI). Flooding in large events via backwater from Hewitts Creek is not prevented.			N	Upgrade to pipe drainage does not target 'stream' flooding. Any benefits would be limited to small storms only (< 10-20yr ARI).
HEWITTS	7.01	Stream 7 - Pass Ave to Lawrence Hargrave Dve	Boulder/Debris control structure	Flood	Construct sloping grate debris trap/holding basin to capture and store boulders and debris and thereby reduce blockages of downstream culverts.	Limited reduction in flooding of properties because of small number of critical culverts downstream		Maintenance costs.	N	Estimated low B/C ratio. Small number of critical culverts downstream.
HEWITTS	7.01	Stream 7 - Pass Ave to Lawrence Hargrave Dve	Retarding basin	Flood	Construct a retarding basin above High St which captures runoff and contains it for a sufficiently long period of time to reduce the peak flowrate downstream of this point.	Possible reduction in flooding in all creeks downstream of this point however size of basin is so limited by site constraints that the flood level reduction would be small.		Risks associated with dam break.	N	Construction unfeasible. Geotechnical/space limitations. Limited storage volume achievable.
HEWITTS	8.01	Stream 8 - Hewitts Ave	Improve pipe drainage (within roadway)	Flood	Replace existing pipe drainage in Hewitts Avenue with pipes of larger capacity	Provide some flood reduction during small events (up to 10 year ARI)			N	Upgrade to pipe drainage does not target 'stream' flooding. Any benefits would be limited to small storms only (< 10-20yr ARI).
HEWITTS	8.01	Stream 8 - Hewitts Ave	House raising	Property	Elevate habitable floors above flooding – normally only applicable in low hazard areas and for certain (site and construction) specific dwellings. Owner funded with government assistance. Both benefit and disbenefits need careful consideration. Homes along Hewitts Avenue backing onto rail.	Reduction in above floor flood damages for all events up to that used to set new floor levels.	Potential for less long term disruption to residents. Increased property values.	Does nothing to reduce damages in flood events rarer than the flood used to set floor levels.	N	Estimated low B/C ratio. Alternative measures to be considered which prevent diversion of Woodlands ck. Potential for disruption to residents.

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
HEWITTS	8.01	Stream 8 - Hewitts Ave	Flood proofing	Property	Refers to the design and construction of new buildings with appropriate water resistant materials such that flood damage to the building itself (structural damage), and possibly its contents, is minimised should the building be inundated. Does not reduce social or economic hardship. Only applicable as an adjunct to other measures.	No reduction in flood levels associated with flood proofing only reduction in building flood damages.			N	Estimated low B/C ratio. Alternative measures to be considered which prevent diversion of Woodlands ck. Potential for disruption to residents.
HEWITTS	8.02	Stream 8 - Lawrence Hargrave Dve	Improve pipe drainage (within roadway)	Flood	Replace existing pipe drainage in Lawrence Hargreave Drive with pipes of larger capacity	Provide some flood reduction during small events (up to 10 year ARI)			N	Upgrade to pipe drainage does not target 'stream' flooding. Any benefits would be limited to small storms only (< 10-20yr ARI).
HEWITTS	8.03	Stream 8 - Pass Ave	Improve pipe drainage (within roadway)	Flood	Replace existing pipe drainage in Pass Avenue with pipes of larger capacity	Provide some flood reduction during small events (up to 10 year ARI). Very defined and relatively clear overflow paths in this section reduce the need for pipe system upgrade.			N	Upgrade to pipe drainage does not target 'stream' flooding. Any benefits would be limited to small storms only (< 10-20yr ARI).
SLACKY	1.00	Ocean outfall	Develop opening policy	Flood	Develop Procedure setting out the conditions under which sand should be cleared from the creek outlet	Reduced risk of property inundation during short duration storm events when local drainage system capacity is exceeded. Minimal benefit during large storm events when Slacky Creek is in flood.		Regular opening of sand bars may negatively impact on some species who depend on these backed up areas as habitat. Some assessment of these risks should be undertaken	Y	(SA/SB)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
SLACKY	1.01	Blackall St	Improve culvert capacity	Flood	Amplify the Blackall St culvert by constructing additional culvert cells. Involves the partial excavation and reconstruction of the road	Significant reductions can be expected for the relatively minor events (5 to 10 year events) however for 50 to 100 year events the culverts would need to be expanded significantly (doubled or tripled) to reduce flood levels (road is a control).			N	Currently being carried out
SLACKY	1.02	Footbridge to Blackall St	Flow training wall south bank	Flood	Construct a reinforced wall (1-2 m in height) integrated into boundary fencing at rear of properties to restrict flood waters to a defined floodplain. May be carried out in conjunction with channel excavation in order to compensate for reduced floodplain capacity.	Height of wall can be easily manipulated to prevent flooding for all ARI events. Height chosen will be dependant on measures considered at Hobart St			Y	(SA/SB)
SLACKY	1.02	Footbridge to Blackall St	Improve pipe drainage (within Beach St)	Flood	Install additional piped drainage within Beach St by excavation of a trench and laying down of additional pipes or shallow surface excavation to provide a clear and open path for surcharging stormwater to flow into Slacky Creek.	Reduced risk of minor property inundation during small (2 to 3 times a year) storm events. Minimal benefit during large storm events.			N	Upgrade to pipe drainage does not target 'stream' flooding. Any benefits would be limited to small storms only (< 10-20yr ARI).
SLACKY	1.03	Footbridge	Redesign footbridge	Flood	Remove and replace existing footbridge with a bridge at a higher level (or possibly remove bridge altogether)	May reduce flooding in large events when the bridge becomes blocked. Flooding benefit is limited (Possibly less <0.5m) because of the wide weir length available at overtopping.		Reduced amenity for cyclists using the bicycle track	N	Estimated low B/C ratio. Wide weir available at overtopping therefore benefits would be small.

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SLACKY	1.04	Rail line to footbridge	Channel enlargement and stabilisation	Flood	Reduced the existing steep side slopes by excavating material from banks of creek while still maintaining the existing creek bottom. Creek banks can then be landscaped	Reduction in flood level directly proportional to amount of excavation undertaken. Approximate upper limit given reasonable excavation = 0.5m drop in FL. (25 - 50 houses are potentially effected)			Y	(SA)
SLACKY	1.04	Rail line to footbridge	Formalise overflow path	Flood	Create an overflowpath to safely convey Slacky Ck floodwaters (directed into Beacon Ave from the railway pedestrian underpass). May involve construction of an open channel along the western side of no. 47 Beacon Ave and localised street regrading.	Reduction in shallow flooding of properties along southern side of Beacon Ave. Reduction likely to be limited to small flood events as large events could not be contained within proposed overland flow channel. Shallow flooding may also occur directly from Slacky Ck in larger events.	Improved safety/trafficabilty in Beacon Ave		Y	(SA)
SLACKY	1.05	Rail line	Increase culvert capacity	Flood	Upgrade culverts beneath rail by improving approach hydraulics and constructing an additional culvert immediately to the north of the main south culvert. A debris control structure would also be required as part of the works to ensure the culvert remains clear.	Culvert upgrade will be sufficient to ensure that flood levels are not increased with respect to the existing condition.			Y	(SA)
SLACKY	1.06	Princes Highway to Rail line	Modify retarding basin (increase volume)	Flood	Increase capacity of existing retardation basin possibly by construction of a levee around the basin.	5 to 10 houses are potentially effected by flooding. Current designs should be sufficient to handle 100 year flows (assuming the Hobart St embankment is removed)			N	Estimated low B/C ratio. Low benefit from increased storage during large events/blockage.

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
SLACKY	1.06	Princes Highway to Rail line	Reconfigure basin outlet	Flood	Reconfigure basin outlet to reduce frequency of overtopping in direction of Beacon Ave underpass and increase overtopping capacity in direction of main creek channel.	Reduction in shallow flooding of properties along southern side of Beacon Ave. Benefits likely to be limited to small flood events as large events would need to still utilise the pedestrian underpass.		May reduce the peak attenuation effect of the basin.	Y	(SA/SB)
SLACKY	1.07	Princes Highway	Improve culvert capacity	Flood	Replace or enlarge existing culvert at Highway. Requires excavation through the road. Or Improved inlet configuration.	Reductions in flood level are limited because of the wide available weir length			N	Estimated low B/C ratio. Wide weir avaialbel at overtopping. High cost.
SLACKY	1.07	Princes Highway	Flood access enhancement	Property	Enhance access to and egress from flood prone property – difficult to retrofit best implemented during development/ redevelopment under appropriate development control. Could be incorporated into future Northern Distributor ext.	No reduction in flood levels. Could increase upstream flood levels if not appropriately designed.	Enhanced safety and emergency access/egress		N	Does not target above floor flooding. Estimated low B/C ratio
SLACKY	1.08	Old mine rail to Princes Highway	Channel enlargement and stabilisation	Flood	Excavate material from banks of creek adjacent to Bulli Showground while still maintaining the existing creek bottom. Creek banks can then be landscaped and stabilised.	Houses are generally elevated above the creek therefore flooding benefit is minimal.			Y	(SA)

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SLACKY	1.08	Old mine rail to Princes Highway	Levee east bank	Flood	Construct a low earthen wall (1-2 m in height) at rear of 190 to 194 Princes Highway, Bulli. Levee should also span the rear entrance to the showground.	Height of levee can be easily manipulated to prevent flooding for all ARI events.		Property Devaluation (levee highlights flood risks). Would not be suitable for any scheme that proposes to formalise diversion to Tramway as levee would trap floodwaters and may excacerbate flooding.	Y	(SA)
SLACKY	1.09	Old mine rail	Remove diversion to Tramway (at rail)	Flood	Partially remove the existing old railway embankment (adjacent to Hobart St), and provide controlled diversion structure to optimise diversion into Tramway Ck (i.e split flows in such a way as to minimise cost of flooding downstream.	Will increase flooding in lower Slacky Creek however can minimise flooding of homes in Tramway Ck adjacent to the highway.		Will require consideration of downstream flooding in Slacky Ck (esp. downstream of railway where 25 to 50 homes are at risk).	Y	(SA)
SLACKY	1.09	Old mine rail	Formalise diversion to Tramway (at rail)	Flood	Formalise diversion down Hobart St. Remove culverts between Hobart St and old rail. Re-grade entry to overflow path to provide smooth transition. Remove impediments to diversion.	Reduced flooding of properties in Slacky Ck (d/s of old rail)		Reduced trafficability of Hobart St during flood. No improvement to flooding of homes in Tramway (u/s of main south coast rail). Consolidates existing problem, needs mitigation in Tramway to offset impacts.	Y	(SB)
SLACKY	1.10	Hobart St	Remove diversion to Tramway (at Hobart)	Flood	Eliminate diversion to Tramway Ck by elevating Hobart St pavement (0.5m approx) between the Slacky Ck culverts and the Haig Rd Roundabout	Minimal as areas immediately upstream and downstream of Hobart St are vacant			Y	(SA)

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SLACKY	1.10	Hobart St	Formalise diversion to Tramway (at Hobart)	Flood	Formalise diversion down Hobart St. Re-grade entry to overflow path where required to provide smooth transition. Remove impediments to diversion.	Reduced flooding of properties in Slacky Ck (d/s of old rail)		Reduced trafficability of Hobart St during flood. No improvement to flooding of homes in Tramway (u/s of main south coast rail). Consolidates existing problem, needs mitigation in Tramway to offset impacts.	Y	(SB)
SLACKY	1.11	William St to Hobart St	Channel enlargement and stabilisation	Flood	Restore original capacity of waterway by excavating material from banks of creek while still maintaining the existing creek bottom. Creek banks can then be landscaped.	Minimal. Homes generally elevated above channel. Additional capacity afforded by creek excavation is a relatively small proportion of the total capacity of the creek and its overbanks			Y	(SA/SB)
SLACKY	1.12	William St	Improve culvert capacity	Flood	Upgrade culverts beneath William St by increasing the number of culvert cells (requires property acquisition) or reconfiguring the existing cells to maximise capacity within the existing drainage reserve	At least two homes on the downstream side of the culvert would benefit if improved culvert remained unblocked		Flooding benefit is reduced if culverts block. Existing culverts may have capacity which is under utilised because of blockage.	N	Estimated low B/C ratio. Homes upstream are generally elevated.
SLACKY	1.11	William St to Hobart St	Sediment basin	Flood	Construct a sedment basin upstream of Hobart St to provide for capture of sediment/rocks etc. Typical size of structure may be of the order of 1-2000m^2 by 1m deep, constructed below existing floodplain level.	No direct reduction in flooding however will reduce blockage of downstream culverts and potential for diversion down Hobart St.	Enhanced water quality	Maintenance. Potential adverse impacts on creek ecosystem at site (though this area is degraded by horse grazing). Reduced natural bed load migration. Could be impacted apon by future design of Northern Distibutor extension.	Y	(SA/SB)

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Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
SLACKY	1.13	Rex Ave to William St	Channel enlargement and stabilisation	Flood	Excavation of deposited material to increase the capacity of the original creek. May require some tree removal if significant capacity inceases are sought. Lower half of this zone is already a constructed channel and therefore should not require excavation.	Dependant on whether excavation considered acceptable		Possible loss of existing trees	N	Estimated low B/C ratio. Low benefit, homes generally elevated w.r.t creek.
SLACKY	1.13	Rex Ave to William St	Sediment basin	Flood	Construct a sedment basin upstream of William St to provide for capture of sediment/rocks etc. Typical size of structure may be of the order of 5-1000m^2 by 1m deep, constructed below existing floodway level. Will require removal of existing low flow pipe.	No direct reduction in flooding however will reduce blockage of downstream culverts.	Enhanced water quality	Maintenance. Potential adverse impacts on creek ecosystem at site (though this area is already highly engineered with a low flow pipe). Reduced natural bed load migration.	Y	(SA/SB)
SLACKY	1.12	William St	Formailise Overland Flow Path	Flood	Improve overtopping characteristics of William St culvert through modifications to the culvert inlet and overflow path	Reduced potential for flooding of two homes on downsream side of culvert			Y	(SA/SB)
SLACKY	1.13	Rex Ave to William St	Restore pre-Aug 98 capacity	Flood	Restore original capacity of waterway by removing material deposited during Aug 98 event (already partially carried out)	Restore flood levels to pre Aug 98. No reduction in flood levels relative to these levels. It is noted that many properties in this zone are elevated with respect to creek.	Reduced bed load available for future transport downstream therefore potentially reduced blockage in future	Disruption to residents, removal of trees.	Y	(SA/SB)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
SLACKY	1.14	National Ave to Rex Ave	Channel stabilisation	Flood	Protect creek banks from further scour and erosion by excavating to reduce bank batters (reduce bank collapse) and placing rock in appropriate positions (eg outside of bends, toe of batter) to reduce bank erosion.	None, however it will prevent loss of property through gradual stream migration and reduce downstream deposition			N	Does not target 'stream' flooding. Homes generally elevated w.r.t creek
SLACKY	1.14	National Ave to Rex Ave	Coarse debris trap	Flood	Coarse 'bollard' type debris trap to reduce blockage of William St culvert	Reduced flooding at William St culvert		Maintenance	Y	(SA/SB)
SLACKY	2.01	Southern Tributary - minor access rd	Improve culvert capacity	Flood	Upgrade culvert capacity by increasing the number of culvert cells or excavating to reduce overtopping level	None, No houses upstream or downstream of culvert. However upgrade or complete removal could reduce diversion down Hobart St particularly if the downstream embankment (Zone 1.9) is removed.		Only of real benefit if embankment removed.	N	To be incorporated into designs for future development
SLACKY	2.02	Southern Tributary - mine basin to minor access rd	Channel enlargement and stabilisation	Flood	Excavate material from banks of creek while still maintaining the existing creek bottom. Creek banks can then be landscaped and stabilised.	No houses in the immediate area although measure may reduce the possibility of overtopping and diversion down Hobart St.			N	To be incorporated into designs for future development
SLACKY	2.03	Southern Tributary - mine basin	Retarding basin	Flood	Optimise the existing informal retardation basin (formed by the construction of the railway embankment at the old Bulli mine) Optimisation will typically include: outlet structure upgrading improvment of embankment stability (if required); reduction in overtopping level and construction of spillway. Basin outlet to incorporate coarse debris trap.	Reduction in Peak flows for lower Slacky Ck. Reduced diversion into Tramway Creek. Sediment trap function.			Y	(SA/SB)

APPENDIX 3.1

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
SLACKY	2.03	Southern Tributary - mine basin	Debris trap	Flood	Construct debris trap to minimise downstream blockage and deposition. Debris traps can take the form of a sedimentation basin (reduces sediment load/rocks etc) and or a steel mesh type screen. Final selection dependant on land availability.	Could assist in preventing blockage at d/s culvert. Could therefore reduce diversion down Hobart St.		Really only assists in preventing blockage of one culvert (The embankment culvert which most likely will be removed)	N	To be incorporated into designs for retarding basin (to be considered in schemes SA and SB
TRAMWAY	3.01	Ocean outfall	Develop opening policy	Flood	Develop Procedure setting out the conditions under which sand should be cleared from the creek outlet	Minimal benefit as there are currently no homes immediately upstream.		Regular opening of sand bars may negatively impact on some species who depend on the Tramway Creek wetlands as habitat. Some assessment of these risks should be undertaken.	Y	(TA1/TA2/TB1/TB2/TB3)
TRAMWAY	3.02	Rail line to Tramway Creek Wetlands	Channel enlargement and stabilisation	Flood	Excavate material from banks of creek while still maintaining the existing creek bottom. Creek banks can then be landscaped and stabilised.	Currently no houses in the immediate area.			N	To be incorporated into designs for future development (by Stocklands)
TRAMWAY	3.03	Rail line	Replace culvert with bridge or high flow culvert/underpass (>6m span)	Flood	Increase conveyance through rail by constructing an underpass (greater than 6m diagonal width).	Reduce flooding of homes in Allenby Pde		Increased flows through downstream property will require increased trunk drainage requirements	Y	(TA1/TB1)
TRAMWAY	3.03	Rail line	Debris control structure	Flood	Provide a debris control structure immediately upstream of the rail to reduce the likelihood of culvert blockage	Reduction in flooding for up to 10 properties upstream of rail which would currently be inundated if culvert blocked.		Access to trap could be difficult	Y	(TA2/TB2)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
TRAMWAY	3.04	Princes Highway to Rail line	Voluntary purchase offer	Property	Acquire property in areas of high hazard where it is impractical or uneconomic to mitigate flooding of existing properties. Property(s) in Allenby Pde (1a,1b,1c,15,15a,17??).	Elimination of flooding risk for properties aqcuired. Potential benefits to Slacky Ck where flooding could be significantly reduced by formalisation of existing diversion	Removal of continuing flood risk		Y	(TB1/TB2/TB3)
TRAMWAY	3.04 a	Princes Highway to Rail line	Voluntary purchase offer	Property	Acquire property in areas of high hazard where it is impractical or uneconomic to mitigate flooding of existing properties. Property(s) along Princes H'way opposite Hobart St intersection (no.s 169?-177?).	Elimination of flooding risk for properties aqcuired. Potential benefits to Slacky Ck where flooding could be significantly reduced by formalisation of existing diversion	Removal of continuing flood risk		Y	(TB1/TB2/TB3)
TRAMWAY	3.04	Princes Highway to Rail line	Flood proofing	Property	Refers to the design and construction of new buildings with appropriate water resistant materials such that flood damage to the building itself (structural damage), and possibly its contents, is minimised should the building be inundated. Does not reduce social or economic hardship. Only applicable as an adjunct to other measures.	No reduction in flood levels associated with flood proofing only reduction in building flood damages.			Y	(TB3)
TRAMWAY	3.04	Princes Highway to Rail line	Formalise overflow path	Flood	Provide overflow path along Hobart st and through properties opposite highway intersection to link Hobart St diversion to Tramway Ck. May involve creation of easement, modifications to footpath, fencing, acquisition of property.	Limited to those properties which are in direct path of current overflows	May reduce backwater onto highway therby limiting flow depths (but not velocity).	Not worth pursuing if it is resolved to remove diversion into Tramway Ck.	Y	(TB1/TB2/TB3)

APPENDIX 3.1

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
TRAMWAY	3.05	Princes Highway	Improve pipe drainage (within roadway)	Flood	Upgrade Prince Highway culvert capacity by increasing the number of culvert cells	Limited reduction in flooding as upstream system is piped			N	Upgrade to pipe drainage does not target 'stream' flooding. Any benefits would be limited to small storms only (< 10-20yr ARI).
TRAMWAY	3.05	Princes Highway	Flood access enhance ment	Property	Enhance access to and egress from flood prone property – difficult to retrofit best implemented during development/ redevelopment under appropriate development control. Could be incorporated into future Northern Distributor ext.	No reduction in flood levels. Could increase upstream flood levels if not appropriately designed.	Enhanced safety and emergency access/egress		N	Estimated low B/C ratio. Does not target above floor flooding
TRAMWAY	3.06	Haig Rd to Princes Highway	Improve pipe drainage (within roadway)	Flood	Replace existing pipe drainage in the vicinity of the school with pipes of larger capacity	Limited flooding benefit (and restricted to events of low ARI). The upstream catchment is relatively small therefore flooding to great depth is unlikely.			N	Upgrade to pipe drainage does not target 'stream' flooding. Any benefits would be limited to small storms only (< 10-20yr ARI).
TRAMWAY	3.07	William St	Improve pipe drainage (within roadway)	Flood	Replace existing pipe drainage within William Street with pipes of larger capacity	Limited reduction in flooding as upstream system is piped and catchment is small.			N	Upgrade to pipe drainage does not target 'stream' flooding. Any benefits would be limited to small storms only (< 10-20yr ARI).
TRAMWAY	4.01	Northern Tributary - Cookson Site	Channel enlargem ent and stabilisati on	Flood	Restore original capacity of water way by excavating material from banks of creek while still maintaining the existing creek bottom. Creek banks can then be landscaped.	Currently no houses in the immediate area.			N	To be incorporated into designs for future development (by Stocklands)
TRAMWAY	4.02	Northern Tributary - Rail line	Improve culvert capacity	Flood	Upgrade culvert beneath rail by the addition of extra pipes.	May reduce flooding in large events when the culvert becomes partially blocked. Houses are generally elevated.			N	Estimated low B/C ratio. Very low benefit as houses are elevated above rail line

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
WOODLANDS	2.01 a	Near Sewer Pumping Station	Channel enlargement and stabilisation	Flood	Channel improvement works to limit flooding of SPS	Reduced flooding of SPS			Y	(WA/WB)
WOODLANDS	2.02	Stocklands Site	Channel enlargement and stabilisation	Flood	Excavate channel to improve its capacity and alignment. Landscaping/ erosion protection also required to establish a permanent watercourse	Minimal as the adjoining property is currently vacant and flows through site are minimised due to the railway culvert blocking.		Potential loss of development land	N	To be incorporated into designs for future development (by Stocklands)
WOODLANDS	2.03	Rail line	Partial diversion to Hewitts Ck (formalise flow path)	Flood	Formalise diversion between Woodlands and Hewitts upstream of rail by constructing a large open drainage channel along the western edge of the railway easement. May require a flow training wall to direct flow into proposed diversion channel	Assuming all available railway land could be used then the channel could significantly reduce flooding (approximately 13 properties by up to a metre).	May reduce need to construct (at considerable expense) a new culvert at railway.	Loss of land for possible future construction of additional tracks. Will require negotiations with railway authorities.	N	Consolidates existing problem in Hewitts Ave and Corbett Ave. Estimated low B/C ratio.
WOODLANDS	2.03	Rail line	Replace culvert with bridge or high flow culvert/underpass (>6m span)	Flood	Increase conveyance through rail by constructing an underpass (greater than 6m diagonal width) which could be used to reduce diversion to Hewitts Creek.	Reduce flooding of homes in Hewitts Ave (Contingent on safety ramp also being improved/reconfigured and flow training wall constructed).	Reduced flow in lower Hewitts Creek (only if Woodlands is re-diverted).	Increased flows through downstream property will require increased trunk drainage requirements	Y	(WA)
WOODLANDS	2.04	Princes Highway to Rail line	Modify safety ramp (provide sag opposite ck)	Flood	Reconfigure safety ramp so as to prevent/minimise diversion through properties in Hewitts Ave.	Possible reduction in flooding of homes in Hewitts Ave (Contingent on railway culvert also being improved/basin upstream).	Reduced flow in Hewitts Creek (only if Woodlands is re-diverted). Reduces need to amplify culverts	Could increase backwater flooding of Lawrence Hargreave Drive, reducing accessibility during flooding.	Y	(WA/WB)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
WOODLANDS	2.04	Princes Highway to Rail line	Improve culvert capacity	Flood	Improve capacity of safety ramp culvert by constructing additional culvert cells.	Possible reduction in flooding of homes in Hewitts Ave (Contingent on railway culvert also being improved).	Reduced flow in Hewitts Creek (only if Woodlands is re-diverted).	Increased flows through downstream property will require increased trunk drainage requirements	N	Estimated low B/C ratio. Modifications to safety ramp to provide for overtopping is considered significantly more feasible in terms of cost and performance
WOODLANDS	2.04	Princes Highway to Rail line	Levee north bank	Flood	Provide levee along northern bank (just south of properties in Hewitts Ave) to reduce diversion to Hewitts Ave.	Large reduction in flooding of homes in Hewitts Ave	Reduced flow through Corbett Ave (if carried out in conjunction with re-diversion of Woodlands Creek.	Increased damage to rail line due to overtopping.	Y	(WA/WB)
WOODLANDS	2.05	Princes Highway	Debris trap	Flood	Construct sloping grate debris trap above Prince Highway to capture and store debris/boulders and reduce blockage of downstream culverts.	Reduced flooding of properties in Hewitts Avenue and the blockage of culverts at the safety ramp/ railway.	Reduces need to amplify downstream culverts.	Maintenance would be high as trap is on a large creek	N	Construction unfeasible. High debris load. Does not target sediment which is a significant proportion of the debris load from the catchment upstream
WOODLANDS	2.05	Princes Highway	Sediment basin/debris control structure	Flood	Construct a sedment basin/debris control structure upstream of LHD to provide for capture of sediment/rocks etc. Typical size of structure may be of the order of 2 - 3000m^2 by 1m deep, constructed below existing floodplain level. Floating debris trap also to be incorporated.	No direct reduction in flooding however will reduce blockage of downstream culverts and potential for diversion to Hewitts Ave.	Enhanced water quality	Maintenance. Potential adverse impacts on creek ecosystem at site (though this area is degraded by horse grazing). Reduced natural bed load migration (though this has already most likely ceased due to culvert crossings). Could be impacted apon by future design of Northern Distibutor extension.	Y	(WA/WB)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
WOODLANDS	2.05	Princes Highway	Flood access enhance ment	Property	Enhance access to and egress from flood prone property – difficult to retrofit best implemented during development/ redevelopment under appropriate development control. Could be incorporated into future Northern Distributor ext.	No reduction in flood levels. Could increase upstream flood levels if not appropriately designed.	Enhanced safety and emergency access/egress		N	Does not target above floor flooding. Proposed northern distributor will most likely incorporate provision for enhanced access.
WOODLANDS	2.05	Princes Highway	Improve culvert capacity	Flood	Improve capacity by constructing additional culvert cells or improving inlet configuration. Would need to be greater than 6m diagonal width to prevent blockage.	Reduce property flooding upstream of culvert. No direct reduction in floor level flooding through would assist in minimising the diversion to Hewitts Ck	Improved emergency access/egress	Inconvenience to traffic during construction	N	Does not target above floor flooding. Estimated low B/C ratio.
WOODLANDS	2.05	Princes Highway	Retarding basin	Flood	Construct a large holding basin above the Princes Highway which captures runoff and contains it for a sufficiently long period of time to reduce the peak flowrate downstream of this point. A sediment basin and debris control structure would also need to be incorporated into any scheme which includes this measure.	No existing properties downstream of the basin on Woodlands Ck. Would provide some benefit to properties in Hewitts Avenue and Lower Hewitts Ck if current creek/diversion is retained. No benefit if Woodlands Ck is re-diverted at Corbett Ave.	Reduces need to amplify railway culverts.	Could be impacted apon by future design of Northern Distibutor extension.	Y	(WB)
THOMAS GIBSON	1.00	Ocean outfall - North Arm	Develop opening policy	Flood	Develop Procedure setting out the conditions under which sand should be cleared from the creek outlet	Small reduction in risk of property inundation during short duration storm events. Minimal benefit during large storm events as outlet is likely to have scoured prior to peak.		Regular opening of sand bars may negatively impact on some species who depend on these backed up areas as habitat. Some assessment of these risks should be undertaken	Y	(TGA/TGB)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
THOMAS GIBSON	1.00	Ocean outfall - North Arm	Lower south bank	Flood	Lower a section of the southern bank of Flanagans Ck and public reserve area by excavating and removing between 0.5 and 1.0m of material (to match adjoining low point in road). Provide scour protection along bank. Restoration of riparian corridor/bank vegetation.	Will reduce ponding of floodwaters within large area around The Esplanade and adjacent public reserve. Flood level reduction expected to be up to 0.5m. Should be carried out in conjunction with expanded floodway adjacent to The Esplanade.	May be able to reduce potential for Flanagans Creek to spill into Thomas Gibson Creek		Y	(TGA/TGB)
THOMAS GIBSON	1.01	The Esplanade North Arm	Expand floodway	Flood	Expand existing floodway along The Esplanade by deepening and widening the floodway adjoining the eastern side of the roadway.	Will reduce ponding of floodwaters within large area around The Esplanade and adjacent public reserve. Flood level reduction expected to be up to 0.5m. Needs to be done in conjunction with lowering of the southern bank.	Improved access along The Esplanade		Y	(TGB)
THOMAS GIBSON	1.01	The Esplanade North Arm	Upgrade Pipe Drainage	Flood	Install a large piped drainage system with multiple inlets to augment capacity of existing twin 750mm dia pipes which drain the low-lying area around The Esplanade. Achieve capacity of 50 to 100 yr flow.	Reduced flooding of approx 8 properties by up to 0.5m.	Improved flood access along The Esplanade		Y	(TGA)
THOMAS GIBSON	1.02	Cliff Pde - North Arm							N	No site specific non-structural measures for this zone. (though benefits from other works)
THOMAS GIBSON	1.03	Macauley St to Cliff Pde - North Arm	Upgrade pipe drainage	Flood	Install pipe drainage within Bath St (within roadway) and connect into proposed pipe drainage upgrade along The Esplanade. Pipes to be designed for 10 -20 year ARI capacity with multiple inlets.	Reduced yard flooding of all properties along south side of Bath St. Reduction of up to 0.5m expected for events of up to 20yr ARI with a smaller reduction for larger events.	Reduced gutter flows in Bath St		Y	(TGA)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
THOMAS GIBSON	1.03	Macauley St to Cliff Pde - North Arm	Lower roadway	Flood	Reconstruct Bath St at a lower level to form an overflow path, road lowering of approximately 280m of roadway by up to 0.5m.	Reduced yard flooding of all properties along south side of Bath St.		Reduced safety along Bath St during flood due to greater flow depth	N	Estimated Low B/C ratio, highly disruptive to existing residents
THOMAS GIBSON	1.03	Macauley St to Cliff Pde - North Arm	Overland flow path	Flood	Construct overflow path along rear of properties on south side of Bath St including provision of flood compatible fencing, relocation of structures for distance of say 5-10m from rear boundary.	Reduced yard flooding of all properties along south side of Bath St.		Reduced privacy where fencing is modified to be open type.	N	To be incorporated into planning controls for zone
THOMAS GIBSON	1.03	Macauley St to Cliff Pde - North Arm	Raise Kerb/Driveway	Flood	Raise the kerb level and lift driveways along the south side of Bath St opposite 25 and 27 Bath St to afford additional flood protection and encourage flows down Bath Street.	Reduced yard flooding of all properties along south side of Bath St.		Reduced trafficabilty of driveway entrances. Reduced safety along Bath St during flood due to greater flow depth.	Y	(TGA/TGB)
THOMAS GIBSON	1.04	Macauley St - North Arm	Investigate culvert inlet improvements	Flood	Investigate possibility of upgrading the existing culvert inlet to reduce entrance loss and depth of ponding over inlet	Small reduction in flood level for properties in Bath St and in the vicinity of the culvert inlet.			Y	(TGA/TGB)
THOMAS GIBSON	1.05	LHD to Macauley St	Upgrade pipe drainage	Flood	Upgrade piped drainage through commercial area and connect into culvert at Macauley St. Provide multiple inlets at upstream end and surcharge pit at downstream end.	Reduced flooding of approx 5 commercial properties at corner of Raymond Rd and LHD.	Improved flood access along Lawrence Hargrave Drive		N	Estimated Low B/C ratio, does not target residential damages
THOMAS GIBSON	1.06	Lawrence Hargrave Dve - North Arm	Overland flow path	Flood	Expand existing overflow path that follows pedestrian link between King St carpark and LHD. May involve partial reconstruction of retaining walls alongside footpath and/or provision of underground piped drainage.	Reduced flooding of commercial properties along western side of LHD opposite King St carpark.		Reduced safety allong pedestrian accessway during flood due to greater flow depth.	N	Does not target residential damages

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THOMAS GIBSON	1.07	Ocean outfall - North Arm	Overland flow path	Flood	Regrade King St carpark and provide flow training walls along rear of commercial buildings	Large reduction in flooding of affected properties (almost total protection could be afforded depending on extent of works		Ease of pedestrian/loading access reduced	N	Does not target residential damages
THOMAS GIBSON	1.08	Rail Line - North Arm	Investigate culvert inlet improvements	Flood	Investigate possibility of upgrading the existing culvert inlet to enhance capacity.	Small reduction in potential for overtopping of railway and subsequent flooding of commercial area downstream of rail. Benefit limited to maximum capacity of rail culvert.	Reduced overtopping of rail		Y	(TGA/TGB)
THOMAS GIBSON	1.08	Rail Line - North Arm	Debris Control Structure	Flood	Construct sloping grate debris trap/holding basin to capture and store debris and thereby reduce blockages of the downstream culvert.	Flood level reduction upstream is limited (less <0.5m) because of the wide weir length available at overtopping at rail. Debris trap would reduce potential for blockage and subsequent surface flow through commercial area downstream.		Increased maintenance costs	Y	(TGA/TGB)
THOMAS GIBSON	1.09	Church St to Rail Line - North Arm							N	No site specific non-structural measures for this zone.
THOMAS GIBSON	1.10	Church St - North Arm							N	No site specific non-structural measures for this zone.
THOMAS GIBSON	1.11	Sea Foam Ave to Church Street- North Arm	Overland flow path	Flood	Provide overflow path through school site including relocation of structures, provision of flood compatible fencing	Reduced flooding of school site			N	Estimated low B/C ratio. Limited number of structures within existing flow path

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THOMAS GIBSON	1.12	Sea Foam Ave - North Arm	Raise Kerb/Driveway	Flood	Raise the kerb level and lift driveways along the south side of Sea Foam Ave to increase the capacity of the roadway as an overflow path	Reduced yard flooding of all properties along south side of Sea Foam Ave.		Reduced trafficabilty of driveway entrances. Reduced safety along Sea Foam Ave during flood due to greater flow depth.	Y	(TGB)
THOMAS GIBSON	1.13	Phillip St to Sea Foam Ave - North Arm	Culvert and Overland flow path	Flood	Upgrade the existing inlet upstream of Phillip Street and direct into a new (large) pipe system (50-100 yr ARI) along eastern edge of Phillip St with multiple inlets to divert flow around properties at western end of The Lookout. Provide overflow path in the form of an open lined channel with regular drop structures along the northern side of the unformed section of Sea Foam Ave. Provide energy dissipation at downstream end (before discharge back into creek immediately upstream of Sea Foam Ave).	Reduced flooding (for events up to 50-100 yr ARI) for dwellings along southern side of The Lookout.			Y	(TGB)
THOMAS GIBSON	1.13	Phillip St to Sea Foam Ave - North Arm	Upgrade Pipe Drainage	Flood	Upgrade the existing inlet upstream of Phillip Street and direct into an upgraded pipe drainage system within The Lookout to divert flow away from Sea Foam Avenue. Pipes to be designed for 10 year ARI capacity.	Reduced flooding (for events up to 10 yr ARI) for 4 (approx) dwellings along southern side of The Lookout (at western end).	Reduced gutter flows for length of street		Y	(TGA)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
THOMAS GIBSON	1.13	Phillip St to Sea Foam Ave - North Arm	Re-shape roadway to improve capacity	Flood	Re-shape the roadway possibly by lowering the northern edge and providing a one way cross fall to the north.	Increased ability for the roadway to accept flows in excess of the pipe system capacity. Design to provide sufficient capacity for all events up to the 100 year event		Reduced trafficabilty of driveway entrances along north side. Reduced safety along The Lookout during flood due to greater flow depth.	Y	(TGA)
THOMAS GIBSON	1.14	Phillip St - North Arm							N	No site specific non-structural measures for this zone. (though benefits from other works)
THOMAS GIBSON	1.15	Mt Gilead Rd to Phillip St - North Arm	Upgrade Pipe Drainage	Flood	Upgrade pipe drainage within Mt Gilead Rd. Pipes to be designed for 10 year ARI capacity and connected into Phillip St/Sea Foam Ave pipe drainage	Reduced yard flooding (for events up to 10 yr ARI) for properties along south side of Mt Gilead Rd. Catchment is small at this location therefore benefit is also likely to be small.	Reduced gutter flows for length of street		N	Estimated low B/C ratio. Small catchment and limited damages in this area
THOMAS GIBSON	2.01	Raymond Rd to Macauley St	Overland flow path	Flood	Ensure overflow path along rear of properties is maintained. May involve repositioning of structures, increase of existing channel capacity, modifications to fencing.	Small (<0.5m) reduction in flood levels. Floor levels are generally elevated with respect to flood levels so reduction in damages is likely to be small.			N	To be incorporated into planning controls for zone
THOMAS GIBSON	2.02	Raymond Rd							N	No site specific non-structural measures for this zone. (though benefits from other works)
THOMAS GIBSON	2.02 a	Station St diversion - D/S of Macauley	Overland flow path	Flood	Ensure overflow path between end of Station St and creek is maintained. May involve repositioning of structures, lowering of driveway/kerb, modifications to fencing.	Reduce yard (and possibly floor) flooding of approximately 6 properties immediately downstream of Macauley St in events greater than 10 yr ARI only when Station St diversion occurs.		Reduced safety along accessway during flood due to greater flow depth	N	Reduced safety along accessway and road upstream.

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THOMAS GIBSON	2.03	Rail Line to Raymond Rd	Check condition and rehabilitate pipe drainage	Flood	Conduct a condition survey of main pipe system and rehabilitate any sections of pipe which are identified as being in need of repair	Reduce the likelihood of the pipe system failing when running under pressure.			Y	(TGA/TGB)
THOMAS GIBSON	2.03 a	Station St diversion - Station St	Overland flow path	Flood	Increase capacity of diversion path by increasing size of table drain along southern edge of roadway.	Reduce shallow flooding of front yards belonging to 7 or 8 properties along the northern side of Station St in events greater than 10 year ARI when Station St diversion occurs.		Reduced carparking along southern side of street	N	Reduced safety along road compared with other measures for this zone (I.e. divert flow into Thomas Gibson park)
THOMAS GIBSON	2.03 a	Station St diversion - Station St	Overland flow path	Flood	Construct new overflow path linking upstream end of Station St with proposed detention basin at Thomas Gibson Park. May require regrading of Station St to encourage flows into (and then across) rugby field. May include bunding along northern edge of field.	Reduced diversion of flow down Station St in larger events (>10 yr ARI)		Increase in flow down Thomas Gibson South Arm (though this will be offset through removal of diversion from Hewitts Ck)	Y	(TGA/TGB)
THOMAS GIBSON	2.04	Rail Line	Investigate culvert inlet improvements	Flood	Investigate possibility of upgrading the existing culvert inlet to enhance capacity and reduce depth of ponding upstream.	Small reduction in flood level upstream of rail line as a result of increase culvert capacity. Small reduction in diversion down Station St		Increased pressure in pipe system (Zone 2.03)	Y	(TGA/TGB)
THOMAS GIBSON	2.04 a	Station St diversion - Rail Line	Low profile culvert	Flood	Construct low profile culvert beneath rail (immediately underneath ballast level) at northern edge of rail platform. Construct flow path connecting culverts to Station St (or alternative) overflow path	Reduced level of ponding during large flood (>10 year ARI) in commercial area (west of train station and around RSL club).			N	Does not target residential above floor damages. Low benefit cost.
THOMAS GIBSON	2.05	LHD to Rail Line							N	No site specific non-structural measures for this zone. (though benefits from other works)

APPENDIX 3.1

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
THOMAS GIBSON	2.06	Lawrence Hargrave Drive							N	No site specific non-structural measures for this zone. (though benefits from other works)
THOMAS GIBSON	2.07	Phillip St to LHD	Overflow path	Flood	Construct overflow path between Phillip St and Lawrence Hargrave Drive through the Council Carpark and vacant land to the east. Work to include raising of kerb and driveway entrance to residential properties along eastern side of Phillip St and possible lowering of Phillip St driveway entrance to WCC carpark.	Reduced shallow flooding of approx 4 residential properties along east side of Phillip St (in large 5-10 yr ARI events only)		Reduced safety along carpark accessway during flood.	Y	(TGA/TGB)
THOMAS GIBSON	2.07	Phillip St to LHD	Overland flow path	Flood	Construct overflow path along Phillip St and LHD. May need to raise kerb and driveways along Phillip St to prevent flows from spilling into properties along eastern side of Phillip St.	Reduced shallow flooding of approx 4 residential properties along east side of Phillip St (in large 5-10 yr ARI events only)		Reduced safety along Lawrence Hargrave Drive during flood.	N	Reduced safety along road compared with other measures for this zone (I.e. divert flow into council car park)
THOMAS GIBSON	2.08	Phillip St							N	No site specific non-structural measures for this zone. (though benefits from other works)
THOMAS GIBSON	2.09	Virginia Tce to Phillip St	Overland flow path	Flood	Ensure overflow path along through properties is maintained. May involve repositioning of structures, modifications to fencing.	Reduced yard flooding of approximately 10 properties. Catchment is small at this location therefore benefit is also likely to be small. Benefit limited to events larger than capacity of existing pipe system (say 5-10 yr).		Reduced privacy where fencing is modified to be open type.	N	To be incorporated into planning controls for zone
THOMAS GIBSON	2.10	Virginia Tce							N	No site specific non-structural measures for this zone.

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
THOMAS GIBSON	2.11	Mason Ave to Virginia Tce	Upgrade pipe drainage	Flood	Upgrade pipe drainage within Mason St and connect into creek at Virginia Terrace crossing. Pipes to be designed for 5 to 10 year ARI capacity	Reduced yard flooding (in small frequent events) of approximately 7 properties. Catchment is small at this location therefore benefit is also likely to be small.	Reduced gutter flows in Mason St and Virginia Tce		N	Estimated low B/C ratio. Small catchment and limited damages in this area
THOMAS GIBSON	3.00	Ocean outfall - South Arm	Develop opening policy	Flood	Develop Procedure setting out the conditions under which sand should be cleared from the creek outlet	Small reduction in risk of property inundation during short duration storm events. Minimal benefit during large storm events as outlet is likely to have scoured prior to peak. Benefit is reduced in this location as Cliff Pde is a hydraulic control.		Regular opening of sand bars may negatively impact on some species who depend on these backed up areas as habitat. Some assessment of these risks should be undertaken	Y	(TGA/TGB)
THOMAS GIBSON	3.00	Ocean outfall - South Arm	Reduce diversion to north	Flood	Lower northern bank and public reserve area beyond by excavating and removing between 0.5 and 1.0m of material. Create swale to direct flows back into creek. Provide one-way cross-fall on Cliff Pde and remove eastern kerb to direct overflows into swale.	Lowering will assist with retaining flows (which overtop the road) within the south arm and reduce the amount of diversion to the north along Cliff Pde.			Y	(TGA/TGB)
THOMAS GIBSON	3.00 a	Cliff Pde diversion							N	No site specific non-structural measures for this zone. (though benefits from other works)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
THOMAS GIBSON	3.01	Cliff Pde	Improve culvert capacity	Flood	Amplify the Cliff Pde culvert by constructing additional culvert cells. Involves the partial excavation and reconstruction of the road	Significant reductions can be expected for the relatively minor events (5 to 10 year events) however for 50 to 100 year events the culverts would need to be expanded significantly (doubled or tripled) to reduce flood levels (road is a control). Debris control structure also required to reduce blockage.	Improved flood access for residents south of creek crossing		Y	(TGA/TGB)
THOMAS GIBSON	3.02	Macauley St to Cliff Pde to Blackall St	Modify Existing Flood Gate	Flood	Carry out modifications to the existing flood gate (on fence upstream of Cliff Pde) to reduce impediment to flow. Would involve re-building the fence for say 10-20m using a more flood compatible type of fencing and provision of a larger flood gate.	May slightly reduce flood levels upstream (say 0.3m). Level reduction limited to expected afflux at fence. Existing fence is unlikely to maintain FSL differential of much more than 0.3m.		Reduced privacy for landowners upstream as fencing would be open style to allow floodwaters to pass through	Y	(TGA/TGB)
THOMAS GIBSON	3.02	Macauley St to Cliff Pde	Debris Control Structure	Flood	Construct sloping grate debris trap/holding basin to capture and store debris and thereby reduce blockages of the downstream culvert.	Flood level reduction is limited (Possibly less <0.5m) because of the wide weir length available at overtopping at culvert downstream. Would reduce diversion of flow to the north along Cliff Pde.		Increased maintenance costs	Y	(TGA/TGB)
THOMAS GIBSON	3.02	Macauley St to Cliff Pde	Overland Flowpath	Flood	Provide a clear passage for floodwaters which exceed the capacity of the Macauley St culvert to pass through properties downstream of the road embankment. May involve modifications to driveways, repositioning of structures, increase of existing channel capacity, modifications to fencing.	Improved saftey within dwelling		Reduced safety within overflow path due to greater flow depth	Y	(TGA/TGB)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
THOMAS GIBSON	3.03	Macauley St	Improve culvert capacity	Flood	Amplify the Macauley St culvert by constructing additional culvert cells. Involves the partial excavation and reconstruction of the road, and works within properties downstream to dissipate energy and provide controlled transition into channel flow.	Significant reductions can be expected for the relatively minor events (5 to 10 year events) however for 50 to 100 year events the culverts would need to be expanded significantly (doubled or tripled) to reduce flood levels (road is a control).	Improved flood access for residents south of creek crossing		N	Limited opportunity for culvert upgrade due to site constraints
THOMAS GIBSON	3.03	Macauley St	Modify culvert inlet	Flood	Modify the inlet to the existing culvert to enhance its capacity (e.g. provision of tapered inlet).	Flood level reduction anticipated to be small and limited to events of between 5 and 10 year ARI. Will help to reduce amount of flow overtopping road and flowing uncontrolled across properties downstream of Macauley St.			Y	(TGA/TGB)
THOMAS GIBSON	3.04	Thomas Gibson park outlet to Macauley St							N	No site specific non-structural measures for this zone. (though benefits from other works)
THOMAS GIBSON	3.05	Thomas Gibson Park outlet	Formalise existing detention basin	Flood	Modify the existing outlet to the informal basin structure at Thomas Gibson Park to improve the basins detention characteristics. May involve increasing the height of the embankment, modifications to the pipe outlet and improvements to spillway to allow controlled discharge up to PMF. Obtain formal easement over site and add to Council's register of detention basins.	Significant attenuation of flow (and therefore reductions in flood level) anticipated due to the volume of storage available.			Y	(TGA/TGB)

Catchment	Zone	Reach/ Structure	Measure Type	Modification Category	Measure Description	Potential Flooding Benefit	Other Benefits	Other Costs	Include into Scheme (Y/N)	Reason for exclusion OR (Scheme into which measure has been included)
THOMAS GIBSON	3.05	Thomas Gibson Park outlet	Debris control structure	Flood	Construct sloping grate debris trap/holding basin to capture and store debris and thereby reduce blockages of the proposed basin outlet.	Debris trap would trap debris and reduce potential for blockage at downstream structures (e.g. Macauley St)		Increased maintenance costs	Y	(TGA/TGB)
THOMAS GIBSON	3.06	Thomas Gibson Park							N	No site specific non-structural measures for this zone. (though benefits from other works)
THOMAS GIBSON	3.07	Rail line							N	No site specific non-structural measures for this zone. (though benefits from other works)
THOMAS GIBSON	3.08	LHD to Rail Line							N	No site specific non-structural measures for this zone. (though benefits from other works)
THOMAS GIBSON	3.09	Lawrence Hargrave Drive							N	No site specific non-structural measures for this zone. (though benefits from other works)
THOMAS GIBSON	3.10	Lachlan St to LHD	Overland flow path	Flood	Construct overflow path to re-divert floodwaters (diverted from Hewitts Creek into Thomas Gibson Creek) to re-enter Hewitts Creek. Channel to be excavated through small ridge SW of church site. Channel size sufficient to redirect all flows back into Hewitts Creek.	Significant reduction in flow and flood level during large events (>100 yr ARI)		Flow in Hewitts Creek is increased during larger events. Direct impact on property required for overflow path.	Y	(TGA/TGB)

APPENDIX 4

RISK MANAGEMENT SCHEME DESCRIPTIONS

APPENDIX

Slacky/Tramway 4.1

DO NOT SCALE IF IN DOUBT ASK

HEWITTS CREEK

WOODLANDS CREEK

TRAMWAY CREEK

SLACKY CREEK (Upper)

SLACKY CREEK (Lower)

WHARTONS CREEK

CATCHMENT BOUNDARY SHOWN THUS

RESTORE PRE AUG '98 CAPACITY SCHEME SA / SB

FORMALISE OVERLAND FLOW PATH OVER WILLIAM STREET CULVERT SCHEME SA / SB

FILL GABION CHANNEL

REOPEN TRAMWAY / WOODLANDS DIVERSION SCHEME WA1 / WA2

OPENING POLICY

OPENING POLICY

SEDIMENT BASIN SCHEME SA / SB

FORMALISE DIVERSION TO TRAMWAY OVERFLOW PATH 350m SCHEME TB1 / TB2 / TB3

CHANNEL ENLARGED & STABILISED 200m SCHEME SA

STABILISE OLD MINE RAIL EMBANKMENT & ADD DEBRIS TRAP SCHEME SA / SB

ROCK LINED SPILLWAY SCHEME SA / SB

MODIFY CULVERT SCHEME SA / SB

HIGH FLOW CULVERT SCHEMES TB1 / TB2 & TB3

REMOVE DIVERSION TO TRAMWAY AT OLD MINE RAIL EMBANKMENT SCHEME SA

CHANNEL ENLARGEMENT WITH ROCK LINNING OF BANKS – 440m SCHEME SA

RESHAPE CULVERT BASE & DIRECT FLOW TO NEW CHANNEL SCHEME SA

RECONFIGURE BASIN OUTLET SCHEME SA / SB

INCREASE CULVERT CAPACITY SCHEME SA

CHANNEL ENLARGEMENT 500m SCHEME SA

ROCK LINED ARMOUR 10m EACH SIDE OF FOOTBRIDGE SCHEME SA

1.5m LEVEE 450m LENGTH SCHEME SA

OPENING POLICY

1,200,500 N

1,200,000 N

1,100,500 N

1,100,000 N

290,500 E

291,000 E

291,500 E

292,000 E

292,500 E

0 250 500

SCALE 1:4,000

REV	DATE	BY	APP.	DETAILS

DRAWING STATUS		
DESIGN BY	EH.RIGBY	OCTOBER'01
DRAWN BY	CE.DAVIS	OCTOBER'01
DRAFTING CHECK		
DESIGN CHECK		
FINAL APPROVAL		

PRELIMINARY

SCALE: (on A1 Original) 1:4000

DATUM: AHD

FORBES RIGBY PTY LTD
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PROJECT TITLE
FLOOD PLAIN MANAGEMENT
CONSOLIDATED HEWITTS CREEK
FOR
WOLLONGONG CITY COUNCIL

DRAWING TITLE
PROPOSED MITIGATION SCHEMES
SLACKY/TRAMWAY CREEKS

Project No.	Drawing No.	REV
93073	11101	P0

File Plotted: U:\99JOBS\93073-11 CONSOLIDATED FPMS\REPORTS\FPM STUDY\APPENDIX\BUILD\APP 4.1 PROPOSED MITIGATION SCHEMES SLACKY TRAMWAY CREEK.DWG
March 15, 2001 3:25:24 p.m.

A1

Consolidated Hewitts Creek Floodplain Risk Management Study

Risk Management Scheme Descriptions

Catchment	Zone	Reach/Structure	Mitigation Measure	Modification Category	Scheme
S	°	***SCHEME SA***	*(DIVERSION TO TRAMWAY REMOVED)*		***SA***
S	1.00	Ocean outfall	Develop opening policy	Flood	SA
S	1.02	Footbridge to Blackall St	Flow training wall south bank	Flood	SA
S	1.04	Rail line to footbridge	Channel enlargement and stabilisation	Flood	SA
S	1.04	Rail line to footbridge	Formalise overland flow path	Flood	SA
S	1.05	Rail line	Increase culvert capacity	Flood	SA
S	1.06	Princes Highway to Rail line	Reconfigure basin outlet	Flood	SA
S	1.08	Old mine rail to Princes Highway	Channel enlargement and stabilisation	Flood	SA
S	1.08	Old mine rail to Princes Highway	Levee east bank	Flood	SA
S	1.09	Old mine rail	**Remove diversion (at old rail)**	Flood	SA
S	1.10	Hobart St	**Remove diversion (at Hobart)**	Flood	SA
S	1.11	William St to Hobart St	Sediment basin	Flood	SA
S	1.11	William St to Hobart St	Channel enlargement and stabilisation	Flood	SA
S	1.12	William St	Formalise overland flowpath	Flood	SA
S	1.13	Rex Ave to William St	Sediment basin	Flood	SA
S	1.13	Rex Ave to William St	Restore pre Aug 98 capacity	Flood	SA
S	1.14	National Ave to Rex Ave	Coarse debris trap	Flood	SA
S	2.03	Southern Tributary - mine basin	Retarding basin	Flood	SA

Consolidated Hewitts Creek Floodplain Risk Management Study

Risk Management Scheme Descriptions

Catchment	Zone	Reach/Structure	Mitigation Measure	Modification Category	Scheme
S	°	***SCHEME SB***	*(DIVERSION TO TRAMWAY FORMALISED)*		***SB***
S	1.00	Ocean outfall	Develop opening policy (as per SA)	Flood	SB
S	1.02	Footbridge to Blackall St	Flow training wall south bank (as per SA)	Flood	SB
S	1.06	Princes Highway to Rail line	Reconfigure basin outlet (as per SA)	Flood	SB
S	1.09	Old mine rail	**Formalise diversion (at old rail)**	Flood	SB
S	1.10	Hobart St	**Formalise diversion (at Hobart)**	Flood	SB
S	1.11	William St to Hobart St	Sediment basin (as per SA)	Flood	SB
S	1.11	William St to Hobart St	Channel enlargement and stabilisation (as per SA)	Flood	SB
S	1.12	William St	Formalise overland flowpath (as per SA)	Flood	SB
S	1.13	Rex Ave to William St	Sediment basin (as per SA)	Flood	SB
S	1.13	Rex Ave to William St	Restore pre Aug 98 capacity (as per SA)	Flood	SB
S	1.14	National Ave to Rex Ave	Coarse Debris trap (as per HA)	Flood	SB
S	2.03	Southern Tributary - mine basin	Retarding basin (as per SA)	Flood	SB

SLACKY CREEK

Develop Opening Policy (Zone 1.00) (SA &SB)
Development of a procedure setting out the conditions under which an elevated sand berm should be removed from the creek outlet taking into account ecological considerations. Generally, this would involve setting of a maximum beach berm height of around 2.5 to 3.0m, when this height is exceeded Council would be required to lower the beach berm. Guidelines for frequency and extent of clearing would need to be developed for each specific site and tailored to suit the specific ecological requirements of upstream lagoon systems.

The intent of such a policy would be to ensure that the beach berm would not be so high at the start of the storm as to prevent it from scouring out prior to the peak of the flood.

In Slacky Creek, the ability of the opening to scour is constrained by a concrete slab which forms the invert of the Blackall St bridge.

Levee South Bank (Zone 1.02) (SA &SB)
This measure would involve construction of a low earth wall (1-2 m in height) at rear of properties in Hutton Ave to restrict the spread of flood waters at this location. The height of the levee would be sufficient to afford protection to yards in events up to the 1% AEP event.

As part of this work, modifications would be required to the driveway entrance to 26 Blackall St in order to also afford protection to this dwelling.

Channel Enlargement and Stabilisation (Zone 1.04) (SA only)
This measure would involve excavation on the creek banks to reduce the bank grade to a maximum of 1 in 3 and provide additional waterway area and hydraulic benefits. The banks could then be planted and landscaped to provide for ecological enhancement and restore natural stream functioning. Natural rock toe protection may be required in some locations. . This measure will also

Formalise overflow path in vicinity of Beacon Ave (immediately d/s of rail) (Zone 1.04) (SA only)
This measure involves creation of an overflow path to safely convey Slacky Ck floodwaters (directed into Beacon Ave from the railway pedestrian underpass). The overflow path would involve construction of an open channel along the western side of No. 47 Beacon Ave, construction of a flow training wall along the boundary, gabion protection to the toe of the rail embankment, and modifications to the culvert outlet to direct floodwaters into the head of this channel. The benefit of this measure would be to reduce yard flooding of properties in Beacon Avenue.

Increase Culvert Capacity (Zone 1.05) (SA only)
This measure involves upgrading of the capacity of the culvert through the rail through installation of a third culvert cell (minimum 6m diagonal width) immediately adjacent to and to the north of the existing main southern culvert. Other works would include: reconfiguration of the existing pedestrian bridge, improvements to the overall hydraulics of the culvert and a debris control structure (possibly incorporated as part of the reconstructed pedestrian bridge).

Reconfigure Basin Outlet (to reduce nuisance flows into Beacon Ave) (Zone 1.06) (SA &SB)
This measure would involve filling of the existing secondary outlet of the Slacky Flat basin (which currently directs flow to the northern culvert). This would reduce the frequency of overtopping in the direction of Beacon Ave and reduce yard flooding for these properties. To offset the impact of this on the basin outlet hydraulics, modifications would be required to the southern basin outlet (near the small pedestrian bridge).

Levee East Bank (Zone 1.08) (SA only)
This measure would involve construction of a low earth wall (1-2 m in height) at rear of properties in Lawrence Hargrave Drive (no's 190 to 194) to restrict the spread of flood waters at this location. The height of the levee would be sufficient to afford protection in events up to the 1% AEP event. The levee would span across the rear entrance to the showground and key into the coal haulage embankment.

Channel Enlargement and Stabilisation (Zone 1.08) (SA only)
This measure would involve excavation on the creek banks to reduce the bank grade to a maximum of 1 in 3 and provide additional waterway area and hydraulic benefits. The banks could then be planted and landscaped. Natural rock toe protection may be required in some locations.

Remove Diversion to Tramway at Old Rail (Zone 1.09) (SA only)
This measure involves partial removal of the large coal haulage embankment and the complete removal of the triple cell culvert through the embankment. This will allow flood waters to be retained within Slacky Creek and reduce the existing diversion of water into Tramway Creek.

The twin 1800mm dia pipe culvert immediately upstream of the coal haulage embankment would also be removed as part of this measure.

Formalise Diversion to Tramway at Old Rail (Zone 1.09) (SB only)
This measure involves preserving the coal haulage embankment in its existing condition and the retention of the existing Hobart St diversion.

Remove Diversion to Tramway at Hobart St (Zone 1.10) (SA only)
This measure would involve modifications to Hobart St to the east of the Slacky Creek culvert in order to contain floodwaters to Slacky Creek (and prevent diversion to Hobart St). The roadway would require reconstruction (and lifting by up to 0.5m) for the full distance between the Slacky Creek culverts and the Haig Road roundabout. Modifications would also be required to the driveways of properties along the northern side of Hobart St east of Slacky Creek.

Formalise Diversion to Tramway at Hobart St (Zone 1.10) (SB only)
This measure would involve retention of the existing Hobart St culverts on Slacky Creek which allow floodwaters to divert to Tramway Creek. As part of this measure an overflow path would be required along the southern side of Hobart St. This is discussed further with the Tramway Creek measures.

Sediment Basins (Zones 1.11 and 1.13) (SA & SB)
These measures would involve construction of sediment basins upstream of Hobart St and William St to provide for capture of sediment/rocks. These would typically take the form of ponds 1-2000m3 in size which allow larger material to be deposited, thus reducing potential for blockage of downstream structures.

Channel Enlargement and Stabilisation (Zone 1.11) (SA & SB)
This measure would involve enlargement of the existing creek to have a minimum dimension of 2m base width and 1 in 3 batters through this zone. The banks could then be planted and landscaped. Natural rock toe protection may be required in some locations. The limit of works would be between the downstream end of the piped section and the Hobart St culverts.

Formalise Overflow Path (Zone 1.12) (SA & SB)
This measure would involve modifications to the culvert inlet including removal of the existing blockwork wall which partially obstructs the opening and modifications to the southern headwall to improve culvert capacity. The existing large handrails and culvert headwall would also be modified to reduce obstruction to flow and improve overtopping characteristics of the culvert.

Restore Pre Aug '98 Capacity (Zone 1.13) (SA & SB)
Implementation of this measure seeks to restore the original (pre 98) capacity of waterway by removing material deposited during the Aug 98 event in the upper part of this zone.

Coarse Debris Trap (Zone 1.13) (SA & SB)
This measure would typically involve construction of large steel 'bollards' across the creek (driven or concreted into the bed of the creek). These bollards would be at sufficient spacing to allow small debris to pass through but capture the larger boulders and trees washed down with a flood. It is anticipated that these would be effective at eliminating blockage of downstream structures for events up to and including the 5% AEP event. They are unlikely to be effective in events larger than this.

Retarding Basin with Debris Control Structure (Zone 2.03) (SA & SB)
This would involve formalisation of the existing coal haulage embankment (as it crosses the south arm of Upper Slacky Creek) as a retarding basin. Works to be carried out would include: Modifications to the culvert to reduce its capacity (and improve its performance as a retarding basin), provision of a spillway capable of containing the PMF; and provision of a debris control structure (to ensure the outlet does not block).

TRAMWAY CREEK

Develop Opening Policy (Zone 1.00) (All Schemes)
Development of a procedure setting out the conditions under which sand should be cleared from the creek outlet taking into account ecological considerations. Generally, this would involve setting of a maximum beach berm height of around 2.8 to 2.9m, when this height is exceeded then Council would be required to lower the beach berm.

The intent of such a policy would be to ensure that if a flood occurred that the beach berm would not be so high at the start of the storm as to prevent it from scouring prior to the peak of the flood.

High Flow Culvert or Bridge (Zone 3.03) (TA1 & TB1)
This measure involves increasing conveyance through the rail by constructing a rail underpass/high flow culvert. The underpass would most likely take the form of a 6m wide culvert (6m width will reduce blockage) or alternatively a smaller culvert if a debris control structure is installed upstream. The culvert would need to have sufficient capacity to accommodate the 1% AEP event. Opportunity exists to utilise this structure as a pedestrian underpass if designed appropriately.

Debris Control Structure (3.03)(TA2 & TB2)
This measure would involve construction of a debris control structure upstream of the rail to provide for capture of debris. The structure would be constructed within the Council depot site and would require access for maintenance. Provision of a debris control structure would allow the existing culvert (which is less than 6m dia) to remain clear during smaller more frequent events.

Formalise Overflow Path (3.04)(TB1, TB2, & TB3)
This measure would involve provision of an overflow path along Hobart St and through properties opposite the highway intersection to link the Hobart St diversion to Tramway Ck. A large culvert may also be required beneath the Princes Highway.

A shallow open channel would be provided along the southern side of Hobart St to convey these flows east to the highway (modifications would be required at the Haig Rd roundabout). On the eastern side of the highway, acquisition of property would be required to provide a formal overflow path and safely convey diverted flows into Tramway Creek.

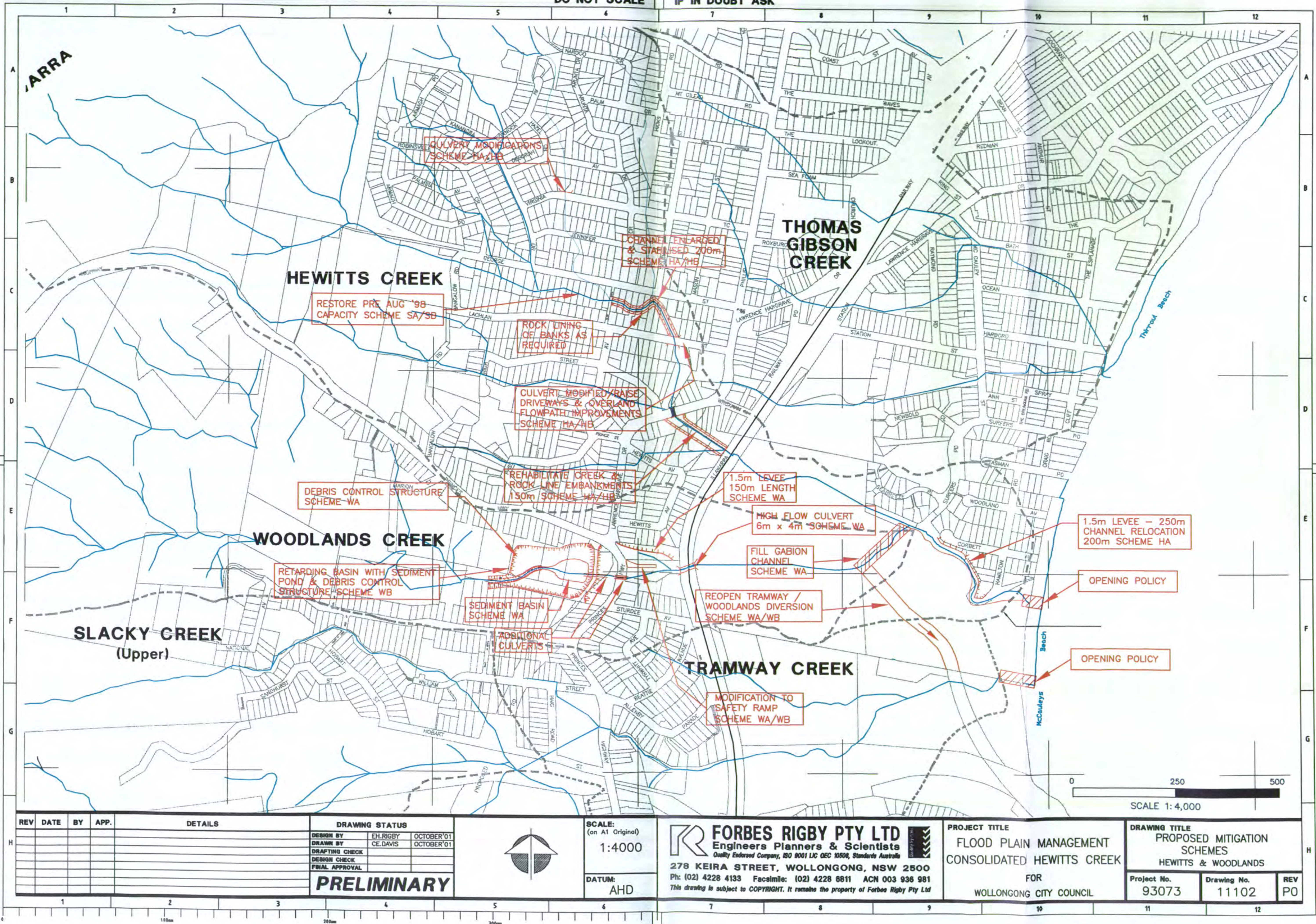
Voluntary Purchase Offer (Zone 3.04) (TB1, TB2, & TB3)
This measure involves the acquisition of property in areas of high hazard where it is impractical or uneconomic to mitigate flooding of existing properties. May include partial purchase/easement over properties to provide a safe overflow path. Scheme TB3 requires the acquisition of an additional 6 properties compared to TB1 and TB3.

APPENDIX

Hewitts/Woodlands

4.2

DO NOT SCALE IF IN DOUBT ASK



Consolidated Hewitts Creek Floodplain Risk Management Study

Risk Management Scheme Descriptions

Catchment	Zone	Reach/Structure	Mitigation Measure	Modification Category	Scheme
H		***SCHEME HA***	*(LEVEE AT CORBETT AVE)*		***HA***
H	1.00	Ocean outfall	Develop opening policy	Flood	HA
H	1.02	Adjacent to Corbett Ave	Levee north bank	Flood	HA
H	1.05	LHD to the Rail line	Voluntary purchase offer (2 properties)	Property	HA
H	1.05	LHD to the Rail line	Rehabilitate creek channel	Flood	HA
H	1.08	Lachlan St	Culvert inlet improvements	Flood	HA
H	1.08	Lachlan St	Formalise overland flowpath	Flood	HA
H	1.08	Lachlan St	Voluntary purchase offer (4 properties)	Property	HA
H	1.09	Kelton Ln to Lachlan St	Channel enlargement and stabilisation	Flood	HA
H	1.10	Kelton Ln	Coarse Debris trap	Flood	HA
H	1.11	Bangalow Rd to Kelton Ln	Restore pre Aug 98 capacity	Flood	HA
H	1.11	Bangalow Rd to Kelton Ln	Coarse Debris trap	Flood	HA
H		***SCHEME HB***	*(PROPERTY MOD'S AT CORBETT AVE)*		***HB***
H	1.00	Ocean outfall	Develop opening policy (as per HA)	Flood	HB
H	1.02	Adjacent to Corbett Ave	House raising	Property	HB
H	1.02	Adjacent to Corbett Ave	Flood proofing	Property	HB
H	1.05	LHD to the Rail line	Voluntary purchase offer (as per HA)	Property	HB
H	1.05	LHD to the Rail line	Rehabilitate creek channel (as per HA)	Flood	HB
H	1.08	Lachlan St	Culvert inlet improvements (as per HA)	Flood	HB
H	1.08	Lachlan St	Formalise overland flow path (as per HA)	Flood	HB
H	1.08	Lachlan St	Voluntary purchase offer (per HA)	Property	HB
H	1.09	Kelton Ln to Lachlan St	Channel enlargement and stabilisation (per HA)	Flood	HB
H	1.10	Kelton Ln	Coarse Debris trap (as per HA)	Flood	HB
H	1.11	Bangalow Rd to Kelton Ln	Restore pre Aug 98 capacity (as per HA)	Flood	HB
H	1.11	Bangalow Rd to Kelton Ln	Coarse Debris trap (as per HA)	Flood	HB

Catchment	Zone	Reach/Structure	Mitigation Measure	Modification Category	Scheme
H		***SCHEME HS4-A***	*(FLOOD/PROPERTY MOD'S - VIRGINIA TCE)*		***HS4-A***
H	4.03	Stream 4 - Virginia Tce	Culvert mod's (to reduce surcharge freq'y)	Flood	HS4-A
H	4.03	Stream 4 - Virginia Tce	Property modification (flow deflectors)	Property	HS4-A
H	4.04	Stream 4 - Deborah Ave	Coarse debris trap	Flood	HS4-A
H		***SCHEME HS4-B***	*(PURCHASE PROPERTY - VIRGINIA TCE)*		***HS4-B***
H	4.03	Stream 4 - Virginia Tce	Voluntary purchase offer (2 properties)	Property	HS4-B
H	4.04	Stream 4 - Deborah Ave	Coarse Debris trap (as per HA)	Flood	HS4-B

Consolidated Hewitts Creek Floodplain Risk Management Study

Risk Management Scheme Descriptions

Catchment	Zone	Reach/Structure	Mitigation Measure	Modification Category	Scheme
W		***SCHEME WA***	*(HIGH FLOW CULVERT AT RAIL)*		***WA***
W	2.01	Diversion to Hewitts	Re-divert Woodlands Ck to Tramway Ck	Flood	WA
W	2.01a	Near Sewer Pumping Station	Channel enlargement and stabilisation	Flood	WA
W	2.03	Rail line	High flow culvert/bridge	Flood	WA
W	2.04	Princes Highway to Rail line	Modify safety ramp and provide sag	Flood	WA
W	2.04	Princes Highway to Rail line	Levee north bank	Flood	WA
W	2.05	Princes Highway	Sediment basin/debris control structure	Flood	WA
W		***SCHEME WB***	*(RETARDING BASIN ABOVE HIGHWAY)*		***WB***
W	2.01	Diversion to Hewitts	Re-divert Woodlands Ck to Tramway Ck(perWA)	Flood	WB
W	2.01a	Near Sewer Pumping Station	Channel enlargement and stabilisation (per WA)	Flood	WB
W	2.04	Princes Highway to Rail line	Modify safety ramp and provide sag (per WA)	Flood	WB
W	2.04	Princes Highway to Rail line	Levee north bank (as per WA)	Flood	WB
W	2.05	Princes Highway	Retarding basin	Flood	WB
W	2.05	Princes Highway	Sediment basin/debris control structure (as per WA)	Flood	WB

HEWITTS CREEK

Develop Opening Policy (Zone 1.00) (HA & HB)
Development of a procedure setting out the conditions under which sand should be cleared from the creek outlet taking into account ecological considerations. Generally, this would involve setting of a maximum beach berm height of around 2.8 to 2.9m, when this height is exceeded then Council would be required to lower the beach berm.

The intent of such a policy would be to ensure that if a flood occurred that the beach berm would not be so high at the start of the storm as to prevent it from scouring prior to the peak of the flood.

House Raising (Zone 1.02) (HB only)
This measure would involve elevating habitable floors above the 1% AEP flood level. The work would generally be funded by the owners with government assistance and could only be applied to those dwellings of weatherboard construction.

Flood Proofing (Zone 1.02) (HB only)
This would involve the mandatory design and construction of new buildings with appropriate water resistant materials such that flood damage to the building itself (structural damage), and possibly its contents, is minimised should the building be inundated.

Levee North Bank (Zone 1.02) (HA only)
Construct a low earth wall (1-2 m in height) at rear of properties in Corbett Ave to restrict flood waters to within the creek banks. Levee construction may require relocation of a section of creek to provide room for the levee to be constructed at the rear of properties between the western end of Corbett Avenue and the southern end of Hamilton Road. The height of the levee would be sufficient to afford protection in events up to the 1% AEP event.

Creek Rehabilitation (Zone 1.05) (HA & HB)
This measure involves the closure of the existing access road to the BHP refractory site. The road would be excavated to restore the original waterway area of Hewitts Creek. The creek would need to be rehabilitated with natural rock protection, small pools and riffle beds, rock drop structures and landscaping with native species. This measure would also need to incorporate some minor modifications to the rail bridge invert to 'match' creek bed invert levels across the structure.

Voluntary Purchase Offer (Zone 1.05) (HA & HB)
This measure involves the acquisition of property in areas of high hazard where it is impractical or uneconomic to mitigate flooding of existing properties. May include partial purchase/easement over properties to provide a safe overflow path.

Culvert Inlet Improvements (Zone 1.08) (HA & HB)
In order to improve the capacity of the existing culvert several measures are proposed for this location including: a projecting centre wall or similar in front of the entrance to reduce the likelihood of the pillar collecting debris; a sloping grate to collect debris (if room available); a tapered inlet to improve inlet hydraulics and reduce turbulence at the inlet.

Formalise Overload Flowpath (Zone 1.08) (HA & HB)
This measure would involve provision of an improved overflow path across Lachlan St. including possible modifications to railings, fences footpath(s), lowering of kerb, earthworks to lower the southern footpath, elevating of driveways (to contain flows within street)

Voluntary Purchase Offer (Zone 1.08) (HA & HB)
This measure involves the acquisition of property in areas of high hazard where it is impractical or uneconomic to mitigate flooding of existing properties. May include partial purchase/easement over properties to provide a safe overflow path.

Channel Enlargement and Stabilisation (Zone 1.09) (HA & HB)
For this measure it is proposed to increase the capacity of the waterway by removing material deposited during Aug 98 event and some excavation of material from the southern bank while still maintaining the existing creek bottom (to minimise disruption to the stream). Some toe protection would be required on the northern bank opposite no's 11 and 11a. Where possible the creek would be widened and landscaped following completion. Material excavated from the creek would be used to construct a small flow training wall/levee along the southern bank to prevent break out of flows for smaller events.

Coarse Debris Traps (Zone 1.10 and Zone 1.11) (HA & HB)
Coarse debris traps proposed for these two zones would typically involve construction of large steel 'bollards' across the creek (driven or concreted into the bed of the creek). These bollards would be at sufficient spacing to allow small debris to pass through but capture the larger boulders and trees washed down with a flood. It is anticipated that these would be effective at eliminating blockage of downstream structures for events up to and including the 5% AEP event. They are unlikely to be effective in events larger than this.

Restore pre August 1998 capacity (Zone 1.11) (HA & HB)
Implementation of this measure seeks to restore the original (pre 98) capacity of waterway by removing material deposited during the Aug 98 event. Some of this work has already been partially carried out in the upper part of this zone.

HEWITTS CREEK (STREAM 4)

Voluntary Purchase Offer (Zone 4.03) (HS4B only)
This measure involves the acquisition of property in areas of high hazard where it is impractical or uneconomic to mitigate flooding of existing properties. May include partial purchase/easement over properties to provide a safe overflow path.

Culvert Modification (Zone 4.03) (HS4A only)
This measure would involve several measures to modify the culvert such that its capacity is increased. These may include: reducing the length of the culvert; improvements to the inlet structure to increase the culvert capacity; sealing of downstream junction pits to prevent surcharge; provision of a debris control structure; and creek rehabilitation works immediately upstream of the culvert to reduce scour and improve its hydraulic characteristics.

Property Modification (Zone 4.03) (HS4A only)
This measure would involve modifications to the front of no's 23 and 25 Virginia Terrace to provide a safe overflow path through these properties. Typical modifications may include: flow training walls (possibly constructed as fences) to redirect flow away from dwellings, structural improvements to the dwelling, modifications to the driveway and footpath to direct flows safely through the site.

Coarse Debris Trap (Zone 4.04) (HS4A & HS4B)
The coarse debris trap proposed for this zone would typically involve construction of large steel 'bollards' across the creek (driven or concreted into the bed of the creek). These bollards would be at sufficient spacing to allow small debris to pass through but capture the larger boulders and trees washed down with a flood. It is anticipated that these would be effective at eliminating blockage of downstream structures for events up to and including the 5% AEP event. They are unlikely to be effective in events larger than this. The final position of this structure may or may not be immediately above Deborah Avenue depending on accessibility.

WOODLANDS CREEK

Re-divert Woodlands Creek to Tramway Creek (Zone 2.01)(WA &WB)
This measure involves the closure of the existing diversion of Woodlands Creek into Hewitts Creek and reinstatement of the original route of Woodlands Creek towards Tramway Creek. This would require upgrading of the original Woodlands Creek (see measure for Zone 2.01a), and filling of the old channel, possibly with material already on site.

Channel Enlargement and Stabilisation (Zone 2.01a) (WA &WB)
Would involve rehabilitation of the original Woodlands Creek. Minor excavation works may be required in order to ensure flooding is contained to an acceptable corridor and that the existing Sewer Pumping Station is not affected. The creek would need to have some minor natural rock protection at outer bends and be landscaped upon completion.

High Flow Culvert (Zone 2.03)(WA only)
This measure involves increasing conveyance through the rail by constructing a rail underpass/high flow culvert. The underpass would most likely take the form of a 6m wide culvert (6m width will reduce blockage) or alternatively a smaller culvert if a debris control structure is installed upstream. The culvert would need to have sufficient capacity to accommodate the 1% AEP event. Opportunity exists to utilise this structure as a pedestrian underpass if designed appropriately.

Modify Safety Ramp (Zone 2.04) (WA &WB)
This measure would involve modifications to the safety ramp to reduce the depth of ponding across Lawrence Hargrave Drive (caused by blockage of the culverts through the safety ramp) as well as minimise diversion through properties in Hewitts Ave. This would typically involve lowering of the ramp by an average 0.3m for approximately 20-30m.

Levee North Bank (Zone 2.04) (WA &WB)
This would involve provision of a levee along the northern bank of Woodlands Creek to the rear of properties in Hewitts Ave. The levee would be constructed at sufficient height to prevent diversion to Hewitts Creek and contain floodwaters to Woodlands Creek. Some excavation may also be required to direct flows into the proposed high flow culvert at the rail.

Retarding Basin (Zone 2.05)(WB only)
This measure would involve construction of a large retardation basin above the Princes Highway to capture runoff and contain it for a sufficiently long period of time to reduce the peak flowrate downstream of this point to the capacity of the downstream culverts. Based on a preliminary assessment of the site it may be possible to construct a very large basin (approximately 100,000m3) in this location. This would reduce peak flows downstream of the basin by over 50% which would avert the need for a second culvert at the rail. As part of this measure a sediment basin and debris control structure would need to be incorporated into the design of the basin to ensure the basin outlet does not block (as well as other downstream structures).

Sediment Basin with Debris Control Structure (Zone 2.05) (WA &WB)
This measure would involve construction of a sediment basin and debris control structure upstream of Lawrence Hargrave Drive to provide for capture of sediment/rocks as well as trap floating debris. The available area means that the sediment basin structure may be of the order of 3000m3. The basin would be constructed below existing floodplain level with the debris control structure situated on the downstream outlet of the basin.

APPENDIX

Thomas Gibson 4.3

DO NOT SCALE | IF IN DOUBT ASK

ESCARPMENT

HEWITTS CREEK

THOMAS GIBSON CREEK

WOODLANDS CREEK

SLACKY CREEK (Upper)

TRAMWAY CREEK

CULVERT & OVER FLOW PATH TGB

UPGRADE PIPE DRAINAGE TGA

DEBRIS CONTROL STRUCTURE TGA\TGB

LOWER SOUTH BANK TGA\TGB

INVESTIGATE CULVERT INLET IMPROVEMENTS TGA\TGB

DEVELOP OPENING POLICY TGA\TGB

RAISE KERB & DRIVEWAYS TGB

RAISE KERB & DRIVEWAYS TGB

UPGRADE PIPE DRAINAGE TGA

UPGRADE PIPE DRAINAGE TGA

EXPAND FLOODWAY TGB

CHECK CONDITION & REHAB PIPE DRAINAGE TGA\TGB

OVERLAND FLOW PATH TGA\TGB

REDUCE DIVERSION TO NORTH TGA\TGB

DEVELOP OPENING POLICY TGA\TGB

FORMALISE EXISTING DETENTION BASIN TGA\TGB

OVERLAND FLOWPATH (THOMAS GIBSON PK) TGA\TGB

IMPROVE CULVERT CAPACITY TGA\TGB

DEBRIS CONTROL STRUCTURE TGA\TGB

MODIFY EXISTING FLOOD GATE TGA\TGB

OVERLAND FLOW PATH TGA\TGB

MODIFY CULVERT INLET TGA\TGB

DEBRIS CONTROL STRUCTURE TGA\TGB

Catchment Boundary Shown Thus

0 250 500

SCALE 1:4,000

REV	DATE	BY	APP.	DETAILS

DRAWING STATUS		
DESIGN BY	EH.RIGBY	OCTOBER'01
DRAWN BY	CE.DAVIS	OCTOBER'01
DRAFTING CHECK		
DESIGN CHECK		
FINAL APPROVAL		

PRELIMINARY

SCALE: (on A1 Original) 1:4000

DATUM: AHD

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PROJECT TITLE
FLOOD PLAIN MANAGEMENT
CONSOLIDATED HEWITTS CREEK
FOR
WOLLONGONG CITY COUNCIL

DRAWING TITLE
PROPOSED MITIGATION SCHEMES
THOMAS GIBSON

Project No.	Drawing No.	REV
93073	11103	P0

File Plotted: U:\P93\93073-11 CONSOLIDATED FPMS\REPORTS\FPM STUDY\APPENDIX\BUILD\APP 4.3 PROPOSED MITIGATION SCHEMES THOMAS GIBSON.DWG
August 29, 2002 @3:39 a.m.

A1

Consolidated Hewitts Creek Floodplain Risk Management Study

Risk Management Scheme Descriptions

Catchment	Zone	Reach/Structure	Mitigation Measure	Modification Category	Scheme
TG		***SCHEME TGA***	*(PIPE UPGRADE)*		*TGA*
TG	1.01	The Esplanade - North Arm	Upgrade Pipe Drainage	Flood	TGA
TG	1.03	Macauley St to Cliff Pde - North Arm	Upgrade pipe drainage	Flood	TGA
TG	1.13	Phillip St to Sea Foam Ave - North Arm	Upgrade Pipe Drainage	Flood	TGA
TG	1.13	Phillip St to Sea Foam Ave - North Arm	Re-shape roadway to improve capacity	Flood	TGA
TG	1.00	Ocean outfall - North Arm	Develop opening policy	Flood	TGA
TG	1.00	Ocean outfall - North Arm	Lower south bank	Flood	TGA
TG	1.03	Macauley St to Cliff Pde - North Arm	Raise Kerb/Driveway	Flood	TGA
TG	1.04	Macauley St - North Arm	Investigate culvert inlet improvements	Flood	TGA
TG	1.08	Rail Line - North Arm	Investigate culvert inlet improvements	Flood	TGA
TG	1.08	Rail Line - North Arm	Debris Control Structure	Flood	TGA
TG	2.03	Rail Line to Raymond Rd	Check condition and rehabilitate pipe drainage	Flood	TGA
TG	2.04	Rail Line	Investigate culvert inlet improvements	Flood	TGA
TG	2.07	Phillip St to LHD	Overland Flowpath	Flood	TGB
TG	3.00	Ocean outfall - South Arm	Develop opening policy	Flood	TGA
TG	3.00	Ocean outfall - South Arm	Reduce diversion to north	Flood	TGA
TG	3.01	Cliff Pde	Improve culvert capacity	Flood	TGA
TG	3.02	Macauley St to Cliff Pde to Blackall St	Modify Existing Flood Gate	Flood	TGA
TG	3.02	Macauley St to Cliff Pde	Debris Control Structure	Flood	TGA
TG	3.02	Macauley St to Cliff Pde	Overland Flowpath	Flood	TGA
TG	3.03	Macauley St	Modify culvert inlet	Flood	TGA
TG	3.05	Thomas Gibson Park outlet	Formalise existing detention basin	Flood	TGA
TG	3.05	Thomas Gibson Park outlet	Debris control structure	Flood	TGA
TG	3.10	Lachlan St to LHD	Overland flow path	Flood	TGA
TG	2.03a	Station St diversion - Station St	Overland flow path	Flood	TGA

Consolidated Hewitts Creek Floodplain Risk Management Study

Risk Management Scheme Descriptions

Catchment	Zone	Reach/Structure	Mitigation Measure	Modification Category	Scheme
TG		***SCHEME TGB***	*(OVERLAND FLOW PATH)*		***TGB***
TG	1.01	The Esplanade - North Arm	Expand floodway	Flood	TGB
TG	1.12	Sea Foam Ave - North Arm	Raise Kerb/Driveway	Flood	TGB
TG	1.13	Phillip St to Sea Foam Ave - North Arm	Culvert and Overland flow path	Flood	TGB
TG	1.00	Ocean outfall - North Arm	Develop opening policy	Flood	TGB
TG	1.00	Ocean outfall - North Arm	Lower south bank	Flood	TGB
TG	1.03	Macauley St to Cliff Pde - North Arm	Raise Kerb/Driveway	Flood	TGB
TG	1.04	Macauley St - North Arm	Investigate culvert inlet improvements	Flood	TGB
TG	1.08	Rail Line - North Arm	Investigate culvert inlet improvements	Flood	TGB
TG	1.08	Rail Line - North Arm	Debris Control Structure	Flood	TGB
TG	2.03	Rail Line to Raymond Rd	Check condition and rehabilitate pipe drainage	Flood	TGB
TG	2.04	Rail Line	Investigate culvert inlet improvements	Flood	TGB
TG	2.07	Phillip St to LHD	Overland Flowpath	Flood	TGB
TG	3.00	Ocean outfall - South Arm	Develop opening policy	Flood	TGB
TG	3.00	Ocean outfall - South Arm	Reduce diversion to north	Flood	TGB
TG	3.01	Cliff Pde	Improve culvert capacity	Flood	TGB
TG	3.02	Macauley St to Cliff Pde to Blackall St	Modify Existing Flood Gate	Flood	TGB
TG	3.02	Macauley St to Cliff Pde	Debris Control Structure	Flood	TGB
TG	3.02	Macauley St to Cliff Pde	Overland Flowpath	Flood	TGB
TG	3.03	Macauley St	Modify culvert inlet	Flood	TGB
TG	3.05	Thomas Gibson Park outlet	Formalise existing detention basin	Flood	TGB
TG	3.05	Thomas Gibson Park outlet	Debris control structure	Flood	TGB
TG	3.10	Lachlan St to LHD	Overland flow path	Flood	TGB
TG	2.03a	Station St diversion - Station St	Overland flow path	Flood	TGB

THOMAS GIBSON CREEK

Develop Opening Policy (Zone 1.00) (TGA & TGB)
Development of a procedure setting out the conditions under which sand should be cleared from the creek outlet taking into account ecological considerations. Generally, this would involve setting of a maximum beach berm height of around 2.8 to 2.9m, when this height is exceeded then Council would be required to lower the beach berm.

A preliminary assessment of these lagoon systems is currently being undertaken by Council in conjunction with the DLWC Estuary Management Programme. This assessment should be expanded to investigate the environmental impacts associated with beach bar opening prior to formal adoption of such a policy.

The intent of such a policy would be to ensure that the beach berm would not be so high at the start of the storm as to prevent it from scouring out prior to the peak of the flood. It would not require the beach berm to be lowered below the level required to support estuarine ecology.

Lower South Bank (Zone 1.00) (TGA & TGB)
Lower a section of the southern bank of Flanagans Ck and public reserve area by excavating and removing between 0.5 and 1.0m of material (to match adjoining low point in road). Provide scour protection along the bank and reduce steep undercutting banks. Undertake landscaping of the creek banks to stabilise using native vegetation.

Expand Floodway (Zone 1.00) (TGB)
Expand the existing floodway along The Esplanade by carrying out minor excavation (deepening and widening) to the existing floodway adjoining the eastern side of the roadway. Extends between the low point in Cliff Pde (between Bath and Ocean St) and Flanagans Creek.

Upgrade Pipe Drainage (Zone 1.01) (TGA)
Install a large piped drainage system with multiple inlets to augment the capacity of the existing twin 750mm dia pipes which drain the low-lying area around The Esplanade Opposite the bath house. The pipes should have sufficient capacity to achieve a capacity of between 50 and 100 yr ARI.

Upgrade Pipe Drainage (Zone 1.03) (TGA)
Install a large pipe drainage system within Bath St (within roadway) and connect this into the proposed pipe drainage system along The Esplanade (Zone 1.01). Pipes to be designed for 10 - 20 year ARI capacity with multiple inlets to ensure they do not block. This system will not prevent flooding of low-lying properties in Bath St in large to extreme events.

Raise Kerb/Driveway (Zone 1.03) (TGA & TGB)
Raise the kerb level and lift driveways along the south side of Bath St opposite 25 and 27 Bath St to afford additional flood protection and encourage flows down Bath Street. This raising would take the form of a small amount of filling on the footpath along Bath St and raising/reconstruction of driveways.

Investigate Culvert Inlet Improvements (Zone 1.04) (TGA & TGB)
This option involves an investigation to see if upgrading the inlet to the existing balloon drain is feasible, and if so to carry out some improvement works. These works may involve improvements to the inlet to reduce entrance loss and depth of ponding.

Investigate Culvert Inlet Improvements (Zone 1.08) (TGA & TGB)
This option involves an investigation to see if upgrading the inlet to the existing culvert which passes through the commercial area is feasible, and if so to carry out some improvement works. These works may involve improvements to the inlet to reduce entrance loss and depth of ponding.

Debris Control Structure (Zone 1.08) (TGA & TGB)
This measure would involve construction of a debris control structure upstream of the rail to provide for capture of debris. The structure would be constructed within the rail depot site and would require access for maintenance. Provision of a debris control structure would allow the existing culvert (which is less than 6m dia) to remain clear during smaller more frequent events.

Raise Kerb/Driveway (Zone 1.12) (TGB)
Raise the kerb level and lift driveways along the south side of Sea Foam Avenue opposite 25 and 27 Bath St to afford additional flood protection and encourage flows down the roadway. This raising would take the form of a small amount of filling on the footpath along Sea Foam Avenue and raising/reconstruction of driveways.

Culvert and Overflow Path (Zone 1.13) (TGB)
This measure involves an extensive upgrade to the existing inlet upstream of Phillip Street and direct into a new (large) pipe system (50-100 yr ARI) along eastern edge of Phillip St with multiple inlets to divert flow around properties at western end of The Lookout. In addition, this measure will provide an overflow path in the form of an open lined channel with regular drop structures along the northern side of the unformed section of Sea Foam Ave. At the downstream end of this overflow path an energy dissipator will be required (before discharge back into creek immediately upstream of Sea Foam Ave).

Reshape Roadway to Improve Capacity (Zone 1.13) (TGA)
This option involves re-shaping of the roadway possibly by lowering the northern edge and providing a one way cross fall to the north. This will contain floodwaters to the roadway and prevent overflows into properties on the north side of Sea Foam Avenue.

Upgrade Pipe Drainage (Zone 1.13) (TGA)
This measure involves an upgrade to the existing pipe drainage system upstream of Phillip Street and construction of a new/upgraded system along The Lookout to divert flow away from Sea Foam Avenue. Pipes to be designed for a 10 year ARI capacity with the balance of larger events being contained within the roadway.

Check Condition and Rehabilitate Pipe Drainage (Zone 2.03) (TGA & TGB)
This area has a very old pipe system. This measure requires a condition survey to be conducted using CCTV inspection of the main pipe systems in this general area and rehabilitate any sections of pipe which are identified as being in need of repair.

Overflow Path (Zone 2.03a) (TGA & TGB)
This measure involves the construction of a new overflow path linking the upstream end of Station St with proposed detention basin at Thomas Gibson Park. This will possibly involve the regrading of Station St to encourage flows into (and then across) the rugby field and into the southern soccer fields. This measure may also require some bunding along the northern edge of the rugby field to encourage flows to the south.

Investigate Culvert Inlet Improvements (Zone 2.04) (TGA & TGB)
This measure involves an investigation to see if upgrading the inlet to the existing culvert which passes underneath the railway just north of the station is feasible, and if so to carry out some improvement works. These works may involve improvements to the inlet to reduce entrance loss and depth of ponding near the RSL club.

Overflow Path (Zone 2.07) (TGA & TGB)
This measure involves the construction of an overflow path between Phillip St and Lawrence Hargrave Drive through the Council Carpark and vacant land to the east. This may also include raising of footpaths and driveway entrances to residential properties along eastern side of Phillip St (to prevent water frequently spilling through these properties and possible the lowering of the Phillip St driveway entrance to WCC carpark to encourage flows in this direction.

Develop Opening Policy (Zone 3.00) (TGA & TGB)
Development of a procedure setting out the conditions under which sand should be cleared from the creek outlet taking into account ecological considerations. Generally, this would involve setting of a maximum beach berm height of around 2.8 to 2.9m, when this height is exceeded then Council would be required to lower the beach berm.

A preliminary assessment of these lagoon systems is currently being undertaken by Council in conjunction with the DLWC Estuary Management Programme. This assessment should be expanded to investigate the environmental impacts associated with beach bar opening prior to formal adoption of such a policy.

The intent of such a policy would be to ensure that the beach berm would not be so high at the start of the storm as to prevent it from scouring out prior to the peak of the flood. It would not require the beach berm to be lowered below the level required to support estuarine ecology.

Reduce Diversion to North (Zone 3.00) (TGA & TGB)
Carry out minor excavation to lower the northern creek bank and general public reserve area beyond by between 0.5 and 1.0m. This may also include creation of a swale to direct flows back into creek. Road works may also be required including provision of one-way cross-fall on Cliff Pde and removal of the eastern kerb to direct overflows into the proposed swale.

Improve Culvert Capacity (Zone 3.01) (TGA & TGB)
Amplify the Cliff Pde culvert by constructing additional culvert cells or enhancing the capacity of the existing system. If new culverts are required then this would involve the partial excavation and reconstruction of the road, in addition to modifications to the culvert inlet.

Modify Existing Flood Gate (Zone 3.02) (TGA & TGB)
Carry out modifications to the existing flood gate (on fence upstream of Cliff Pde) to reduce the impediment to flow this provides. This measure would involve re-building of the fence for say 10-20m using a more flood compatible type of fencing and also provision of a larger flood gate that is less likely to block and cause ponding of waters upstream. Other fences upstream should also be investigated.

Debris Control Structure (Zone 3.02) (TGA & TGB)
This measure would involve construction of a debris control structure upstream of Macauley St to provide for capture of debris. The structure would be constructed within the creek and would require access for maintenance. Provision of a debris control structure would allow the existing culvert (which is less than 6m dia) to remain clear during smaller more frequent events.

Overflow Path (Zone 3.02) (TGA & TGB)
This measure involves provision of a clear passage for floodwaters which exceed the capacity of the Macauley St culvert to pass through properties downstream of the road embankment. Works may involve carrying out modifications to driveways, repositioning of garage and shed structures, excavation and reconstruction of the existing channel to increase its capacity and modifications to fencing to reduce potential obstructions to flow.

Modify Culvert Inlet (Zone 3.03) (TGA & TGB)
Carry out modifications to the existing inlet to the Macauley St culvert to enhance the culvert capacity. Works would typically involve re-construction of the inlet to provide a larger diameter inlet.

Formalise Existing Detention Basin (Zone 3.05) (TGA & TGB)
This measure involves modification to the existing outlet to the informal basin structure at Thomas Gibson Park (southern playing fields) to improve the basins detention characteristics. May involve increasing the height of the embankment by a small amount, modifications to the pipe outlet and improvements to the existing spillway to allow controlled discharge up to PMF and improve safety.

It would also be necessary to obtain a formal drainage easement over the site and add the basin to Council's register of detention basins.

Debris Control Structure (Zone 3.05) (TGA & TGB)
This measure would involve construction of a debris control structure upstream of the detention basin outlet to provide for capture of debris. The structure would require access for maintenance.

Overflow Path (Zone 3.10) (TGA & TGB)
Construct an overflow path through the Uniting Church property to re-divert floodwaters (diverted from Hewitts Creek into Thomas Gibson Creek) to re-enter Hewitts Creek. A small channel would be excavated through the small ridge to the south west of the church. The channel size should be sufficient to redirect all diverted flows back into Hewitts Creek.

APPENDIX 5

RISK MANAGEMENT SCHEME ASSESSMENTS

APPENDIX 5.1

Scheme Performance Matrix (Unweighted)

Consolidated Hewitts Creek Floodplain Risk Management Study

Scheme Performance Matrix (unweighted)

Mitigation Scheme		Mitigation Objectives												
		Economic			Social						Ecological			
		1.1 - Flood damages	1.2 - Management Costs	1.3 - Residual damages	2.1 - Reduced threat life	2.2 - Reduced Stress	2.3 - Reduced disruption	2.4 - Reduced relocation	2.5 - Enhanced prop value	2.6 - Community growth	3.1 - Stream stabilised	3.2 - Water quality	3.3 - Riparian zone	3.4 - Stream ecosystem
Catchment	Scheme													
ALL CREEKS	ALL													
HEWITTS	DO NOTHING	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
HEWITTS	HA	4.0	3.8	3.5	4.0	4.3	3.7	3.7	3.4	2.8	3.1	3.3	3.7	3.3
HEWITTS	HB	4.0	3.8	3.7	3.7	4.1	3.8	3.8	3.2	2.8	3.2	3.3	3.7	3.3
HEWITTS	HS4-A	4.0	4.0	3.0	4.0	3.7	3.7	3.7	3.0	3.0	3.0	3.3	3.0	3.0
HEWITTS	HS4-B	4.5	4.0	4.0	3.5	3.5	3.5	3.5	3.5	3.0	3.0	3.5	4.0	3.0
SLACKY	DO NOTHING	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
SLACKY	SA	4.1	3.8	3.2	3.8	4.0	3.7	3.7	3.8	3.0	3.1	3.2	3.5	3.1
SLACKY	SB	3.7	3.6	3.2	3.7	3.7	3.5	3.6	3.7	3.0	3.0	3.3	3.5	3.0
TRAMWAY	DO NOTHING	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
TRAMWAY	TA1	4.0	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.0	2.5	3.0	3.0	2.5
TRAMWAY	TA2	4.0	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.0	2.5	3.5	3.0	2.5
TRAMWAY	TB1	4.4	3.8	3.8	4.2	4.2	4.2	4.2	4.2	2.6	2.8	3.0	3.0	2.8
TRAMWAY	TB2	4.4	3.8	3.8	4.2	4.2	4.2	4.2	4.2	2.6	2.8	3.2	3.0	2.8
TRAMWAY	TB3	4.2	3.8	3.8	3.8	3.8	4.2	4.2	4.0	2.6	2.8	3.0	3.0	2.8
WOODLANDS	DO NOTHING	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
WOODLANDS	WA	3.8	3.7	3.5	3.8	4.0	3.8	3.8	3.8	3.0	3.2	3.3	3.3	3.3
WOODLANDS	WB	3.8	3.5	3.3	3.8	4.0	3.8	3.8	3.8	3.0	3.2	3.5	3.5	3.3
THOMAS GIBSON	TGA	3.8	3.4	3.3	3.4	3.4	3.7	3.1	3.2	3.2	3.0	3.1	3.0	3.0
THOMAS GIBSON	TGB	3.8	3.6	3.4	3.6	3.7	3.6	3.6	3.5	2.9	2.9	3.2	3.2	3.0

In the above table, each management scheme is given an average ranked score in relation to its impact on each management objective.

Where;

1. ***Implies the measure has a substantially adverse impact relative to that objective***
2. ***Implies the measure has a measurably adverse impact relative to that objective***
3. ***Implies the measure has no impact on that objective***
4. ***Implies the measure has a measurably beneficial impact relative to that objective***
5. ***Implies the measure has a substantially beneficial impact relative to that objective***

APPENDIX 5.2

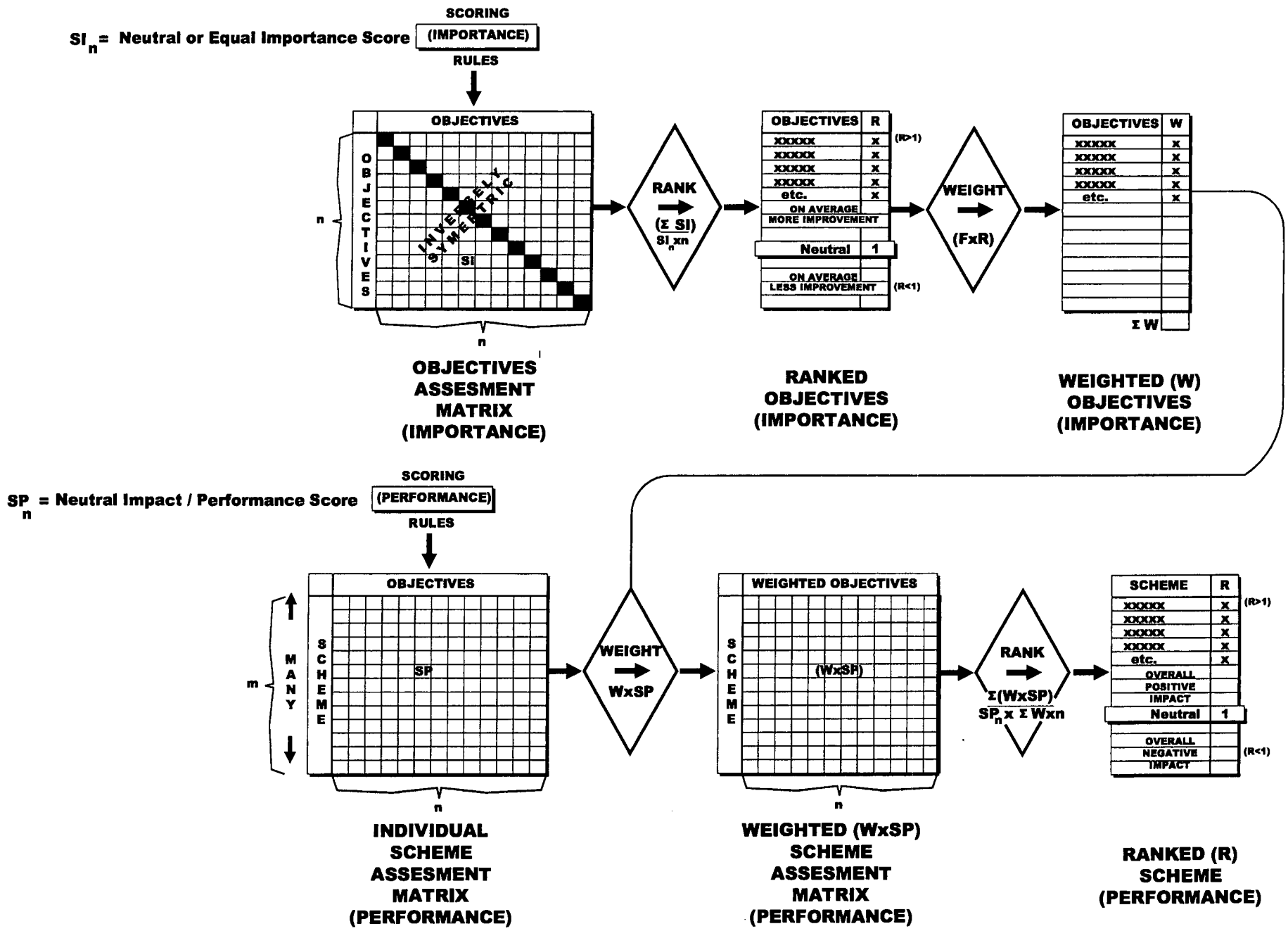
Scheme Performance Matrix (Weighted by Objectives)

Consolidated Hewitts Creek Floodplain Risk Management Study

Scheme Performance Matrix (weighted by objectives)

Mitigation Scheme		Mitigation Objectives														
		Economic			Social						Ecological					
		1.1 - Flood damages	1.2 - Management Costs	1.3 - Residual damages	2.1 - Reduced threat life	2.2 - Reduced Stress	2.3 - Reduced disruption	2.4 - Reduced relocation	2.5 - Enhanced prop value	2.6 - Community growth	3.1 - Stream stabilised	3.2 - Water quality	3.3 - Riparian zone	3.4 - Stream ecosystem		
	Objective Weighting	**5.9**	**4.5**	**5.1**	**8.2**	**5.7**	**5.1**	**5.5**	**3.3**	**2.6**	**4.8**	**4.3**	**4.1**	**4.1**		
Catchment	Scheme														Total Score	Scheme Performance Weighting (Normalised)
ALL CREEKS	ALL															
HEWITTS	DO NOTHING	17.7	13.4	15.4	24.5	17.0	15.4	16.5	9.8	7.7	14.3	12.9	12.4	12.4	**189.4**	**1.0**
HEWITTS	HA	23.6	17.0	18.2	32.6	24.3	19.2	20.5	11.0	7.2	14.8	14.1	15.4	13.6	**231.4**	**1.2**
HEWITTS	HB	23.6	16.7	18.8	29.9	23.2	19.7	20.6	10.4	7.2	15.1	14.0	15.1	13.8	**228.2**	**1.2**
HEWITTS	HS4-A	23.6	17.8	15.4	32.6	20.8	18.9	20.1	9.8	7.7	14.3	14.3	12.4	12.4	**220.3**	**1.1**
HEWITTS	HS4-B	26.6	17.8	20.5	28.5	19.9	18.0	19.2	11.5	7.7	14.3	15.0	16.5	12.4	**228.0**	**1.2**
SLACKY	DO NOTHING	17.7	13.4	15.4	24.5	17.0	15.4	16.5	9.8	7.7	14.3	12.9	12.4	12.4	**189.4**	**1.0**
SLACKY	SA	24.3	17.1	16.6	30.7	22.7	19.1	20.3	12.5	7.7	14.6	13.9	14.3	12.7	**226.5**	**1.2**
SLACKY	SB	21.7	16.0	16.2	29.9	20.8	18.0	19.7	12.0	7.7	14.3	14.3	14.4	12.4	**217.5**	**1.1**
TRAMWAY	DO NOTHING	17.7	13.4	15.4	24.5	17.0	15.4	16.5	9.8	7.7	14.3	12.9	12.4	12.4	**189.4**	**1.0**
TRAMWAY	TA1	23.6	15.6	17.9	28.5	19.9	18.0	19.2	11.5	7.7	12.0	12.9	12.4	10.4	**209.5**	**1.1**
TRAMWAY	TA2	23.6	15.6	17.9	28.5	19.9	18.0	19.2	11.5	7.7	12.0	15.0	12.4	10.4	**211.7**	**1.1**
TRAMWAY	TB1	26.0	17.0	19.5	34.2	23.9	21.6	23.0	13.8	6.6	13.4	12.9	12.4	11.6	**235.9**	**1.2**
TRAMWAY	TB2	26.0	17.0	19.5	34.2	23.9	21.6	23.0	13.8	6.6	13.4	13.7	12.4	11.6	**236.7**	**1.2**
TRAMWAY	TB3	24.8	17.0	19.5	31.0	21.6	21.6	23.0	13.1	6.6	13.4	12.9	12.4	11.6	**228.5**	**1.2**
WOODLANDS	DO NOTHING	17.7	13.4	15.4	24.5	17.0	15.4	16.5	9.8	7.7	14.3	12.9	12.4	12.4	**189.4**	**1.0**
WOODLANDS	WA	22.7	16.4	17.9	31.3	22.7	19.7	21.0	12.6	7.7	15.1	14.3	13.8	13.8	**228.9**	**1.2**
WOODLANDS	WB	22.7	15.6	17.1	31.3	22.7	19.7	21.0	12.6	7.7	15.1	15.0	14.4	13.8	**228.7**	**1.2**
THOMAS GIBSON	TGA	22.7	15.2	17.1	27.5	19.4	18.9	17.1	10.5	8.2	14.3	13.4	12.4	12.6	**209.4**	**1.1**
THOMAS GIBSON	TGB	22.6	15.9	17.4	29.4	20.8	18.5	19.6	11.4	7.5	14.1	13.7	13.3	12.4	**218.6**	**1.1**

In the above table, each management scheme is given a weighted average ranked score in relation to its impact on each management objective
This score is then normalised against a hypothetical scheme which has a neutral impact for all objectives.



MULTI-CRITERIA ANALYSIS OF FLOODPLAIN MANAGEMENT OPTIONS

APPENDIX 5.3

Flood Damages Assessment – Existing Conditions

FLOOD DAMAGES ASSESSMENT
SLACKY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme			Existing Conditions																											
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K								
House	Street	Reach	Chain	AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above
26	BLACKALL ST	S1	75		0	0	0	0	0	0	18	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	47	0.23	0.15
24A	BLACKALL ST	S1	110		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
24B	BLACKALL ST	S1	110		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
1	HUTTON AVE	S1	110		0	0	0	0	0	0	20	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	49	0.24	0.16
1	BEACH ST	S1	125		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
2	HUTTON AVE	S1	140		0	0	0	0	0	0	19	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	48	0.24	0.16
4	HUTTON AVE	S1	170		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
6	HUTTON AVE	S1	200		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
8	HUTTON AVE	S1	220		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
17	BEACH ST	S1	225		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
19	BEACH ST	S1	240		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
21	BEACH ST	S1	255		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
2	BEACON AVE	S1	435		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
1	BEACON AVE	S1	450		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
26	HUTTON AVE	S1	465		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
3	BEACON AVE	S1	475		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
5	BEACON AVE	S1	495		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
7	BEACON AVE	S1	510		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
9	BEACON AVE	S1	530		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
11	BEACON AVE	S1	550		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
13	BEACON AVE	S1	570		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
15	BEACON AVE	S1	585		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
17	BEACON AVE	S1	610		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
19	BEACON AVE	S1	625		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
21	BEACON AVE	S1	645		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
25	BEACON AVE	S1	675		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
27	BEACON AVE	S1	690		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
29	BEACON AVE	S1	710		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
31	BEACON AVE	S1	725		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
33	BEACON AVE	S1	745		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
35	BEACON AVE	S1	760		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
37	BEACON AVE	S1	775		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
39	BEACON AVE	S1	785		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
40	BEACON AVE	S1	800		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
41	BEACON AVE	S1	805		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
38	BEACON AVE	S1	810		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
43	BEACON AVE	S1	810		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
45	BEACON AVE	S1	815		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
74	HUTTON AVE	S1	820		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
47	BEACON AVE	S1	830		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
76	HUTTON AVE	S1	840		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
78A	HUTTON AVE	S1	885		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
19	BLACK DIAMOND PLACE	S1	925		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00

FLOOD DAMAGES ASSESSMENT
SLACKY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Existing Conditions																											
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							
House	Street	Reach	Chain	AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above
21	BLACK DIAMOND PLACE	S1	925		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
3	BLACKBUTT PLACE	S1	935		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
17	BLACK DIAMOND PLACE	S1	945		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
23	BLACK DIAMOND PLACE	S1	945		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
5	BLACKBUTT PLACE	S1	950		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
15	BLACK DIAMOND PLACE	S1	965		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
11	BLACKBUTT PLACE	S1	970		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
7	BLACKBUTT PLACE	S1	970		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
13	BLACK DIAMOND PLACE	S1	980		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
9	BLACKBUTT PLACE	S1	985		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
11	BLACK DIAMOND PLACE	S1	1000		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
13	BLACKBUTT PLACE	S1	1005		0	0	0	0	0	0	10	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0.13	0.05
15	BLACKBUTT PLACE	S1	1005		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
9	BLACK DIAMOND PLACE	S1	1015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
17	BLACKBUTT PLACE	S1	1015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
7	BLACK DIAMOND PLACE	S1	1030		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
19	BLACKBUTT PLACE	S1	1035		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
5	BLACK DIAMOND PLACE	S1	1045		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
21	BLACKBUTT PLACE	S1	1050		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
0	QUILKEY PLACE	S1	1050		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
3	BLACK DIAMOND PLACE	S1	1060		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
23	BLACKBUTT PLACE	S1	1070		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
1	BLACK DIAMOND PLACE	S1	1080		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
0	PRINCES HIGHWAY	S1	1080		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
20	BLACKBUTT PLACE	S1	1090		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
195	PRINCES HIGHWAY	S1	1095		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
455-459	PRINCES HIGHWAY	S1	1115		0	0	0	21	22	22	21	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	51	51	51	51	3.83	2.58
210	PRINCES HIGHWAY	S1	1230		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
208	PRINCES HIGHWAY	S1	1245		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
206	PRINCES HIGHWAY	S1	1260		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
204	PRINCES HIGHWAY	S1	1275		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
202	PRINCES HIGHWAY	S1	1290		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
200	PRINCES HIGHWAY	S1	1305		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
198	PRINCES HIGHWAY	S1	1320		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
196	PRINCES HIGHWAY	S1	1330		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
194	PRINCES HIGHWAY	S1	1345		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
192	PRINCES HIGHWAY	S1	1360		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
190	PRINCES HIGHWAY	S1	1380		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
1/10	HOBART ST	S1	1710		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
10	HOBART ST	S1	1710		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
2/10	HOBART ST	S1	1720		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
12	HOBART ST	S1	1730		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
15A	WILLIAM ST	S1	1760		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
3/17A	WILLIAM ST	S1	1760		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00

FLOOD DAMAGES ASSESSMENT
SLACKY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme			Existing Conditions																											
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K								
House	Street	Reach	Chain	AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above
17A	WILLIAM ST	S1	1770		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
2/17A	WILLIAM ST	S1	1770		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
1/17A	WILLIAM ST	S1	1780		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
19	WILLIAM ST	S1	1800		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
21	WILLIAM ST	S1	1820		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
34	WILLIAM ST	S1	1870		0	0	0	0	0	0	17	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	33	0.33	0.08
38	WILLIAM ST	S1	1955		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
41	WILLIAM ST	S1	1980		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
43	WILLIAM ST	S1	1990		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
40	WILLIAM ST	S1	2010		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
63	GEORGE AVE	S1	2175		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
61	GEORGE AVE	S1	2190		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Totals For Slacky Creek				Total Flood Damage	0	0	0	21	22	22	104	0	0	0	451	451	468	585	0	0	0	13	13	13	52	0	0	0	485	486	502	741	38	3
				AADD	0	0	0	1	1	0	1	0	0	0	11	14	5	5	0	0	0	0	0	0	0	0	0	0	12	15	5	6	38	
				Number of Lots Flooded by Event	0	0	0	1	1	1	6	0	0	0	27	27	28	35	0	0	0	1	1	1	4	0	0	0	27	27	28	35		

FLOOD DAMAGES ASSESSMENT
TRAMWAY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Existing Conditions																													
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K								
House	Street	Creek	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD
Lot 2	STURDEE AVE	T1	795		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
1A	ALLENBY PDE	T1	860		0	0	0	42	42	42	44	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	72	72	72	74	5.38	4.13
1B	ALLENBY PDE	T1	880		0	0	0	43	43	43	45	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	73	73	73	75	5.46	4.21
1C	ALLENBY PDE	T1	905		0	0	0	44	44	44	46	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	73	74	74	75	5.52	4.27
15	ALLENBY PDE	T1	940		0	0	0	43	43	43	45	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	73	73	73	75	5.46	4.21
15A	ALLENBY PDE	T1	960		0	0	0	42	43	43	44	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	72	72	72	74	5.41	4.16
17	ALLENBY PDE	T1	980		0	0	0	41	41	41	43	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	70	71	71	72	5.29	4.04
17A	ALLENBY PDE	T1	1005		0	0	0	38	39	39	40	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	68	68	68	70	5.12	3.87
19	ALLENBY PDE	T1	1015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
19	ALLENBY PDE	T1	1025		0	0	0	23	24	25	33	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	53	53	55	62	4.02	2.77
21	ALLENBY PDE	T1	1040		0	0	0	0	0	0	16	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	32	0.66	0.08
23	ALLENBY PDE	T1	1050		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
171	PRINCES HIGHWAY	T1	1090		0	0	0	11	13	14	28	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	27	29	31	57	2.28	1.03
177	PRINCES HIGHWAY	T1	1100		0	0	0	0	0	0	14	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0.15	0.07
169	PRINCES HIGHWAY	T1	1110		0	0	0	3	5	7	23	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	3	5	7	53	0.54	0.45
167	PRINCES HIGHWAY	T1	1115		0	0	0	0	0	3	21	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	3	51	0.28	0.20
165	PRINCES HIGHWAY	T1	1120		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
163	PRINCES HIGHWAY	T1	1130		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
161	PRINCES HIGHWAY	T1	1130		0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.01	0.01
180	PRINCES HIGHWAY	T1	1200		0	0	0	0	0	0	32	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	17	17	61	1.47	0.22
2	HAIG RD	T1	1315		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
4	HAIG RD	T1	1320		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
6	HAIG RD	T1	1325		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
4	HOBART ST	T1	1350		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
6	HOBART ST	T1	1365		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
Totals For Slacky Creek				**Total Flood Damage**	0	0	0	330	336	345	475	0	0	0	167	184	184	317	0	0	0	104	104	104	156	0	0	0	601	624	633	948	47	34
				AADD	0	0	0	8	10	3	4	0	0	0	4	5	2	2	0	0	0	3	3	1	1	0	0	0	15	18	6	8	47	
				Number of Lots Flooded by Event	0	0	0	10	10	11	15	0	0	0	10	11	11	20	0	0	0	8	8	8	12	0	0	0	11	12	13	21		
Totals For Slacky/Tramway System				**Total Flood Damage**	0	0	0	351	358	367	579	0	0	0	618	635	651	902	0	0	0	117	117	117	207	0	0	0	1086	1109	1135	1688	85	37
				AADD	0	0	0	9	11	4	5	0	0	0	15	19	6	8	0	0	0	3	4	1	2	0	0	0	27	33	11	14	85	

FLOOD DAMAGES ASSESSMENT
WOODLANDS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Existing Conditions																										
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K								
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD
8	HEWITTS AVE	WOODLANDS	650		0	0	0	13	17	22	34	0	0	0	17	17	17	17	0	0	0	0	13	13	13	0	0	0	30	46	52	64	2.97	1.72
1	HEWITTS AVE	WOODLANDS	660		0	0	0	4	8	13	31	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	20	25	30	61	1.90	0.65
6	HEWITTS AVE	WOODLANDS	660		0	0	0	0	6	12	30	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	23	29	60	1.71	0.46
4	HEWITTS AVE	WOODLANDS	670		0	0	0	18	21	24	34	0	0	17	17	17	17	17	0	0	0	13	13	13	13	0	0	17	48	51	54	64	5.04	2.54
2	HEWITTS AVE	WOODLANDS	680		0	0	14	33	34	34	36	0	17	17	17	17	17	17	0	0	0	13	13	13	13	0	17	30	63	63	64	66	10.34	4.50
449	LHD	WOODLANDS	680		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
Lot 105	YENDA AVE	WOODLANDS	1530		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
			Total Flood Damage		0	0	14	68	86	106	166	0	17	33	84	84	84	100	0	0	0	26	39	39	65	0	17	47	178	208	228	331	22	10
			AADD		0	0	1	2	2	1	1	0	3	3	3	3	1	1	0	0	0	1	1	0	1	0	3	3	6	6	2	3	22	
			Number of Lots Flooded by Event		0	0	1	4	5	5	5	0	1	2	5	5	5	6	0	0	0	2	3	3	5	0	1	2	5	5	5	6		

FLOOD DAMAGES ASSESSMENT

HEWITTS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Existing Conditions																												
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							AADC	Total Above
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF		
35	GEORGE ST	H1	1550		0	0	3	17	26	32	36	0	0	0	17	17	17	17	0	0	0	0	13	13	13	0	0	3	33	56	62	65	3.60	2.35
37	GEORGE ST	H1	1570		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
37	GEORGE ST	H1	1585		0	0	0	0	0	0	0	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	17	0.25	0.00
41	GEORGE ST	H1	1605		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
43	GEORGE ST	H1	1620		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
45	GEORGE ST	H1	1635		0	0	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	32	0.16	0.16
47	GEORGE ST	H1	1650		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
49	GEORGE ST	H1	1660		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
51	GEORGE ST	H1	1675		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
53	GEORGE ST	H1	1690		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
55	GEORGE ST	H1	1705		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
57	GEORGE ST	H1	1720		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
61	GEORGE ST	H1	1760		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
63	GEORGE ST	H1	1785		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
65	GEORGE ST	H1	1805		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
67	GEORGE ST	H1	1820		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
69	GEORGE ST	H1	1835		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
71	GEORGE ST	H1	1850		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
73	GEORGE ST	H1	1865		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
75	GEORGE ST	H1	1885		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
17	LACHLAN ST	H3	75		0	16	22	27	30	32	36	17	17	17	17	17	17	17	0	0	13	13	13	13	13	17	33	52	57	60	62	65	21.60	9.08
19	LACHLAN ST	H3	90		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
27	GEORGE ST	H3	145		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
21	LACHLAN ST	H3	155		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
29	GEORGE ST	H3	180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
31	GEORGE ST	H3	210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
23	LACHLAN ST	H3	210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
33	GEORGE ST	H3	220		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
25	LACHLAN ST	H3	255		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
19	GEORGE ST	H4	270		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
23	GEORGE ST	H4	275		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
25	GEORGE ST	H4	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
18	GEORGE ST	H4	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
36	SOUDAN ST	H4	370		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
34	SOUDAN ST	H4	390		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
32	SOUDAN ST	H4	400		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
30	SOUDAN ST	H4	560		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
28	SOUDAN ST	H4	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
26	SOUDAN ST	H4	1460		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
1	JENNIFER CRES	H4	1480		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
24	SOUDAN ST	H4	1485		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
74	VIRGINIA TERRACE	H4	1490		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
33	ARUNTA DRIVE	H4	1515		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
31	ARUNTA DRIVE	H4	1520		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
29	ARUNTA DRIVE	H4	1520		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00

FLOOD DAMAGES ASSESSMENT
HEWITTS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Existing Conditions																											
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K								
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADC	Total Above
27	ARUNTA DRIVE	H4	1535		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
25	ARUNTA DRIVE	H4	1540		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
23	ARUNTA DRIVE	H4	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
21	ARUNTA DRIVE	H4	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
19	ARUNTA DRIVE	H4	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
1	PALM GROVE	H4	55		0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0.04	0.04
2	HICKS RD	H4	130		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
21	CORNOCK AVE	H4	140		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
435	LAWRENCE HARGRAVE	H5	160		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
433	LAWRENCE HARGRAVE	H5	175		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
409	LAWRENCE HARGRAVE	H5	190		0	0	0	17	33	33	34	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	46	63	62	64	4.05	2.80
444	LAWRENCE HARGRAVE	H5	210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
413	LAWRENCE HARGRAVE	H5	220		0	0	0	36	39	39	40	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	66	69	69	70	5.04	3.79
431	LAWRENCE HARGRAVE	H5	250		0	0	0	9	30	30	33	0	0	0	17	17	17	17	0	0	0	0	13	13	13	0	0	0	26	60	59	63	3.15	1.89
442	LAWRENCE HARGRAVE	H5	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
36	HEWITTS AVE	H5	280		0	0	0	40	43	43	44	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	70	73	73	74	5.36	4.11
36	HEWITTS AVE	H5	290		0	0	0	40	43	43	44	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	70	73	73	74	5.33	4.08
440	LAWRENCE HARGRAVE	H5	325		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
21	HEWITTS AVE	H5	340		0	0	0	13	32	31	34	0	0	0	17	17	17	17	0	0	0	0	13	13	13	0	0	0	30	62	61	64	3.35	2.10
34	HEWITTS AVE	H5	365		0	0	0	37	40	40	41	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	67	70	70	71	5.11	3.85
415	LAWRENCE HARGRAVE	H5	375		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00
419	LAWRENCE HARGRAVE	H5	395		0	0	0	43	46	46	47	0	0	17	17	17	17	17	0	0	0	13	13	13	13	0	0	17	73	76	76	77	6.84	4.33
421	LAWRENCE HARGRAVE	H5	400		0	0	0	43	46	46	47	0	0	17	17	17	17	17	0	0	0	13	13	13	13	0	0	17	73	76	75	77	6.80	4.30
423	LAWRENCE HARGRAVE	H5	495		0	0	0	38	41	41	42	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	68	71	71	72	5.19	3.94
425	LAWRENCE HARGRAVE	H5	520		0	0	0	37	40	39	41	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	66	69	69	70	5.07	3.82
427	LAWRENCE HARGRAVE	H5	605		0	0	0	32	36	36	37	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	62	66	66	67	4.78	3.62
429	LAWRENCE HARGRAVE	H5	1050		0	0	0	40	43	43	44	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	70	73	73	74	5.35	4.10
438	LAWRENCE HARGRAVE	H5	1055		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
23	HEWITTS AVE	H5	1060		0	0	0	14	33	32	34	0	0	0	17	17	17	17	0	0	0	0	13	13	13	0	0	0	31	62	61	64	3.42	2.17
25	HEWITTS AVE	H5	1060		0	0	0	27	35	35	36	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	56	65	64	66	4.52	3.27
428	LAWRENCE HARGRAVE	H5	1070		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
426	LAWRENCE HARGRAVE	H5	1070		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00
436	LAWRENCE HARGRAVE	H5	1070		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
418	LAWRENCE HARGRAVE	H5	1080		0	0	0	41	44	44	45	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	71	74	74	75	5.42	4.17
422	LAWRENCE HARGRAVE	H5	1080		0	0	0	34	37	37	38	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	63	67	66	68	4.86	3.61
424	LAWRENCE HARGRAVE	H5	1080		0	0	0	0	18	15	25	0	0	0	17	17	17	17	0	0	0	0	13	0	13	0	0	0	17	48	32	55	2.22	0.97
2	HIGH ST	H5	1100		0	0	0	36	39	39	40	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	66	69	69	70	5.05	3.80
4	HIGH ST	H5	1100		0	0	0	35	38	38	39	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	64	68	67	69	4.94	3.69
416	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	28	26	32	0	0	0	17	17	17	17	0	0	0	0	13	13	13	0	0	0	17	58	55	62	2.68	1.43
3	HIGH ST	H5	1100		0	0	0	0	28	25	32	0	0	0	17	17	17	17	0	0	0	0	13	13	13	0	0	0	17	57	55	61	2.66	1.41
414	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	14	9	21	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	30	25	51	1.78	0.53
412	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	18	13	25	0	0	0	0	17	17	17	0	0	0	0	13	0	13	0	0	0	0	48	30	54	1.53	0.95
399	LAWRENCE HARGRAVE	H5	1100		0	0	0	36	40	39	40	0	0	0	0	0	0	0	0	0	0	13	13	13	13	0	0	0	49	53	52	53	3.79	3.79
406	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
397	LAWRENCE HARGRAVE	H5	1100		0	0	0	29	36	35	37	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	59	66	65	66	4.65	3.39
393	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00

FLOOD DAMAGES ASSESSMENT

HEWITTS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme			Existing Conditions																											
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K								
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADC	Total Above
2	LACHLAN ST	H5	1110		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
4	LACHLAN ST	H5	1120		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
1	LACHLAN ST	H5	1120		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00
10	LACHLAN ST	H5	1130		0	16	27	27	29	30	34	0	17	17	17	17	17	17	0	0	13	13	13	13	13	0	33	57	57	58	60	64	15.15	9.31
12	LACHLAN ST	H5	1130		0	0	14	13	17	19	29	0	0	17	17	17	17	17	0	0	0	0	13	13	13	0	0	30	30	46	49	59	5.19	2.68
14	LACHLAN ST	H5	1140		0	0	9	9	12	15	27	0	17	17	17	17	17	17	0	0	0	0	0	0	13	0	17	26	25	29	32	57	7.46	1.62
16	LACHLAN ST	H5	1140		0	0	0	0	0	0	12	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	28	0.64	0.06
18	LACHLAN ST	H5	1140		0	18	28	28	30	31	34	0	0	0	0	17	17	17	0	13	13	13	13	13	13	0	31	41	41	60	61	64	13.03	12.45
6	LACHLAN ST	H5	1150		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
8	LACHLAN ST	H5	1160		0	10	23	23	26	27	33	0	17	17	17	17	17	17	0	0	13	13	13	13	13	0	27	53	53	55	57	63	13.49	7.64
381	LAWRENCE HARGRAVE	H5	1160		0	0	0	0	3	6	21	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	3	6	51	0.37	0.28
385	LAWRENCE HARGRAVE	H5	1165		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
387	LAWRENCE HARGRAVE	H5	1170		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
389	LAWRENCE HARGRAVE	H5	1180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
391	LAWRENCE HARGRAVE	H5	1210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
398	LAWRENCE HARGRAVE	H5	1215		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	17	2.34	0.00
3	LACHLAN ST	H5	1220		0	0	0	0	0	0	0	0	0	17	17	17	0	17	0	0	0	0	0	0	0	0	0	0	0	17	0	17	0.42	0.00
5	LACHLAN ST	H5	1240		0	0	0	0	0	0	0	0	0	0	0	17	0	17	0	0	0	0	0	0	0	0	0	0	21	53	46	59	2.68	1.43
7	LACHLAN ST	H5	1270		0	0	0	5	24	17	30	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
9A	LACHLAN ST	H5	1280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	17	17	31	1.32	0.07
9	LACHLAN ST	H5	1300		0	0	0	0	0	0	14	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	17	56	2.70	0.19
11A	LACHLAN ST	H5	1300		0	0	0	0	0	0	26	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	17	52	2.68	0.18
11	LACHLAN ST	H5	1300		0	0	0	0	0	0	23	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00
15	LACHLAN ST	H5	1300		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
11	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
15	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
17	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
2/19	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
1/19	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
21	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
23	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
8	HAMILTON RD	H7	1300		0	0	0	0	0	9	34	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	17	25	63	1.57	0.32
9	CORBETT AVE	H7	1300		0	0	0	0	0	0	25	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	54	0.27	0.19
6	HAMILTON RD	H7	1300		0	0	0	0	0	0	17	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	17	17	47	1.40	0.15
11	CORBETT AVE	H7	1320		0	0	0	3	13	19	35	0	0	0	0	17	17	17	0	0	0	0	0	13	13	0	0	0	3	29	49	65	1.50	0.92
4	HAMILTON RD	H7	1325		0	0	0	16	23	28	36	0	0	17	17	17	17	17	0	0	0	0	13	13	13	0	0	17	32	53	57	66	4.50	2.00
12	CORBETT AVE	H7	1335		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
13	CORBETT AVE	H7	1335		0	0	0	16	24	28	36	0	17	17	17	17	17	17	0	0	0	0	13	13	13	0	17	17	33	53	58	66	7.87	2.02
14	CORBETT AVE	H7	1340		0	0	0	0	0	0	5	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0.11	0.02
15	CORBETT AVE	H7	1355		0	0	0	13	22	26	36	0	0	17	17	17	17	17	0	0	0	0	13	13	13	0	0	17	30	51	56	66	4.37	1.87
16	CORBETT AVE	H7	1360		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
17	CORBETT AVE	H7	1360		0	10	19	30	33	34	38	0	17	17	17	17	17	17	0	0	13	13	13	13	13	0	27	49	60	63	64	68	13.68	7.84
18	CORBETT AVE	H7	460		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
20	CORBETT AVE	H7	490		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
22	CORBETT AVE	H7	510		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
24	CORBETT AVE	H7	515		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00

FLOOD DAMAGES ASSESSMENT
HEWITTS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme / Existing Conditions																												
				Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							AADC	Total Above
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF		
26	CORBETT AVE	H7	520		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
28	CORBETT AVE	H7	550		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
30	CORBETT AVE	H7	570		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
9	SEABREEZE PLACE	H7	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
32A	HEWITTS AVE	H9	215		0	0	0	36	38	38	39	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	65	68	68	69	4.99	3.73
32	HEWITTS AVE	H9	215		0	0	0	32	36	36	37	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	62	66	66	66	4.77	3.52
30	HEWITTS AVE	H9	235		0	0	0	32	36	36	37	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	61	65	65	66	4.74	3.49
28	HEWITTS AVE	H9	235		0	0	0	27	35	35	36	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	57	64	64	65	4.52	3.27
17	HEWITTS AVE	H9	260		0	0	0	18	33	33	34	0	0	17	17	17	17	17	0	0	0	13	13	13	13	0	0	17	48	62	62	64	5.35	2.85
19	HEWITTS AVE	H9	260		0	0	0	16	32	32	34	0	0	17	17	17	17	17	0	0	0	0	13	13	13	0	0	17	33	62	62	64	4.75	2.25
26	HEWITTS AVE	H9	265		0	0	0	19	33	33	34	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	48	63	63	64	4.13	2.88
15	HEWITTS AVE	H9	265		0	0	0	29	35	35	36	0	17	17	17	17	17	17	0	0	0	13	13	13	13	0	17	17	59	65	65	66	9.20	3.36
24	HEWITTS AVE	H9	275		0	0	0	13	31	31	34	0	0	0	17	17	17	17	0	0	0	0	13	13	13	0	0	0	30	61	61	63	3.31	2.06
13	HEWITTS AVE	H9	275		0	0	0	0	14	14	22	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	30	31	51	1.84	0.59
22	HEWITTS AVE	H9	285		0	0	0	29	35	35	36	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	59	65	65	66	4.63	3.38
11	HEWITTS AVE	H9	295		0	0	0	0	0	0	3	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	20	1.26	0.01
20	HEWITTS AVE	H9	310		0	0	0	0	18	18	25	0	0	0	17	17	17	17	0	0	0	0	13	13	13	0	0	0	17	48	48	55	2.38	1.13
18	HEWITTS AVE	H9	330		0	0	0	0	10	10	18	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	27	27	48	1.70	0.45
9	HEWITTS AVE	H9	350		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00
16	HEWITTS AVE	H9	375		0	0	0	0	9	10	18	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	26	26	47	1.69	0.44
7	HEWITTS AVE	H9	390		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00
14	HEWITTS AVE	H9	440		0	0	0	5	16	16	20	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	21	32	32	50	2.07	0.82
5	HEWITTS AVE	H9	650		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
12	HEWITTS AVE	H9	660		0	0	0	0	0	0	14	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	31	1.32	0.07
3	HEWITTS AVE	H9	660		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
10	HEWITTS AVE	H9	670		0	0	0	0	0	0	0	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	17	0.25	0.00
			Total Damages		0	71	145	1161	1643	1660	2094	17	117	301	1019	1169	1169	1420	0	13	65	402	609	597	791	17	201	510	2582	3422	3426	4305	312	177
			AADD		0	11	11	33	42	17	19	4	20	21	33	33	12	13	0	2	4	12	15	6	7	4	33	36	77	90	34	38	312	
	Number of Lots Flooded by Event				0	5	8	45	55	56	67	1	7	18	61	70	70	85	0	1	5	31	47	46	61	1	8	20	64	72	72	88		

FLOOD DAMAGES ASSESSMENT
HEWITTS CREEK STREAM 4

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Existing Conditions																										
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K								
House	Street	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD
36	GEORGE ST	H2	75		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
38	GEORGE ST	H2	90		0	0	0	0	0	0	0	0	17	17	17	17	17	17	0	0	0	0	0	0	0	0	17	17	17	17	17	17	5.84	0.00
25	JENNIFER CRES	H2	145		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
27	JENNIFER CRES	H2	155		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
29	JENNIFER CRES	H2	180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
22	JENNIFER CRES	H2	210		0	0	0	0	0	0	0	17	17	17	17	17	17	17	0	0	0	0	0	0	0	17	17	17	17	17	17	17	12.53	0.00
24	JENNIFER CRES	H2	210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
26	JENNIFER CRES	H2	220		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
21	VIRGINIA TERRACE	H2	255		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
23	VIRGINIA TERRACE	H2	270		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
25	VIRGINIA TERRACE	H2	275		34	34	35	35	35	35	36	17	17	17	17	17	17	17	13	13	13	13	13	13	13	64	64	64	65	65	65	66	47.94	35.42
32	VIRGINIA TERRACE	H2	310		0	0	0	9	10	12	21	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	26	27	28	51	3.35	0.85
30	VIRGINIA TERRACE	H2	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
13	DEBORAH AVE	H2	370		0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0.06	0.06
11	HAZEL CRES	H2	390		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
14	DEBORAH AVE	H2	400		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
17	CORNOCK AVE	H2	560		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
19	CORNOCK AVE	H2	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Totals For Hewitts Stream 4				Total Flood Damage	34	34	35	44	46	47	70	33	50	67	67	67	67	67	13	13	13	13	13	13	26	80	98	114	124	125	127	163	70	36
				AADD	8	10	3	2	1	0	1	8	13	6	3	2	1	1	3	4	1	1	0	0	0	20	27	11	6	4	1	1	70	
				Number of Lots Flooded by Event	1	1	1	2	2	2	3	2	3	4	4	4	4	4	1	1	1	1	1	1	2	2	3	4	4	4	4	5		
Total For Hewitts/Woodlands Svstem				Total Flood Damage	34	106	193	1273	1775	1813	2330	50	184	401	1169	1320	1320	1587	13	26	78	441	661	648	882	97	316	672	2884	3756	3781	4799	404	223
				AADD	8	21	15	37	46	18	21	13	35	29	39	37	13	14	3	6	5	13	17	7	8	24	62	49	89	100	38	42	404	

FLOOD DAMAGES ASSESSMENT
THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

House	Street	Reach	Chain	Scheme	Existing Conditions																												
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD
				AEP %	1 50	1 20	1 10	1 5	1 2	1 1	1 PMF	2 50	2 20	2 10	2 5	2 2	2 1	2 PMF	3 50	3 20	3 10	3 5	3 2	3 1	3 PMF	50	20	10	5	2	1	PMF		
2	MCCAULEY ST	TG1	50		7	7	9	14	17	18	22	0	0	17	17	17	17	17	0	0	0	0	13	13	13	7	7	26	31	47	48	52	8.98	6.48
3	RAYMOND RD	TG1	50		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
291	LAWRENCE HARG	TG1	60		0	0	0	0	0	0	4	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	21	1.27	0.02
291	LAWRENCE HARG	TG1	60		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
1	RAYMOND RD	TG1	60		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
46	SEA FOAM AVE	TG1	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
48	SEA FOAM AVE	TG1	330		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
50	SEA FOAM AVE	TG1	350		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
52	SEA FOAM AVE	TG1	365		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
54	SEA FOAM AVE	TG1	380		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
56	SEA FOAM AVE	TG1	410		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
29	SEA FOAM AVE	TG1	415		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	SEA FOAM AVE	TG1	420		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
31	SEA FOAM AVE	TG1	420		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
33	SEA FOAM AVE	TG1	425		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
58	SEA FOAM AVE	TG1	425		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
36	THE LOOKOUT	TG1	430		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
74	SEA FOAM AVE	TG1	430		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
74	SEA FOAM AVE	TG1	440		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
60	SEA FOAM AVE	TG1	450		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
74	SEA FOAM AVE	TG1	450		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
74	SEA FOAM AVE	TG1	460		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
74	SEA FOAM AVE	TG1	475		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
74	SEA FOAM AVE	TG1	475		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
104	PHILLIP ST	TG1	475		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
3	SEAVIEW TERRAC	TG1	560		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
1	MT GILEAD RD	TG1	575		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
3	MT GILEAD RD	TG1	590		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
5	MT GILEAD RD	TG1	605		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
7	MT GILEAD RD	TG1	620		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
9	MT GILEAD RD	TG1	635		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
11	MT GILEAD RD	TG1	650		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
13	MT GILEAD RD	TG1	665		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
15	MT GILEAD RD	TG1	680		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
17	MT GILEAD RD	TG1	695		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
19	MT GILEAD RD	TG1	710		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
21	MT GILEAD RD	TG1	720		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
23	MT GILEAD RD	TG1	720		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
25	MCCAULEY ST	TG10	10		16	18	19	20	21	21	33	0	0	17	17	17	17	17	17	13	13	13	13	13	13	33	31	48	50	51	51	63	26.59	24.09
28	MCCAULEY ST	TG10	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
30	MCCAULEY ST	TG10	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00

FLOOD DAMAGES ASSESSMENT
THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

House	Street	Reach	Chain	Scheme / Existing Conditions: Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD
				1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3									
			AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF		
32	MCCAULEY ST	TG10	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
34	MCCAULEY ST	TG10	40	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
22	STATION ST	TG10	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
35	STATION ST	TG10	50	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
11	STATION ST	TG10	250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	STATION ST	TG10	270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	STATION ST	TG10	270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	STATION ST	TG10	270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	STATION ST	TG10	270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
9	STATION ST	TG10	280	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
4	MCCAULEY ST	TG2	30	0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00
6	MCCAULEY ST	TG2	40	0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00
0	RAYMOND RD	TG2	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
8	MCCAULEY ST	TG2	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
10	MCCAULEY ST	TG2	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
12	MCCAULEY ST	TG2	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
14	MCCAULEY ST	TG2	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
16	MCCAULEY ST	TG2	115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
18	MCCAULEY ST	TG2	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
20	MCCAULEY ST	TG2	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
22	MCCAULEY ST	TG2	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
26	MCCAULEY ST	TG2	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
26A	MCCAULEY ST	TG2	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
24	MCCAULEY ST	TG2	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
21	RAYMOND RD	TG2	165	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
23	RAYMOND RD	TG2	175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
25	RAYMOND RD	TG2	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
27	RAYMOND RD	TG2	190	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
16	RAYMOND RD	TG2	240	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
10	RAYMOND RD	TG2	240	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
1	BATH ST	TG3	30	0	0	0	0	0	8	25	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	25	55	2.77	0.27
5	BATH ST	TG3	50	0	0	0	0	0	0	11	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	28	2.56	0.06
27	OCEAN ST	TG3	55	0	0	4	6	10	15	29	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	21	22	26	32	59	3.58	1.07
7	BATH ST	TG3	65	0	0	0	0	0	0	7	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	23	2.54	0.03
9	BATH ST	TG3	80	0	0	0	0	0	0	14	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	31	2.57	0.07
11	BATH ST	TG3	95	0	0	0	0	0	0	5	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	22	2.53	0.03
13	BATH ST	TG3	110	0	0	0	0	0	0	13	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	29	2.57	0.06
15	BATH ST	TG3	130	0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00
17	BATH ST	TG3	150	0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00
21	BATH ST	TG3	175	0	0	0	0	0	4	10	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	21	27	2.59	0.09
23	BATH ST	TG3	190	0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00
25	BATH ST	TG3	200	0	0	0	0	5	7	12	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	21	23	29	2.73	0.22

FLOOD DAMAGES ASSESSMENT
THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

House	Street	Reach	Chain	Scheme	Existing Conditions																										
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD
				AEP %	1 50	1 20	1 10	1 5	1 2	1 1	1 PMF	2 50	2 20	2 10	2 5	2 2	2 1	2 PMF	3 50	3 20	3 10	3 5	3 2	3 1	3 PMF	50	20	10	5	2	1	PMF	
27	BATH ST	TG3	220		0	0	3	9	12	14	19	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	20	26	29	31	49	3.65	1.14
3	MCCAULEY ST	TG3	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
5	MCCAULEY ST	TG3	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
29	BATH ST	TG3	260		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00
45	THE ESPLANADE	TG4	80		0	0	0	0	0	0	7	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0.12	0.03
47	THE ESPLANADE	TG4	90		0	0	0	0	0	0	9	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0.13	0.04
43	THE ESPLANADE	TG4	125		10	11	16	20	23	25	33	0	0	17	17	17	17	17	0	0	0	13	13	13	13	10	11	33	50	52	54	63	12.65	10.15
41	THE ESPLANADE	TG4	145		0	0	6	11	15	17	30	0	0	17	17	17	17	17	0	0	0	0	0	13	13	0	0	23	28	31	47	59	4.22	1.71
39	THE ESPLANADE	TG4	155		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
37	THE ESPLANADE	TG4	175		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
35A	THE ESPLANADE	TG4	195		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
35	THE ESPLANADE	TG4	200		0	0	0	5	9	12	27	0	0	0	0	17	17	17	0	0	0	0	0	0	13	0	0	0	5	26	29	57	1.28	0.69
33	THE ESPLANADE	TG4	225		0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.02	0.02
31	THE ESPLANADE	TG4	245		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
29	THE ESPLANADE	TG4	255		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
12	CLIFF PDE	TG4	265		0	0	5	9	12	16	30	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	21	25	29	33	59	3.81	1.31
26	OCEAN ST	TG5	100		0	0	0	0	6	10	28	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	22	27	58	1.67	0.41
23	HARBORD ST	TG5	135		0	0	0	0	0	4	24	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	21	54	2.73	0.23
345	LAWRENCE HARG	TG6	150		0	0	0	0	8	10	16	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	8	27	32	0.59	0.35
345	LAWRENCE HARG	TG6	165		0	0	0	0	8	11	18	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	8	27	47	0.68	0.43
6	RAILWAY PDE	TG6	200		0	0	0	0	3	6	13	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	19	22	30	2.68	0.17
8	RAILWAY PDE	TG6	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
10	RAILWAY PDE	TG6	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
12	RAILWAY PDE	TG6	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
14	RAILWAY PDE	TG6	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
354	LAWRENCE HARG	TG6	210		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00
360	LAWRENCE HARG	TG6	220		19	19	19	22	25	26	30	0	0	17	17	17	17	17	17	13	13	13	13	13	13	36	32	49	51	54	56	59	28.32	25.81
351	LAWRENCE HARG	TG6	230		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00
364	LAWRENCE HARG	TG6	240		0	0	0	7	10	13	18	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	24	27	29	48	3.27	0.77
353	LAWRENCE HARG	TG6	240		0	0	0	0	0	4	10	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	4	26	0.17	0.08
368	LAWRENCE HARG	TG6	260		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
374	LAWRENCE HARG	TG6	280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
105	PHILLIP ST	TG6	280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
378	LAWRENCE HARG	TG6	300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
382	LAWRENCE HARG	TG6	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
103	PHILLIP ST	TG6	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
138	PHILLIP ST	TG6	330		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
101	PHILLIP ST	TG6	350		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
99	PHILLIP ST	TG6	360		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
136	PHILLIP ST	TG6	365		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
134	PHILLIP ST	TG6	380		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
132	PHILLIP ST	TG6	390		0	0	0	0	0	0	0	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	17	0.25	0.00

FLOOD DAMAGES ASSESSMENT
THOMAS GIBSON CREEK

[redacted] AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

House	Street	Reach	Chain	Scheme	Existing Conditions																												
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD
				AEP %	1 50	1 20	1 10	1 5	1 2	1 1	1 PMF	2 50	2 20	2 10	2 5	2 2	2 1	2 PMF	3 50	3 20	3 10	3 5	3 2	3 1	3 PMF	50	20	10	5	2	1	PMF		
93	PHILLIP ST	TG6	400		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
130	PHILLIP ST	TG6	400		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00
128	PHILLIP ST	TG6	410		5	5	5	8	10	11	13	0	0	17	17	17	17	17	0	0	0	0	0	0	0	5	5	22	25	26	28	30	6.72	4.22
126	PHILLIP ST	TG6	440		0	0	0	0	0	4	7	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	20	24	2.58	0.07
124	PHILLIP ST	TG6	455		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
4	VIRGINIA TERRAC	TG6	490		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
6	VIRGINIA TERRAC	TG6	500		0	0	0	0	3	4	5	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	20	21	22	2.63	0.13
8	VIRGINIA TERRAC	TG6	510		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
15	MASON ST	TG6	535		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
13	MASON ST	TG6	550		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
11	MASON ST	TG6	570		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00
9	MASON ST	TG6	585		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
44	MCCAULEY ST	TG7	50		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
42	MCCAULEY ST	TG7	60		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00
36	MCCAULEY ST	TG7	60		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
6	NEWBOLD CLOSE	TG7	80		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
8	NEWBOLD CLOSE	TG7	115		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
10	NEWBOLD CLOSE	TG7	135		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
12	NEWBOLD CLOSE	TG7	150		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
14	NEWBOLD CLOSE	TG7	165		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
16	NEWBOLD CLOSE	TG7	180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
18	NEWBOLD CLOSE	TG7	195		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
20	NEWBOLD CLOSE	TG7	215		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
22	NEWBOLD CLOSE	TG7	230		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
24	NEWBOLD CLOSE	TG7	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
15	NEWBOLD CLOSE	TG7	270		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
26	NEWBOLD CLOSE	TG7	280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
17	NEWBOLD CLOSE	TG7	285		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
16	RAILWAY PDE	TG7	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
18	RAILWAY PDE	TG7	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
20	RAILWAY PDE	TG7	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
22	RAILWAY PDE	TG7	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
24	RAILWAY PDE	TG7	580		0	0	0	26	27	27	31	0	0	0	0	0	0	0	0	0	0	13	13	13	13	0	0	0	39	40	40	44	2.97	2.97
	WREXHAM RD	TG7	580		0	0	0	22	23	23	28	0	0	17	17	17	17	17	0	0	0	13	13	13	13	0	0	17	51	52	53	57	5.17	2.66
397	LAWRENCE HARG	TG7	620		0	0	0	16	34	34	34	0	0	0	17	17	17	17	0	0	0	0	13	13	13	0	0	0	32	64	64	64	3.52	2.27
30	HARBORD ST	TG8	86		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
28	HARBORD ST	TG8	91		0	0	0	4	5	6	24	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	20	22	23	54	3.01	0.51
11	SPRAY ST	TG8	91		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00
26	HARBORD ST	TG8	101		0	0	0	0	0	0	20	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	17	50	2.67	0.16
9	SPRAY ST	TG8	111		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
24	HARBORD ST	TG8	116		0	0	0	0	0	0	16	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0.16	0.08
7	SPRAY ST	TG8	131		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00

FLOOD DAMAGES ASSESSMENT
THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

House	Street	Reach	Chain	Scheme	Existing Conditions																											
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD
				AEP %	1 50	1 20	1 10	1 5	1 2	1 1	1 PMF	2 50	2 20	2 10	2 5	2 2	2 1	2 PMF	3 50	3 20	3 10	3 5	3 2	3 1	3 PMF	50	20	10	5	2	1	PMF		
5	SPRAY ST	TG8	151		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
3	SPRAY ST	TG8	161		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
16	HARBORD ST	TG8	181		0	0	0	0	0	0	5	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	21	2.53	0.02
1	SPRAY ST	TG8	181		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
14	HARBORD ST	TG8	191		0	0	0	0	0	0	17	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	17	47	2.65	0.15
18	HARBORD ST	TG8	231		0	0	0	0	0	5	26	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	22	56	2.75	0.25
12	ANN ST	TG8	281		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
29	MCCAULEY ST	TG8	291		30	31	32	32	33	33	36	0	0	17	17	17	17	17	17	13	13	13	13	13	13	47	44	61	62	62	63	66	36.81	34.30
10	ANN ST	TG8	296		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
27	MCCAULEY ST	TG8	296		3	6	7	9	11	14	29	0	0	17	17	17	17	17	0	0	0	0	0	0	13	3	6	24	26	28	30	59	6.45	3.94
15	CLIFF PDE	TG9	60		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
				Total Flood Damages	90	98	125	239	329	403	791	0	0	668	718	752	802	969	50	39	39	78	104	117	298	140	137	832	1035	1185	1321	2058	234	128
				AADD	23	28	11	9	9	4	6	0	0	33	35	22	8	9	13	13	4	3	3	1	2	35	42	48	47	33	13	17	234	
				Number of lots Flooded by Event	5	5	7	13	18	22	29	0	0	23	25	27	30	38	2	2	2	5	6	7	18	5	5	23	27	30	32	40		

APPENDIX 5.4

Flood Damages Assessment – Proposed Schemes)

APPENDIX 5.4

Flood Damages Assessment – Proposed Schemes)

FLOOD DAMAGES ASSESSMEN
SLACKY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme			Scheme SA - Diversion to Tramway Removed																															
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K											
House	Street	Reach	Chain	AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
26	BLACKALL ST	S1	75		0	0	0	0	0	0	31	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	60	0.30	0.22	0	0	No
24A	BLACKALL ST	S1	110		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24B	BLACKALL ST	S1	110		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	HUTTON AVE	S1	110		0	0	0	0	0	0	31	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	61	0.30	0.22	0	0	No
1	BEACH ST	S1	125		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
2	HUTTON AVE	S1	140		0	0	0	0	0	0	31	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	61	0.30	0.22	0	0	No
4	HUTTON AVE	S1	170		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
6	HUTTON AVE	S1	200		0	0	0	0	0	0	18	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	47	0.23	0.15	0	0	No
8	HUTTON AVE	S1	220		0	0	0	0	0	0	3	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0.10	0.01	0	0	No
17	BEACH ST	S1	225		0	0	0	0	0	0	5	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0.11	0.03	0	0	No
19	BEACH ST	S1	240		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	BEACH ST	S1	255		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
2	BEACON AVE	S1	435		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
1	BEACON AVE	S1	450		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
26	HUTTON AVE	S1	465		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	BEACON AVE	S1	475		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
5	BEACON AVE	S1	495		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
7	BEACON AVE	S1	510		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
9	BEACON AVE	S1	530		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
11	BEACON AVE	S1	550		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
13	BEACON AVE	S1	570		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
15	BEACON AVE	S1	585		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
17	BEACON AVE	S1	610		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
19	BEACON AVE	S1	625		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	0	No
21	BEACON AVE	S1	645		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	0	No
25	BEACON AVE	S1	675		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
27	BEACON AVE	S1	690		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
29	BEACON AVE	S1	710		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
31	BEACON AVE	S1	725		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
33	BEACON AVE	S1	745		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
35	BEACON AVE	S1	760		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
37	BEACON AVE	S1	775		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
39	BEACON AVE	S1	785		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
40	BEACON AVE	S1	800		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
41	BEACON AVE	S1	805		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
38	BEACON AVE	S1	810		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
43	BEACON AVE	S1	810		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
45	BEACON AVE	S1	815		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
74	HUTTON AVE	S1	820		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
47	BEACON AVE	S1	830		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
76	HUTTON AVE	S1	840		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
78A	HUTTON AVE	S1	885		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	BLACK DIAMOND PLACE	S1	925		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN
SLACKY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme			Scheme SA - Diversion to Tramway Removed																														
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K										
House	Street	Reach	Chain	AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
21	BLACK DIAMOND PLACE	S1	925		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	BLACKBUTT PLACE	S1	935		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	BLACK DIAMOND PLACE	S1	945		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	BLACK DIAMOND PLACE	S1	945		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
5	BLACKBUTT PLACE	S1	950		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
15	BLACK DIAMOND PLACE	S1	965		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
11	BLACKBUTT PLACE	S1	970		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
7	BLACKBUTT PLACE	S1	970		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
13	BLACK DIAMOND PLACE	S1	980		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
9	BLACKBUTT PLACE	S1	985		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
11	BLACK DIAMOND PLACE	S1	1000		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
13	BLACKBUTT PLACE	S1	1005		0	0	0	0	0	0	10	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0.13	0.05	1	1	No
15	BLACKBUTT PLACE	S1	1005		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
9	BLACK DIAMOND PLACE	S1	1015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	BLACKBUTT PLACE	S1	1015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
7	BLACK DIAMOND PLACE	S1	1030		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	BLACKBUTT PLACE	S1	1035		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
5	BLACK DIAMOND PLACE	S1	1045		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	BLACKBUTT PLACE	S1	1050		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
0	QUILKEY PLACE	S1	1050		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	BLACK DIAMOND PLACE	S1	1060		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	BLACKBUTT PLACE	S1	1070		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	BLACK DIAMOND PLACE	S1	1080		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
0	PRINCES HIGHWAY	S1	1080		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
20	BLACKBUTT PLACE	S1	1090		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
195	PRINCES HIGHWAY	S1	1095		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
455-459	PRINCES HIGHWAY	S1	1115		0	0	0	0	0	0	9	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	26	0.13	0.04	1	1	Yes
210	PRINCES HIGHWAY	S1	1230		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
208	PRINCES HIGHWAY	S1	1245		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
206	PRINCES HIGHWAY	S1	1260		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
204	PRINCES HIGHWAY	S1	1275		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
202	PRINCES HIGHWAY	S1	1290		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
200	PRINCES HIGHWAY	S1	1305		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
198	PRINCES HIGHWAY	S1	1320		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
196	PRINCES HIGHWAY	S1	1330		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
194	PRINCES HIGHWAY	S1	1345		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
192	PRINCES HIGHWAY	S1	1360		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
190	PRINCES HIGHWAY	S1	1380		0	0	0	0	0	0	27	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	56	0.28	0.20	0	0	No
1/10	HOBART ST	S1	1710		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
10	HOBART ST	S1	1710		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
2/10	HOBART ST	S1	1720		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
12	HOBART ST	S1	1730		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
15A	WILLIAM ST	S1	1760		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3/17A	WILLIAM ST	S1	1760		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN
SLACKY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme			Scheme SA - Diversion to Tramway Removed																													
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K										
House	Street	Reach	Chain	AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
17A	WILLIAM ST	S1	1770		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
2/17A	WILLIAM ST	S1	1770		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1/17A	WILLIAM ST	S1	1780		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	WILLIAM ST	S1	1800		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	WILLIAM ST	S1	1820		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
34	WILLIAM ST	S1	1870		0	0	0	0	0	0	17	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	33	0.33	0.08	0	0	No
38	WILLIAM ST	S1	1955		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
41	WILLIAM ST	S1	1980		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
43	WILLIAM ST	S1	1990		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
40	WILLIAM ST	S1	2010		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
63	GEORGE AVE	S1	2175		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
61	GEORGE AVE	S1	2190		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
Totals For Slacky Creek		Total Flood Damage			0	0	0	0	0	0	181	0	0	0	0	0	17	234	0	0	0	0	0	0	65	0	0	0	0	0	17	480	3	1	28	2	1
		AADD			0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3				
		Number of Lots Flooded by Event			0	0	0	0	0	0	10	0	0	0	0	0	1	14	0	0	0	0	0	0	5	0	0	0	0	0	1	14					

FLOOD DAMAGES ASSESSMEN
SLACKY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme			Scheme SB - Diversion to Tramway Formalised																														
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K											
House	Street	Reach	Chain	AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
26	BLACKALL ST	S1	75		0	0	0	0	0	0	17	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	46	0.23	0.15	1	1	No
24A	BLACKALL ST	S1	110		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24B	BLACKALL ST	S1	110		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	HUTTON AVE	S1	110		0	0	0	0	0	0	19	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	49	0.24	0.16	1	1	No
1	BEACH ST	S1	125		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
2	HUTTON AVE	S1	140		0	0	0	0	0	0	18	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	48	0.24	0.15	1	1	No
4	HUTTON AVE	S1	170		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
6	HUTTON AVE	S1	200		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
8	HUTTON AVE	S1	220		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	BEACH ST	S1	225		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	BEACH ST	S1	240		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	BEACH ST	S1	255		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
2	BEACON AVE	S1	435		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
1	BEACON AVE	S1	450		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
26	HUTTON AVE	S1	465		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	BEACON AVE	S1	475		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
5	BEACON AVE	S1	495		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
7	BEACON AVE	S1	510		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
9	BEACON AVE	S1	530		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
11	BEACON AVE	S1	550		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
13	BEACON AVE	S1	570		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
15	BEACON AVE	S1	585		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
17	BEACON AVE	S1	610		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
19	BEACON AVE	S1	625		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
21	BEACON AVE	S1	645		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	0	No
25	BEACON AVE	S1	675		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
27	BEACON AVE	S1	690		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
29	BEACON AVE	S1	710		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
31	BEACON AVE	S1	725		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
33	BEACON AVE	S1	745		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
35	BEACON AVE	S1	760		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
37	BEACON AVE	S1	775		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
39	BEACON AVE	S1	785		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
40	BEACON AVE	S1	800		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
41	BEACON AVE	S1	805		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
38	BEACON AVE	S1	810		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
43	BEACON AVE	S1	810		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
45	BEACON AVE	S1	815		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
74	HUTTON AVE	S1	820		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
47	BEACON AVE	S1	830		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
76	HUTTON AVE	S1	840		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
78A	HUTTON AVE	S1	885		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	BLACK DIAMOND PLACE	S1	925		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN
SLACKY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Scheme SB - Diversion to Tramway Formalised																													
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K										
House	Street	Reach	Chain	AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
21	BLACK DIAMOND PLACE	S1	925		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	BLACKBUTT PLACE	S1	935		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	BLACK DIAMOND PLACE	S1	945		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	BLACK DIAMOND PLACE	S1	945		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
5	BLACKBUTT PLACE	S1	950		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
15	BLACK DIAMOND PLACE	S1	965		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
11	BLACKBUTT PLACE	S1	970		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
7	BLACKBUTT PLACE	S1	970		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
13	BLACK DIAMOND PLACE	S1	980		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
9	BLACKBUTT PLACE	S1	985		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
11	BLACK DIAMOND PLACE	S1	1000		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
13	BLACKBUTT PLACE	S1	1005		0	0	0	0	0	0	13	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0.15	0.06	0	0	No
15	BLACKBUTT PLACE	S1	1005		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
9	BLACK DIAMOND PLACE	S1	1015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	BLACKBUTT PLACE	S1	1015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
7	BLACK DIAMOND PLACE	S1	1030		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	BLACKBUTT PLACE	S1	1035		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
5	BLACK DIAMOND PLACE	S1	1045		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	BLACKBUTT PLACE	S1	1050		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
0	QUILKEY PLACE	S1	1050		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	BLACK DIAMOND PLACE	S1	1060		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	BLACKBUTT PLACE	S1	1070		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	BLACK DIAMOND PLACE	S1	1080		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
0.	PRINCES HIGHWAY	S1	1080		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
20	BLACKBUTT PLACE	S1	1090		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
195	PRINCES HIGHWAY	S1	1095		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
455-459	PRINCES HIGHWAY	S1	1115		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	1	Yes
210	PRINCES HIGHWAY	S1	1230		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
208	PRINCES HIGHWAY	S1	1245		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
206	PRINCES HIGHWAY	S1	1260		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
204	PRINCES HIGHWAY	S1	1275		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
202	PRINCES HIGHWAY	S1	1290		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
200	PRINCES HIGHWAY	S1	1305		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
198	PRINCES HIGHWAY	S1	1320		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
196	PRINCES HIGHWAY	S1	1330		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
194	PRINCES HIGHWAY	S1	1345		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
192	PRINCES HIGHWAY	S1	1360		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
190	PRINCES HIGHWAY	S1	1380		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1/10	HOBART ST	S1	1710		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
10	HOBART ST	S1	1710		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
2/10	HOBART ST	S1	1720		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
12	HOBART ST	S1	1730		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
15A	WILLIAM ST	S1	1760		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3/17A	WILLIAM ST	S1	1760		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN
SLACKY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme		Scheme SB - Diversion to Tramway Formalised																													
				Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							AADD	Total Above	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
House	Street	Reach	Chain	AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF					
17A	WILLIAM ST	S1	1770		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
2/17A	WILLIAM ST	S1	1770		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1/17A	WILLIAM ST	S1	1780		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	WILLIAM ST	S1	1800		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	WILLIAM ST	S1	1820		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
34	WILLIAM ST	S1	1870		0	0	0	0	0	0	17	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	33	0.33	0.08	0	0	No
38	WILLIAM ST	S1	1955		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
41	WILLIAM ST	S1	1980		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
43	WILLIAM ST	S1	1990		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
40	WILLIAM ST	S1	2010		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
63	GEORGE AVE	S1	2175		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
61	GEORGE AVE	S1	2190		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
Totals For Slacky Creek			Total Flood Damage		0	0	0	0	0	0	83	0	0	0	0	0	17	167	0	0	0	0	0	0	39	0	0	0	0	0	17	289	2	1	30	4	1
			AADD		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2				
			Number of Lots Flooded by Event		0	0	0	0	0	0	5	0	0	0	0	0	1	10	0	0	0	0	0	0	3	0	0	0	0	0	1	10					

FLOOD DAMAGES ASSESSMEN
TRAMWAY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme		Scheme TA1 - Culvert Upgrade with Diversion Removed																														
				Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K										
House	Street	Creek	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
Lot 2	STURDEE AVE	T1	795		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1A	ALLENBY PDE	T1	860		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
1B	ALLENBY PDE	T1	880		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
1C	ALLENBY PDE	T1	905		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
15	ALLENBY PDE	T1	940		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
15A	ALLENBY PDE	T1	960		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
17	ALLENBY PDE	T1	980		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
17A	ALLENBY PDE	T1	1005		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
19	ALLENBY PDE	T1	1015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	ALLENBY PDE	T1	1025		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
21	ALLENBY PDE	T1	1040		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
23	ALLENBY PDE	T1	1050		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
171	PRINCES HIGHWAY	T1	1090		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
177	PRINCES HIGHWAY	T1	1100		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
169	PRINCES HIGHWAY	T1	1110		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
167	PRINCES HIGHWAY	T1	1115		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
165	PRINCES HIGHWAY	T1	1120		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
163	PRINCES HIGHWAY	T1	1130		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
161	PRINCES HIGHWAY	T1	1130		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
180	PRINCES HIGHWAY	T1	1200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
2	HAIG RD	T1	1315		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
4	HAIG RD	T1	1320		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
6	HAIG RD	T1	1325		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
4	HOBART ST	T1	1350		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
6	HOBART ST	T1	1365		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
Totals For Slacky Creek		**Total Flood Damage**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	20	15	11
		AADD		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00				
		Number of Lots Flooded by Event		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Totals For Slacky/Tramway System		**Total Flood Damage**		0	0	0	0	0	0	181	0	0	0	0	0	17	234	0	0	0	0	0	0	65	0	0	0	0	0	17	480	3	1	48	17	12
		AADD		0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3					

FLOOD DAMAGES ASSESSMEN
TRAMWAY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Scheme TA2 - Diversion Removed - Debris Control Structure																														
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K										
House	Street	Creek	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
Lot 2	STURDEE AVE	T1	795		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1A	ALLENBY PDE	T1	860		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
1B	ALLENBY PDE	T1	880		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
1C	ALLENBY PDE	T1	905		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
15	ALLENBY PDE	T1	940		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
15A	ALLENBY PDE	T1	960		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
17	ALLENBY PDE	T1	980		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
17A	ALLENBY PDE	T1	1005		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
19	ALLENBY PDE	T1	1015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	ALLENBY PDE	T1	1025		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
21	ALLENBY PDE	T1	1040		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
23	ALLENBY PDE	T1	1050		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
171	PRINCES HIGHWAY	T1	1090		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
177	PRINCES HIGHWAY	T1	1100		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
169	PRINCES HIGHWAY	T1	1110		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
167	PRINCES HIGHWAY	T1	1115		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
165	PRINCES HIGHWAY	T1	1120		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
163	PRINCES HIGHWAY	T1	1130		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
161	PRINCES HIGHWAY	T1	1130		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
180	PRINCES HIGHWAY	T1	1200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
2	HAIG RD	T1	1315		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
4	HAIG RD	T1	1320		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
6	HAIG RD	T1	1325		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
4	HOBART ST	T1	1350		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
6	HOBART ST	T1	1365		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
Totals For Slacky Creek				**Total Flood Damage**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	15	11
				AADD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
				Number of Lots Flooded by Event	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Totals For Slacky/Tramway System				**Total Flood Damage**	0	0	0	0	0	0	181	0	0	0	0	0	17	234	0	0	0	0	0	0	65	0	0	0	0	0	17	480	3	1	48	17	12
				AADD	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3				

FLOOD DAMAGES ASSESSMEN
TRAMWAY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Scheme TB1 - Diversion Formalised - Culvert Upgrade																															
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit Wet to Dry in 1% AEP
House	Street	Creek	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF				
Lot 2	STURDEE AVE	T1	795		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0 No
1A	ALLENBY PDE	T1	860		0	0	0	0	0	0	42	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	71	0.35	0.27	1	1 Yes
1B	ALLENBY PDE	T1	880		0	0	0	0	0	0	43	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	73	0.36	0.28	1	1 Yes
1C	ALLENBY PDE	T1	905		0	0	0	0	0	0	44	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	73	0.36	0.28	1	1 Yes
15	ALLENBY PDE	T1	940		0	0	0	0	0	0	43	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	73	0.36	0.28	1	1 Yes
15A	ALLENBY PDE	T1	960		0	0	0	0	0	0	42	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	72	0.36	0.27	1	1 Yes
17	ALLENBY PDE	T1	980		0	0	0	0	0	0	41	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	70	0.35	0.27	1	1 Yes
17A	ALLENBY PDE	T1	1005		0	0	0	0	0	0	38	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	68	0.34	0.25	1	1 Yes
19	ALLENBY PDE	T1	1015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0 No
19	ALLENBY PDE	T1	1025		0	0	0	0	0	0	22	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	52	0.26	0.17	1	1 Yes
21	ALLENBY PDE	T1	1040		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1 No
23	ALLENBY PDE	T1	1050		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0 No
171	PRINCES HIGHWAY	T1	1090		0	0	0	0	0	0	14	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0.15	0.07	1	1 Yes
177	PRINCES HIGHWAY	T1	1100		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1 No
169	PRINCES HIGHWAY	T1	1110		0	0	0	0	0	0	VP	0	0	0	0	0	0	VP	0	0	0	0	0	0	VP	0	0	0	0	0	0	0	0.00	0.00	1	1 Yes
167	PRINCES HIGHWAY	T1	1115		0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.02	0.02	1	1 Yes
165	PRINCES HIGHWAY	T1	1120		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0 No
163	PRINCES HIGHWAY	T1	1130		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0 No
161	PRINCES HIGHWAY	T1	1130		0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.01	0.01	0	0 No
180	PRINCES HIGHWAY	T1	1200		0	0	0	0	0	0	17	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	47	0.23	0.15	1	1 No
2	HAIG RD	T1	1315		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0 No
4	HAIG RD	T1	1320		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0 No
6	HAIG RD	T1	1325		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0 No
4	HOBART ST	T1	1350		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0 No
6	HOBART ST	T1	1365		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0 No
Totals For Slacky Creek				Total Flood Damage	0	0	0	0	0	0	351	0	0	0	0	0	0	200	0	0	0	0	0	0	117	0	0	0	0	0	0	669	3	2	17	14 11
				AADD	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	3	3			
				Number of Lots Flooded by Event	0	0	0	0	0	0	12	0	0	0	0	0	0	12	0	0	0	0	0	0	9	0	0	0	0	0	0	14				
Totals For Slacky/Tramway System				Total Flood Damage	0	0	0	0	0	0	435	0	0	0	0	0	17	367	0	0	0	0	0	0	156	0	0	0	0	0	17	958	5	3	47	18 12
				AADD	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	5	5			

FLOOD DAMAGES ASSESSMEN
TRAMWAY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme		Scheme TB2 - Diversion Formalised - Debris Control Structure																																
				Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
House	Street	Creek	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF					
Lot 2	STURDEE AVE	T1	795		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1A	ALLENBY PDE	T1	860		0	0	0	0	0	42	44	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	72	74	1.08	0.83	1	1	No
1B	ALLENBY PDE	T1	880		0	0	0	0	0	43	45	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	73	75	1.10	0.85	1	1	No
1C	ALLENBY PDE	T1	905		0	0	0	0	0	44	46	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	74	76	1.11	0.86	1	1	No
15	ALLENBY PDE	T1	940		0	0	0	0	0	43	45	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	73	75	1.10	0.85	1	1	No
15A	ALLENBY PDE	T1	960		0	0	0	0	0	43	44	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	72	74	1.09	0.84	1	1	No
17	ALLENBY PDE	T1	980		0	0	0	0	0	41	43	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	71	73	1.06	0.81	1	1	No
17A	ALLENBY PDE	T1	1005		0	0	0	0	0	39	41	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	68	70	1.03	0.78	1	1	No
19	ALLENBY PDE	T1	1015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	ALLENBY PDE	T1	1025		0	0	0	0	0	24	33	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	53	63	0.84	0.59	1	1	No
21	ALLENBY PDE	T1	1040		0	0	0	0	0	0	17	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	47	0.40	0.15	1	0	No
23	ALLENBY PDE	T1	1050		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
171	PRINCES HIGHWAY	T1	1090		0	0	0	0	0	13	29	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	29	58	0.58	0.33	1	1	No
177	PRINCES HIGHWAY	T1	1100		0	0	0	0	0	0	VP	0	0	0	0	0	0	VP	0	0	0	0	0	0	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	No
169	PRINCES HIGHWAY	T1	1110		0	0	0	0	0	VP	VP	0	0	0	0	0	VP	VP	0	0	0	0	0	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
167	PRINCES HIGHWAY	T1	1115		0	0	0	0	0	0	22	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	52	0.26	0.17	1	1	Yes
165	PRINCES HIGHWAY	T1	1120		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
163	PRINCES HIGHWAY	T1	1130		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
161	PRINCES HIGHWAY	T1	1130		0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.01	0.01	0	0	No
180	PRINCES HIGHWAY	T1	1200		0	0	0	0	0	0	17	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	47	0.23	0.15	1	1	No
2	HAIG RD	T1	1315		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
4	HAIG RD	T1	1320		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
6	HAIG RD	T1	1325		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
4	HOBART ST	T1	1350		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
6	HOBART ST	T1	1365		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
Totals For Slacky Creek		**Total Flood Damage**		0	0	0	0	0	331	429	0	0	0	0	0	167	251	0	0	0	0	0	104	156	0	0	0	0	0	602	835	10	7	16	13	2
		AADD		0	0	0	0	0	2	4	0	0	0	0	0	1	2	0	0	0	0	0	1	1	0	0	0	0	0	3	7	10				
		Number of Lots Flooded by Event		0	0	0	0	0	9	13	0	0	0	0	0	10	15	0	0	0	0	0	8	12	0	0	0	0	0	10	16					
Totals For Slacky/Tramway System		**Total Flood Damage**		0	0	0	0	0	331	512	0	0	0	0	0	184	418	0	0	0	0	0	104	195	0	0	0	0	0	618	1124	12	8	46	17	3
		AADD		0	0	0	0	0	2	4	0	0	0	0	0	1	3	0	0	0	0	0	1	1	0	0	0	0	0	3	9	12				

FLOOD DAMAGES ASSESSMEN
TRAMWAY CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Scheme TB3 - Diversion formalised - Flood Proofing/ Vol purchase																													
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K										
House	Street	Creek	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
Lot 2	STURDEE AVE	T1	795		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1A	ALLENBY PDE	T1	860		0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
1B	ALLENBY PDE	T1	880		0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
1C	ALLENBY PDE	T1	905		0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
15	ALLENBY PDE	T1	940		0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
15A	ALLENBY PDE	T1	960		0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
17	ALLENBY PDE	T1	980		0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
17A	ALLENBY PDE	T1	1005		0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
19	ALLENBY PDE	T1	1015		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	ALLENBY PDE	T1	1025		0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
21	ALLENBY PDE	T1	1040		0	0	0	0	0	0	17	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	47	0.40	0.15	1	0	No
23	ALLENBY PDE	T1	1050		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
171	PRINCES HIGHWAY	T1	1090		0	0	0	8	11	13	29	0	0	0	0	17	17	17	0	0	0	0	0	0	13	0	0	0	8	28	29	58	1.46	0.87	1	1	No
177	PRINCES HIGHWAY	T1	1100		0	0	0	0	0	0	VP	0	0	0	0	0	0	VP	0	0	0	0	0	0	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	No
169	PRINCES HIGHWAY	T1	1110		0	0	0	0	VP	VP	VP	0	0	0	VP	VP	VP	VP	0	0	0	0	VP	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
167	PRINCES HIGHWAY	T1	1115		0	0	0	0	0	0	22	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	52	0.26	0.17	1	1	Yes
165	PRINCES HIGHWAY	T1	1120		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
163	PRINCES HIGHWAY	T1	1130		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
161	PRINCES HIGHWAY	T1	1130		0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.01	0.01	0	0	No
180	PRINCES HIGHWAY	T1	1200		0	0	0	0	0	0	17	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	47	0.23	0.15	1	1	No
2	HAIG RD	T1	1315		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
4	HAIG RD	T1	1320		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
6	HAIG RD	T1	1325		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
4	HOBART ST	T1	1350		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
6	HOBART ST	T1	1365		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
Totals For Slacky Creek				**Total Flood Damage**	0	0	0	8	11	13	88	0	0	0	0	17	33	117	0	0	0	0	0	0	52	0	0	0	8	28	46	256	3	1	16	13	10
				AADD	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3				
				Number of Lots Flooded by Event	0	0	0	1	1	1	5	0	0	0	0	1	2	7	0	0	0	0	0	0	4	0	0	0	1	1	2	8					
Totals For Slacky/Tramway System				**Total Flood Damage**	0	0	0	8	11	13	171	0	0	0	0	17	50	284	0	0	0	0	0	0	91	0	0	0	8	28	63	546	4	2	46	17	11
				AADD	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	3	4				

FLOOD DAMAGES ASSESSMEN
WOODLANDS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Scheme A - High Flow Culvert at Rail																													
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K											
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD	No. properties	No. Floors that benefit	Wet to Dry in 1% AEP
8	HEWITTS AVE	WOODLANDS	650		0	0	0	0	0	0	32	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	61	0.30	0.22	1	1	Yes
1	HEWITTS AVE	WOODLANDS	660		0	0	0	0	0	0	24	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	54	0.27	0.18	1	1	Yes
6	HEWITTS AVE	WOODLANDS	660		0	0	0	0	0	0	23	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	53	0.26	0.18	1	1	Yes
4	HEWITTS AVE	WOODLANDS	670		0	0	0	0	0	0	29	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	58	0.29	0.21	1	1	Yes
2	HEWITTS AVE	WOODLANDS	680		0	0	0	0	0	0	34	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	64	0.32	0.23	1	1	Yes
449	LHD	WOODLANDS	680		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
Lot 105	YENDA AVE	WOODLANDS	1530		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
			Total Flood Damage		0	0	0	0	0	0	142	0	0	0	0	0	0	84	0	0	0	0	0	0	65	0	0	0	0	0	0	291	1	1	6	5	5
			AADD		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1				
			Number of Lots Flooded by Event		0	0	0	0	0	0	5	0	0	0	0	0	0	5	0	0	0	0	0	0	5	0	0	0	0	0	0	5					

FLOOD DAMAGES ASSESSMEN
WOODLANDS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Scheme B - Retarding Basin Above Highway																												
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K									
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD	No. properties	No. Floors that benefit	Wet to Dry in 1% AEP
8	HEWITTS AVE	WOODLANDS	650		0	0	0	0	0	0	41	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	71	0.35	0.27	1	1	Yes
1	HEWITTS AVE	WOODLANDS	660		0	0	0	0	0	0	38	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	68	0.34	0.25	1	1	Yes
6	HEWITTS AVE	WOODLANDS	660		0	0	0	0	0	0	38	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	68	0.34	0.25	1	1	Yes
4	HEWITTS AVE	WOODLANDS	670		0	0	0	0	0	0	38	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	68	0.33	0.25	1	1	Yes
2	HEWITTS AVE	WOODLANDS	680		0	0	0	0	0	0	39	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	68	0.34	0.26	1	1	Yes
449	LHD	WOODLANDS	680		0	0	0	0	0	0	3	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0.10	0.01	0	0	No
Lot 105	YENDA AVE	WOODLANDS	1530		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
			Total Flood Damage		0	0	0	0	0	0	197	0	0	0	0	0	0	100	0	0	0	0	0	0	65	0	0	0	0	0	0	362	2	1	5	5	5
			AADD		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2				
			Number of Lots Flooded by Event		0	0	0	0	0	0	6	0	0	0	0	0	0	6	0	0	0	0	0	0	5	0	0	0	0	0	0	6					

FLOOD DAMAGES ASSESSMEN

HEWITTS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme			Scheme A - Levee at Corbett Avenue																														
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							AADD	Total Above Floor AADD	No. properties	No. Floors that benefit	Wet to Dry in 1% AEP
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF					
35	GEORGE ST	H1	1550		0	0	6	15	26	32	36	0	0	17	17	17	17	17	0	0	0	0	13	13	13	0	0	23	32	56	62	65	5.04	2.53	0	0	No
37	GEORGE ST	H1	1570		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
37	GEORGE ST	H1	1585		0	0	0	0	0	0	2	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	19	0.26	0.01	0	0	No
41	GEORGE ST	H1	1605		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
43	GEORGE ST	H1	1620		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
45	GEORGE ST	H1	1635		0	0	0	0	0	0	26	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	39	0.19	0.19	0	0	No
47	GEORGE ST	H1	1650		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
49	GEORGE ST	H1	1660		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
51	GEORGE ST	H1	1675		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
53	GEORGE ST	H1	1690		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
55	GEORGE ST	H1	1705		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
57	GEORGE ST	H1	1720		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
61	GEORGE ST	H1	1760		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
63	GEORGE ST	H1	1785		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
65	GEORGE ST	H1	1805		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
67	GEORGE ST	H1	1820		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
69	GEORGE ST	H1	1835		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
71	GEORGE ST	H1	1850		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
73	GEORGE ST	H1	1865		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
75	GEORGE ST	H1	1885		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	LACHLAN ST	H3	75		0	0	0	0	0	0	34	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	64	0.32	0.23	1	1	Yes
19	LACHLAN ST	H3	90		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
27	GEORGE ST	H3	145		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	LACHLAN ST	H3	155		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	GEORGE ST	H3	180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
31	GEORGE ST	H3	210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	LACHLAN ST	H3	210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
33	GEORGE ST	H3	220		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
25	LACHLAN ST	H3	255		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
19	GEORGE ST	H4	270		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
23	GEORGE ST	H4	275		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
25	GEORGE ST	H4	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
18	GEORGE ST	H4	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
36	SOUDAN ST	H4	370		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
34	SOUDAN ST	H4	390		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
32	SOUDAN ST	H4	400		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
30	SOUDAN ST	H4	560		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
28	SOUDAN ST	H4	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
26	SOUDAN ST	H4	1460		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	JENNIFER CRES	H4	1480		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24	SOUDAN ST	H4	1485		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	VIRGINIA TERRACE	H4	1490		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
33	ARUNTA DRIVE	H4	1515		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
31	ARUNTA DRIVE	H4	1520		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	ARUNTA DRIVE	H4	1520		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN

HEWITTS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Scheme A - Levee at Corbett Avenue																														
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K											
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD	No. properties	No. Floors that benefit	Wet to Dry in 1% AEP
27	ARUNTA DRIVE	H4	1535		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
25	ARUNTA DRIVE	H4	1540		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	ARUNTA DRIVE	H4	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	ARUNTA DRIVE	H4	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	ARUNTA DRIVE	H4	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	PALM GROVE	H4	55		0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0.04	0.04	0	0	No
2	HICKS RD	H4	130		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	CORNOCK AVE	H4	140		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
435	LAWRENCE HARGRAVE	H5	160		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
433	LAWRENCE HARGRAVE	H5	175		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	17	0.58	0.00	1	0	No
409	LAWRENCE HARGRAVE	H5	190		0	0	0	0	0	0	33	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	62	0.47	0.23	1	1	Yes
444	LAWRENCE HARGRAVE	H5	210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
413	LAWRENCE HARGRAVE	H5	220		0	0	0	0	4	34	39	0	0	0	0	17	17	17	0	0	0	0	0	13	13	0	0	0	0	21	64	69	1.40	0.82	1	1	No
431	LAWRENCE HARGRAVE	H5	250		0	0	0	0	0	0	30	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	59	0.46	0.21	1	1	Yes
442	LAWRENCE HARGRAVE	H5	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
36	HEWITTS AVE	H5	280		0	0	0	27	33	39	43	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	56	63	68	73	4.55	3.30	1	1	No
36	HEWITTS AVE	H5	290		0	0	0	25	33	38	43	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	54	62	68	73	4.45	3.20	1	1	No
440	LAWRENCE HARGRAVE	H5	325		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	HEWITTS AVE	H5	340		0	0	0	0	0	0	31	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	61	0.47	0.22	1	1	Yes
34	HEWITTS AVE	H5	365		0	0	0	0	14	35	40	0	0	0	17	17	17	17	0	0	0	0	0	13	13	0	0	0	17	31	65	69	2.27	1.02	1	1	No
415	LAWRENCE HARGRAVE	H5	375		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00	0	0	No
419	LAWRENCE HARGRAVE	H5	395		0	0	0	35	37	42	46	0	0	17	17	17	17	17	0	0	0	13	13	13	13	0	0	17	65	66	71	76	6.25	3.75	1	1	No
421	LAWRENCE HARGRAVE	H5	400		0	0	0	35	36	41	46	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	64	66	71	75	4.96	3.71	1	1	No
423	LAWRENCE HARGRAVE	H5	495		0	0	0	8	24	37	41	0	0	0	17	17	17	17	0	0	0	0	13	13	13	0	0	0	25	53	66	71	3.08	1.83	1	1	No
425	LAWRENCE HARGRAVE	H5	520		0	0	0	0	10	35	39	0	0	0	0	17	17	17	0	0	0	0	0	13	13	0	0	0	0	26	65	69	1.51	0.93	1	1	No
427	LAWRENCE HARGRAVE	H5	605		0	0	0	0	0	24	36	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	53	66	0.86	0.61	1	1	No
429	LAWRENCE HARGRAVE	H5	1050		0	0	0	26	33	39	43	0	0	0	0	0	17	17	0	0	0	13	13	13	13	0	0	0	39	46	68	73	3.51	3.27	1	1	No
438	LAWRENCE HARGRAVE	H5	1055		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	HEWITTS AVE	H5	1060		0	0	0	0	0	0	32	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	61	0.47	0.22	1	1	Yes
25	HEWITTS AVE	H5	1060		0	0	0	0	0	13	35	0	0	0	0	17	17	17	0	0	0	0	0	0	13	0	0	0	0	17	30	64	0.95	0.37	1	1	No
428	LAWRENCE HARGRAVE	H5	1070		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
426	LAWRENCE HARGRAVE	H5	1070		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	0	No
436	LAWRENCE HARGRAVE	H5	1070		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
418	LAWRENCE HARGRAVE	H5	1080		0	0	0	30	34	39	44	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	60	64	69	74	4.73	3.48	1	1	No
422	LAWRENCE HARGRAVE	H5	1080		0	0	0	0	0	27	37	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	57	66	0.90	0.65	1	1	No
424	LAWRENCE HARGRAVE	H5	1080		0	0	0	0	0	0	15	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0.16	0.07	1	1	Yes
2	HIGH ST	H5	1100		0	0	0	0	5	35	39	0	0	0	17	17	17	17	0	0	0	0	0	13	13	0	0	0	17	22	64	69	2.08	0.83	1	1	No
4	HIGH ST	H5	1100		0	0	0	0	0	32	38	0	0	0	0	17	17	17	0	0	0	0	0	13	13	0	0	0	0	17	61	67	1.28	0.70	1	1	No
416	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	0	26	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	56	0.44	0.19	1	1	Yes
3	HIGH ST	H5	1100		0	0	0	0	0	0	26	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	0	55	0.27	0.19	1	1	Yes
414	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	0	10	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0.13	0.05	1	1	Yes
412	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	0	15	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0.16	0.07	1	1	Yes
399	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	3	34	39	0	0	0	0	0	0	0	0	0	0	0	0	13	13	0	0	0	0	3	47	52	0.79	0.79	1	1	No
406	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
397	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	17	36	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	47	65	0.79	0.54	1	1	No
393	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN

HEWITTS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Scheme A - Levee at Corbett Avenue																												
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K									
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD	No. properties	No. Floors that benefit	Wet to Dry in 1% AEP
2	LACHLAN ST	H5	1110		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
4	LACHLAN ST	H5	1120		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	LACHLAN ST	H5	1120		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00	0	0	No
10	LACHLAN ST	H5	1130		0	17	27	27	29	31	34	0	17	17	17	17	17	17	0	13	13	13	13	13	13	0	47	57	57	59	60	64	17.94	12.10	0	0	No
12	LACHLAN ST	H5	1130		0	0	0	0	0	0	30	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	59	0.29	0.21	1	1	Yes
14	LACHLAN ST	H5	1140		0	0	0	0	0	0	28	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	57	0.28	0.20	1	1	Yes
16	LACHLAN ST	H5	1140		0	0	0	0	0	0	13	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0.15	0.06	1	0	No
18	LACHLAN ST	H5	1140		0	0	0	0	0	0	35	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	64	0.32	0.24	1	1	Yes
6	LACHLAN ST	H5	1150		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
8	LACHLAN ST	H5	1160		0	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	0	VP	VP	VP	VP	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	No
381	LAWRENCE HARGRAVE	H5	1160		0	0	0	0	4	7	22	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	4	24	51	0.57	0.32	0	0	No
385	LAWRENCE HARGRAVE	H5	1165		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
387	LAWRENCE HARGRAVE	H5	1170		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
389	LAWRENCE HARGRAVE	H5	1180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
391	LAWRENCE HARGRAVE	H5	1210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
398	LAWRENCE HARGRAVE	H5	1215		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	LACHLAN ST	H5	1220		0	0	0	0	0	0	0	0	0	17	0	17	17	17	0	0	0	0	0	0	0	0	0	17	0	17	17	17	1.84	0.00	1	0	No
5	LACHLAN ST	H5	1240		0	0	0	0	0	0	0	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	17	0.25	0.00	1	0	No
7	LACHLAN ST	H5	1270		0	0	0	6	12	19	23	0	0	0	17	17	17	17	0	0	0	0	0	13	13	0	0	0	22	28	49	53	2.21	0.96	1	1	No
9A	LACHLAN ST	H5	1280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
9	LACHLAN ST	H5	1300		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00	1	1	No
11A	LACHLAN ST	H5	1300		0	0	0	0	0	0	15	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0.16	0.07	1	1	No
11	LACHLAN ST	H5	1300		0	0	0	0	0	0	17	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	17	17	47	1.40	0.15	1	1	No
15	LACHLAN ST	H5	1300		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00	1	0	No
11	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
15	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
2/19	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1/19	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
8	HAMILTON RD	H7	1300		0	0	0	0	0	0	28	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	57	0.28	0.20	1	1	Yes
9	CORBETT AVE	H7	1300		0	0	0	0	0	0	8	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0.12	0.04	1	1	No
6	HAMILTON RD	H7	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	1	No
11	CORBETT AVE	H7	1320		0	0	0	0	0	0	32	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	61	0.30	0.22	1	1	Yes
4	HAMILTON RD	H7	1325		0	0	0	0	0	0	34	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	64	0.32	0.23	1	1	Yes
12	CORBETT AVE	H7	1335		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
13	CORBETT AVE	H7	1335		0	0	0	0	0	0	35	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	64	0.32	0.24	1	1	Yes
14	CORBETT AVE	H7	1340		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
15	CORBETT AVE	H7	1355		0	0	0	0	0	0	34	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	64	0.32	0.23	1	1	Yes
16	CORBETT AVE	H7	1360		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	CORBETT AVE	H7	1360		0	0	0	0	0	0	37	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	66	0.33	0.25	1	1	Yes
18	CORBETT AVE	H7	460		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
20	CORBETT AVE	H7	490		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
22	CORBETT AVE	H7	510		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24	CORBETT AVE	H7	515		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN
HEWITTS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Scheme A - Levee at Corbett Avenue																														
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K										
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD	No. properties	No. Floors that benefit Wet to Dry in 1% AEP
26	CORBETT AVE	H7	520		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0 No
28	CORBETT AVE	H7	550		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0 No
30	CORBETT AVE	H7	570		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0 No
9	SEABREEZE PLACE	H7	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0 No
32A	HEWITTS AVE	H9	215		0	0	0	0	0	34	38	0	0	0	0	17	17	17	0	0	0	0	0	13	13	0	0	0	0	17	63	68	1.30	0.72	1	1 No
32	HEWITTS AVE	H9	215		0	0	0	0	0	24	36	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	53	66	0.85	0.61	1	1 No
30	HEWITTS AVE	H9	235		0	0	0	0	0	21	36	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	51	65	0.83	0.58	1	1 No
28	HEWITTS AVE	H9	235		0	0	0	0	0	12	35	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	29	64	0.60	0.36	1	1 No
17	HEWITTS AVE	H9	260		0	0	0	0	0	0	32	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	62	0.47	0.22	1	1 Yes
19	HEWITTS AVE	H9	260		0	0	0	0	0	0	32	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	61	0.47	0.22	1	1 Yes
26	HEWITTS AVE	H9	265		0	0	0	0	0	0	32	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	62	0.47	0.22	1	1 Yes
15	HEWITTS AVE	H9	265		0	0	0	0	0	15	35	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	32	65	0.63	0.38	1	1 No
24	HEWITTS AVE	H9	275		0	0	0	0	0	0	30	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	60	0.46	0.21	1	1 Yes
13	HEWITTS AVE	H9	275		0	0	0	0	0	0	11	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0.14	0.06	1	1 Yes
22	HEWITTS AVE	H9	285		0	0	0	0	0	15	35	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	15	65	0.47	0.39	1	1 No
11	HEWITTS AVE	H9	295		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	1 No
20	HEWITTS AVE	H9	310		0	0	0	0	0	0	16	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0.16	0.08	1	1 Yes
18	HEWITTS AVE	H9	330		0	0	0	0	0	0	7	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0.12	0.03	1	1 Yes
9	HEWITTS AVE	H9	350		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	0 No
16	HEWITTS AVE	H9	375		0	0	0	0	0	0	7	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0.12	0.03	1	1 Yes
7	HEWITTS AVE	H9	390		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0 No
14	HEWITTS AVE	H9	440		0	0	0	0	0	0	14	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0.15	0.07	1	1 Yes
5	HEWITTS AVE	H9	650		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0 No
12	HEWITTS AVE	H9	660		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1 No
3	HEWITTS AVE	H9	660		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0 No
10	HEWITTS AVE	H9	670		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0 No
			Total Damages		0	17	33	233	337	771	1825	0	17	67	217	384	718	1286	0	13	13	91	117	285	635	0	47	113	541	838	1775	3747	92	54	73	61 28
			AADD		0	3	3	7	9	6	13	0	3	4	7	9	6	10	0	2	1	3	3	2	5	0	7	8	16	21	13	27	92			
Number of Lots Flooded by Event					0	1	2	10	16	27	62	0	1	4	13	23	43	77	0	1	1	7	9	22	49	0	1	4	14	26	45	80				

FLOOD DAMAGES ASSESSMEN

HEWITTS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme			Scheme B - Property Modifications at Corbett Avenue																												
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K										
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
35	GEORGE ST	H1	1550		0	0	6	15	26	32	36	0	0	17	17	17	17	17	0	0	0	0	13	13	13	0	0	23	32	56	62	65	5.04	2.53	0	0	No
37	GEORGE ST	H1	1570		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
37	GEORGE ST	H1	1585		0	0	0	0	0	0	2	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	19	0.26	0.01	0	0	No
41	GEORGE ST	H1	1605		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
43	GEORGE ST	H1	1620		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
45	GEORGE ST	H1	1635		0	0	0	0	0	0	26	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	39	0.19	0.19	0	0	No
47	GEORGE ST	H1	1650		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
49	GEORGE ST	H1	1660		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
51	GEORGE ST	H1	1675		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
53	GEORGE ST	H1	1690		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
55	GEORGE ST	H1	1705		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
57	GEORGE ST	H1	1720		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
61	GEORGE ST	H1	1760		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
63	GEORGE ST	H1	1785		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
65	GEORGE ST	H1	1805		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
67	GEORGE ST	H1	1820		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
69	GEORGE ST	H1	1835		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
71	GEORGE ST	H1	1850		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
73	GEORGE ST	H1	1865		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
75	GEORGE ST	H1	1885		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	LACHLAN ST	H3	75		0	0	0	0	0	0	34	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	64	0.32	0.23	1	1	Yes
19	LACHLAN ST	H3	90		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
27	GEORGE ST	H3	145		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	LACHLAN ST	H3	155		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	GEORGE ST	H3	180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
31	GEORGE ST	H3	210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	LACHLAN ST	H3	210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
33	GEORGE ST	H3	220		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
25	LACHLAN ST	H3	255		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
19	GEORGE ST	H4	270		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
23	GEORGE ST	H4	275		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
25	GEORGE ST	H4	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
18	GEORGE ST	H4	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
36	SOUDAN ST	H4	370		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
34	SOUDAN ST	H4	390		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
32	SOUDAN ST	H4	400		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
30	SOUDAN ST	H4	560		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
28	SOUDAN ST	H4	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
26	SOUDAN ST	H4	1460		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	JENNIFER CRES	H4	1480		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24	SOUDAN ST	H4	1485		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	VIRGINIA TERRACE	H4	1490		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
33	ARUNTA DRIVE	H4	1515		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
31	ARUNTA DRIVE	H4	1520		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	ARUNTA DRIVE	H4	1520		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN

HEWITTS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Scheme B - Property Modifications at Corbett Avenue																														
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K										
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
27	ARUNTA DRIVE	H4	1535		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
25	ARUNTA DRIVE	H4	1540		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	ARUNTA DRIVE	H4	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	ARUNTA DRIVE	H4	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	ARUNTA DRIVE	H4	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	PALM GROVE	H4	55		0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0.04	0.04	0	0	No
2	HICKS RD	H4	130		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	CORNOCK AVE	H4	140		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
435	LAWRENCE HARGRAVE	H5	160		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
433	LAWRENCE HARGRAVE	H5	175		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	17	0.58	0.00	1	0	No
409	LAWRENCE HARGRAVE	H5	190		0	0	0	0	0	0	33	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	62	0.47	0.23	1	1	Yes
444	LAWRENCE HARGRAVE	H5	210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
413	LAWRENCE HARGRAVE	H5	220		0	0	0	0	4	34	39	0	0	0	0	17	17	17	0	0	0	0	0	13	13	0	0	0	0	21	64	69	1.40	0.82	1	1	No
431	LAWRENCE HARGRAVE	H5	250		0	0	0	0	0	0	30	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	59	0.46	0.21	1	1	Yes
442	LAWRENCE HARGRAVE	H5	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
36	HEWITTS AVE	H5	280		0	0	0	27	33	39	43	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	56	63	68	73	4.55	3.30	1	1	No
36	HEWITTS AVE	H5	290		0	0	0	25	33	38	43	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	54	62	68	73	4.45	3.20	1	1	No
440	LAWRENCE HARGRAVE	H5	325		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	HEWITTS AVE	H5	340		0	0	0	0	0	0	31	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	61	0.47	0.22	1	1	Yes
34	HEWITTS AVE	H5	365		0	0	0	0	14	35	40	0	0	0	17	17	17	17	0	0	0	0	0	13	13	0	0	0	17	31	65	69	2.27	1.02	1	1	No
415	LAWRENCE HARGRAVE	H5	375		0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00	0	0	No
419	LAWRENCE HARGRAVE	H5	395		0	0	0	35	37	42	46	0	0	17	17	17	17	17	0	0	0	13	13	13	13	0	0	17	65	66	71	76	6.25	3.75	1	1	No
421	LAWRENCE HARGRAVE	H5	400		0	0	0	35	36	41	46	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	64	66	71	75	4.96	3.71	1	1	No
423	LAWRENCE HARGRAVE	H5	495		0	0	0	8	24	37	41	0	0	0	17	17	17	17	0	0	0	0	13	13	13	0	0	0	25	53	66	71	3.08	1.83	1	1	No
425	LAWRENCE HARGRAVE	H5	520		0	0	0	0	10	35	39	0	0	0	0	17	17	17	0	0	0	0	0	13	13	0	0	0	0	26	65	69	1.51	0.93	1	1	No
427	LAWRENCE HARGRAVE	H5	605		0	0	0	0	0	24	36	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	53	66	0.86	0.61	1	1	No
429	LAWRENCE HARGRAVE	H5	1050		0	0	0	26	33	39	43	0	0	0	0	0	17	17	0	0	0	13	13	13	13	0	0	0	39	46	68	73	3.51	3.27	1	1	No
438	LAWRENCE HARGRAVE	H5	1055		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	HEWITTS AVE	H5	1060		0	0	0	0	0	0	32	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	61	0.47	0.22	1	1	Yes
25	HEWITTS AVE	H5	1060		0	0	0	0	0	13	35	0	0	0	0	17	17	17	0	0	0	0	0	0	13	0	0	0	0	17	30	64	0.95	0.37	1	1	No
428	LAWRENCE HARGRAVE	H5	1070		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
426	LAWRENCE HARGRAVE	H5	1070		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	0	No
436	LAWRENCE HARGRAVE	H5	1070		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
418	LAWRENCE HARGRAVE	H5	1080		0	0	0	30	34	39	44	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	60	64	69	74	4.73	3.48	1	1	No
422	LAWRENCE HARGRAVE	H5	1080		0	0	0	0	0	27	37	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	57	66	0.90	0.65	1	1	No
424	LAWRENCE HARGRAVE	H5	1080		0	0	0	0	0	0	15	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0.16	0.07	1	1	Yes
2	HIGH ST	H5	1100		0	0	0	0	5	35	39	0	0	0	17	17	17	17	0	0	0	0	0	13	13	0	0	0	17	22	64	69	2.08	0.83	1	1	No
4	HIGH ST	H5	1100		0	0	0	0	0	32	38	0	0	0	0	17	17	17	0	0	0	0	0	13	13	0	0	0	0	17	61	67	1.28	0.70	1	1	No
416	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	0	26	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	56	0.44	0.19	1	1	Yes
3	HIGH ST	H5	1100		0	0	0	0	0	0	26	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	0	55	0.27	0.19	1	1	Yes
414	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	0	10	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0.13	0.05	1	1	Yes
412	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	0	15	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0.16	0.07	1	1	Yes
399	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	3	34	39	0	0	0	0	0	0	0	0	0	0	0	0	13	13	0	0	0	0	3	47	52	0.79	0.79	1	1	No
406	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
397	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	17	36	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	47	65	0.79	0.54	1	1	No
393	LAWRENCE HARGRAVE	H5	1100		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN

HEWITTS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Scheme B - Property Modifications at Corbett Avenue																													
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							AADD	Total Above	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF					
2	LACHLAN ST	H5	1110		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
4	LACHLAN ST	H5	1120		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	LACHLAN ST	H5	1120		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00	0	0	No
10	LACHLAN ST	H5	1130		0	17	27	27	29	31	34	0	17	17	17	17	17	17	0	13	13	13	13	13	13	0	47	57	57	59	60	64	17.94	12.10	0	0	No
12	LACHLAN ST	H5	1130		0	0	0	0	0	0	30	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	59	0.29	0.21	1	1	Yes
14	LACHLAN ST	H5	1140		0	0	0	0	0	0	28	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	57	0.28	0.20	1	1	Yes
16	LACHLAN ST	H5	1140		0	0	0	0	0	0	13	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0.15	0.06	1	0	No
18	LACHLAN ST	H5	1140		0	0	0	0	0	0	35	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	64	0.32	0.24	1	1	Yes
6	LACHLAN ST	H5	1150		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
8	LACHLAN ST	H5	1160		0	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	0	VP	VP	VP	VP	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	No
381	LAWRENCE HARGRAVE	H5	1160		0	0	0	0	4	7	22	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	4	24	51	0.57	0.32	0	0	No
385	LAWRENCE HARGRAVE	H5	1165		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
387	LAWRENCE HARGRAVE	H5	1170		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
389	LAWRENCE HARGRAVE	H5	1180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
391	LAWRENCE HARGRAVE	H5	1210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
398	LAWRENCE HARGRAVE	H5	1215		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	LACHLAN ST	H5	1220		0	0	0	0	0	0	0	0	0	17	0	17	17	17	0	0	0	0	0	0	0	0	0	17	0	17	17	17	1.84	0.00	1	0	No
5	LACHLAN ST	H5	1240		0	0	0	0	0	0	0	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	17	0.25	0.00	1	0	No
7	LACHLAN ST	H5	1270		0	0	0	6	12	19	23	0	0	0	17	17	17	17	0	0	0	0	0	13	13	0	0	0	22	28	49	53	2.21	0.96	1	1	No
9A	LACHLAN ST	H5	1280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
9	LACHLAN ST	H5	1300		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00	1	1	No
11A	LACHLAN ST	H5	1300		0	0	0	0	0	0	15	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0.16	0.07	1	1	No
11	LACHLAN ST	H5	1300		0	0	0	0	0	0	17	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	17	17	47	1.40	0.15	1	1	No
15	LACHLAN ST	H5	1300		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00	1	0	No
11	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
15	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
2/19	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1/19	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	SEABREEZE PLACE	H6	1300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
8	HAMILTON RD	H7	1300		0	0	0	0	0	0	23	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	0	52	0.26	0.18	1	1	Yes
9	CORBETT AVE	H7	1300		0	0	0	0	0	0	3	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0.10	0.01	1	1	No
6	HAMILTON RD	H7	1300		0	0	0	0	0	0	0	0	0	0	0	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0.12	0.00	1	1	No
11	CORBETT AVE	H7	1320		0	0	0	0	0	0	15	0	0	0	0	0	8	8	0	0	0	0	0	0	6	0	0	0	0	0	0	29	0.15	0.10	1	1	Yes
4	HAMILTON RD	H7	1325		0	0	0	0	0	5	17	0	0	0	0	8	8	8	0	0	0	0	0	0	6	0	0	0	0	8	14	32	0.46	0.17	1	1	No
12	CORBETT AVE	H7	1335		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
13	CORBETT AVE	H7	1335		0	0	0	0	0	5	17	0	0	0	8	8	8	8	0	0	0	0	0	0	6	0	0	0	0	8	14	32	0.79	0.17	1	1	No
14	CORBETT AVE	H7	1340		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
15	CORBETT AVE	H7	1355		0	0	0	0	0	4	16	0	0	0	8	8	8	8	0	0	0	0	0	0	6	0	0	0	8	8	12	31	0.78	0.15	1	1	No
16	CORBETT AVE	H7	1360		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	CORBETT AVE	H7	1360		0	0	2	7	11	14	18	0	0	8	8	8	8	8	0	0	0	0	6	6	6	0	0	11	15	26	28	39	2.38	1.13	1	1	No
18	CORBETT AVE	H7	460		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
20	CORBETT AVE	H7	490		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
22	CORBETT AVE	H7	510		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24	CORBETT AVE	H7	515		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN

HEWITTS CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data				Scheme	Scheme B - Property Modifications at Corbett Avenue																																
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K												
House	Street Name	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
26	CORBETT AVE	H7	520		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
28	CORBETT AVE	H7	550		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
30	CORBETT AVE	H7	570		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
9	SEABREEZE PLACE	H7	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
32A	HEWITTS AVE	H9	215		0	0	0	0	0	34	38	0	0	0	0	17	17	17	0	0	0	0	0	13	13	0	0	0	0	17	63	68	1.30	0.72	1	1	No
32	HEWITTS AVE	H9	215		0	0	0	0	0	24	36	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	53	66	0.85	0.61	1	1	No
30	HEWITTS AVE	H9	235		0	0	0	0	0	21	36	0	0	0	0	0	17	17	0	0	0	0	0	13	13	0	0	0	0	0	51	65	0.83	0.58	1	1	No
28	HEWITTS AVE	H9	235		0	0	0	0	0	12	35	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	29	64	0.60	0.36	1	1	No
17	HEWITTS AVE	H9	260		0	0	0	0	0	0	32	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	62	0.47	0.22	1	1	Yes
19	HEWITTS AVE	H9	260		0	0	0	0	0	0	32	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	61	0.47	0.22	1	1	Yes
26	HEWITTS AVE	H9	265		0	0	0	0	0	0	32	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	62	0.47	0.22	1	1	Yes
15	HEWITTS AVE	H9	265		0	0	0	0	0	15	35	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	32	65	0.63	0.38	1	1	No
24	HEWITTS AVE	H9	275		0	0	0	0	0	0	30	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	60	0.46	0.21	1	1	Yes
13	HEWITTS AVE	H9	275		0	0	0	0	0	0	11	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0.14	0.06	1	1	Yes
22	HEWITTS AVE	H9	285		0	0	0	0	0	15	35	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	15	65	0.47	0.39	1	1	No
11	HEWITTS AVE	H9	295		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	1	No
20	HEWITTS AVE	H9	310		0	0	0	0	0	0	16	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0.16	0.08	1	1	Yes
18	HEWITTS AVE	H9	330		0	0	0	0	0	0	7	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0.12	0.03	1	1	Yes
9	HEWITTS AVE	H9	350		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	0	No
16	HEWITTS AVE	H9	375		0	0	0	0	0	0	7	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0.12	0.03	1	1	Yes
7	HEWITTS AVE	H9	390		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
14	HEWITTS AVE	H9	440		0	0	0	0	0	0	14	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0.15	0.07	1	1	Yes
5	HEWITTS AVE	H9	650		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
12	HEWITTS AVE	H9	660		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
3	HEWITTS AVE	H9	660		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
10	HEWITTS AVE	H9	670		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
			Total Damages		0	17	36	240	348	799	1724	0	17	75	242	418	760	1219	0	13	13	91	123	292	603	0	47	124	573	889	1851	3547	95	55	74	61	24
			AADD		0	3	3	7	9	6	12	0	3	5	8	10	6	10	0	2	1	3	3	2	4	0	7	9	17	22	14	27	95				
	Number of Lots Flooded by Event				0	1	3	11	17	31	62	0	1	5	16	27	48	76	0	1	1	7	10	23	49	0	1	5	17	30	50	79					

FLOOD DAMAGES ASSESSMEN
HEWITTS CREEK STREAM 4

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme		Scheme A - Flood/Property Mods -Virginia TCE																														
				Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K										
House	Street	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
36	GEORGE ST	H2	75		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
38	GEORGE ST	H2	90		0	0	0	0	0	0	0	0	8	8	8	8	8	8	0	0	0	0	0	0	0	0	8	8	8	8	8	8	2.92	0.00	1	0	No
25	JENNIFER CRES	H2	145		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
27	JENNIFER CRES	H2	155		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	JENNIFER CRES	H2	180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
22	JENNIFER CRES	H2	210		0	0	0	0	0	0	0	8	8	8	8	8	8	8	0	0	0	0	0	0	0	8	8	8	8	8	8	8	6.26	0.00	1	0	No
24	JENNIFER CRES	H2	210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
26	JENNIFER CRES	H2	220		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	VIRGINIA TERRACE	H2	255		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	VIRGINIA TERRACE	H2	270		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
25	VIRGINIA TERRACE	H2	275		13	13	13	13	18	18	18	8	8	8	8	8	8	8	6	6	6	6	6	6	6	28	28	28	28	32	33	33	20.95	14.69	1	1	No
32	VIRGINIA TERRACE	H2	310		0	0	0	0	5	6	11	0	0	0	8	8	8	8	0	0	0	0	0	0	6	0	0	0	8	14	14	25	0.87	0.25	1	1	No
30	VIRGINIA TERRACE	H2	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
13	DEBORAH AVE	H2	370		0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0.03	0.03	1	1	No
11	HAZEL CRES	H2	390		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
14	DEBORAH AVE	H2	400		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	CORNOCK AVE	H2	560		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	CORNOCK AVE	H2	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
Totals For Hewitts Stream 4		Total Flood Damage			13	13	13	13	23	24	35	17	25	25	33	33	33	33	6	6	6	6	6	6	13	36	44	44	53	63	63	81	31	15	5	3	0
		AADD			3	4	1	1	1	0	0	4	6	3	1	1	0	0	2	2	1	0	0	0	0	9	12	4	2	2	1	1	31				
Number of Lots Flooded by Event					1	1	1	1	2	2	3	2	3	3	4	4	4	4	1	1	1	1	1	1	2	2	3	3	4	4	4	5					
Total For Hewitts/Woodlands System		Total Flood Damage			13	30	46	246	360	795	2002	17	42	92	251	418	752	1403	6	19	19	97	123	292	713	36	91	157	594	901	1838	4118	125				
		AADD			3	6	4	7	9	6	14	4	9	7	9	10	6	11	2	4	2	3	3	2	5	9	19	12	19	22	14	29	125				

FLOOD DAMAGES ASSESSMEN
HEWITTS CREEK STREAM 4

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Location Data		Scheme			Scheme B - VP at Virginia																														
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K										
House	Street	Reach	Chain	AEP%	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
36	GEORGE ST	H2	75		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
38	GEORGE ST	H2	90		0	0	0	0	0	0	0	0	17	17	17	17	17	17	0	0	0	0	0	0	0	0	17	17	17	17	17	17	5.84	0.00	0	0	No
25	JENNIFER CRES	H2	145		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
27	JENNIFER CRES	H2	155		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	JENNIFER CRES	H2	180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
22	JENNIFER CRES	H2	210		0	0	0	0	0	0	0	17	17	17	17	17	17	17	0	0	0	0	0	0	0	17	17	17	17	17	17	17	12.53	0.00	0	0	No
24	JENNIFER CRES	H2	210		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
26	JENNIFER CRES	H2	220		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	VIRGINIA TERRACE	H2	255		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	VIRGINIA TERRACE	H2	270		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
25	VIRGINIA TERRACE	H2	275		VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	0	0	0	0	0	0	0	0.00	0.00	1	1	Yes
32	VIRGINIA TERRACE	H2	310		0	0	0	0	10	12	21	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	27	28	51	1.75	0.49	1	1	No
30	VIRGINIA TERRACE	H2	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
13	DEBORAH AVE	H2	370		0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0.06	0.06	0	0	No
11	HAZEL CRES	H2	390		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
14	DEBORAH AVE	H2	400		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	CORNOCK AVE	H2	560		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	CORNOCK AVE	H2	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
Totals For Hewitts Stream 4		Total Flood Damage			0	0	0	0	10	12	34	17	33	33	50	50	50	50	0	0	0	0	0	0	13	17	33	33	50	61	62	97	20	1	2	2	1
		AADD			0	0	0	0	0	0	0	4	8	3	2	2	1	0	0	0	0	0	0	0	0	4	8	3	2	2	1	1	20				
		Number of Lots Flooded by Event			0	0	0	0	1	1	2	1	2	2	3	3	3	3	0	0	0	0	0	0	1	1	2	2	3	3	3	4					
Total For Hewitts/Woodlands Svstem		Total Flood Damage			0	17	36	240	359	811	1955	17	50	109	292	468	810	1370	0	13	13	91	123	292	681	17	80	157	623	950	1913	4006	117				
		AADD			0	3	3	7	9	6	14	4	10	8	10	11	6	11	0	2	1	3	3	2	5	4	15	12	20	24	14	29	117				

FLOOD DAMAGES ASSESSMEN
THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

House	Street	Reach	Chain	Scheme	Scheme A - Augment Piped Draiange System																													
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
				AEP %	1 50	1 20	1 10	1 5	1 2	1 1	1 PMF	2 50	2 20	2 10	2 5	2 2	2 1	2 PMF	3 50	3 20	3 10	3 5	3 2	3 1	3 PMF	50	20	10	5	2	1	PMF					
2	MCCAULEY ST	TG1	50		7	7	9	14	17	18	22	0	0	17	17	17	17	17	0	0	0	0	13	13	13	7	7	26	31	47	48	52	8.98	6.48	0	0	No
3	RAYMOND RD	TG1	50		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
291	LAWRENCE HARG	TG1	60		0	0	0	0	0	0	4	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	21	1.27	0.02	0	0	No
291	LAWRENCE HARG	TG1	60		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	RAYMOND RD	TG1	60		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
46	SEA FOAM AVE	TG1	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
48	SEA FOAM AVE	TG1	330		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
50	SEA FOAM AVE	TG1	350		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
52	SEA FOAM AVE	TG1	365		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
54	SEA FOAM AVE	TG1	380		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
56	SEA FOAM AVE	TG1	410		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	SEA FOAM AVE	TG1	415		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
	SEA FOAM AVE	TG1	420		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
31	SEA FOAM AVE	TG1	420		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
33	SEA FOAM AVE	TG1	425		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
58	SEA FOAM AVE	TG1	425		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
36	THE LOOKOUT	TG1	430		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	SEA FOAM AVE	TG1	430		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	SEA FOAM AVE	TG1	440		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
60	SEA FOAM AVE	TG1	450		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	SEA FOAM AVE	TG1	450		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	SEA FOAM AVE	TG1	460		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	SEA FOAM AVE	TG1	475		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	SEA FOAM AVE	TG1	475		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
104	PHILLIP ST	TG1	475		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	SEAVIEW TERRAC	TG1	560		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	MT GILEAD RD	TG1	575		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	MT GILEAD RD	TG1	590		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
5	MT GILEAD RD	TG1	605		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
7	MT GILEAD RD	TG1	620		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
9	MT GILEAD RD	TG1	635		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
11	MT GILEAD RD	TG1	650		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
13	MT GILEAD RD	TG1	665		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
15	MT GILEAD RD	TG1	680		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	MT GILEAD RD	TG1	695		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	MT GILEAD RD	TG1	710		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	MT GILEAD RD	TG1	720		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	MT GILEAD RD	TG1	720		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
25	MCCAULEY ST	TG10	10		16	18	18	20	20	21	34	0	0	17	17	17	17	17	0	13	13	13	13	13	13	16	31	48	50	50	51	63	19.77	17.27	1	1	No
28	MCCAULEY ST	TG10	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
30	MCCAULEY ST	TG10	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN

THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Scheme — **Scheme A - Augment Piped Draiange System**

House	Street	Reach	Chain	Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
				1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3												
			AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF					
32	MCCAULEY ST	TG10	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
34	MCCAULEY ST	TG10	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
22	STATION ST	TG10	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
35	STATION ST	TG10	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
11	STATION ST	TG10	250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
	STATION ST	TG10	270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
	STATION ST	TG10	270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
	STATION ST	TG10	270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
	STATION ST	TG10	270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
9	STATION ST	TG10	280	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
4	MCCAULEY ST	TG2	30	0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
6	MCCAULEY ST	TG2	40	0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
0	RAYMOND RD	TG2	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
8	MCCAULEY ST	TG2	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
10	MCCAULEY ST	TG2	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
12	MCCAULEY ST	TG2	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
14	MCCAULEY ST	TG2	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
16	MCCAULEY ST	TG2	115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
18	MCCAULEY ST	TG2	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
20	MCCAULEY ST	TG2	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
22	MCCAULEY ST	TG2	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
26	MCCAULEY ST	TG2	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
26A	MCCAULEY ST	TG2	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24	MCCAULEY ST	TG2	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	RAYMOND RD	TG2	165	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	RAYMOND RD	TG2	175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
25	RAYMOND RD	TG2	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
27	RAYMOND RD	TG2	190	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
16	RAYMOND RD	TG2	240	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
10	RAYMOND RD	TG2	240	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	BATH ST	TG3	30	0	0	0	0	0	0	23	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	17	53	2.68	0.18	1	1	Yes
5	BATH ST	TG3	50	0	0	0	0	0	0	8	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	24	2.54	0.04	1	1	No
27	OCEAN ST	TG3	55	0	0	0	0	0	4	28	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	21	57	2.74	0.24	1	1	No
7	BATH ST	TG3	65	0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	1	1	No
9	BATH ST	TG3	80	0	0	0	0	0	0	11	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	28	0.64	0.05	1	1	No
11	BATH ST	TG3	95	0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	1	1	No
13	BATH ST	TG3	110	0	0	0	0	0	0	9	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	26	1.30	0.04	1	1	No
15	BATH ST	TG3	130	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00	1	0	No
17	BATH ST	TG3	150	0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00	1	0	No
21	BATH ST	TG3	175	0	0	0	0	0	0	6	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	22	1.28	0.03	1	1	Yes
23	BATH ST	TG3	190	0	0	0	0	0	0	0	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	17	1.25	0.00	1	0	No
25	BATH ST	TG3	200	0	0	0	0	0	0	7	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	24	2.54	0.04	1	1	Yes

FLOOD DAMAGES ASSESSMEN
THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Scheme A - Augment Piped Draiange System

House	Street	Reach	Chain	Scheme	Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
				AEP %	1 50	1 20	1 10	1 5	1 2	1 1	1 PMF	2 50	2 20	2 10	2 5	2 2	2 1	2 PMF	3 50	3 20	3 10	3 5	3 2	3 1	3 PMF	50	20	10	5	2	1	PMF					
27	BATH ST	TG3	220		0	0	0	0	0	4	15	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	21	32	1.37	0.12	1	1	No
3	MCCAULEY ST	TG3	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
5	MCCAULEY ST	TG3	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	BATH ST	TG3	260		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
45	THE ESPLANADE	TG4	80		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	1	No
47	THE ESPLANADE	TG4	90		0	0	0	0	0	0	6	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0.11	0.03	1	1	No
43	THE ESPLANADE	TG4	125		11	12	13	15	15	19	32	0	0	17	17	17	17	17	0	0	0	0	0	13	13	11	12	30	31	32	49	62	11.63	9.12	1	1	No
41	THE ESPLANADE	TG4	145		0	0	3	4	6	10	28	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	20	21	22	26	58	3.29	0.78	1	1	No
39	THE ESPLANADE	TG4	155		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
37	THE ESPLANADE	TG4	175		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
35A	THE ESPLANADE	TG4	195		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
35	THE ESPLANADE	TG4	200		0	0	0	0	0	3	25	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	3	55	0.31	0.22	1	1	No
33	THE ESPLANADE	TG4	225		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
31	THE ESPLANADE	TG4	245		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	THE ESPLANADE	TG4	255		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
12	CLIFF PDE	TG4	265		0	0	0	0	4	7	28	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	21	24	58	2.86	0.35	1	1	No
26	OCEAN ST	TG5	100		0	0	0	0	0	0	28	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	17	58	0.45	0.20	1	1	Yes
23	HARBORD ST	TG5	135		0	0	0	0	0	0	23	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	17	53	2.68	0.18	1	1	Yes
345	LAWRENCE HARG	TG6	150		0	0	0	0	8	10	16	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	8	27	32	0.59	0.35	0	0	No
345	LAWRENCE HARG	TG6	165		0	0	0	0	8	11	18	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	8	27	47	0.68	0.43	0	0	No
6	RAILWAY PDE	TG6	200		0	0	0	0	3	6	13	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	19	22	30	2.68	0.17	0	0	No
8	RAILWAY PDE	TG6	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
10	RAILWAY PDE	TG6	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
12	RAILWAY PDE	TG6	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
14	RAILWAY PDE	TG6	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
354	LAWRENCE HARG	TG6	210		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
360	LAWRENCE HARG	TG6	220		19	19	19	22	25	26	30	0	0	17	17	17	17	17	13	13	13	13	13	13	13	32	32	48	51	54	56	59	26.79	24.29	1	1	No
351	LAWRENCE HARG	TG6	230		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00	0	0	No
364	LAWRENCE HARG	TG6	240		0	0	0	7	10	13	18	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	24	27	29	48	3.27	0.77	0	0	No
353	LAWRENCE HARG	TG6	240		0	0	0	0	0	4	10	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	4	26	0.17	0.08	0	0	No
368	LAWRENCE HARG	TG6	260		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
374	LAWRENCE HARG	TG6	280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
105	PHILLIP ST	TG6	280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
378	LAWRENCE HARG	TG6	300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
382	LAWRENCE HARG	TG6	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
103	PHILLIP ST	TG6	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
138	PHILLIP ST	TG6	330		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
101	PHILLIP ST	TG6	350		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
99	PHILLIP ST	TG6	360		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
136	PHILLIP ST	TG6	365		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
134	PHILLIP ST	TG6	380		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
132	PHILLIP ST	TG6	390		0	0	0	0	0	0	0	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	17	0.25	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN
THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

House	Street	Reach	Chain	Scheme	Scheme A - Augment Piped Draiange System																														
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
				AEP %	1 50	1 20	1 10	1 5	1 2	1 1	1 PMF	2 50	2 20	2 10	2 5	2 2	2 1	2 PMF	3 50	3 20	3 10	3 5	3 2	3 1	3 PMF	50	20	10	5	2	1	PMF					
93	PHILLIP ST	TG6	400		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
130	PHILLIP ST	TG6	400		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
128	PHILLIP ST	TG6	410		5	5	5	8	10	11	13	0	0	17	17	17	17	17	0	0	0	0	0	0	0	5	5	21	25	26	28	30	6.68	4.18	1	1	No
126	PHILLIP ST	TG6	440		0	0	0	0	0	4	7	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	20	24	2.58	0.07	0	0	No
124	PHILLIP ST	TG6	455		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
4	VIRGINIA TERRAC	TG6	490		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
6	VIRGINIA TERRAC	TG6	500		0	0	0	0	3	4	5	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	20	21	22	2.63	0.13	0	0	No
8	VIRGINIA TERRAC	TG6	510		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
15	MASON ST	TG6	535		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
13	MASON ST	TG6	550		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
11	MASON ST	TG6	570		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
9	MASON ST	TG6	585		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
44	MCCAULEY ST	TG7	50		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
42	MCCAULEY ST	TG7	60		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
36	MCCAULEY ST	TG7	60		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
6	NEWBOLD CLOSE	TG7	80		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
8	NEWBOLD CLOSE	TG7	115		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
10	NEWBOLD CLOSE	TG7	135		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
12	NEWBOLD CLOSE	TG7	150		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
14	NEWBOLD CLOSE	TG7	165		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
16	NEWBOLD CLOSE	TG7	180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
18	NEWBOLD CLOSE	TG7	195		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
20	NEWBOLD CLOSE	TG7	215		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
22	NEWBOLD CLOSE	TG7	230		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24	NEWBOLD CLOSE	TG7	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
15	NEWBOLD CLOSE	TG7	270		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
26	NEWBOLD CLOSE	TG7	280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	NEWBOLD CLOSE	TG7	285		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
16	RAILWAY PDE	TG7	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
18	RAILWAY PDE	TG7	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
20	RAILWAY PDE	TG7	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
22	RAILWAY PDE	TG7	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24	RAILWAY PDE	TG7	580		0	0	0	15	15	15	30	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	15	15	15	43	1.27	1.27	1	1	No
	WREXHAM RD	TG7	580		0	0	0	9	9	9	27	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	25	25	26	57	3.31	0.81	1	1	No
397	LAWRENCE HARG	TG7	620		0	0	0	27	27	27	34	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	57	57	57	64	4.28	3.03	0	0	No
30	HARBORD ST	TG8	86		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
28	HARBORD ST	TG8	91		0	0	0	0	0	3	24	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	19	54	2.71	0.21	1	1	No
11	SPRAY ST	TG8	91		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
26	HARBORD ST	TG8	101		0	0	0	0	0	0	21	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	17	17	50	1.42	0.17	1	0	No
9	SPRAY ST	TG8	111		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24	HARBORD ST	TG8	116		0	0	0	0	0	0	17	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0.16	0.08	0	0	No
7	SPRAY ST	TG8	131		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN
THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

Scheme — **Scheme A - Augment Piped Draiange System**

House	Street	Reach	Chain	Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
			AEP %	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3											
				50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF					
5	SPRAY ST	TG8	151	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	SPRAY ST	TG8	161	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
16	HARBORD ST	TG8	181	0	0	0	0	0	0	6	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	22	1.28	0.03	1	0	No
1	SPRAY ST	TG8	181	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
14	HARBORD ST	TG8	191	0	0	0	0	0	0	18	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	17	17	47	1.40	0.15	1	0	No
18	HARBORD ST	TG8	231	0	0	0	0	0	0	26	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	17	56	2.70	0.19	1	1	Yes
12	ANN ST	TG8	281	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	MCCAULEY ST	TG8	291	30	31	32	32	32	33	36	0	0	17	17	17	17	17	13	13	13	13	13	13	13	43	44	61	62	62	62	66	35.17	32.66	1	1	No
10	ANN ST	TG8	296	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
27	MCCAULEY ST	TG8	296	2	6	7	9	10	12	30	0	0	17	17	17	17	17	0	0	0	0	0	0	13	2	6	24	26	27	28	59	6.06	3.56	1	1	No
15	CLIFF PDE	TG9	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
	Total Flood Damages			90	98	106	181	223	274	734	0	0	501	668	718	785	935	26	39	39	52	65	78	285	115	137	646	901	1006	1137	1954	199	108	36	28	6
	AADD			22	28	10	7	6	2	5	0	0	25	29	21	8	9	6	10	4	2	2	1	2	29	38	39	39	29	11	15	199				
	Number of lots Flooded by Event			5	5	6	10	15	19	27	0	0	20	24	25	29	38	2	2	2	3	3	4	18	5	5	20	25	28	32	39					

FLOOD DAMAGES ASSESSMEN
THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

House	Street	Reach	Chain	Scheme	Scheme B - Establish Overland Flow Paths																														
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
					1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3											
				AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF					
2	MCCAULEY ST	TG1	50		7	7	9	14	17	18	22	0	0	17	17	17	17	17	0	0	0	0	13	13	13	7	7	26	31	47	48	52	8.98	6.48	0	0	No
3	RAYMOND RD	TG1	50		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
291	LAWRENCE HARG	TG1	60		0	0	0	0	0	0	4	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	21	1.27	0.02	0	0	No
291	LAWRENCE HARG	TG1	60		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	RAYMOND RD	TG1	60		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
46	SEA FOAM AVE	TG1	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
48	SEA FOAM AVE	TG1	330		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
50	SEA FOAM AVE	TG1	350		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
52	SEA FOAM AVE	TG1	365		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
54	SEA FOAM AVE	TG1	380		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
56	SEA FOAM AVE	TG1	410		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	SEA FOAM AVE	TG1	415		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
	SEA FOAM AVE	TG1	420		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
31	SEA FOAM AVE	TG1	420		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
33	SEA FOAM AVE	TG1	425		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
58	SEA FOAM AVE	TG1	425		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
36	THE LOOKOUT	TG1	430		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	SEA FOAM AVE	TG1	430		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	SEA FOAM AVE	TG1	440		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
60	SEA FOAM AVE	TG1	450		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	SEA FOAM AVE	TG1	450		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	SEA FOAM AVE	TG1	460		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	SEA FOAM AVE	TG1	475		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
74	SEA FOAM AVE	TG1	475		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
104	PHILLIP ST	TG1	475		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	SEAVIEW TERRAC	TG1	560		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	MT GILEAD RD	TG1	575		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	MT GILEAD RD	TG1	590		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
5	MT GILEAD RD	TG1	605		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
7	MT GILEAD RD	TG1	620		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
9	MT GILEAD RD	TG1	635		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
11	MT GILEAD RD	TG1	650		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
13	MT GILEAD RD	TG1	665		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
15	MT GILEAD RD	TG1	680		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	MT GILEAD RD	TG1	695		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
19	MT GILEAD RD	TG1	710		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	MT GILEAD RD	TG1	720		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	MT GILEAD RD	TG1	720		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
25	MCCAULEY ST	TG10	10		16	18	18	20	20	21	34	0	0	17	17	17	17	17	0	13	13	13	13	13	13	16	31	48	50	50	51	63	19.77	17.27	1	1	No
28	MCCAULEY ST	TG10	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
30	MCCAULEY ST	TG10	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN

THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

House	Street	Reach	Chain	Scheme	Scheme B - Establish Overland Flow Paths																													
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
					1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3												
				AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF					
32	MCCAULEY ST	TG10	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
34	MCCAULEY ST	TG10	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
22	STATION ST	TG10	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
35	STATION ST	TG10	50		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	0	No
11	STATION ST	TG10	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
	STATION ST	TG10	270		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
	STATION ST	TG10	270		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
	STATION ST	TG10	270		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
	STATION ST	TG10	270		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
9	STATION ST	TG10	280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
4	MCCAULEY ST	TG2	30		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
6	MCCAULEY ST	TG2	40		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
0	RAYMOND RD	TG2	50		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
8	MCCAULEY ST	TG2	60		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
10	MCCAULEY ST	TG2	80		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
12	MCCAULEY ST	TG2	90		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
14	MCCAULEY ST	TG2	105		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
16	MCCAULEY ST	TG2	115		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
18	MCCAULEY ST	TG2	125		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
20	MCCAULEY ST	TG2	135		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
22	MCCAULEY ST	TG2	145		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
26	MCCAULEY ST	TG2	145		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
26A	MCCAULEY ST	TG2	150		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24	MCCAULEY ST	TG2	160		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
21	RAYMOND RD	TG2	165		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
23	RAYMOND RD	TG2	175		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
25	RAYMOND RD	TG2	180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
27	RAYMOND RD	TG2	190		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
16	RAYMOND RD	TG2	240		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
10	RAYMOND RD	TG2	240		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
1	BATH ST	TG3	30		0	0	0	0	0	0	22	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	17	51	2.67	0.17	1	1	Yes
5	BATH ST	TG3	50		0	0	0	0	0	0	6	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	22	2.53	0.03	1	1	No
27	OCEAN ST	TG3	55		0	0	0	0	0	6	27	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	22	56	2.76	0.25	1	1	No
7	BATH ST	TG3	65		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	1	1	No
9	BATH ST	TG3	80		0	0	0	0	0	0	9	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	26	0.63	0.05	1	1	No
11	BATH ST	TG3	95		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	1	1	No
13	BATH ST	TG3	110		0	0	0	0	0	0	7	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	24	2.54	0.04	1	1	No
15	BATH ST	TG3	130		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
17	BATH ST	TG3	150		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
21	BATH ST	TG3	175		0	0	0	0	0	4	9	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	21	26	2.59	0.09	1	1	No
23	BATH ST	TG3	190		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
25	BATH ST	TG3	200		0	0	0	0	5	7	12	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	21	23	29	2.73	0.22	0	0	No

FLOOD DAMAGES ASSESSMEN
THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

House	Street	Reach	Chain	Scheme	Scheme B - Establish Overland Flow Paths																																
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
					1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3												
				AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF					
27	BATH ST	TG3	220		0	0	0	0	12	14	19	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	29	31	49	3.05	0.55	1	1	No
3	MCCAULEY ST	TG3	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
5	MCCAULEY ST	TG3	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	BATH ST	TG3	260		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
45	THE ESPLANADE	TG4	80		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	1	No
47	THE ESPLANADE	TG4	90		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	1	1	No
43	THE ESPLANADE	TG4	125		0	6	7	12	16	19	31	0	0	17	17	17	17	17	0	0	0	0	0	13	13	0	6	24	29	33	49	61	5.50	2.99	1	1	No
41	THE ESPLANADE	TG4	145		0	0	0	0	6	11	27	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	23	27	57	2.93	0.42	1	1	No
39	THE ESPLANADE	TG4	155		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
37	THE ESPLANADE	TG4	175		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
35A	THE ESPLANADE	TG4	195		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
35	THE ESPLANADE	TG4	200		0	0	0	0	0	4	23	0	0	0	0	0	0	17	0	0	0	0	0	0	13	0	0	0	0	0	4	53	0.31	0.22	1	1	No
33	THE ESPLANADE	TG4	225		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	1	1	No
31	THE ESPLANADE	TG4	245		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	THE ESPLANADE	TG4	255		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
12	CLIFF PDE	TG4	265		0	0	0	0	3	8	26	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	20	25	56	1.58	0.33	1	1	No
26	OCEAN ST	TG5	100		0	0	0	0	0	3	28	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	0	20	58	0.48	0.23	1	1	No
23	HARBORD ST	TG5	135		0	0	0	0	0	0	24	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	17	54	2.69	0.18	1	1	Yes
345	LAWRENCE HARG	TG6	150		0	0	0	0	8	10	16	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	8	27	32	0.59	0.35	0	0	No
345	LAWRENCE HARG	TG6	165		0	0	0	0	8	11	18	0	0	0	0	0	17	17	0	0	0	0	0	0	13	0	0	0	0	8	27	47	0.68	0.43	0	0	No
6	RAILWAY PDE	TG6	200		0	0	0	0	3	6	13	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	19	22	30	2.68	0.17	0	0	No
8	RAILWAY PDE	TG6	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
10	RAILWAY PDE	TG6	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
12	RAILWAY PDE	TG6	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
14	RAILWAY PDE	TG6	200		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
354	LAWRENCE HARG	TG6	210		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
360	LAWRENCE HARG	TG6	220		19	19	19	22	25	26	30	0	0	17	17	17	17	17	13	13	13	13	13	13	13	32	32	48	51	54	56	59	26.79	24.29	1	1	No
351	LAWRENCE HARG	TG6	230		0	0	0	0	0	0	0	0	0	0	0	17	17	17	0	0	0	0	0	0	0	0	0	0	0	17	17	17	0.58	0.00	0	0	No
364	LAWRENCE HARG	TG6	240		0	0	0	7	10	13	18	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	24	27	29	48	3.27	0.77	0	0	No
353	LAWRENCE HARG	TG6	240		0	0	0	0	0	4	10	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	4	26	0.17	0.08	0	0	No
368	LAWRENCE HARG	TG6	260		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
374	LAWRENCE HARG	TG6	280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
105	PHILLIP ST	TG6	280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
378	LAWRENCE HARG	TG6	300		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
382	LAWRENCE HARG	TG6	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
103	PHILLIP ST	TG6	310		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
138	PHILLIP ST	TG6	330		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
101	PHILLIP ST	TG6	350		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
99	PHILLIP ST	TG6	360		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
136	PHILLIP ST	TG6	365		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
134	PHILLIP ST	TG6	380		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
132	PHILLIP ST	TG6	390		0	0	0	0	0	0	0	0	0	0	0	0	17	17	0	0	0	0	0	0	0	0	0	0	0	0	17	17	0.25	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN
THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

House	Street	Reach	Chain	Scheme	Scheme B - Establish Overland Flow Paths																														
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
				AEP %	1 50	1 20	1 10	1 5	1 2	1 1	1 PMF	2 50	2 20	2 10	2 5	2 2	2 1	2 PMF	3 50	3 20	3 10	3 5	3 2	3 1	3 PMF	50	20	10	5	2	1	PMF					
93	PHILLIP ST	TG6	400		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
130	PHILLIP ST	TG6	400		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
128	PHILLIP ST	TG6	410		5	5	5	8	10	11	13	0	0	17	17	17	17	17	0	0	0	0	0	0	0	5	5	21	25	28	28	30	6.68	4.18	1	1	No
126	PHILLIP ST	TG6	440		0	0	0	0	0	4	7	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	20	24	2.58	0.07	0	0	No
124	PHILLIP ST	TG6	455		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
4	VIRGINIA TERRAC	TG6	490		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
6	VIRGINIA TERRAC	TG6	500		0	0	0	0	3	4	5	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	20	21	22	2.63	0.13	0	0	No
8	VIRGINIA TERRAC	TG6	510		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
15	MASON ST	TG6	535		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
13	MASON ST	TG6	550		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
11	MASON ST	TG6	570		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
9	MASON ST	TG6	585		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
44	MCCAULEY ST	TG7	50		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
42	MCCAULEY ST	TG7	60		0	0	0	0	0	0	0	0	0	17	17	17	17	17	0	0	0	0	0	0	0	0	0	17	17	17	17	17	2.50	0.00	0	0	No
36	MCCAULEY ST	TG7	60		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
6	NEWBOLD CLOSE	TG7	80		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
8	NEWBOLD CLOSE	TG7	115		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
10	NEWBOLD CLOSE	TG7	135		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
12	NEWBOLD CLOSE	TG7	150		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
14	NEWBOLD CLOSE	TG7	165		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
16	NEWBOLD CLOSE	TG7	180		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
18	NEWBOLD CLOSE	TG7	195		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
20	NEWBOLD CLOSE	TG7	215		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
22	NEWBOLD CLOSE	TG7	230		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24	NEWBOLD CLOSE	TG7	250		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
15	NEWBOLD CLOSE	TG7	270		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
26	NEWBOLD CLOSE	TG7	280		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
17	NEWBOLD CLOSE	TG7	285		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
16	RAILWAY PDE	TG7	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
18	RAILWAY PDE	TG7	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
20	RAILWAY PDE	TG7	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
22	RAILWAY PDE	TG7	580		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24	RAILWAY PDE	TG7	580		0	0	0	15	15	15	30	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	15	15	15	43	1.27	1.27	1	1	No
	WREXHAM RD	TG7	580		0	0	0	9	9	9	27	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	25	25	26	57	3.31	0.81	1	1	No
397	LAWRENCE HARG	TG7	620		0	0	0	27	27	27	34	0	0	0	17	17	17	17	0	0	0	13	13	13	13	0	0	0	57	57	57	64	4.28	3.03	0	0	No
30	HARBORD ST	TG8	86		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
28	HARBORD ST	TG8	91		0	0	0	0	0	3	24	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	19	54	2.71	0.21	1	1	No
11	SPRAY ST	TG8	91		0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.08	0.00	0	0	No
26	HARBORD ST	TG8	101		0	0	0	0	0	0	21	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	17	17	50	1.42	0.17	1	0	No
9	SPRAY ST	TG8	111		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
24	HARBORD ST	TG8	116		0	0	0	0	0	0	17	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0.16	0.08	0	0	No
7	SPRAY ST	TG8	131		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No

FLOOD DAMAGES ASSESSMEN
THOMAS GIBSON CREEK

AADD > 30 $K
AADD 10$K to 30$K
AADD from 0 to 10$k

House	Street	Reach	Chain	Scheme	Scheme B - Establish Overland Flow Paths																														
					Internal Property Damage $K							External Property Damage $K							Structural Property Damage $K							Total Property Damage $K							Total AADD	Total Above Floor AADD	No. properties that benefit	No. Floors that benefit	Wet to Dry in 1% AEP
					1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3										
				AEP %	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF	50	20	10	5	2	1	PMF					
5	SPRAY ST	TG8	151		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
3	SPRAY ST	TG8	161		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
16	HARBORD ST	TG8	181		0	0	0	0	0	0	6	0	0	0	17	17	17	17	0	0	0	0	0	0	0	0	0	0	17	17	17	22	1.28	0.03	1	0	No
1	SPRAY ST	TG8	181		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
14	HARBORD ST	TG8	191		0	0	0	0	0	0	18	0	0	0	17	17	17	17	0	0	0	0	0	0	13	0	0	0	17	17	17	47	1.40	0.15	1	0	No
18	HARBORD ST	TG8	231		0	0	0	0	0	0	26	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	17	17	56	2.70	0.19	1	1	Yes
12	ANN ST	TG8	281		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
29	MCCAULEY ST	TG8	291		0	0	0	0	32	33	36	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	62	62	66	4.11	1.61	1	1	No
10	ANN ST	TG8	296		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
27	MCCAULEY ST	TG8	296		0	0	0	0	10	12	30	0	0	17	17	17	17	17	0	0	0	0	0	0	13	0	0	17	17	27	28	59	3.03	0.53	1	1	No
15	CLIFF PDE	TG9	60		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0	0	No
				Total Flood Damages	47	54	58	134	240	303	728	0	0	585	685	718	785	935	13	26	26	39	65	78	298	60	80	669	858	1023	1166	1962	166	68	32	27	3
				AADD	12	15	6	5	6	3	5	0	0	29	32	21	8	9	3	6	3	2	2	1	2	15	21	37	38	28	11	15	166				
				Number of lots Flooded by Event	2	3	3	7	15	20	26	0	0	19	24	25	29	38	1	1	1	2	3	4	18	2	3	19	25	28	32	39					

APPENDIX

Scheme Cost Estimate 5.5

Consolidated Hewitts Creek Floodplain Risk Management Study

Scheme Cost Estimates

S		SCHEME SA	(DIVERSION TO TRAMWAY REMOVED)	Estimated Capital Cost	Ongoing Maintenance ($ per year)	PV of Maintenance ($) (based on 50yrs @ 7%)	Total Capital plus Maintenance
S	1.00	Ocean outfall	Develop opening policy	$ 6,000	$ 6,000	$82,804	$ 88,804
S	1.02	Footbridge to Blackall St	Flow training wall south bank	$ 143,000	$ 1,000	$13,801	$ 156,801
S	1.04	Rail line to footbridge	Channel enlargement and stabilisation	$ 318,150	$ 1,000	$13,801	$ 331,951
S	1.04	Rail line to footbridge	Formalise overland flow path in vicinity of Beacon Ave (immediately d/s of rail)	$ 119,000	$ 1,000	$13,801	$ 132,801
S	1.05	Rail line	Increase culvert capacity	$ 1,101,000	$ 3,000	$41,402	$ 1,142,402
S	1.06	Princes Highway to Rail line	Reconfigure basin outlet (to reduce nuisance flows into Beacon Ave)	$ 29,000	$ 1,000	$13,801	$ 42,801
S	1.08	Old mine rail to Princes Highway	Channel enlargement and stabilisation	$ 376,000	$ 1,000	$13,801	$ 389,801
S	1.08	Old Mine Rail	Levee East Bank	$ 77,000	$ 1,000	$13,801	$ 90,801
S	1.09	Old mine rail	**Remove diversion (at old rail)**	$ 785,000	$ 1,000	$13,801	$ 798,801
S	1.10	Hobart St	**Remove diversion (at Hobart)**		$ 1,000	$13,801	$ 13,801
S	1.11	William St to Hobart St	Sediment basin	$ 105,000	$ 3,000	$41,402	$ 146,402
S	1.11	William St to Hobart St	Channel enlargement and stabilisation	$ 165,000	$ 1,000	$13,801	$ 178,801
S	1.12	William St	Formalise overland flowpath	$ 78,000	$ 1,000	$13,801	$ 91,801
S	1.13	Rex Ave to William St	Sediment basin	$ 105,000	$ 3,000	$41,402	$ 146,402
S	1.13	Rex Ave to William St	Restore pre Aug 98 capacity	$ 148,960	$ 1,000	$13,801	$ 162,761
S	1.13	Rex Ave to William St	Coarse debris trap	$ 17,000	$ 3,000	$41,402	$ 58,402
S	2.03	Southern Tributary - mine basin	Retarding basin	$ 518,000	$ 3,000	$41,402	$ 559,402
			Total Scheme Cost	**$ 4,091,110**	**$ 32,000**	**$441,624**	**$ 4,532,734**
S		**SCHEME SB**	*(DIVERSION TO TRAMWAY FORMALISED)*	**Estimated Cost**	**Ongoing Maintenance ($ per year)**	**PV of Maintenance ($) (based on 50yrs @ 7%)**	**Total Capital plus Maintenance**
S	1.00	Ocean outfall	Develop opening policy (as per SA)	$ 6,000	$ 6,000	$82,804	$ 88,804
S	1.02	Footbridge to Blackall St	Flow training wall south bank (as per SA)	$ 143,000	$ 1,000	$13,801	$ 156,801
S	1.06	Princes Highway to Rail line	Reconfigure basin outlet (to reduce nuisance flows into Beacon Ave)	$ 29,000	$ 1,000	$13,801	$ 42,801
S	1.09	Old mine rail	**Formalise diversion (at old rail)**	See TB1,2,3	$ 1,000	$13,801	
S	1.10	Hobart St	**Formalise diversion (at Hobart)**		$ 1,000	$13,801	
S	1.11	William St to Hobart St	Channel enlargement and stabilisation	$ 165,000	$ 1,000	$13,801	$ 178,801
S	1.11	William St to Hobart St	Sediment basin (as per SA)	$ 105,000	$ 3,000	$41,402	$ 146,402
S	1.12	William St	Formalise overland flowpath (as per SA)	$ 78,000	$ 1,000	$13,801	$ 91,801
S	1.13	Rex Ave to William St	Sediment basin (as per SA)	$ 105,000	$ 3,000	$41,402	$ 146,402
S	1.13	Rex Ave to William St	Restore pre Aug 98 capacity (as per SA)	$ 148,960	$ 1,000	$13,801	$ 162,761
S	1.13	Rex Ave to William St	Coarse debris trap	$ 17,000	$ 3,000	$41,402	$ 58,402
S	2.03	Southern Tributary - mine basin	Retarding basin (as per SA)	$ 518,000	$ 3,000	$41,402	$ 559,402
			Total Scheme Cost	**$ 1,314,960**	**$ 25,000**	**$345,019**	**$ 1,659,979**
T		**SCHEME TA1**	*(DIV' REMOVED - CULVERT UPGRADE)*	**Estimated Cost**	**Ongoing Maintenance ($ per year)**	**PV of Maintenance ($) (based on 50yrs @ 7%)**	**Total Capital plus Maintenance**
T	3.01	Ocean outfall	Develop opening policy	$ 6,000	$ 6,000	$82,804	$ 88,804
T	3.03	Rail line	High flow culvert/bridge	$ 640,000	$ 1,000	$13,801	$ 653,801
			Total Scheme Cost	**$ 646,000**	**$ 7,000**	**$96,605**	**$ 742,605**
T		**SCHEME TA2**	*(DIV' REMOVED - DEBRIS TRAP)*	**Estimated Cost**	**Ongoing Maintenance ($ per year)**	**PV of Maintenance ($) (based on 50yrs @ 7%)**	**Total Capital plus Maintenance**
T	3.01	Ocean outfall	Develop opening policy (as per TA1)	$ 6,000	$ 6,000	$82,804	
T	3.03	Rail line	Debris Control Structure	$ 72,000	$ 3,000	$41,402	
			Total Scheme Cost	**$ 78,000**	**$ 9,000**	**$124,207**	**$ 202,207**
T		**SCHEME TB1**	*(DIV' FORMALISED - CULVERT UPGRADE)*	**Estimated Cost**	**Ongoing Maintenance ($ per year)**	**PV of Maintenance ($) (based on 50yrs @ 7%)**	**Total Capital plus Maintenance**
T	3.01	Ocean outfall	Develop opening policy (as per TA1)	$ 6,000	$ 6,000	$82,804	$ 88,804
T	3.03	Rail line	High flow culvert/bridge	$ 640,000	$ 1,000	$13,801	$ 653,801
T	3.04	Princes Highway to Rail line	Formalise overland flowpath	$ 1,340,000	$ 1,000	$13,801	$ 1,353,801
T	3.04	Princes Highway to Rail line	Voluntary purchase offer	$ -	$ -	$0	$ -
T	3.04a	Princes Highway to Rail line	Voluntary purchase offer	$ 600,000	$ -	$0	$ 600,000
			Total Scheme Cost	**$ 2,586,000**	**$ 8,000**	**$110,406**	**$ 2,696,406**

Scheme Cost Estimates

T		SCHEME TB2	(DIV' FORMALISED - DEBRIS TRAP)	Estimated Cost	Ongoing Maintenance ($ per year)	PV of Maintenance ($) (based on 50yrs @ 7%)	Total Capital plus Maintenance
T	3.01	Ocean outfall	Develop opening policy (as per TA1)	$ 6,000	$ 6,000	$82,804	$ 88,804
T	3.03	Princes Highway	Debris Control Structure	$ 72,000	$ 3,000	$41,402	$ 113,402
T	3.03	Rail line	Debris Control Structure	$ 72,000	$ 3,000	$41,402	$ 113,402
T	3.04	Princes Highway to Rail line	Formalise overland flowpath (as per TB1)	$ 1,340,000	$ 1,000	$13,801	$ 1,353,801
T	3.04a	Princes Highway to Rail line	Voluntary purchase offer	$ -	$ -	$0	$ -
T	3.04a	Princes Highway to Rail line	Voluntary purchase offer (per TB1)	$ 600,000	$ -	$0	$ 600,000
			Total Scheme Cost	**$ 2,090,000**	**$ 13,000**	**$179,410**	**$ 2,269,410**
T		**SCHEME TB3**	*(DIV' FORMALISED - FLOOD PROOFING)*	**Estimated Cost**	**Ongoing Maintenance ($ per year)**	**PV of Maintenance ($) (based on 50yrs @ 7%)**	**Total Capital plus Maintenance**
T	3.01	Ocean outfall	Develop opening policy (as per TA1)	$ 6,000	$ 6,000	$82,804	
T	3.04	Princes Highway to Rail line	Formalise overland flowpath (as per TB1)	$ 1,340,000	$ 1,000	$13,801	$ 1,353,801
T	3.04	Princes Highway to Rail line	Flood proofing	$ -	$ -	$0	$ -
T	3.04a	Princes Highway to Rail line	Voluntary purchase offer	$ 2,400,000	$ -	$0	$ 2,400,000
T	3.04a	Princes Highway to Rail line	Voluntary purchase offer (per TB1)	$ 600,000	$ -	$0	$ 600,000
			Total Scheme Cost	**$ 4,346,000**	**$ 7,000**	**$96,605**	**$ 4,442,605**
W		**SCHEME WA**	*(HIGH FLOW CULVERT AT RAIL)*	**Estimated Cost**	**Ongoing Maintenance ($ per year)**	**PV of Maintenance ($) (based on 50yrs @ 7%)**	**Total Capital plus Maintenance**
W	2.01	Diversion to Hewitts	Re-divert Woodlands Ck to Tramway Ck	$ 172,000	$ 1,000	$13,801	$ 185,801
W	2.01a	Near Sewer Pumping	Channel enlargement and stabilisation	$ 240,000	$ 1,000	$13,801	$ 253,801
W	2.03	Rail line	High flow culvert/bridge	$ 640,000	$ 1,000	$13,801	$ 653,801
W	2.04	Princes Highway to Rail line	Modify safety ramp and provide sag	$ 70,000	$ 1,000	$13,801	$ 83,801
W	2.04	Princes Highway to Rail line	Levee north bank	$ 103,000	$ 1,000	$13,801	$ 116,801
W	2.05	Princes Highway	Sediment basin/debris control structure	$ 177,000	$ 6,000	$82,804	$ 259,804
			Total Scheme Cost	**$ 1,230,000**	**$ 11,000**	**$151,808**	**$ 1,381,808**
W		**SCHEME WB**	*(RETARDING BASIN ABOVE HIGHWAY)*	**Estimated Cost**	**Ongoing Maintenance ($ per year)**	**PV of Maintenance ($) (based on 50yrs @ 7%)**	**Total Capital plus Maintenance**
W	2.01	Diversion to Hewitts	Re-divert Woodlands Ck to Tramway Ck (perWA)	$ 172,000	$ 1,000	$13,801	$ 185,801
W	2.01a	Near Sewer Pumping Station	Channel enlargement and stabilisation (per WA)	$ 240,000	$ 1,000	$13,801	$ 253,801
W	2.04	Princes Highway to Rail line	Modify safety ramp and provide sag (per WA)	$ 70,000	$ 1,000	$13,801	$ 83,801
W	2.04	Princes Highway to Rail line	Levee north bank (as per WA)	$ 103,000	$ 1,000	$13,801	$ 116,801
W	2.05	Princes Highway	Retarding basin	$ 2,300,000	$ 1,000	$13,801	$ 2,313,801
W	2.05	Princes Highway	Sediment basin/debris structure (as per WA)	$ 177,000	$ 6,000	$82,804	$ 259,804
			Total Scheme Cost	**$ 3,062,000**	**$ 11,000**	**$151,808**	**$ 3,213,808**
H		**SCHEME HA**	*(LEVEE AT CORBETT AVE)*	**Estimated Cost**	**Ongoing Maintenance ($ per year)**	**PV of Maintenance ($) (based on 50yrs @ 7%)**	**Total Capital plus Maintenance**
H	1.00	Ocean outfall	Develop opening policy	$ 6,000	$ 6,000	$82,804	$ 88,804
H	1.02	Adjacent to Corbett Ave	Levee north bank	$ 394,000	$ 1,000	$13,801	$ 407,801
H	1.05	LHD to the Rail line	Voluntary purchase offer	$ 300,000	$ -	$0	$ 300,000
H	1.05	LHD to the Rail line	Rehabilitate creek channel	$ 360,000	$ 1,000	$13,801	$ 373,801
H	1.08	Lachlan St	Culvert inlet improvements	$ 82,000	$ 1,000	$13,801	$ 95,801
H	1.08	Lachlan St	Formalise overland flowpath		$ 1,000	$13,801	$ 13,801
H	1.09	Kelton Ln to Lachlan St	Channel enlargement and stabilisation	$ 193,000	$ 1,000	$13,801	$ 206,801
H	1.11	Bangalow Rd to Kelton Ln	Restore pre Aug 98 capacity	$ 241,000	$ 1,000	$13,801	$ 254,801
H	1.11	Bangalow Rd to Kelton Ln	Coarse Debris trap	$ 17,000	$ 3,000	$41,402	$ 58,402
			Total Scheme Cost	**$ 1,593,000**	**$ 15,000**	**$207,011**	**$ 1,800,011**

Scheme Cost Estimates

H		SCHEME HB	(PROPERTY MOD'S AT CORBETT AVE)	Estimated Cost	Ongoing Maintenance ($ per year)	PV of Maintenance ($) (based on 50yrs @ 7%)	Total Capital plus Maintenance
H	1.00	Ocean outfall	Develop opening policy (as per HA)	$ 6,000	$ 6,000	$82,804	$ 88,804
H	1.02	Adjacent to Corbett Ave	House raising	$ 400,000	$ -	$0	$ 400,000
H	1.02	Adjacent to Corbett Ave	Flood proofing	$ 400,000	$ -	$0	$ 400,000
H	1.05	LHD to the Rail line	Voluntary purchase offer (as per HA)	$ 300,000	$ -	$0	$ 300,000
H	1.05	LHD to the Rail line	Rehabilitate creek channel (as per HA)	$ 360,000	$ 1,000	$13,801	$ 373,801
H	1.08	Lachlan St	Culvert inlet improvements (as per HA)	$ 82,000	$ 1,000	$13,801	$ 95,801
H	1.08	Lachlan St	Formalise overland flow path (as per HA)		$ 1,000	$13,801	$ 13,801
H	1.09	Kelton Ln to Lachlan St	Channel enlargement and stabilisation (per HA)	$ 193,000	$ 1,000	$13,801	$ 206,801
H	1.11	Bangalow Rd to Kelton Ln	Restore pre Aug 98 capacity (as per HA)	$ 241,000	$ 1,000	$13,801	$ 254,801
H	1.11	Bangalow Rd to Kelton Ln	Coarse Debris trap (as per HA)	$ 17,000	$ 3,000	$41,402	$ 58,402
			Total Scheme Cost	**$ 1,999,000**	**$ 14,000**	**$193,210**	**$ 2,192,210**

H		SCHEME HS4-A	(FLOOD/PROPERTY MOD'S - VIRGINIA TCE)	Estimated Cost	Ongoing Maintenance ($ per year)	PV of Maintenance ($) (based on 50yrs @ 7%)	Total Capital plus Maintenance
H	4.03	Stream 4 - Virginia Tce	Culvert mod's (to reduce surcharge freq'y)	$ 136,000	$ 3,000	$41,402	$ 177,402
H	4.03	Stream 4 - Virginia Tce	Property modification (flow deflectors)	$ 107,000	$ 1,000	$13,801	$ 120,801
H	4.04	Stream 4 - Deborah Ave	Coarse debris trap	$ 17,000	$ 3,000	$41,402	$ 58,402
			Total Scheme Cost	**$ 260,000**	**$ 7,000**	**$96,605**	**$ 356,605**
H		**SCHEME HS4-B**	*(PURCHASE PROPERTY - VIRGINIA TCE)*	**Estimated Cost**	**Ongoing Maintenance ($ per year)**	**PV of Maintenance ($) (based on 50yrs @ 7%)**	**Total Capital plus Maintenance**
H	4.03	Stream 4 - Virginia Tce	Voluntary purchase offer and provision for flowpath through downstream properties	$ 400,000	$ -	$0	$ 400,000
H	4.04	Stream 4 - Deborah Ave	Coarse debris trap (as per HS4-A)	$ 17,000	$ 3,000	$41,402	$ 58,402
			Total Scheme Cost	**$ 417,000**	**$ 3,000**	**$41,402**	**$ 458,402**

TG		SCHEME TGA	(INSTALL EXTRA PIPED DRAINAGE)	Estimated Cost	Ongoing Maintenance ($ per year)	PV of Maintenance ($) (based on 50yrs @ 7%)	Total Capital plus Maintenance
TG	1.00	Ocean outfall - North Arm	Develop opening policy	$ 6,000.00	6000	$82,804	$ 88,804
TG	1.00	Ocean outfall - North Arm	Lower south bank	$ 79,000.00	6000	$82,804	$ 161,804
TG	1.01	The Esplanade - North Arm	Upgrade Pipe Drainage	$ 412,400.00	1000	$13,801	$ 426,201
TG	1.03	Macauley St to Cliff Pde - North Arm	Upgrade pipe drainage	$ 595,000.00	1000	$13,801	$ 608,801
TG	1.03	Macauley St to Cliff Pde - North Arm	Raise Kerb/Driveway	$ 14,000.00	0	$0	$ 14,000
TG	1.04	Macauley St - North Arm	Investigate culvert inlet improvements	$ 50,000.00	0	$0	$ 50,000
TG	1.08	Rail Line - North Arm	Investigate culvert inlet improvements	$ 50,000.00	0	$0	$ 50,000
TG	1.08	Rail Line - North Arm	Debris Control Structure	$ 95,000.00	3000	$41,402	$ 136,402
TG	1.13	Phillip St to Sea Foam Ave - North Arm	Upgrade Pipe Drainage	$ 445,000.00	1000	$13,801	$ 458,801
TG	1.13	Phillip St to Sea Foam Ave - North Arm	Re-shape roadway to improve capacity	$ 250,000.00	0	$0	$ 250,000
TG	2.03	Rail Line to Raymond Rd	Check condition and rehabilitate pipe drainage	$ 32,500.00	0	$0	$ 32,500
TG	2.03a	Station St diversion - Station St	Overland flow path	$ 90,000.00	1000	$13,801	$ 103,801
TG	2.04	Rail Line	Investigate culvert inlet improvements	$ 50,000.00	0	$0	$ 50,000
TG	2.07	Phillip St to LHD	Overland flow path	$ 92,000.00	1000	$13,801	$ 105,801
TG	3.00	Ocean outfall - South Arm	Develop opening policy	$ 6,000.00	6000	$82,804	$ 88,804
TG	3.00	Ocean outfall - South Arm	Reduce diversion to north	$ 86,000.00	1000	$13,801	$ 99,801
TG	3.01	Cliff Pde	Improve culvert capacity	$ 128,000.00	1000	$13,801	$ 141,801
TG	3.02	Macauley St to Cliff Pde to Blackall St	Modify Existing Flood Gate	$ 7,000.00	1000	$13,801	$ 20,801
TG	3.02	Macauley St to Cliff Pde	Debris Control Structure	$ 94,000.00	3000	$41,402	$ 135,402
TG	3.02	Macauley St to Cliff Pde	Overland Flowpath	$ 127,000.00	1000	$13,801	$ 140,801
TG	3.03	Macauley St	Modify culvert inlet	$ 65,000.00	1000	$13,801	$ 78,801
TG	3.05	Thomas Gibson Park outlet	Formalise existing detention basin	$ 135,000.00	3000	$41,402	$ 176,402
TG	3.05	Thomas Gibson Park outlet	Debris control structure	$ 94,000.00	3000	$41,402	$ 135,402
TG	3.10	Lachlan St to LHD	Overland flow path	$ 85,000.00	1000	$13,801	$ 98,801
			Total Scheme Cost	**$ 3,087,900**	**$ 41,000.00**	**$565,831**	**$ 3,653,731**

Scheme Cost Estimates

TG		SCHEME TGB	(PROVIDE OVERLAND FLOW PATHS)	Estimated Cost	Ongoing Maintenance ($ per year)	PV of Maintenance ($) (based on 50yrs @ 7%)	Total Capital plus Maintenance
TG	1.00	Ocean outfall - North Arm	Develop opening policy	$ 6,000.00	$ 6,000.00	$82,804	$ 88,804
TG	1.00	Ocean outfall - North Arm	Lower south bank	$ 79,000.00	$ 6,000.00	$82,804	$ 161,804
TG	1.01	The Esplanade - North Arm	Expand floodway	$ 124,000.00	$ 2,000.00	$27,601	$ 151,601
TG	1.03	Macauley St to Cliff Pde - North Arm	Raise Kerb/Driveway	$ 14,000.00	$ -	$0	$ 14,000
TG	1.04	Macauley St - North Arm	Investigate culvert inlet improvements	$ 50,000.00	$ -	$0	$ 50,000
TG	1.08	Rail Line - North Arm	Investigate culvert inlet improvements	$ 50,000.00	$ -	$0	$ 50,000
TG	1.08	Rail Line - North Arm	Debris Control Structure	$ 94,000.00	$ 3,000.00	$41,402	$ 135,402
TG	1.12	Sea Foam Ave - North Arm	Raise Kerb/Driveway	$ 28,000.00	$ -	$0	$ 28,000
TG	1.13	Phillip St to Sea Foam Ave - North Arm	Culvert and Overland flow path	$ 315,000.00	$ 1,000.00	$13,801	$ 328,801
TG	2.03	Rail Line to Raymond Rd	Check condition and rehabilitate pipe drainage	$ 32,000.00	$ -	$0	$ 32,000
TG	2.03a	Station St diversion - Station St	Overland flow path	$ 90,000.00	$ 1,000.00	$13,801	$ 103,801
TG	2.04	Rail Line	Investigate culvert inlet improvements	$ 50,000.00	$ -	$0	$ 50,000
TG	2.07	Phillip St to LHD	Overland flow path	$ 92,000.00	$ 1,000.00	$13,801	$ 105,801
TG	3.00	Ocean outfall - South Arm	Develop opening policy	$ 6,000.00	$ 6,000.00	$82,804	$ 88,804
TG	3.00	Ocean outfall - South Arm	Reduce diversion to north	$ 86,000.00	$ 1,000.00	$13,801	$ 99,801
TG	3.01	Cliff Pde	Improve culvert capacity	$ 128,000.00	$ 1,000.00	$13,801	$ 141,801
TG	3.02	Macauley St to Cliff Pde to Blackall St	Modify Existing Flood Gate	$ 7,000.00	$ 1,000.00	$13,801	$ 20,801
TG	3.02	Macauley St to Cliff Pde	Debris Control Structure	$ 94,000.00	$ 3,000.00	$41,402	$ 135,402
TG	3.02	Macauley St to Cliff Pde	Overland Flowpath	$ 127,000.00	$ 1,000.00	$13,801	$ 140,801
TG	3.03	Macauley St	Modify culvert inlet	$ 65,000.00	$ 1,000.00	$13,801	$ 78,801
TG	3.05	Thomas Gibson Park outlet	Formalise existing detention basin	$ 135,000.00	$ 3,000.00	$41,402	$ 176,402
TG	3.05	Thomas Gibson Park outlet	Debris control structure	$ 94,000.00	$ 3,000.00	$41,402	$ 135,402
TG	3.10	Lachlan St to LHD	Overland flow path	$ 85,000.00	$ 1,000.00	$13,801	$ 98,801
			Total Scheme Cost	**$ 1,851,000**	**$ 41,000.00**	**$565,831**	**$ 2,416,831**

APPENDIX 6

PLANNING CONTROL PRECINCTS

APPENDIX 6.1

Hewitts Creek Planning Control Precincts

Planning Control Precincts

The Planning Control Precincts presented in this plan represent zones in which particular planning controls apply in respect to the management of 'risk' of development on a flood plain in the study area.

In summary theses Planning Control Precincts are defined as;

High Risk Precinct: [RED]
Land located in the high hydraulic hazard zone as defined in Fig G2 of the FPMM in which;

- V > 2m/sec in a 1% AEP flood event
- or D > 1m in a 1% AEP flood event
- or V+3.3D > 3.33 in 1% AEP flood event
- or within 10m of the nearest creek bank

Medium Risk Precinct: [ORANGE]
Land located above the high risk precinct up to the limit of flooding in a flood reaching the level of the 1% AEP flood + 500mm.

Low Risk Precinct: [YELLOW]
Land located above the moderate risk precinct but lying below the limit of flood prone land (as defined by the Probable Maximum Flood)

NOTE:-
Risk Precinct extents are approximate only and will be subject to review once detailed ground survey is obtained.

FLOOD RISK PRECINCTS IN THIS AREA MAY BE SUBJECT TO CHANGE DEPENDENT ON PROPOSED FLOOD MITIGATION BY LANDOWNERS.

0 50 100 200
METRES

PLANNING CONTROL PRECINTS

HEWITTS CREEK FLOOD RISK MANAGEMENT STUDY

APPENDIX 6.2

Hewitts Creek Planning Control Matrix

Hewitts Creek Floodplain

Incorporating Slacky, Tramway, Woodlands, Hewitts and Thomas Gibson Creeks

Planning & Development Controls

Planning Consideration	Flood Risk Precincts (FRP's)																							
	Low Flood Risk								Medium Flood Risk								High Flood Risk (& Interim Riverine Corridor)							
	Essential Community Facilities	Critical Utilities	Subdivision	Residential	Commercial & Industrial	Tourist Related Development	Recreation & Non-Urban	Concessional Development	Essential Community Facilities	Critical Utilities	Subdivision	Residential	Commercial & Industrial	Tourist Related Development	Recreation & Non-Urban	Concessional Development	Essential Community Facilities	Critical Utilities	Subdivision	Residential	Commercial & Industrial	Tourist Related Development	Recreation & Non-Urban	Concessional Development
Floor Level		3										2	2or5	2	1	2,4							1	2,4
Building Components		2										1	1	1	1	1							1	1
Structural Soundness		3		3		3						3	2	3	2	2							1	1
Flood Affectation		2	2		2	2					1	2	2	2	2	2							1	1
Evacuation		2,4	*	3,4	4	3,4					*	3,4	1,4	3,4	1	1							1	1
Management & Design		4,5	1								1		2,3,5	2,3,5	2,3,5	2,3,5							2,3,5	2,3,5

Not Relevant

Unsuitable Land Use

* Refer to *'Management & Design'* planning consideration for subdivision

Freeboard equals an additional height of 500mm

Note: 1. Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications.

2. For the Hewitts Catchments it is reccomended that filling in floodplain areas east of the Main South Coast Railway embankment be considered, provided that the applicant can demonstrate there are no local hydraulic impacts on adjoining property as a result of this filling. Filling in floodplain areas west of the Main South Coast Railway is not to be permitted unless an Engineers report is provided that certifies that the development will not increase flood affectation elsewhere.

3. Terms in italics are defined in the glossary of this plan and Schedule 2 specifies development types included in each land use category. These development types are generally as defined within Environmental Planning Instruments applying to the local government area.

Floor Level

1. All Floor Levels to be equal to or greater than the 20 year *flood* level plus *freeboard* unless justified by site specific assessment
2. *Habitable floor* levels to be equal to or greater than the 100 year *flood* level plus *freeboard*
3. All Floor Levels to be equal to or greater than the *PMF flood* level plus *freeboard*
4. Floor levels to be as close to the *design floor level* as practical & no lower than the existing floor level when undertaking alterations or additions
5. Floor levels of shops to be as close to the *design floor level* as practical. Where the below the *design floor level*, more than 30% of the floor area to be above the *design floor level* or premises to be flood proofed below the *design floor level*

Building Components & Method

1. All structures to have *flood compatible building components* below or at the 100 year *flood* level plus *freeboard*
2. All structures to have *flood compatible building components* below or at the *PMF* level plus *freeboard*

Structural Soundness

1. Engineers report to certify that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a 100 year *flood* plus *freeboard*
2. Applicant to demonstrate that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a 100 year *flood* plus *freeboard*
3. Applicant to demonstrate that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a *PMF flood* plus *freeboard*

Flood Affectation

1. Engineers report required to certify that the development will not increase *flood* affectation elsewhere
2. The impact of the development on flooding elsewhere to be considered

Note: When assessing *flood* affectation the following must be considered:
1. Loss of storage area in the *floodplain*
2. Changes in *flood* levels & velocities caused by alteration of conveyance of *flood* waters

Evacuation

1. *Reliable access* for pedestrians required during a 100 year *flood*
2. *Reliable access* for pedestrians and vehicles required during a *PMF flood*
3. *Reliable access* for pedestrians or vehicles is required from the building, commencing at a minimum level equal to the lowest *habitable floor* level to an area of refuge above the *PMF level*, or a minimum of 40% of the gross floor area of the dwelling to be above the *PMF* level.
4. The development is to be consistent with any relevant *flood evacuation strategy* or similar plan

Management and Design

1. Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accordance with this Plan
2. *Site Emergency Response Flood plan* required (except for single dwelling-houses) where floor levels are below the *design floor level*
3. Applicant to demonstrate that area is available to store goods above the 100 year *flood* level plus *freeboard*
4. Applicant to demonstrate that area is available to store goods above the *PMF* level plus *freeboard*
5. No external storage of materials below the *design floor level* which may cause pollution or be potentially hazardous during any *flood*

APPENDIX 7

MANAGEMENT RECOMMENDATIONS

APPENDIX 7.1

Floodplain Risk Management Plan

SLACKY CREEK

S1 Construct a coarse debris trap comprising large steel or timber "bollards" set into the bed of the creek, bollards to be set at 0.5-1m spacings and span full creek width. Provision to be made for maintenance access.

S2 Remove excess boulders and sediment deposited in the August 1998 flood immediately downstream of Rm Ave. Form waterway of similar capacity to that existing Pre 1998 storm.

S3 Modify downstream handrail & headwall structure elevate driveway entrance to No's 21 to 29; & lower kerb. Remove sandstone blockwork obstructing entrance to culvert.

S4 Excavate creek banks to reduce batter, widen where possible. Provide rock armour bank protection as required.

S5 Excavate sediment basin of minimum 2000 m3 volume, offline to creek, include provision for maintenance access.

S6 Modify the access road embankment including provision of a PMF safe spillway & clay lining of upstream faces. Optimisation of basin outlet by reducing outlet size. Provide a debris control structure upstream of basin outlet.

S7 Remove twin 1800 dia. culvert & access road immediately downstream of Hobart St. Construct debris control structures & regrade Hobart St. between the Slacky Creek culvert & Hess Rd.

S8 Partially fill the northern basin outlet to elevate overtopping level. Construct flow training walls upstream of main culvert to improve hydraulic characteristics.

S9 Construct a flow training wall at RL 4.00m (approx) along the rear boundary of properties on the south bank to reduce breakout of flow. Levee to extend downstream from No 16 Hilton Ave. (final extent to be determined at detail design stage).

S10 Implement an opening policy requiring Council to clear sand from the creek outlet once a critical level (RL 2.8m) of sand "build up" is reached.

S11 Owner of Old Bulli Mine site to expedite rehabilitation works including stabilization of mine platform.

TRAMWAY CREEK

T1 Construct grass lined swale along Hobart St. (south side) to provide overland flow path. Lower Hess Rd. roundabout. Swale to extend between culvert proposed at Highway (refer T2) & Slacky Creek diversion (refer S7)

T2 Construct a (6m min.diagonal opening) culvert beneath the Highway (adjacent Hobart St. intersection) to connect the overland flow path at T4 to swale at T1. Provision to be made for debris control on the upstream side.

T3 Purchase properties at eastern end of Hobart St.(No's 177 & 171-175) , demolish &/ or remove all structures to facilitate construction of overland flow path between Princes Highway & Tramway Creek(refer T4)

T4 Construct an overland flow path between the Highway (opposite Hobart St) & Tramway Creek (to the rear of 19 Manley Pde). Construction to include enlargement of existing channel & excavation of a new channel (where required)

T5 Construct a new high level culvert through the railway embankment, 6m wide by 4m high to the south of the existing low level culvert.

T6 Implement an opening policy requiring Council to clear sand from the creek outlet once a critical level (RL 2.8m) of sand "build up" is reached.

ALL CATCHMENTS
(refer study for more details)

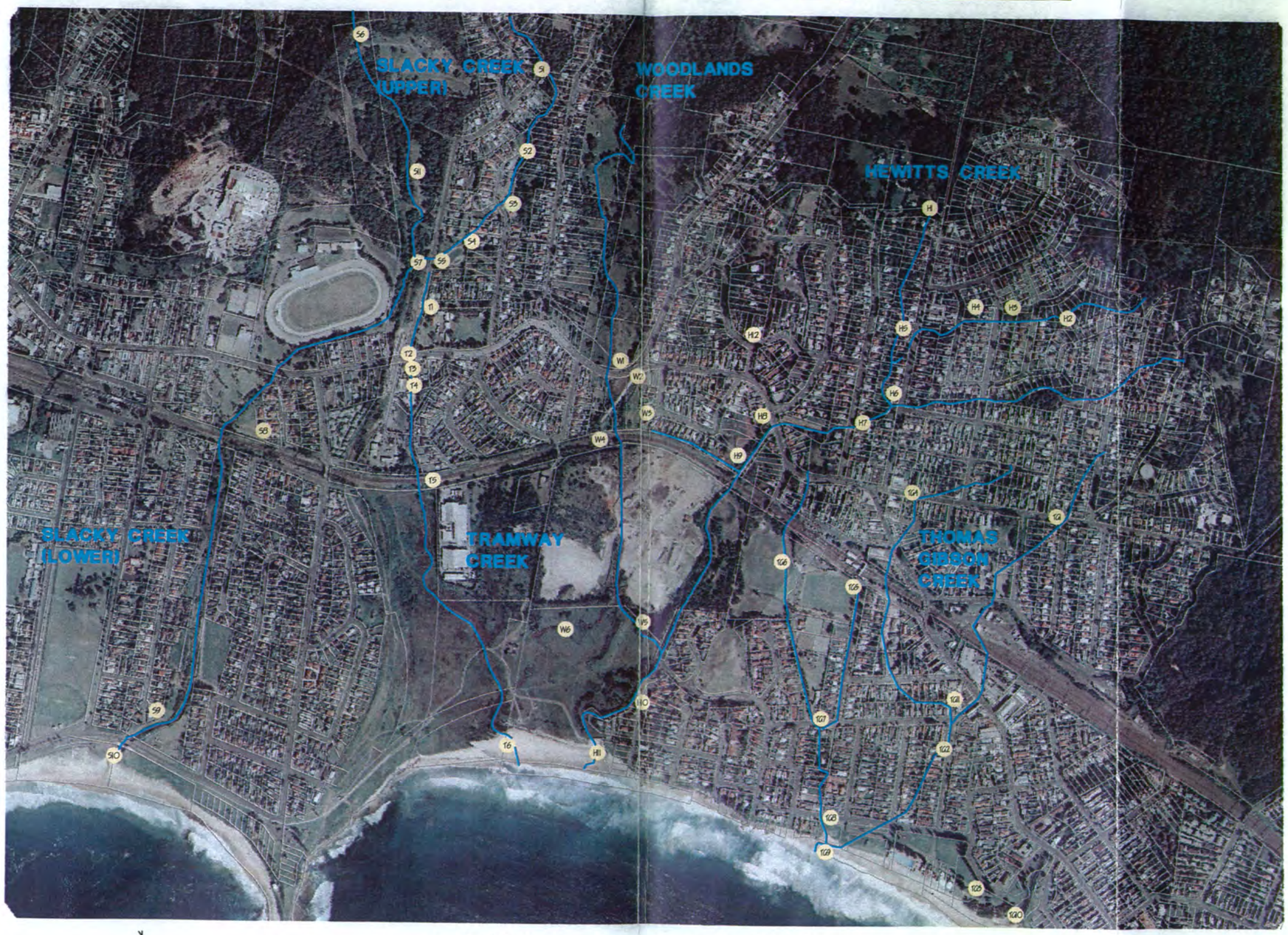
- Implementation of Development Control Plan (DCP) to ensure all future developments is compatible with flooding risks.
- Minimum width overflow paths & riparian setbacks for all development adjoining creeks & natural low points.
- Minimum requirements for floor levels & safe access to be elevated above flood levels.
- All new development to incorporate flood compatible structures including flood proof materials & fencing.
- Council to undertake an education & flood awareness program to raise general awareness of flooding behaviour in the local areas. This may include flood signage, information leaflets & newspaper articles.
- All data collected and processed in this study be provided to the State Emergency Service (SES) by Wollongong City Council in a format suitable for interpretation by the SES as soon as it is available, for incorporation into the "Wollongong City Local Flood Plan".
- A Riparian Management Study be undertaken within the study area to identify possible sources of sediment, areas of general channel and bank instability and opportunities for improving the overall riparian corridor with the associated benefits of reducing wherever possible the potential for future debris mobilisation.

SUMMARY OF PROPERTIES PROTECTED - RECOMMENDED SCHEME

Creek	No. of Properties Protected									
	20% AEP		5% AEP		2% AEP		1% AEP		PMF	
	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor	Yard	Above Floor
WOOL	8	6	18	97	8	98	71	48	472	12
Slacky	0	0	22	1	27	1	29		286	1
Tramway	0	0	10	10	4	10	4	4	8	5
Woodlands	0	0	5	4	5	5	5	5	9	10
Hewitts	6	4	48	56	47	59	22	39	6	9
Hewitts (Stream 4)	0	0	0	1	0	2	0	0	0	0
Thomas Gibson	2	2	1	6	2	3	0	0	0	0

SUMMARY OF FINANCIAL BENEFITS - RECOMMENDED SCHEME

Creek	Scheme	Total Damages ($AUD)	Total Benefits		Scheme Cost ($)	Benefit Cost Ratio
			$AUD	$NPV		
WOOL		9661,790	1428,000	10,103,907	61,800,000	1.2
Slacky/ Tramway	S8/ T6	8,750	80,000	2,072,498	5,990,000	0.6
Woodlands/ Hewitts	W4/ H4	182,750	214,000	6,280,080	2,800,000	2.2
Hewitts (Stream 4)	H5A	54,250	39,000	894,938	280,000	3.2
Thomas Gibson	T2B	349,000	69,000	1,749,003	1,280,000	0.8



HEWITTS CREEK

H1 Construct a coarse debris trap comprising large steel or timber "bollards" set into the bed of the creek, bollards to be set at 0.5-1m spacings and span full creek width. Provision to be made for maintenance access.

H2 Construct a coarse debris trap comprising large steel or timber "bollards" set into the bed of the creek, bollards to be set at 0.5-1m spacings and span full creek width. Provision to be made for maintenance access.

H3 Construct expanded inlet & debris control structure at culvert entrance & modify local drainage to prevent surcharge of pits (in front of No 29 Virginia Terrace). Rehabilitate creek channel upstream of culvert.

H4 Modify driveway entrance to No's 25 & 29 Virginia Terrace. Provide flood compatible fencing & relocate structures within overflow path. Flow training walls as necessary to protect properties.

H5 Remove excess boulders and sediment deposited in the August 1998 flood upstream of Kelton Lane. Stabilise creek banks.

H6 Excavate & enlarge creek channel & construct low levee at rear of properties in Lachlan St. to contain flows. Construct rock revetment at toe of unstable bank at rear of No 19 George St. Landscape all areas upon completion.

H7 Lower kerb & raise driveways on downstream edge of Lachlan St. (between No 6 & No 14). Construct projection control pillar & flow training walls.

H8 Make voluntary purchase offer for No 469 Lawrence Hargrave Drive.

H9 Close access road, reconstruct creek channel between Lawrence Hargrave Dr & the rail. Reinstate natural rock pools & ripples; construction of an offline water quality control pond & sediment trap on south bank. Landscape on completion.

H10 Construct a levee at RL 4.50m (approx) along the rear boundary of properties on the north bank. Levee to extend downstream from No 17 Corlett Ave. Levee to comprise combination of earth & masonry wall. Final extent to be determined at detail design stage.

H11 Implement an opening policy requiring Council to clear sand from the creek outlet once a critical level (RL 2.8m) of sand "build up" is reached.

H12 Council to further investigate flood/ stormwater issues within the vicinity of Penn Avenue and Mak Street.

WOODLANDS CREEK

W1 Excavate basin of minimum 3000m3 volume, offline to creek including provision for water quality controls & landscaping with native species. Incorporate debris control structure upstream of Princes Highway culvert.

W2 Lower subway ramp by approx. 1.0m for a distance of 50m from the entry to the ramp. Excess spoil to be used for construction of levee (refer W3)

W3 Construct a levee at RL 13.50m (approx) along the rear boundary of properties on the north bank. Levee to extend between Lawrence Hargrave Drive & the railway embankment.

W4 Construct a new high level culvert through the railway embankment, 6m wide by 4m high to the north of the existing low level culvert.

W5 Close off diversion of Woodlands into Hewitts by filling existing siphon level channel using appropriate fill material. Landscape on completion.

W6 Upgrade existing flow path to Tramway Creek by excavating an enlarged channel (where required) providing rock armour bank protection. Landscape on completion.

THOMAS GIBSON CREEK

TG1 Construct a new pipe system with multiple inlets along east side of Phillip St. Construct new "natural" watercourse along Sea Foam Ave. Raise kerb & driveways of properties in Sea Foam Ave. (No's 29-39)

TG2 Raise kerb & driveway entrances along south side of Bath St. by 150mm approx. to contain minor flooding within roadway.

TG3 Lower the south bank of Flinnegans Creek by up to 1m near bend in The Esplanade. Rehabilitate steep eroding banks. Enlarge table drain along east side of The Esplanade to enhance capacity.

TG4 Modify the entrance to public car park to provide for overflow. Raise kerb & driveways to protect low lying properties. (No's 101 to 109)

TG5 Modify Station St to provide one-way cross fall to south. Enlarge southern table drain to convey major flows towards playing field & into proposed detention basin. Investigate improvements to rail culvert near War Memorial.

TG6 Enlarge & strengthen existing embankment at east end of Thomas Gibson Park. Provide new outlet structure & reinforced spillway to formalise as detention basin. Remove existing diversion into Thomas Gibson Park at Lachlan St (near Uniting Church)

TG7 Modify the inlet to the Macauley St culvert by constructing tapered inlets to enhance hydraulic capacity. Modify watercourse downstream of culvert to enhance capacity. Relocate structures as necessary.

TG8 Improve culvert capacity by constructing an additional culvert or enhancing capacity of existing system. Modify roadway & existing floodgate to reduce diversion northwards to Bath St.

TG9 Implement an opening policy requiring Council to clear sand from the creek outlet once a critical level (RL 2.8m) of sand "build up" is reached.

TG10 Implement an opening policy requiring Council to clear sand from the creek outlet once a critical level (RL 2.8m) of sand "build up" is reached.

TG11 Carry out investigation to determine the capacity & condition of existing drainage infrastructure in the general area. Carry out any improvements determined necessary.

0 25 50 100 200m

HEWITTS CREEK

Incorporating Slacky, Tramway, Woodlands & Thomas Gibson Creeks

FLOODPLAIN RISK MANAGEMENT PLAN

WOLLONGONG
City of Innovation