Appendix A

APPENDIX A: GLOSSARY

Taken from the Floodplain Development Manual (April 2005 edition)

acid sulfate soils	Are sediments which contain sulfidic mineral pyrite which may become extremely acid following disturbance or drainage as sulfur compounds react when exposed to oxygen to form sulfuric acid. More detailed explanation and definition can be found in the NSW Government Acid Sulfate Soil Manual published by Acid Sulfate Soil Management Advisory Committee.
Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500 m^3/s has an AEP of 5%, it means that there is a 5% chance (that is one-in-20 chance) of a 500 m^3/s or larger event occurring in any one year (see ARI).
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
Average Annual Damage (AAD)	Depending on its size (or severity), each flood will cause a different amount of flood damage to a flood prone area. AAD is the average damage per year that would occur in a nominated development situation from flooding over a very long period of time.
Average Recurrence Interval (ARI)	The long term average number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods with a discharge as great as, or greater than, the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.
caravan and moveable home parks	Caravans and moveable dwellings are being increasingly used for long-term and permanent accommodation purposes. Standards relating to their siting, design, construction and management can be found in the Regulations under the LG Act.
catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
consent authority	The Council, government agency or person having the function to determine a development application for land use under the EP&A Act. The consent authority is most often the Council, however legislation or an EPI may specify a Minister or public authority (other than a Council), or the Director General of DIPNR, as having the function to determine an application.
development	Is defined in Part 4 of the Environmental Planning and Assessment Act (EP&A Act). **infill development:** refers to the development of vacant blocks of land that are generally surrounded by developed properties and is permissible under the current zoning of the land. Conditions such as minimum floor levels may be imposed on infill development. **new development:** refers to development of a completely different nature to that associated with the former land use. For example, the urban subdivision of an area previously used for rural purposes. New developments involve rezoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power.

	redevelopment: refers to rebuilding in an area. For example, as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either rezoning or major extensions to urban services.
disaster plan (DISPLAN)	A step by step sequence of previously agreed roles, responsibilities, functions, actions and management arrangements for the conduct of a single or series of connected emergency operations, with the object of ensuring the coordinated response by all agencies having responsibilities and functions in emergencies.
discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
ecologically sustainable development (ESD)	Using, conserving and enhancing natural resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be maintained or increased. A more detailed definition is included in the Local Government Act 1993. The use of sustainability and sustainable in this manual relate to ESD.
effective warning time	The time available after receiving advice of an impending flood and before the floodwaters prevent appropriate flood response actions being undertaken. The effective warning time is typically used to move farm equipment, move stock, raise furniture, evacuate people and transport their possessions.
emergency management	A range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding.
flash flooding	Flooding which is sudden and unexpected. It is often caused by sudden local or nearby heavy rainfall. Often defined as flooding which peaks within six hours of the causative rain.
flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
flood awareness	Flood awareness is an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and evacuation procedures.
flood education	Flood education seeks to provide information to raise awareness of the flood problem so as to enable individuals to understand how to manage themselves an their property in response to flood warnings and in a flood event. It invokes a state of flood readiness.
flood fringe areas	The remaining area of flood prone land after floodway and flood storage areas have been defined.
flood liable land	Is synonymous with flood prone land (i.e. land susceptible to flooding by the probable maximum flood (PMF) event). Note that the term flood liable land covers the whole of the floodplain, not just that part below the flood planning level

	(see flood planning area).
flood mitigation standard	The average recurrence interval of the flood, selected as part of the floodplain risk management process that forms the basis for physical works to modify the impacts of flooding.
floodplain	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land.
floodplain risk management options	The measures that might be feasible for the management of a particular area of the floodplain. Preparation of a floodplain risk management plan requires a detailed evaluation of floodplain risk management options.
floodplain risk management plan	A management plan developed in accordance with the principles and guidelines in this manual. Usually includes both written and diagrammetic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives.
flood plan (local)	A sub-plan of a disaster plan that deals specifically with flooding. They can exist at State, Division and local levels. Local flood plans are prepared under the leadership of the State Emergency Service.
flood planning area	The area of land below the flood planning level and thus subject to flood related development controls. The concept of flood planning area generally supersedes the Aflood liable land@ concept in the 1986 Manual.
Flood Planning Levels (FPLs)	FPL=s are the combinations of flood levels (derived from significant historical flood events or floods of specific AEPs) and freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans. FPLs supersede the Astandard flood event@ in the 1986 manual.
flood proofing	A combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding, to reduce or eliminate flood damages.
flood prone land	Is land susceptible to flooding by the Probable Maximum Flood (PMF) event. Flood prone land is synonymous with flood liable land.
flood readiness	Flood readiness is an ability to react within the effective warning time.
flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future and continuing risks. They are described below. **existing flood risk:** the risk a community is exposed to as a result of its location on the floodplain. **future flood risk:** the risk a community may be exposed to as a result of new development on the floodplain. **continuing flood risk:** the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.

flood storage areas	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.
floodway areas	Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flows, or a significant increase in flood levels.
freeboard	Freeboard provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the FPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the flood planning level.
habitable room	**in a residential situation:** a living or working area, such as a lounge room, dining room, rumpus room, kitchen, bedroom or workroom. **in an industrial or commercial situation:** an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.
hazard	A source of potential harm or a situation with a potential to cause loss. In relation to this manual the hazard is flooding which has the potential to cause damage to the community. Definitions of high and low hazard categories are provided in the Manual.
hydraulics	Term given to the study of water flow in waterways; in particular, the evaluation of flow parameters such as water level and velocity.
hydrograph	A graph which shows how the discharge or stage/flood level at any particular location varies with time during a flood.
hydrology	Term given to the study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
local overland flooding	Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.
local drainage	Are smaller scale problems in urban areas. They are outside the definition of major drainage in this glossary.
mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
major drainage	Councils have discretion in determining whether urban drainage problems are associated with major or local drainage. For the purpose of this manual major drainage involves: $ the floodplains of original watercourses (which may now be piped, channelised or diverted), or sloping areas where overland flows develop along alternative paths once system capacity is exceeded; and/or

- water depths generally in excess of 0.3 m (in the major system design storm as defined in the current version of Australian Rainfall and Runoff). These conditions may result in danger to personal safety and property damage to both premises and vehicles; and/or
- major overland flow paths through developed areas outside of defined drainage reserves; and/or
- the potential to affect a number of buildings along the major flow path.

mathematical/computer models

The mathematical representation of the physical processes involved in runoff generation and stream flow. These models are often run on computers due to the complexity of the mathematical relationships between runoff, stream flow and the distribution of flows across the floodplain.

merit approach

The merit approach weighs social, economic, ecological and cultural impacts of land use options for different flood prone areas together with flood damage, hazard and behaviour implications, and environmental protection and well being of the State=s rivers and floodplains.

The merit approach operates at two levels. At the strategic level it allows for the consideration of social, economic, ecological, cultural and flooding issues to determine strategies for the management of future flood risk which are formulated into Council plans, policy and EPIs. At a site specific level, it involves consideration of the best way of conditioning development allowable under the floodplain risk management plan, local floodplain risk management policy and EPIs.

minor, moderate and major flooding

Both the State Emergency Service and the Bureau of Meteorology use the following definitions in flood warnings to give a general indication of the types of problems expected with a flood:

minor flooding: causes inconvenience such as closing of minor roads and the submergence of low level bridges. The lower limit of this class of flooding on the reference gauge is the initial flood level at which landholders and townspeople begin to be flooded.

moderate flooding: low-lying areas are inundated requiring removal of stock and/or evacuation of some houses. Main traffic routes may be covered.

major flooding: appreciable urban areas are flooded and/or extensive rural areas are flooded. Properties, villages and towns can be isolated.

modification measures

Measures that modify either the flood, the property or the response to flooding. Examples are indicated in Table 2.1 with further discussion in the Manual.

peak discharge

The maximum discharge occurring during a flood event.

Probable Maximum Flood (PMF)

The PMF is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain. The extent, nature and potential consequences of flooding associated with a range of events rarer than the flood used for designing mitigation works and controlling development, up to and including the PMF event

	should be addressed in a floodplain risk management study.
Probable Maximum Precipitation (PMP)	The PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to PMF estimation.
probability	A statistical measure of the expected chance of flooding (see AEP).
risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
runoff	The amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
stage	Equivalent to Awater level@. Both are measured with reference to a specified datum.
stage hydrograph	A graph that shows how the water level at a particular location changes with time during a flood. It must be referenced to a particular datum.
survey plan	A plan prepared by a registered surveyor.
water surface profile	A graph showing the flood stage at any given location along a watercourse at a particular time.
wind fetch	The horizontal distance in the direction of wind over which wind waves are generated.

Appendix B

mid swale

10-11th Sept, 2006 Council Easement with overflow to mid swale

R. BARNES 3 EVANS Rd MEDOWIE

Beside House Nth side

Mid Swale Nth Border

Figure 1 3 Evans Rd Sept '06

Figure 2 45 Coachwood Drive April '07

Figure 3 57 Kula Rd June '07

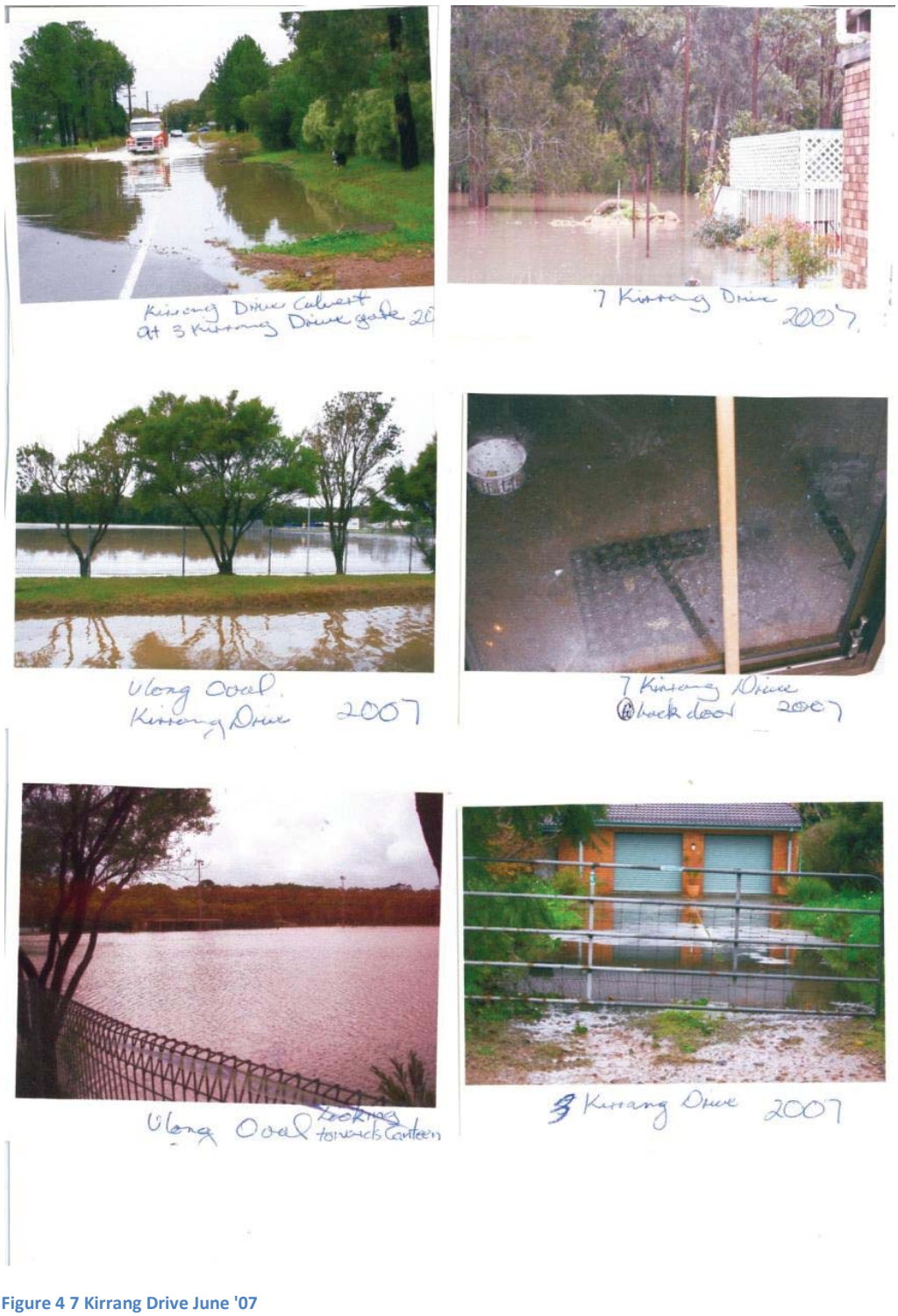


Figure 4 7 Kirrang Drive June '07

June 2007

Mid Swale without overspill from easement

Back Council Easement without overspill

In general any flooding is only a problem if water cannot escape quick enough (like council failing to clear drains & easements before rain)

R. BARNES 3 EVANS RD HIDDEN

Figure 5 3 Evans Road June '07

Figure 6 32 County Close June '07

June 07.

We have a big gap under the private access door to let water run through the garage but it was too much.... still up a coarse of bricks.

June 07.

The drain between No's 33 & 35 Lewis Drv Medowie

The force of the water rushing down the drain, rolled the reeds up like a carpet.... blocking the drain The water backed up & ran into the front yard we copped it from the drain & running down the street & I of the few houses that council wouldn't levy... we did it ourself


3.75HP

June 07.

C.D. player copped.

the rest was ok but couldn't use it anymore case the leads had been soaked & plugs sitting in the water

June 07

Chelsea put towels around & under the doors but the water still flowed through the house... I told her to open the back door & let it run through. She had to go to work. cause the pub was flooding too! So she left the back door open.

June 07.

This one shows the colour ORANGE left behind.... orange mud. Thats how I did both my knees in. cleaning up this orange mud.

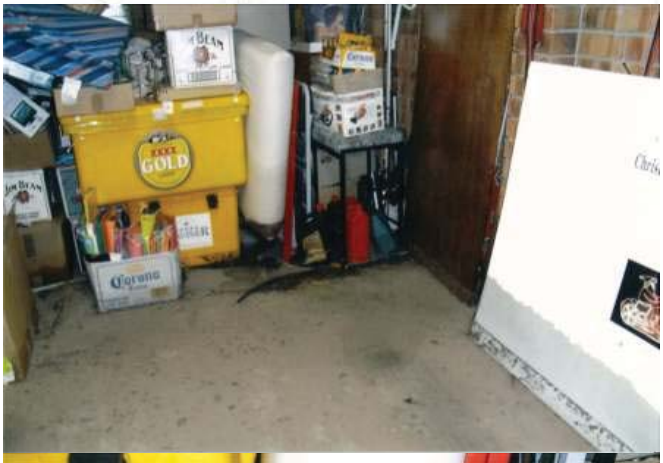
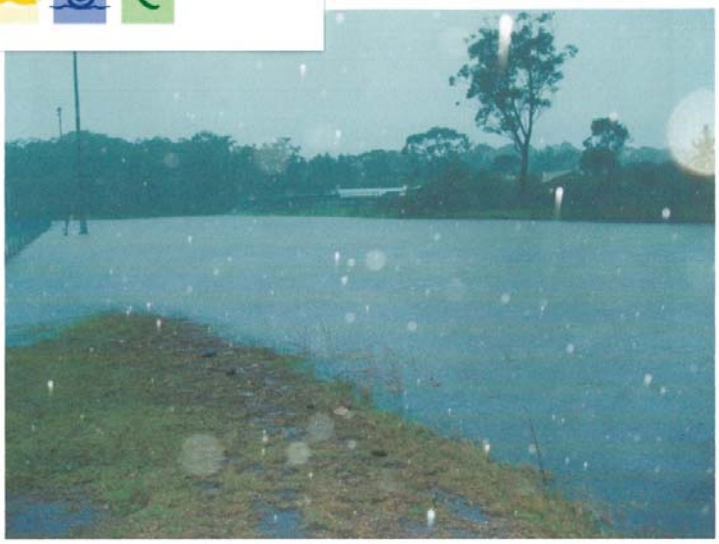


Figure 7 31 Lewis Drive June '07

Port Stephens COUNCIL
... a community partnership

Councillor Geoff Dingle
Central Ward Councillor
Phone: (02) 4982 8468 **Mobile:** 0412 374 990
PO Box 39 Medowie NSW 2318
Email: geoff.dingle@portstephens.nsw.gov.au

e 2007 Storm Event



June 2007 Storm event

Kirrang Dr Campvale drain crossing looking east to rear of hardware store and Yulong fence

June 2007 Storm event

Kirrang Dr Campvale drain crossing looking west water over Kirrang Dr

June 2007 Storm Event Campvale pump Station Inlet

June 2007 following storm event.

Campvale Pump Station levels taken within 8 hours of event showing water level at pump station in relation to inlet pipes and gauge.

June 2007 following storm event.

Campvale Pump Station levels taken within 24 hours after event showing water level at pump station in relation to inlet pipes and request for 4 pumps to operate.

June 2007 Storm event

Water passing under Kula Rd at corner of Karwin Rd looking north

June 2007 Storm event

Water over road in Kirrang Dr Campvale Drain

Figure 8 June '07

June 2007 32 Ryans Rd Meadowie.

Looking at stormwater easement at rear

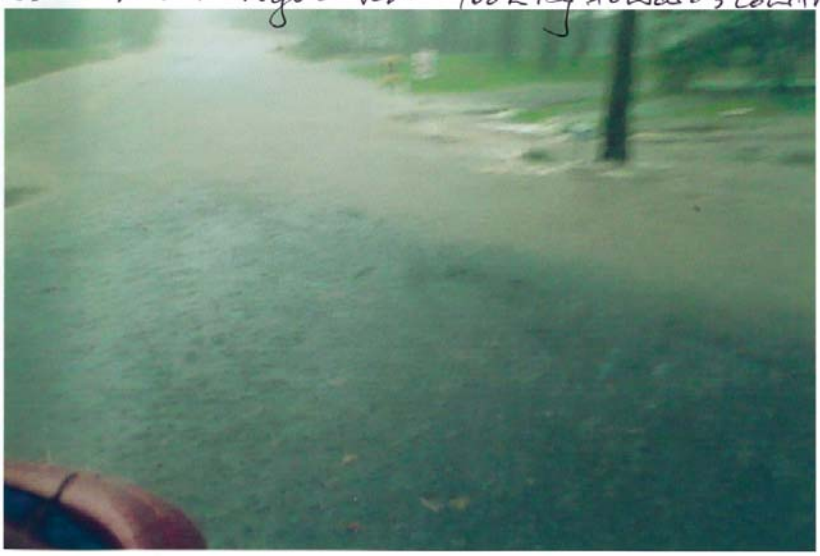
Stormwater easement - looking towards rear of no 30

Driveway of No 32

Backyard of No 32.

June 2007 31 Ryan Rd

June 2007 Ryan Rd - looking towards Court Rd



June 2007 No 32 Ryan Rd looking to No 25

June 2007 No 32 Ryan Rd looking to No 23

June 2004 Ferndale Rd

June 2004 Yulong Oval

June 2007 Yulong Oval

June 2007 From 31 Ryan Rd looking to Court Rd

Figure 9 32 Ryan Rd June '07


2007/06/08


2007/06/08


2007/06/08


2007/06/08


2007/06/08


2007/06/08


2007/06/08


2007/06/08


2007/06/08


2007/06/08

Figure 10 59 Kula Rd June '07


TOOHEYS
NEW

Figure 11 8 Ballat Close June '07

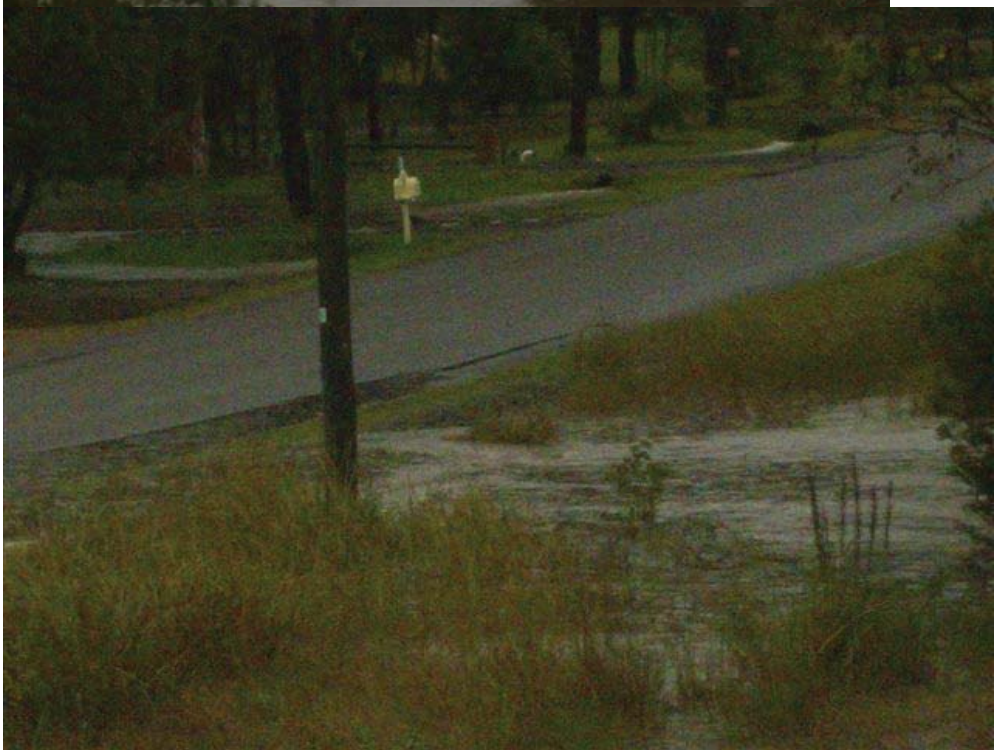


Figure 12 40 Ryan Road April '08

Figure 13 45 Coachwood Drive April '08

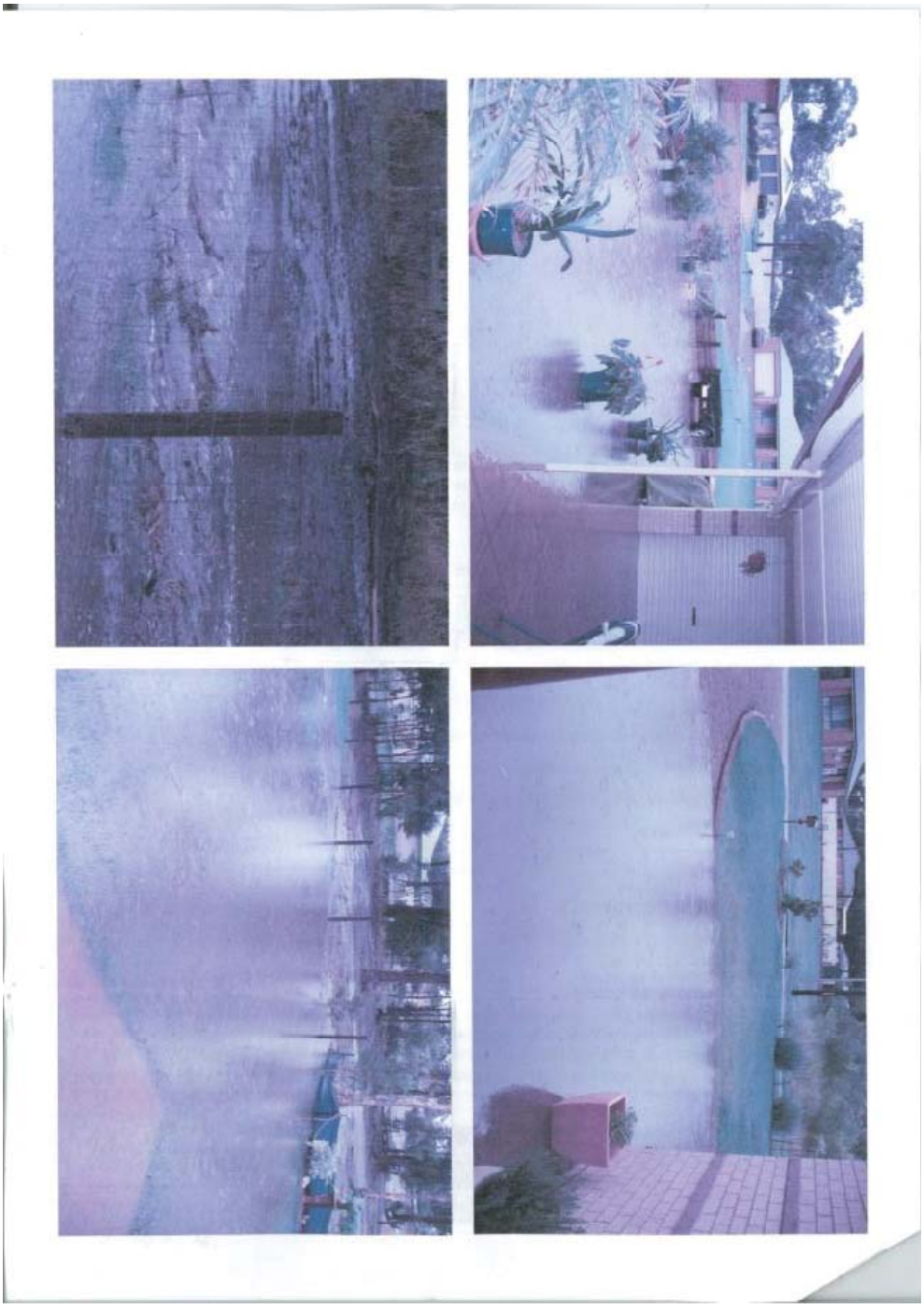


Figure 14 7 Osprey Crescent April '08

April 2008 following storm event.

Corner of Kirrang and Ferodale looking towards Yulong oval

April 2008 following storm event.

Water breaking out of drain in Karwin Rd flooding intersection at corner of Karwin and Kula

April 2008 Storm Event

Photo taken in April 2008 following storm event.

Water over Kirrang Drive level marker visible on edge of bridge

April 2008 following storm event.

Water across the road in front of the hardware store Ferodale Rd. Taken from the corner of Kirrang

April 2008 following storm event.

Water under Ryan Rd in storm water canal just west of Court Rd South side

April 2008 following storm event.

Water under Ryan Rd in storm water canal just west of Court Rd Northern side

April 2008 following storm event.

13 Kula Rd. Water has been through this house 3 times in past 2 years. Council has approved a subdivision on this lot allowing a second house to be constructed at the rear following a DA. Council continues to approve these subdivisions despite this designated flood area, in the past 12 months they have approved and many around it including lots: 11, 40, 31,56A, 58 & 64.

April 2008 following storm event.

15 Kula Rd next door to the drain which runs next to Karwin and under Kula

April 2008 following storm event.

Drains at front of homes in Lewis Drive, upgrade embankments and double piping has been carried out to reduce drive damage in this street. Water enters Campvale system and runs under Lewis then Ryan Rds.

April 2008 following storm event.

Land below Medowie Public school taken from north side of Ferodale Rd

Figure 15 April '08


TCH
Electrical Division

Figure 16 8 Ballat Close April '08


SUZUKI
XFG 124

Figure 17 3 Kirrang Drive Feb '09

Figure 18 13 Kirrang Drive Feb '09

Ulong Oval towards Hardware Store

7 Kirrang

5 Kirrang 2009

Kirrang Culvert 2009

7 Kirrang Drive
A back of House 2009

7 Kirrang 2009

Figure 19 7 Kirrang Drive Feb '09


15/02/2009


15/02/2009


15/02/2009


15/02/2009


15/02/2009

Figure 20 31 County Close Feb '09

Figure 21 31 Lewis Drive Feb '09

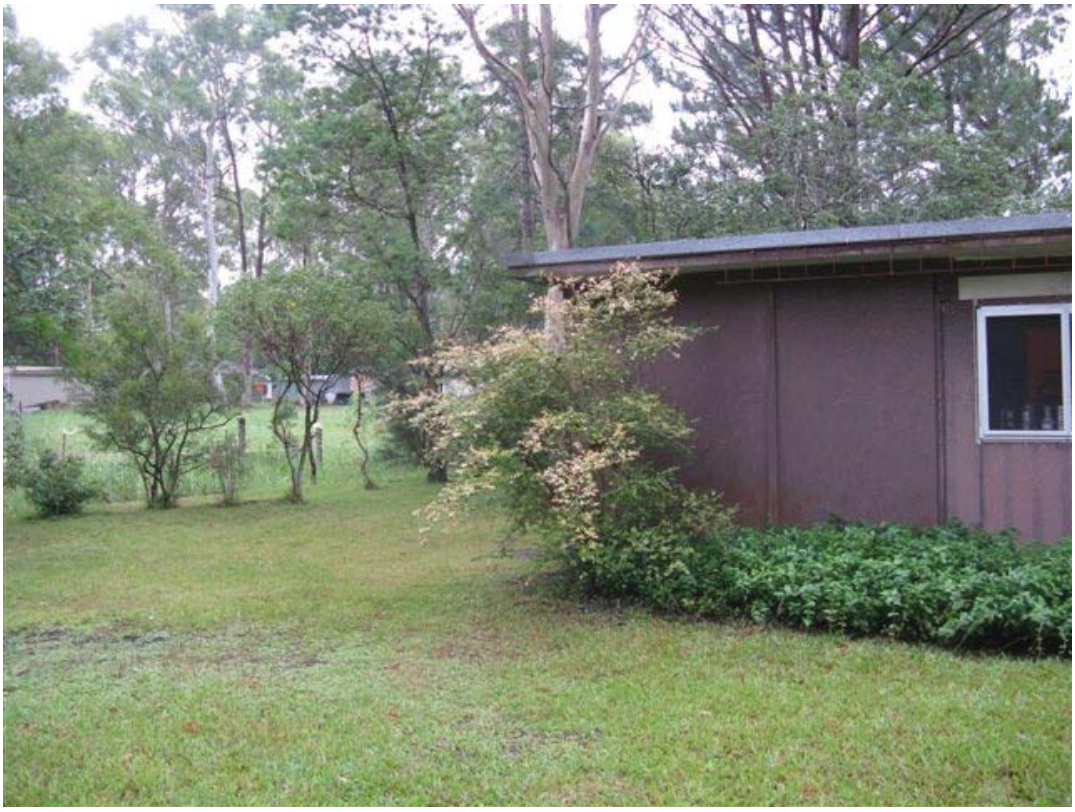
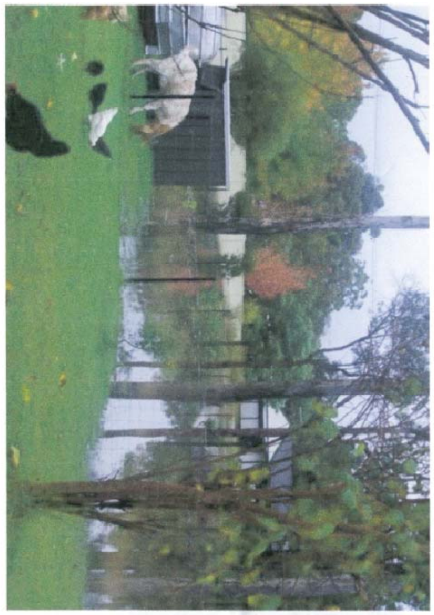


Figure 22 18 Kula Road Feb '09

33 Ryan Rd

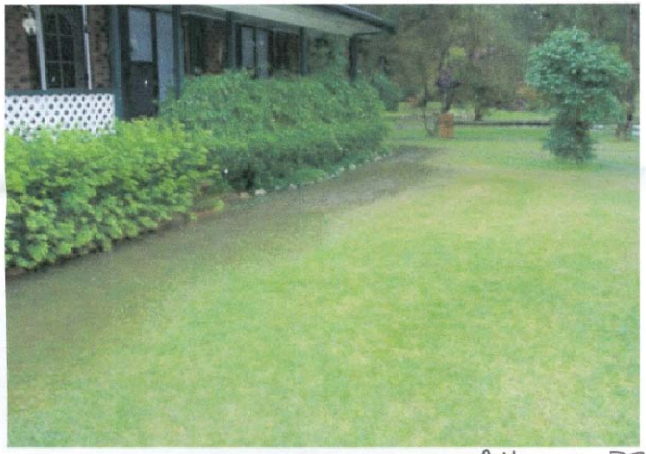
33- Ryan Rd

33 Ryan Rd




33 Ryan Rd

33 Ryan Rd



All are 33 Ryan Rd

All are showing 33 Ryan Rd

Figure 23 33 Ryan Road Unknown Event

Figure 24 13 Richard Close Unknown Event

Figure 25 71 Abundance Road Unknown Event

Appendix C

No. 13

House Floor RL 9.14
Garage Floor RL 8.90
Rear Shed RL 8.45
Flood RL 8.67
Pool Deck - NW Cnr RL 8.69

No. 9

House Floor RL 8.77
Garage Floor RL 8.63
Flood RL 8.67 - Garage
Flood RL 8.64 - Rear Shed
Floor Rear Shed RL 8.09

Owner says water comes from side drain - explains higher level at garage than shed

No. 7

House Floor RL 8.683
Flood RL8.685
Gareage Floor RL 8.41
Pooll Surround RL 8.50
Water comes from front of No. 9

No.5

House Floor RL 8.876
Flood RL 8.666
Pool Surround RL 8.50

No. 3

House Floor RL 8.59
Garage Floor RL 8.586
Flood Level RL 8.588
Water entered house through door to garage.

No. 8

House Floor RL 8.62
Floor of Covered Area
Between Buildings Rl 8.29
Flood RL 8.19

Box Culvert

5 / 3.6 * 1.0
Inv In 6.57
Inv Out 6.47

No. 31

Floor RL 8.45

No.33

Floor RL 8.59

No.35

Flood RL 7.66 2/09
Flood RL 7.69 6/07
Floor RL 8.56

Box Culvert

Inv In RL 6.20
Inv Out RL 6.11

Appendix D

Appendix D - Tabulated Results - Peak Flood Discharge (m^3/s)

Location	Design Event							
	2Y ARI	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	PMF
# 0 - 500m D/S Boundary Rd	12.1	13.6	16.4	20.9	25.4	28.4	31.6	67.2
# 1 - D/S Ryan Rd	13.8	16.4	18.5	23.8	29.9	33.9	37.2	85.2
# 2 - U/S Kula Rd	15.1	18.1	19.3	23.4	28.0	31.1	33.3	67.8
# 3 - D/S Ballat Rd	1.0	1.2	0.5	0.6	0.7	0.7	0.8	53.5
# 4 - Cnr Karwin Rd + Kula Rd	4.5	8.0	10.3	12.9	14.9	18.8	22.8	67.8
# 5 - Back of 11 Kula Rd	20.8	26.9	30.8	35.9	42.9	50.0	54.3	72.4
# 6 - U/S cnr Kula Rd + Kirrang Dr	3.1	5.6	6.6	8.1	12.0	15.1	18.2	30.7
# 7 - Back of 19 Kirrang Dr	22.7	30.0	34.6	40.6	49.6	57.8	65.4	157.5
# 8 - 100m U/S Kirrang Dr	19.9	27.9	32.7	39.2	45.6	50.8	55.3	82.6
# 9 - 40m U/S Ferodale Rd	18.9	26.2	30.4	36.6	43.7	50.4	56.4	130.6
# 10 - 200m U/S County Cl	13.9	19.3	22.7	27.0	39.0	45.3	50.9	154.8
# 11 - Back of 21 Federation Dr	3.3	4.4	5.1	6.0	12.8	15.1	16.9	33.5
# 12 - County Cl drain	17.2	24.1	28.3	34.1	44.5	52.1	58.9	141.6
# 13 - Drain U/S Coachwood Dr	2.8	3.7	4.4	5.2	11.6	13.3	15.4	17.6
# 14 - U/S cnr South St + Potoroo Blvd	2.3	3.0	3.5	4.3	10.2	11.7	12.8	13.6
# 15 - Back of 4 Raymond Cl	2.7	3.7	4.3	5.1	11.0	12.6	14.4	26.5
# 16 - Back of 61 James Rd	4.0	5.4	6.3	7.3	17.5	20.3	21.7	32.2
# 17 - U/S Culvert 754 Medowie Rd	1.4	1.9	2.2	2.8	6.4	7.4	8.3	8.4
# 18 - 12 Sir Henry Parkes Av	0.1	0.1	0.1	0.1	0.3	0.3	0.4	3.3
# 19 - U/S Pinch	5.5	10.1	14.6	23.1	31.6	38.2	45.8	184.4
# 20 - D/S Pinch	3.2	4.8	6.1	7.2	8.2	9.2	10.0	23.7
# 21 - Near Swan Bay outlet	0.3	0.6	0.7	1.4	2.1	2.7	3.2	22.1

*Refer to Figure 19 for indicated locations

Appendix D - Tabulated Results - Peak Flood Level (mAHD)

Location	Design Event							
	2Y ARI	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	PMF
# 0 - 500m D/S Boundary Rd	13.9	13.9	13.9	14.0	14.0	14.1	14.1	14.8
# 1 - D/S Ryan Rd	12.0	12.0	12.1	12.2	12.3	12.3	12.4	13.2
# 2 - U/S Kula Rd	9.4	9.5	9.5	9.5	9.5	9.6	9.6	10.2
# 3 - D/S Ballat Rd	11.7	11.7	11.8	11.8	11.8	11.8	11.8	12.1
# 4 - Cnr Karwin Rd + Kula Rd	9.2	9.4	9.5	9.5	9.5	9.6	9.6	10.4
# 5 - Back of 11 Kula Rd	8.4	8.4	8.5	8.6	8.7	8.7	8.8	9.8
# 6 - U/S cnr Kula Rd + Kirrang Dr	10.2	10.3	10.3	10.3	10.4	10.4	10.5	10.9
# 7 - Back of 19 Kirrang Dr	8.2	8.3	8.4	8.5	8.6	8.6	8.7	9.7
# 8 - 100m U/S Kirrang Dr	8.2	8.3	8.3	8.4	8.4	8.5	8.5	9.4
# 9 - 40m U/S Ferodale Rd	8.1	8.1	8.2	8.2	8.3	8.3	8.3	9.1
# 10 - 200m U/S County Cl	13.6	13.7	13.7	13.8	13.9	14.0	14.1	15.1
# 11 - Back of 21 Federation Dr	13.1	13.1	13.2	13.2	13.5	13.5	13.6	13.9
# 12 - County Cl drain	11.9	12.0	12.0	12.0	12.1	12.1	12.1	12.9
# 13 - Drain U/S Coachwood Dr	13.2	13.2	13.2	13.3	13.4	13.4	13.5	13.7
# 14 - U/S cnr South St + Potoroo Blvd	15.0	15.0	15.0	15.1	15.2	15.2	15.2	15.6
# 15 - Back of 4 Raymond Cl	9.7	9.7	9.7	9.7	9.7	9.8	9.8	10.3
# 16 - Back of 61 James Rd	9.8	9.8	9.8	9.8	9.9	10.0	10.0	10.3
# 17 - U/S Culvert 754 Medowie Rd	12.5	12.5	12.5	12.5	12.6	12.7	12.7	13.0
# 18 - 12 Sir Henry Parkes Av	21.9	21.9	21.9	21.9	21.9	21.9	21.9	22.0
# 19 - U/S Pinch	7.1	7.4	7.5	7.7	7.9	8.1	8.3	9.1
# 20 - D/S Pinch	7.2	7.4	7.5	7.7	7.9	8.1	8.3	9.1
# 21 - Near Swan Bay outlet	8.8	9.0	9.1	9.2	9.4	9.5	9.6	10.3

*Refer to Figure 19 for indicated locations

Appendix D - Tabulated Results - Peak Flood Velocity (m/s)

Location	Design Event							
	2Y ARI	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	PMF
# 0 - 500m D/S Boundary Rd	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.5
# 1 - D/S Ryan Rd	0.8	0.9	1.0	1.2	1.2	1.3	1.3	2.0
# 2 - U/S Kula Rd	1.0	1.1	1.1	1.2	1.3	1.3	1.3	1.8
# 3 - D/S Ballat Rd	0.4	0.6	0.8	0.9	0.9	1.0	1.0	1.3
# 4 - Cnr Karwin Rd + Kula Rd	0.4	0.7	0.7	1.0	1.0	1.1	1.2	2.1
# 5 - Back of 11 Kula Rd	0.9	1.0	1.0	1.0	1.2	1.3	1.3	1.7
# 6 - U/S cnr Kula Rd + Kirrang Dr	0.1	0.1	0.2	0.3	0.4	0.4	0.4	0.5
# 7 - Back of 19 Kirrang Dr	0.5	0.5	0.6	0.6	0.6	0.7	0.7	1.0
# 8 - 100m U/S Kirrang Dr	0.7	0.8	0.8	0.9	1.0	1.1	1.2	1.5
# 9 - 40m U/S Ferodale Rd	0.7	0.8	0.8	0.8	0.9	0.9	1.0	2.4
# 10 - 200m U/S County Cl	0.3	0.3	0.3	0.4	0.4	0.6	0.6	0.9
# 11 - Back of 21 Federation Dr	0.5	0.5	0.5	0.6	0.7	0.7	0.7	1.2
# 12 - County Cl drain	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.8
# 13 - Drain U/S Coachwood Dr	1.4	1.4	1.5	1.5	1.6	2.0	2.0	2.5
# 14 - U/S cnr South St + Potoroo Blvd	0.2	0.3	0.3	0.6	0.6	0.7	0.7	1.2
# 15 - Back of 4 Raymond Cl	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.8
# 16 - Back of 61 James Rd	0.2	0.3	0.3	0.5	0.6	0.6	0.9	1.2
# 17 - U/S Culvert 754 Medowie Rd	0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.5
# 18 - 12 Sir Henry Parkes Av	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3
# 19 - U/S Pinch	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
# 20 - D/S Pinch	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1
# 21 - Near Swan Bay outlet	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2

*Refer to Figure 19 for indicated locations

Appendix E

Concern	Submitted by	Comments
Timing of action to address outcomes of the study regarding the adverse effects of the "pinch" on flood levels in the CDIA.	Sue Hirsch, Scott Broadhead	This concern will be addressed in the Medowie FRMS+P
Disagreement on consequences to CPS caused by flow excess between Report indications and Hunter Water Representative statement.	Sue Hirsch, Scott Broadhead, Nalliah Sivabalan	During major storms events peak flood levels are expected to exceed 7 mAHD. As such it is likely to cause flooding within the pumping station and causing significant damages to its infrastructure.
Re-surfacing of roads and its consequences to flood impact, i.e. Abundance Rd and Richardson Rd. Also, likelyhood of ponded water as a major contributor to health problems.	Sue Hirsch, Scott Broadhead	This concern will be addressed in the Medowie FRMS+P
The drainage study undermines future development in Medowie.	Sue Hirsch	This concern will be addressed in the Medowie FRMS+P
Impact of saturation of upstream lands by increasing storage levels of Grahamstown Dam.	Sue Hirsch, Scott Broadhead	This concern is out of the scope of the Medowie Drainage Flood Study
Likelyhood to direct runoff, upstream of Boundry Rd levee, into Grahamstown Dam to mitigate flood levels in downstream areas.	Scott Broadhead	This concern will be addressed in the Medowie FRMS+P
Inconvenience of data size of report to download from server.	Wal Mills	The report will be sub-divided into different volumes for better handing of downloads and improving computer loading and reading times.
Confusing legend in Figs 16, 17 and 18.	Wal Mills	Changes have been made to the mentioned figures
Agreement on delineation of Flood Prone land as a consequence of scattered "puddles" due to the DRM used.	Wal Mills	This concern will be addressed in the Medowie FRMS+P
Disagreement on soil infiltration capacity between theoretical and "observed" infiltration rates.	Nalliah Sivabalan	This concern has been addressed in previous discussions at Council meetings and as such conservative rainfall loss values have been adopted for the Study.
Tables 16, 17 and 18 can cause potential confusion to the reader.	Nalliah Sivabalan	Medowie Drainage Flood Study Report
Explain difference in water levels immediately upstream and downstream of Ferodale Rd.	Nalliah Sivabalan	Ferodale Road is an important hydraulic control within the Campvale Swamp catchment. As such it has significant impact on flood behaviour in upstream and downstream areas of the Drain. During major storm events flows from upstream areas overtop Ferodale Road, whilst levels in the CDIA increase significantly, reducing the hydraulic gradient across Ferodale Road in major events.
Consider planning levels in CDIA under a pumping outage scenario	Nalliah Sivabalan	Will be considered in the Medowie FRMS+P once freeboard component has been defined.
Peak flow rates discrepancy in Campvale Drain (Appendix D)	Nalliah Sivabalan	Appendix D has been amended
Discrepancy in water levels between observed and modelled water levels in Kirrang Dr.	Nalliah Sivabalan	Addressed in Medowie Drainage Flood Study - Section 5.3.2.1
Clarification of Figures 38A and 38B of the report	Nalliah Sivabalan	Shown on Figure 38A are Design Flood Profiles for different AEP events. Shown on Figure 38B are the results of a sensitivity run which assess the peak flood level impact at the CDIA. In the first scenario the CDIA is considered "dry" (i.e. no initial water level in the drain), whilst the second scenario the CDIA has a starting water level at 7 mAHD.
Flood Behaviour near No. 3 Kirrang Drive.	John & Susan Humphries	As observed by residents along Kirrang Drive and the results of the model, during major storm events the swale along Kirrang Drive can overflow causing flooding to the residents in Kirrang Drive. However, most of the flooding at the back of the properties located to the west of Kirrang Drive is caused by the overflowing of the Drain. Once the floor level survey has been undertaken it will be possible to determine whether the overtopping of Ferodale Road is higher than the lowest slab level. Impacts of the land fill at Yulong Oval have not been assessed in the Study

Brief History or Campvale Drain and Drainage Union

This entire area is generally low with a high water table and naturally subject to restrictive drainage. Four swamps dominated the area being Moffats, Race Course, Campvale and Grahamstown. Moffats when full overflowed across a low ridge into Race Course swamp which ultimately discharged into Pipeclay Creek in a north easterly direction with little impact on Medowie. The area south of Richardson Road is also dominated by natural swamps such as Galloping, Telegraph, Sandhole, Ready and Deep Swamp, which now all fall within the Tomago Water Supply Sand Beds Area some of which is also within the Tilligerry State Conservation area under the control of National Parks and Wildlife Service.

Originally the water level rose high enough in the Campvale Swamp the natural outlet was west via a low saddle into Grahamstown Swamp. An 1836 plan H273 663 shows the surveyed limits of Campvale Swamp so it must have been of some significance. In 1910 the then Department of Lands authorised the construction of the Campvale Drain (through the low saddle) to remove swamp water from part of the properties affected by Campvale Swamp. Grahamstown Swamp also had drains cut in it at the same time as Campvale to hasten the removal of water. The outlet from Campvale was enlarged to become part of the new Campvale Drain which emptied into Grahamstown Swamp. If and when this swamp filled, its natural and improved drainage outlet was into what became known as the Grahamstown Drain. This drain generally runs south east of Raymond Terrace then into Windeyer's Creek under the old Pacific Highway (Adelaide Street), then into the Hunter River between Heatherbrae and Raymond Terrace. The drains worked well and Campvale Swamp all but disappeared except for a small area which still remains in the south west of the swamp where the natural outlet drained into Grahamstown Swamp. This damp area is still evident today along the Campvale Drain about 2km east of the existing Hunter Water Corporation Pump Station. Heavy prolonged rain caused the water level to temporarily rise until the drain took it away. The drain was so efficient it lowered the swamp level so drastically that in 1934 the original subdivision within the swamp area was approved and further ones started being approved. These subdivisions were partly within the whole swamp area between Abundance, Ferodale, Medowie and Richardson Roads as well as the lower area east of Grahamstown Road and south of Lisadell Road. Interestingly one of the subdivisions by Henry F Halloran, D.P.17437 dedicates the roads but also contains a statement "No rights are intended to be created in regard to Main Campvale Drain".

The construction of the wall and later filling of Grahamstown Dam blocked the Campvale Drain outlet so the Hunter Water Corporation replaced the outlet with 4 large pumps to lift the water into the dam. The switching on of the pumps is in 4 stages controlled by water height level switches in the drain at the pump station. This situation still exists and seems to work reasonably well so long as the drain is efficient in supplying the water to the pumps. There is a need for H.W.C. to continually monitor the water quality at the pump site so any possible upstream pollution is checked. It is very rare for more than 2 of the 4 pumps to be used because over recent years there has been a large area of inundation.

When the drain was originally constructed the Department of Lands created the Grahamstown and Campvale Swamps Drainage Trust District, with the Trust being charged with the responsibility of maintaining the drain to ensure the continued drainage of the benefited properties. The Trust levied rates on each of these properties to fund its maintenance works.

After the 1934 subdivisions there were approximately 125 properties within the 1072 ha Campvale Swamp Trust area, which contributed to the maintenance. Property rates were

paid to the Trust under the Water Act 1912. Council had no interest or responsibilities under this Act or any administration of it or maintenance of the drain, they all were encumbered solely on the Trust. The Drainage Act 1939 superseded the earlier Water Act. The new Act made provisions for the continuance of the previously appointed Drainage Trust with very few changes. The 1939 Drainage Act also made provision for when all the financial obligations and benefits of the Trust were settled, including monies payable to the State Treasurer, the Trust was deemed to be a Drainage Union under the Act. With the rapid expansion of Medowie since the 1960's, outside the proclaimed Drainage Union area, there was an increase in the volume of water entering the Campvale Drain. These new developments did not increase any extra properties available to pay rates to the Union as they were outside the proclaimed area of the Union. The extra water created a need for drain maintenance and enlargement beyond the previously recognised requirements to which the ratepayers contributed.

In 1972 the Grahamstown and Campvale Swamp Drainage Union was reconstituted and renamed under the more appropriate title of Campvale-Medowie Drainage Union. Shortly after that, I believe, because of the extra work load and demands on the Drainage Union, difficulties were experienced in reappointing or getting new nominations for the executive of the Union. It failed to function from about 1974. No maintenance was carried out on the Drain and some low lying properties began to suffer as the drain became more and more inefficient. Gradually from that time the community turned towards Council to assist. Part of the reason for this pressure on Council was because of the ever increasing number of subdivisions which were developed outside the Drainage Union area but still within the catchment which contributed to the flow in Campvale Drain. The total catchment area is in the order of 19.5 square kilometres and a large percentage is now developed in some form or another. The result being, the developed areas contribute more water towards the drain, often at a much faster rate than was the case prior to development. Many roads, drainage pipelines and open channels contribute to this situation.

As the main drain was not being maintained and the extra volume from the upper catchment had a significant impact and 'flooding issues' arose, as the subdivisions and development took place. It reached the stage where Council was demanded 'to do something' to assist in protecting the community.

Council began cleaning or removing obstructions from the drain to improve flow to the Hunter Water Corporations pumps, even though there was no legal obligation for it to do so. In August 1988 Council resolved to become involved in the maintenance of the drain and liaison with the Hunter Water Corporation, over the use of the outlet pumps. To that end Council has been endeavouring to obtain "Easements to Drain Water' over the affected properties within the original Campvale-Medowie Drainage Union area. This has resulted in plans being registered at the office of Land and Property Information to facilitate creation of Easement for Drainage of Water from Ferodale Road to the Hunter Water Corporation pump station. Most affected owners have been co-operating by granting easements to Council. Council is currently actively pursuing the finalisation of obtaining the easements over the remaining properties with most owners responding positively. There is much more work required with negotiations, design and construction as well as on going maintenance.

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Principal Property Officer
Port Stephens Council

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