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ITEM 3 POST EXHIBITION - ADOPTION OF CHAPTERS E13 (FLOODPLAIN MANAGEMENT) AND E14 (STORMWATER MANAGEMENT) OF WDCP 2009

On 15 December 2009, Council endorsed the Wollongong Development Control Plan (DCP) 2009. The DCP came into force on the 3 March 2010, following the commencement of the Wollongong Local Environmental Plan (LEP) 2009.

The DCP includes chapters E13: Floodplain Management and E14: Stormwater Management. A review of Chapters E13 and E14 has resulted in proposed amendments. The proposed amendments were publicly exhibited and minor changes have been made following the public exhibition process.

The changes to the DCP chapters are recommended to provide greater clarity, simplify some modelling processes, ensure consistency with the LEP and implement recommendations from adopted Floodplain Risk Management Plans and the Coastal Zone Management Plan so that:

- stormwater and flooding impacts on future developments are managed

- impacts from future developments on stormwater and flooding are managed.

RECOMMENDATION

1 The revised Wollongong Development Control Plan 2009, chapters E13: Floodplain Management and E14: Stormwater Management to be adopted and notice of its adoption be published.

2 Persons who made submissions be thanked and advised of Council's decision.

REPORT AUTHORISATIONS

Report of: Mark Roebuck, Manager Infrastructure Strategy + Planning (Acting)
Authorised by: Andrew Carfield, Director Infrastructure + Works - Connectivity Assets + Liveable City

ATTACHMENTS

1 Reviewed chapter E13: Floodplain Management
2 Reviewed chapter E14: Stormwater Management
3 Detailed comments and responses/actions

BACKGROUND

Since the adoption of chapters E13: Floodplain Management and Chapter E14: Stormwater Management in 2009, Council has adopted a number of Floodplain Risk Management Studies and Plans (FRMS/Ps) which contain DCP related recommendations. The reviewed chapters have considered these recommendations.

Council's Conduit Blockage Policy (2002) was reviewed in 2016 and recommends updating chapters E13 and E14.

New national guidance contained in Australian Rainfall and Runoff (2019) is also being progressively adopted by Council and has been considered in the review of Chapters E13 and E14.

The review of chapters E13 and E14 is occurring over 2 stages. The proposed changes represent Stage 1.

Stage 1

- Ensure DCP chapters are consistent with the Wollongong Local Environment Plan (2009);
- Clarify Council's Section 9.1(2) (previously 117(2)) Ministerial Direction exemption within DCP;
- Consider the review of Council's Conduit Blockage Policy;
- Implement DCP related recommendations from FRMS/Ps;
- Implement recommendations from the Coastal Zone Management Plan (2017);

- Amend inconsistent & ambiguous sections; and
- Clarify the definition of detrimental increases in flood impacts.

Stage 2

Council will implement Stage 2 as Floodplain Risk Management Studies are completed (over the next 5 years). Stage 2 will further incorporate Australian Rainfall and Runoff 2019 and update Flood Risk Precincts in line with national guidance.

PROPOSAL

Council adopt the proposed amendments to DCP chapters E13: Floodplain Management (Attachment 1) and E14: Stormwater Management (Attachment 2) and publish notice of its adoption. The proposed amendments represent Stage 1 of the review. There will be opportunity for further refinement of the DCP chapters during the Stage 2 review.

CONSULTATION AND COMMUNICATION

Key industry stakeholders were informed of Council's intent to review the DCP chapters at an industry forum on 7 December 2018 and initial comments were requested. Three submissions were received and considered in the review.

The review of chapters E13 and E14 has been led by Council's Infrastructure Strategy and Planning division. Internal consultation with Development Assessment and Compliance, and City Strategy, has occurred throughout.

On 18 November 2019, Council resolved to publicly exhibit the draft chapters. The draft chapters were placed on public exhibition from 25 November 2019 to 20 January 2020.

Council's engagement team shared the proposed changes with the community and key stakeholders including Floodplain Risk Management Committee members. Emails with this information were sent to community, Register of Interest (flood) and industry stakeholders. The information was also available at Council's Customer Service Centre. Copies of the draft chapters and change logs, a Frequently Asked Questions sheet and Feedback Forms were made available at Wollongong Library. They were also included on the project webpage. A notice of the exhibition was published in the Advertiser on 27 November and 18 December 2019. The community was invited to provide feedback via Council's website and Customer Service Centre.

Key industry stakeholders were invited to participate in a forum at Council's Administration building on 5 December 2019, to learn about the staged process for the review and proposed updates. Council sought to find out whether the proposed changes were supported, or if there were other changes that should be considered. Council's floodplain engineers gave a presentation, with a question and answer session following. The forum was attended by 35 industry stakeholders. As a result of this consultation, the exhibition period was extended to allow more time for submissions.

Of the 10 submissions received in response to the public exhibition, 7 were from private industry stakeholders and were highly technical in content.

The table below outlines a summary of the key issues raised in submissions, Council comment and actions or changes made to the draft documents.

A more detailed table of submissions and Council response is included in Attachment 3.

Theme Raised	Council Comment	Action
Conduit Blockage – adopting only 1 set (Risk) Management Blockage Factors – opposition raised.	For most flood affected areas in the Local Government Area (LGA), the difference in flood level between the design and risk blockage factors is minimal. At the few locations where there are significant differences in flood levels between the design and risk factors: • Using different blockage factors to determine impact and planning levels is inequitable to the impacted lot(s). • The impact cannot be accommodated within the 500mm freeboard.	No action required as the impacts are minimal for the majority of the LGA
Modelling of Buildings – using TUFLOW Layered Flow Constriction for elevated buildings.	Representing proposed or existing buildings on piers or suspended slabs using Layered Flow Constrictions in TUFLOW is permitted if the opening is modelled as both open and 50% blocked for flood impact assessment. A restriction will be placed on the title to ensure the opening is maintained.	Draft chapter E13 updated to permit elevated buildings to be modelled as layered flow constrictions.
Offsite Flood Impacts – ensure flood impact assessment is merit based.	Section 4.15 3A EPA Act – Councils must be flexible on our prescriptive controls provided the objectives are met DCP Chapter A1, Section 8 states Variation to development control will be considered on a case by case basis and will only be considered where written justification is provided to the satisfaction of Council, that the objectives of the development control have been achieved. Section 5, point 3 of DCP Chapter E13: Floodplain Management, also supports flexibility	No action required as the merit based assessment is already embedded in the DCP
Cut and Fill in the Floodplain	Filling above the 1% event may be permitted if it can be demonstrated there are no adverse impacts in rare events (e.g. 0.2%, 0.5%, PMF).	Draft chapter E13 updated to permit filling above the 1% AEP event.
Testing of cumulative impacts	This requirement has not changed from the previous version of the DCP. Agree this is best investigated through a Flood Risk Management Study (FRMS). However not all flood prone land in the LGA is covered by a FRMS. Historically, when Council has asked developers to model cumulative impact, the modelling has demonstrated adverse impacts.	No action required

PLANNING AND POLICY IMPACT

This report contributes to the delivery of Our Wollongong 2028 Goal "We value and protect our environment". It specifically delivers on the following:

Community Strategic Plan	Delivery Program 2018-2021	Operational Plan 2019-20
Strategy	3 Year Action	Operational Plan Actions
1.1.3 the potential impacts of natural disasters, such as those related to flood and landslips are managed and risks are reduced to protect life, property and the environment	1.1.3.2 Establish effective urban stormwater and floodplain management programs	Develop and implement Floodplain Risk Management Plans

RISK ASSESSMENT

The revised DCP chapters will provided more clarity to Council and industry regarding floodplain and stormwater management requirements.

There will be opportunity for further refinement of the DCP chapters during Stage 2 of the review.

CONCLUSION

The draft DCP chapters E13 and E14 were exhibited from 25 November 2019 to 20 January 2020. Generally, the documents are seen as an improvement to the current chapters. There were a range of issues raised through submissions, which have informed amendments and improvements to the drafts. The reviewed chapters ensure the impacts of future developments on stormwater and flooding are appropriately managed.

Part E– General Controls – Environmental Controls

Chapter E13: Floodplain Management

Contents

Figures

1 INTRODUCTION

a) This chapter of the DCP provides Council's requirements for development upon flood prone land and land below the flood planning level within the City of Wollongong Local Government Area (LGA).

b) This chapter of the DCP has been developed as an outcome of Floodplain Risk Management Plans (FRMPs) prepared in accordance with the process outlined by the NSW Government Flood Prone Lands Policy and the NSW Floodplain Development Manual (FDM) 2005. In areas where FRMPs have not yet been adopted the planning controls reflect Council Policy and are considered to be consistent with the principles of the State Government Flood Prone Lands Policy and FDM.

c) The Department of Planning and the Department of Environment and Climate Change (Now Department of Planning Industry and Environment, DPIE) confirmed that there were exceptional circumstances that allowed Wollongong Council to apply flood related controls to residential development above the 1% Annual Exceedance Probability (AEP) flood level (plus freeboard) in accordance with Ministerial Directions outlined in Planning Circular PS-07-003.

d) Other Chapters of this DCP include flood risk management provisions, which relate to the specific development requirements for specific land uses.

2 LAND TO WHICH THE PLAN APPLIES

1. The Plan applies to all floodplains and land below the flood planning level area within the City of Wollongong LGA. Figure 1 shows catchment boundaries within the Wollongong LGA.

2. The extents of adopted catchment wide flood studies and floodplain risk management studies and plans can be viewed at:

   https://www.wollongong.nsw.gov.au/development/maps

   >planning and environment map>*Constraints and Planning DCPs* layer

   Please note the flood information is only viewable at a scale of 1:15000.

3 OBJECTIVES

1. The key objectives of this chapter are to:

a) Maintain the existing flood regime and flow conveyance capacity;

b) Maintain the function of floodway and flood storage areas;

c) Reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone land;

d) Reduce private and public losses from flooding;

e) Improve public safety with respect to flooding;

f) Minimise the potential impact of development and other activity upon the aesthetic, recreational and environmental value of the waterway corridors;

g) Increase public awareness of the hazard and extent of land affected by the full range of potential floods;

h) Ensure new development must, as far as practical, reduce the existing flood risk, and in no circumstances should the flood risk be worsened;

i) Ensure new development (with the exception of waterway crossings) does not encroach within areas susceptible to channel erosion, migration, bank failure and slumping; and

j) Deal equitably and consistently with all matters requiring Council approval on flood affected land, in accordance with the principles within the latest version of the NSW Floodplain Development Manual or its update.

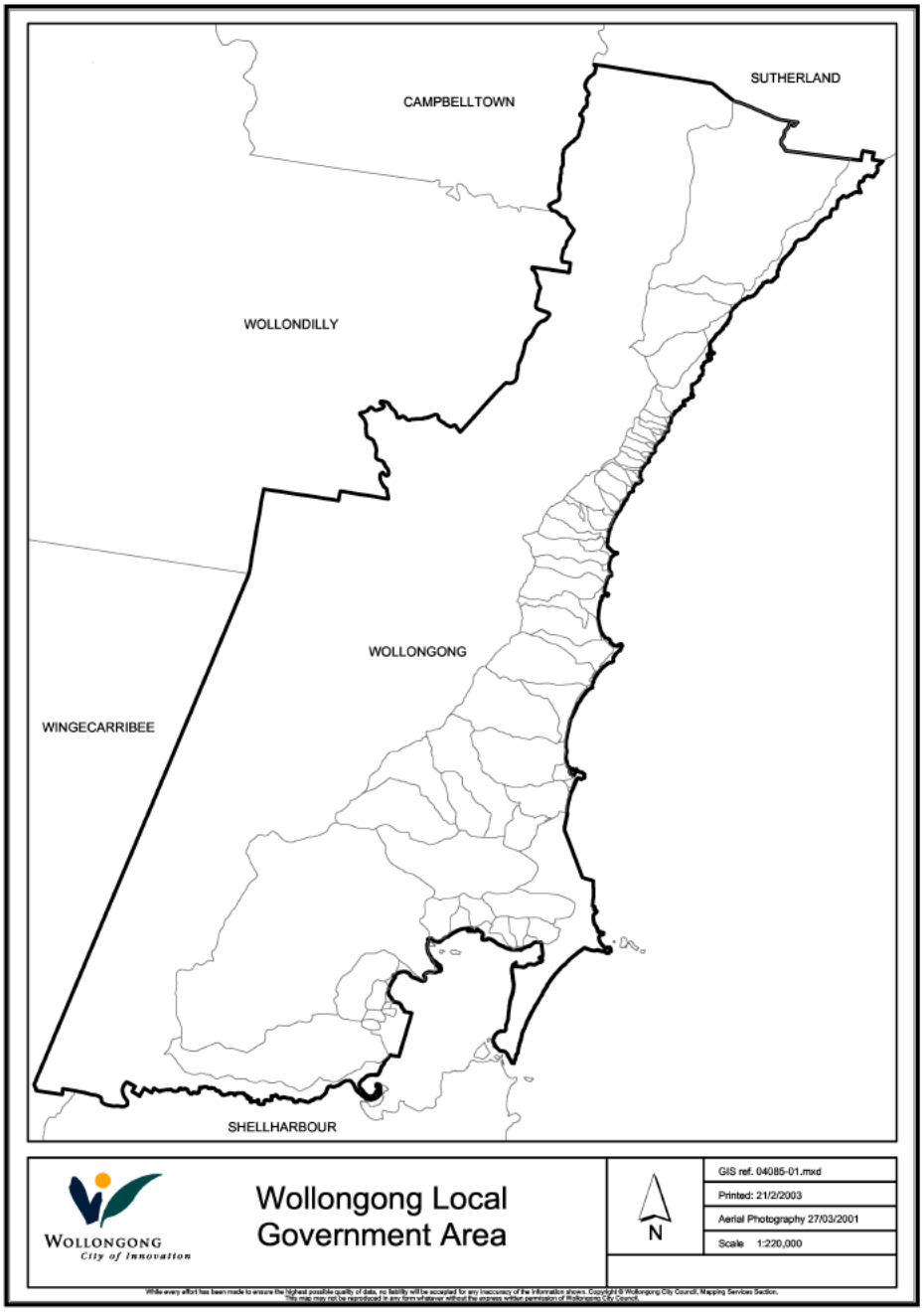


Figure 1 Catchments within the Wollongong Local Government Area. DEFINITIONS

For the purposes of this chapter of the DCP, the following definitions and technical terms apply:

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. Example, if a peak flood discharge of 500 m^3/s has an AEP of 1%, it means that there is a 1% chance (that is one-in-100 chance) of a 500 m^3/s or larger event occurring in any one year.
Australian Height Datum (AHD)	Australian Height Datum: National reference datum for level.
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.
ARR1987	Australian Rainfall and Runoff: 1987 published by the Institute of Engineers, Australia
ARR2019	Australian Rainfall and Runoff 2019, published by the Commonwealth of Australia (Geoscience Australia).
Basement Car Parking	Refers to a car parking area wholly or partly accommodated underground, below a building. The roof of this space, including any solid walls on the podium, must not exceed 1.2 m in height above natural ground level or finished ground level, whichever is the greatest distance.
DPIE	Department of Planning Industry and Environment
Deck	An outdoor living area attached to a dwelling, which may be covered or uncovered, and is not capable of being used or adapted for use as habitable floor area.
Enclosed car parking	Car parking that is potentially subject to rapid inundation, which consequently increases danger to human life and property damage (such as basement or bunded car parking areas). The following criteria apply for the purposes of determining what is enclosed car parking: (a) Flooding of surrounding areas may raise water levels above the perimeter which encloses the car park (normally the entrance), resulting in rapid inundation of the car park to depths greater than 0.8m, and (b) Drainage of accumulated water in the car park has an outflow discharge capacity significantly less than the potential inflow capacity
Filling	Depositing of soil, rock or other material. Filling does not include the depositing of topsoil, or feature rock imported to the lot, that is intended for use in garden landscaping, turf or garden bed establishment or topdressing of lawns.
Flood	A 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 as defined by the Floodplain Development Manual before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
Flood awareness	An appreciation of the likely effects of flooding and a knowledge of the relevant flood warning and evacuation procedures.

Flood compatible building components	A combination of measures incorporated in the design and/or construction and alteration of individual buildings or structures subject to flooding, and the use of flood compatible materials for the reduction or elimination of flood damage.
Flood compatible materials	Those materials used in building which are resistant to damage when inundated. A list of flood compatible materials is attached in Schedule
Flood evacuation strategy	The proposed strategy for the evacuation of areas within effective warning time during periods of flood as specified within any policy of Council, the FRMP, the relevant State Government disaster plan, by advices received from the State Emergency Services (SES) or as determined in the assessment of individual proposals.
Flood Planning Area	The area where flood related development controls apply. It includes land below the flood planning level (FPL) and may extend to include other areas of land where the high consequences in low probability events require additional flood related controls to reduce damages or to not alter the floodway in rarer flood events.
Flood planning levels (FPLs)	***flood planning level*** In the Wollongong LGA, the FPL is the level of a 1 % AEP flood event plus 0.5 metres freeboard, unless otherwise stated in an adopted Floodplain Risk Management Study and/or Floodplain Risk Management Plan
Flood Prone Land	Land susceptible to flooding by the PMF event. Flood Prone Land is synonymous with flood liable land.
Flood Refuge Area	An onsite refuge above the PMF that provides reasonable shelter for the likely occupants of the development commensurate with the period of time that refuge is likely to be required in floods up to the PMF. Note: In general, it is not acceptable to rely on a refuge provided by or on other development sites. In all cases where an onsite refuge is provided, it is to be both intrinsically accessible to all people on the site, sheltered and an integrated part of the development (i.e. a second storey with internal stair access). The route to the refuge is to be fail safe, plainly evident and self-directing.
Flood Fringe Areas	The remaining areas of flood prone land after floodway and flood storage areas have been identified
Floodway Areas	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 flow or a significant increase in flood levels. Where not mapped in an adopted Flood Study or FRMS, floodway areas may be defined using DPIE Floodway Definition Guidance (in Prep 2020), or using a hydraulic 0.4m/s.
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.

Floodplain	Synonymous with ***flood liable*** and ***flood prone land***) is the area of land that is subject to inundation by the probable maximum flood (PMF).
Floodplain Development Manual (FDM)	Floodplain Development Manual (2005) or the latest version.
Floodplain Risk Management Plan (FRMP)	A plan prepared for one or more floodplains in accordance with the requirements of the FDM.
Floodplain Risk Management Study (FRMS)	A study prepared for one or more floodplains in accordance with the requirements of the FDM.
Freeboard	The height above the design flood used, in consideration of local and design factors, to provide reasonable certainty that the risk exposure selected in deciding on a particular design flood is actually provided. It is a factor of safety typically used in relation to the setting of flood levels, levee crest levels and so on. Freeboard compensates for a range of factors including wave action, localised hydraulic behaviour and levee settlement, all of which increase water levels or reduce the level of protection provided. Freeboard should not be relied upon to provide protection for flood events larger than the relevant defined flood event of a design flood. Freeboard is included in the design flood planning level and therefore used in the derivation of the flood planning area.
Government Infrastructure Projects	Infrastructure projects undertaken by public authorities.
Habitable Floor Area	• 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 plan, the hazard is flooding which has the potential to cause harm or loss to the community.
Overland Flow	Runoff from rainfall that flows over the land before entering a watercourse, creek, river, lake or dam. Overland flow can flow down roads, driveways and through homes and buildings. It is typically shallow and fast flowing.
Merit Approach	An approach, the principles of which are embodied in the Floodplain Development Manual that 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 wellbeing of the State's rivers and floodplains.
Outbuilding	A building which is ancillary to a principal residential building and includes sheds, garages, car ports and similar buildings.

Practical	That which in the opinion of Council can be achieved within the design of the development, while not necessitating: (a) floor levels to be raised in a way that would unreasonably hinder access to and from existing floor levels or ground levels on the same site or adjacent public areas; and (b) the raising of a structure to a height that would result in unacceptable impacts on the amenity of adjacent residential properties; and (c) the height or presentation of a building that would be inconsistent with the existing or planned streetscape.
Probable maximum flood (PMF)	The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation.
Probable maximum precipitation (PMP)	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 the estimation of the probable maximum flood.
Probability	A statistical measure of the expected chance of flooding (see ARI).
Reliable access	during a flood means the ability for people to safely evacuate an area subject to imminent flooding within effective warning time, having regard to the depth and velocity of flood waters, the suitability of the evacuation route, and without a need to travel through areas where water depths increase.
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 chapter, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
Survey plan	is a plan prepared by a registered surveyor which shows the information required for the assessment of an application in accordance with the provisions of this Policy.
Suitably Qualified Civil Engineer	A civil engineer who is included in the National Professional Engineers Register, administered by the Institution of Engineers Australia or is eligible for membership of Engineers Australia.

4 KEY STEPS IN THE PROCESS

1. Please read this document carefully and seek assistance from Council officers as required.

2. Figure 2 is a summary of the major steps in the Development Application process for any development within a floodplain.

3. If the proposal does not comply with the prescriptive controls, determine whether the performance criteria and objectives are nonetheless achieved.

4. The assistance of Council staff or an experienced floodplain consultant may be required at various steps in the process to ensure that the requirements of this Plan are fully and satisfactorily addressed.

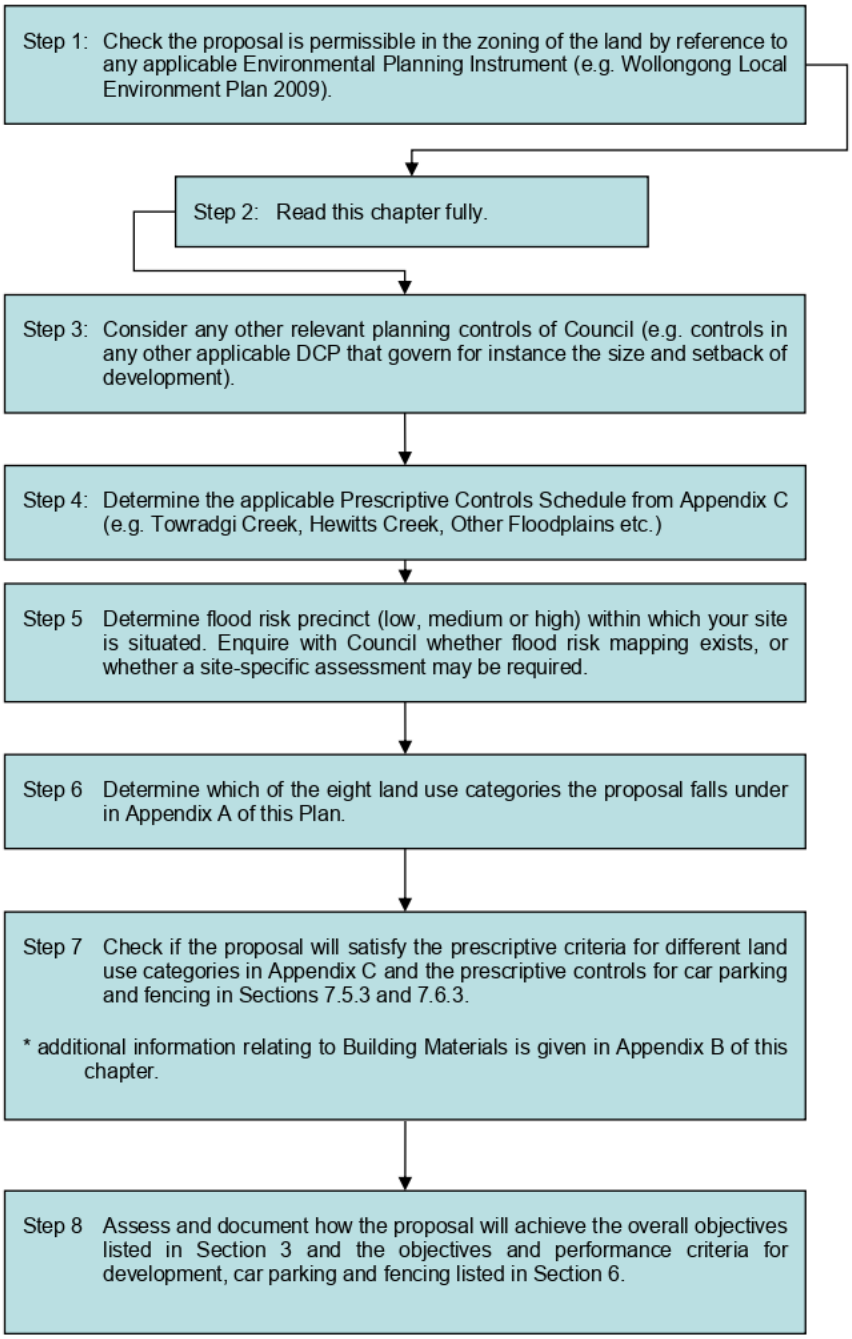


Figure 2: Summary of the major steps in the Development Application process for any development within a floodplain

5 FLOOD STUDIES

a) Flood studies must be prepared by a suitably qualified engineer. The flood study must be prepared in accordance with the relevant sections of this Chapter. The 20% AEP, 1% AEP and PMF flood events must be modelled to assess the flooding impact of a proposed development to property, infrastructure and the environment.

b) An investigation of the effects on the proposed development of upstream diversions caused by blockages and inappropriate development needs to be undertaken as part of the overall flood study.

Council will request a flood study to determine the effects of a proposed development on flooding and the effect of flooding on a proposed development. Flood studies will be required for any type of development where the development occurs in the floodplain or in areas where overland flow is suspected. Section 5.1 details the requirements for hydraulic design; Section 5.2 details requirements for conduit blockage.

Flood studies shall be prepared using a fully dynamic 1- or 2- dimensional computer model unless it can be demonstrated such modelling is not required. The model chosen shall be calibrated against a recorded storm event or Councils adopted flood study of management study if available. All input parameters and assumptions made must be clearly described and justified. A hard copy of the report, including all results, results summary table, and all the relevant information must be submitted with the application.

5.1 Hydraulic Design and Analysis

a) An appropriate computer model must be used for hydraulic design and analysis.

b) The data required for the hydraulic modelling including channel cross sections, hydraulic properties (e.g. roughness), survey and digital elevation models shall be obtained by the developer. This data shall be documented clearly and reflect both the existing and proposed hydraulic characteristics of the creek channel and floodplain. The developer must document any assumptions made.

c) A sufficient number of cross-sections selected at appropriate locations both within the site and extending sufficiently upstream and downstream of the site shall be analysed in order to reflect flood behaviour. This would normally require that the model extend to a boundary condition at the hydraulic control downstream of the site. Alternatively, where a 2-dimensional hydraulic model is used, a suitable grid size shall be adopted to accurately determine flood behaviour and flood impacts for the development at a development specific level

d) If modifications are required to the creek channel or floodplain or if the proposal involves activities with 40 m of the top of the creek bank. A controlled Activity Approval under the Water Management Act 2000 may be required.

e) Council is transitioning to ARR2019 through the completion of Floodplain Risk Management Studies and Plans. During this transition, flow estimates are to use ARR1987 IFDs and hydrologic procedures. The hydrologic techniques used in adopted Council Flood Studies and Floodplain Risk Management Studies will be used for and development-related flood study.

5.2 Conduit Blockage

Blockage of bridges, culverts and other stormwater conduits is a key consideration for Wollongong City Council.

a) Applicability of this section:

i) Blockage applies to all watercourses including creeks, floodways and other trunk drainage systems within the City of Wollongong with the exception of the minor system as defined in Chapter E14 of this DCP. It does not apply to pit blockage. Pit blockage considerations are set out in Section 6.2 of Chapter E14. It does not apply to pipes where the only upstream entry points are from kerb/gutter stormwater inlets (e.g. the minor system).

b) Conduit Blockage Factors

i) The blockage factors in Table 1 are to be applied to structures across all watercourses and overland flow paths for all flood-modelling purposes.

These applications include:

- Estimation of design flood levels, velocities, and depths for flood studies;
- Determining flood hazard and hydraulic categories, including the delineation of Flood Risk Precincts, Floodways and Flood Storage Areas;
- Infrastructure design;
- Structural design of proposed development;
- Impact assessment of proposed development;
- Assessing the benefit of proposed flood mitigation works;
- Estimating flood damages;
- Assessment of risk to life and evacuation considerations; and
- Setting Flood Planning Levels (FPLs), such as floor levels for new development.

c) Peak Flood Envelopes

i) Flooding and impacts are to be assessed using the following two scenarios :

- No Blockage; and
- Blockage factors.

i) Scenarios requiring various combinations of blockage (e.g. no blockage at some culverts, partial blockage at others) are generally not required.

d) Overtopping and Cross-Catchment Flow Diversion Investigation

i) Where flows exceed the capacity of the structure (applying the relevant blockage factor), flood modelling or other calculations should be undertaken to identify the overtopping flow behaviour. The modelling or calculations must be sufficient to identify where flows will return into the watercourse downstream of the structure, and whether flow will be diverted along other flow paths.

ii) Modelling or other calculations must be sufficient to identify whether cross catchment flows from other watercourses need to be considered at the site of interest.

e) Design of New Structures

i) The structure is to be designed using the relevant blockage factor at every stage in the calculations;

ii) Impacts of the structure on existing flood behaviour (levels, velocity and hazard) are to be quantified for a range of flood events, including larger and smaller events than the design AEP;

iii) Impacts are to be mitigated in accordance with the guidance specified in Chapter E13: Floodplain Management of this DCP; and

iv) All aspects of the proposed design with the potential to affect flow behaviour, including ancillary structures such as headwalls, handrails, safety barriers, noise walls, etc., are to be appropriately considered in the flood calculations.

f) Design of detention basins

i) Basins volumes, weirs and low flow outlets to be sized assuming no blockage;

ii) Basin spillway sized assuming relevant blockage factors of the outlet;

iii) Outlets to have debris management structure where blockage affects performance and where there is an identified source of debris upstream.

g) Blockage Factors

i) Culvert and bridge classifications are defined as follows:

- **Class 1**. Pipes 1.2 m internal diameter or smaller. Box culverts or bridges with a diagonal opening less than 1.5 m, and a width or height less than 0.9 m.

- **Class 2.** Pipes greater than 1.2 m internal diameter. Box culverts or bridges with a diagonal opening of more than or equal to 1.5 m, less than 3 m and minimum dimension of 0.9 m for both width and height.

- **Class 3.** Box culverts or bridges with a diagonal opening of more than or equal to 3 m, less than 6 m, and a minimum dimension of 1.2 m for both width and height.

- **Class 4.** Box culverts or bridges with a diagonal opening greater than or equal to 6 m, and a minimum dimension of 2.5 m for both width and height.

ii) For bridges, the dimension refer to the waterway opening between piers, not the total bridge dimensions. When determining the clearance of bridges above a natural channel, a reasonable level representing the long term channel bottom level should be used, using an averaged profile slope. For instance, it is not appropriate to propose localised excavation of the normal channel bed to increase the clearance above 3 m and satisfy the Class 4 requirements.

iii) The blockage factors are to be applied as a reduction in the effective flow area of the unblocked waterway of the structure. The blockage is to be a consistent effective reduction of the total flow area across the entire cross-section (that is, not bottom-up, top-down, or other selective partial blockage of the waterway area). This will typically involve a consistent reduction of the cross-section width (1D hydraulic models) or computational cell width (2D or 3D hydraulic models) representing the structure. For software packages which

implement a blockage factor as a parameter for bridges or culverts, this parameter should be used.

iv) The blockage factors are to be applied to all bridges, culverts and other conduits in the catchment that have the potential to influence the flow behaviour at the point of interest.

v) The blockage factors are to be applied for all locations within the Wollongong LGA, regardless of current land use or other considerations such as creek slope.

vi) Fences, rails and barriers which are within the overtopping flow path of a structure are to be modelled with appropriate energy losses (i.e. using the parameter K which represents the energy losses as a factor of dynamic head ($V^2/2g$), to reflect the influence of the rails on upstream flow. Energy losses resulting from the drag and turbulence induced by the form of the embankment between the culvert soffit (top) and the overtopping crest level are to be included where appropriate.

Table 1 Blockage Factors

Design AEP	Bridge/Culvert Classification				Debris Blockage of Overtopping Flows
	Class 1	Class 2	Class 3	Class 4	
20% AEP	60%	50%	35%	5%	Must appropriately represent obstructions to flow such as bridge decks, fences, handrails, buildings noise barriers etc. Modelling of pervious structures such as fences and railings above the structure should assume a 75% debris blockage of the unblocked flow area through the obstruction, plus associated energy losses.
Rarer than 20% and more frequent than 2% AEP (e.g. 10%, 5% AEP)	75%	65%	50%	10%	
2% AEP or Greater (e.g. 2%. 1% AEP, PMF)	95%	75%	60%	15%	

5.3 Modelling of Buildings

Modelling of proposed and existing buildings will be consistent with the method used in the adopted flood study or FRMS. If the site is not within the extent of an adopted flood study or FRMS, buildings must be represented using a method consistent with those recommended in:

Australian Rainfall and Runoff Revision Project 15: Two-dimensional simulations in urban areas – Representation of buildings in 2D numerical flood models.

Representing proposed or existing buildings on piers or suspended slabs using Layered Flow Constrictions in TUFLOW is permitted if the opening is modelled as both open and 50% blocked for flood impact assessment. A restriction will be placed on the title to ensure the opening is maintained.

5.4 Ocean Levels

a) The downstream boundary condition must be modelled using the same conditions used in the relevant flood study or floodplain risk management study and plan. For unstudied catchments, apply the downstream boundary condition used in the nearest studied catchment. E.g. for catchments in the northern suburbs, use the ocean boundary condition from the latest Hewitts Creek Flood Study or Floodplain Risk Management Study.

5.5 Modifications to Watercourses

a) Modifications to natural watercourses are generally not permitted, as they adversely impact on a number of issues including:

- Hydraulic function
- Channel pattern and form
- Long-term channel stability
- Aesthetic appearance
- Aquatic and bankside habitat diversity
- Water quality

b) Any proposals involving modifications to watercourses will require the submission of a detailed hydraulic assessment as well as a thorough environmental impact assessment of the prepared watercourse modification. Modifications to watercourses will only be considered where no other alternative exists, such as when scour within the watercourse threatens the stability of a dwelling or other high value asset. The reduction of development potential is not be considered justification for waterway modification.

Note: lodgement of an Integrated Development Application will be required for any involving modified to a watercourse since the concurrence of the NSW Department Water and Energy will be required pursuant to the requirements of the Water management Act 2000.

i) Buildings including decks will not be permitted over watercourses.

5.6 Overland Flow

Overland flow is runoff from rainfall which flows over the land before entering a watercourse, creek, river or lake or dam. Overland flow is typically shallow and fast flowing. Where a watercourse has been filled or piped, flooding resulting from overflows from the filled/piped watercourse is considered mainstream flooding and not overland flow.

The flood planning level for overland flow is the 1% AEP plus 0.3m. In an overland flow path, where the difference between the PMF and 1% flood level is greater than 0.3m, freeboard of 0.5m to the 1% flood applies. All other development controls of this chapter and E14 – Stormwater management also apply to overland flow.

In locations where there is uncertainty whether flooding is mainstream of overland flow, Council will decide.

6 WHAT ARE THE KEY CRITERIA FOR DETERMINING APPLICATIONS?

6.1 General

1. The criteria for determining applications for proposals potentially affected by flooding are structured in recognition that different controls are applicable to different land uses and levels of potential flood inundation and hazard.

2. The procedure to determine what controls apply to proposed development are:

   a) Identify the land use category of the development (Appendix: A);

   b) Determine which floodplain and which part of that floodplain the land is located within (Section 6.3) and relevant flood risk mapping; and

   c) Applying the controls outlined under Clause 6.4.

3. Sections 6.4, 6.5 and 6.6 provide objectives, performance criteria and prescriptive controls for development, car parking and fencing within the floodplain and flood planning area.

   - ***The objectives*** represent the outcomes that the Council wishes to achieve from each control.
   - ***The performance criteria*** represent a means of assessing whether the desired outcomes will be achieved.
   - ***The prescriptive controls*** are preferred ways of achieving the outcome. While adherence to the prescriptive controls may be important, it is paramount that the objectives and the performance criteria are clearly satisfied.

6.2 Land Use Categories

1. Eight major land use categories are defined for floodplain management. The specific uses, as defined by the applicable Environmental Planning Instruments, and other specially defined uses, have been grouped within each of these 8 categories.

6.3 Flood Risk Precincts

1. Each of the floodplains within the Wollongong LGA area can be classified based on different levels of potential flood risk. This classification of floodplains into flood risk precincts (FRPs) is achieved by considering the probabilities and consequences of all floods that could potentially occur. The full range of flood events are considered including frequent flooding (e.g. 20% AEP), rare flooding (e.g. the 1% AEP) and extreme flooding (E.g. the PMF).

2. The mapping of FRPs has been undertaken for some floodplains in the Wollongong LGA and some catchments are being reviewed. Studied catchments can be viewed at https://www.wollongong.nsw.gov.au/development/maps within the planning and environment map. Note – flood information is within the Constraints and Planning DCPs layer and viewable at a scale of 1:15000.

3. Council has adopted a three tier FRP classification as follows:

a) **High Flood Risk Precinct -** The High FRP is where high flood damages, potential risk to life and/or evacuation problems would be anticipated or where development would significantly or adversely alter flood behaviour. This area includes floodways. In this precinct, there would be a significant likelihood of flood damages and/or danger to life. The High FRP includes:

i) Areas greater than H3 hazard conditions during a 1% AEP flood from Figure 3;

ii) Land within 10m from the top of a watercourse bank; and

iii) Floodways.

b) **Medium Flood Risk Precinct -** In this precinct there would be a significant likelihood of flood damage and/or danger to life, but these damages or danger to life can be minimised by the application of appropriate development controls. The Medium FRP includes:

i) Includes land below the 1% AEP level plus 0.5 m that is not within the High FRP area inundated in a 1% AEP plus freeboard and not classified as High FRP.

c) **Low Flood Risk Precinct** - This precinct is where the likelihood of damages is low for most land uses. The Low FRP.

i) All areas within the floodplain (i.e. within the extent of the PMF) but not identified within either the High FRP or the Medium FRP; and

ii) All areas within the 2100 Coastal Zone Inundation Extent not classified Medium Flood Risk or High Flood Risk Precinct.

3. Where the FRP mapping has not been undertaken as part of the FRMS process it may be required as part of a flood study prepared for an individual development application. Such FRP mapping is to be undertaken by a suitably qualified engineer.

4. The NSW FDM (2005) is currently being reviewed (October 2019). The Australian Institute for Disaster Resilience (ADR, 2017) recommends the use of Flood Planning Constraint Categories (FPCCs) as an alternative to Flood Risk Precincts. Should the future versions of the NSW FDM also recommend the use of FPCC, Council may review how it considers flood risk in land use planning.

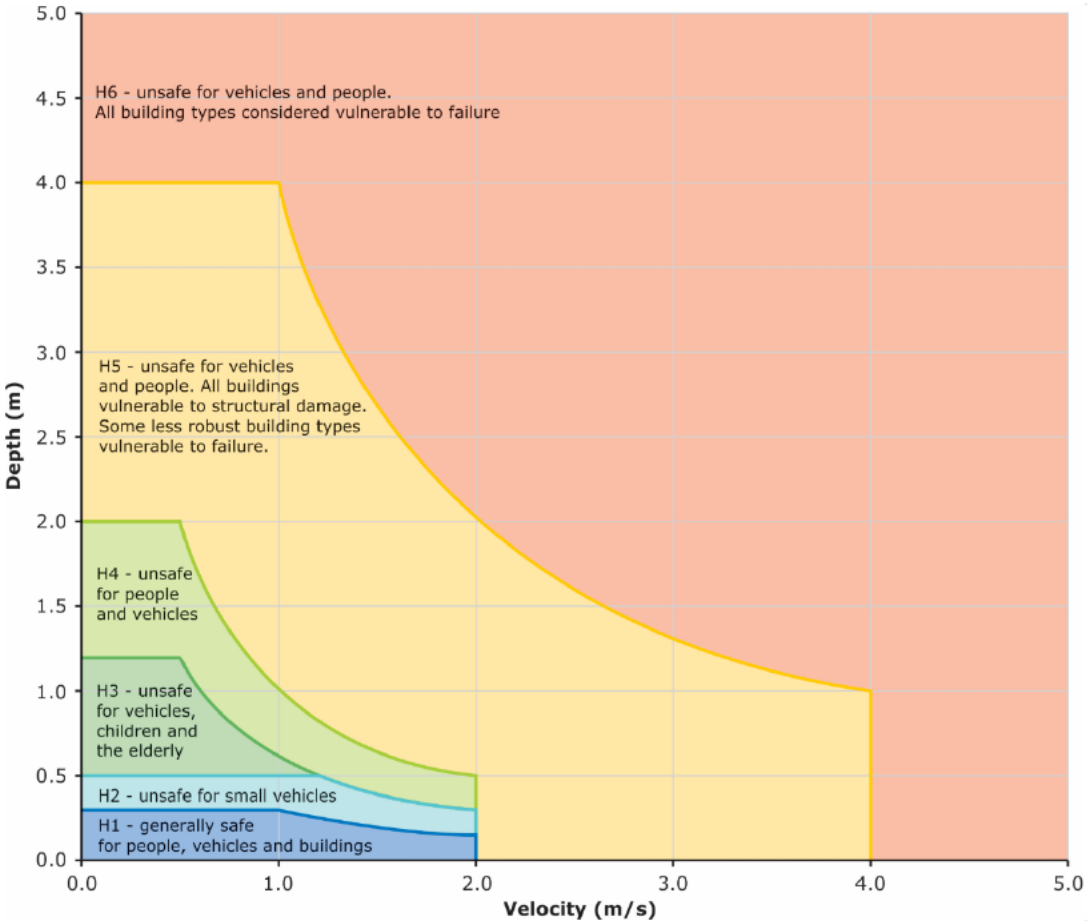


Figure 3: Combined Flood Hazard Curves (Smith et al., 2014)

6.4 Which controls apply to proposed developments?

1. The development controls apply to all land within a Flood Risk Precinct. The controls are graded relative to the severity and frequency of potential floods.

2. If no such study or plan exists, a site specific flood study may be required in accordance with Chapters E13 and E14 of this DCP.

3. The categories applicable to each floodplain are depicted on the planning matrices contained in the following schedules at Appendix C:

   Note: Council is to insert controls for other floodplains as FRMPs are prepared and become adopted. Numbering of schedules takes into account studies yet to be completed. Schedule numbers shown relate to those which have been adopted by Council and included in Appendix C.

   - Schedule 1 –Towradgi Creek Floodplain;
   - Schedule 2 – Hewitts/Slacky/Woodlands/Tramway/ Thomas Gibson Creeks Floodplain;

- Schedule 3 – Minnegang Creek Floodplain;
- Schedule 4 – Allans Creek Floodplain;
- Schedule 5 – Fairy and Cabbage Tree Creeks Floodplain;
- Schedule 6 – Mullet/Brooks Creeks Floodplain;
- Schedule 7 – Wollongong City Floodplain;
- Schedule 8 - Whartons, Collins, Farrahars Creeks, Bellambi Gully and Bellambi Lake Floodplains ;
- Schedule 9 – Lake Illawarra Floodplain;
- Schedule 9a – Lake Illawarra - Windang Peninsula; and
- Schedule 10 – All other floodplains.

6.4.1 Objectives

a) To ensure the proponents of development and the community in general are fully aware of the potential flood hazard and consequent risk associated with the use and development of land within the floodplain;

b) To require developments with high sensitivity to flood risk (e.g. critical public utilities) be sited and designed such that they are subject to no or minimal risk from flooding and have reliable access;

c) Allow development with a lower sensitivity to the flood hazard to be located within the floodplain, subject to appropriate design and siting controls, provided that the potential consequences that could still arise from flooding remain acceptable having regard to the State Government's Flood Policy and the likely expectations of the community in general;

d) To prevent any intensification of the use of High Flood Risk Precinct or floodways, and wherever appropriate and possible, allow for their conversion to natural waterway corridors;

e) To ensure that design and siting controls required to address the flood hazard do not result in unreasonable impacts upon the amenity or ecology of an area; and

f) To minimise the risk to life during flooding.

6.4.2 Performance Criteria

a) The proposed development should not result in any increased risk to life;

b) Development should not detrimentally increase the potential flood affectation on other development or properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain;

c) Development should not result in impacts upon the amenity of an area by way of unacceptable overshadowing of adjoining properties, privacy impacts (e.g. by unsympathetic house-raising) or by being incompatible with the streetscape or character of the locality;

d) The proposal must not have an adverse impact upon the ecological value of the waterway corridors, and where possible, should provide for their enhancement. Proposed development must be consistent with ESD principles; and

e) The geomorphic stability of a waterway corridor does not impose additional risk to human life or property.

6.4.3 Prescriptive Controls

a) Appendix C (Schedules 1 – 10) outlines the prescriptive controls that apply to each of the floodplains to which this Plan applies;

b) Table 2 provides permissible impacts for various development types for flood events up to the 1% AEP flood;

c) Flood impacts in the PMF will be assessed on merit and will consider:

i) Impacts to evacuation routes and onsite refuge service levels;

ii) Additional flood affected allotments;

iii) Flood warning times; and

iv) Changes to above yard and above floor flooding.

Table 2. Permissible Flood Impacts

Development/ Project Type	Allowable Impact (mm)					
	Critical Uses and Facilities	Sensitive Uses and Facilities	Residential	Commercial or Industrial	Tourist Related Development	Recreation or Non-urban Uses
Individual Property	10	10	20	20	20	20
Multi Lot Subdivision	10	10	20	50	50	50
Government Infrastructure Projects	20	20	100	150	150	150

New development must not increase the frequency of over floor flooding for residential, commercial or industrial buildings in a 20%, 1% or PMF event. Additionally, new development must not cause additional lots to be impacted by the 1% or PMF event.

6.5 Car Parking – Flood Related Requirements

6.5.1 Objectives

a) To minimise the damage to motor vehicles from flooding;

b) To ensure that motor vehicles do not become moving debris during floods;

c) To minimize damage to garages and their contents from flooding; and

d) To minimise the risk to human life resulting from the inundation of car parking, or driveway areas.

6.5.2 Performance Criteria

a) The proposed car parking should not result in any increased risk to vehicle damage;

b) The proposed garage should not detrimentally increase the potential flood affectation on other development;

c) The parking should be designed considering the hazard curves in Figure 3;

d) The proposed parking or driveway area must not increase the risk to life from flooding; and

e) The parking should be designed to ensure that vehicles will not be transported by floodwaters.

6.5.3 Prescriptive Standards

a) Open car parking – open car parking subject to inundation should be designed giving regard to vehicle stability in terms of depths and velocity during inundation by floodwaters, ensuring that each car parking space is within hydraulic hazard category H1 in Figure 3 during a 1 % AEP flood.

b) Garage addition or open car parking to an existing house – the minimum floor level should be as high as practical but shall be no lower than 300mm above adjacent finished ground levels. Refer to Schedule 1 for the maximum floor areas within the various FRPs.

c) Garage as part of new development and redevelopment;

i) Not permitted within a floodway;

d) Basement car parks – are to be protected from inundation during a 1 % AEP flood, ensuring all vehicular access, doors and ventilation points are a minimum of 0.2 metres above the 1 % AEP flood level.

6.6 Fencing – Flood Related Requirements

6.6.1 Objectives

a) To ensure that fencing does not result in the undesirable obstruction of the free flow of floodwaters;

b) To ensure that fencing does not become unsafe during floods and potentially become moving debris which threatens the integrity of structures or the safety of people; and

c) To ensure that fencing does not obstruct connectivity and the movement of fauna along riparian corridors.

6.6.2 Performance Criteria

a) Fencing is to be constructed in a manner which does not affect the flow of floods so as to detrimentally increase flood affectation on surrounding land;

b) Ability to be certified by a suitably qualified engineer, that the proposed fencing is adequately constructed so as to withstand the forces of floodwaters, or collapse in a controlled manner to prevent impediment to flood waters; and

c) Where fencing is required across riparian corridors, the fencing is to be of the type that will not harm or obstruct the movement of native fauna.

6.6.3 Prescriptive Standards

a) Fencing within a floodway or High FRP will not be permissible except for security/ permeable/ open type/safety fences of a type approved by Council.

b) Council requires a Development Application for all new solid (non-porous) and continuous fences above 0.6m high, in the High and Medium FRP's.

c) An applicant must demonstrate that the fence would not impede flow or flood water. Appropriate fences must satisfy the following:

i) An open collapsible hinged fence structure of pool fence type;

ii) Brick or other masonry type fence (which will generally not be permitted) or:

iii) A fence type and citing criteria prescribed by Council.

Council will consider other forms of fencing subject to compliance with the performance criteria.

7 FILLING OF THE FLOODPLAIN

1. Filling in flood prone areas is not permitted unless:

- A FRMP for the catchment has been adopted which allows filling to occur; or
- a report from a suitably qualified engineer is submitted to Council that satisfies the requirements of items 2 and 3 below and certifies that the development, in combination with similar filling of developable sites in the area, will not increase flood affectation elsewhere.

2. Filling of individual sites in isolation without consideration of the cumulative effects is not permitted. A case by case decision making approach cannot take into account the cumulative impact on flooding behaviour and associated risks caused by individual developments. Any proposal to fill a site must be accompanied by an analysis of the effect on flood levels of similar filling of developable sites in the area.

3. This analysis would form part of a flood study prepared in accordance with Chapters E13 and E14 of this DCP.

4. Generally, there is to be no net increase in fill in the floodplain. Compensatory excavation may be used to offset fill, however the compensatory excavation must be taken from an adjacent area of similar flood function that is lower in the floodplain (i.e. at a lower AEP inundation extent) than the proposed fill areas. Cut and fill drawings and volume calculations must be supplied to Council.

5. Filling above the 1% event may be permitted if can be demonstrated there are no adverse impacts in rare events (e.g. 0.2%, 0.5%, PMF).

8 OTHER CONSIDERATIONS

1. When assessing proposals for development or other activity within the area to which this Policy applies, Council will take into consideration the following specific matters.

a) The proposal does not have a significant direct or cumulative detrimental impact on:

i) Water quality;

ii) Native bushland vegetation;

iii) Riparian vegetation;

iv) Estuaries, wetlands, lakes or other water bodies;

v) Aquatic and terrestrial ecosystems;

vi) Indigenous flora and fauna; and

vii) Fluvial geomorphology.

b) Development pursued to mitigate the potential impact of flooding (e.g. house raising) must be undertaken in a manner which minimises the impact upon the amenity and character of the locality.

c) The proposal must not constrain the orderly and efficient utilisation of the waterways for multiple purposes.

d) Proposals for house raising must provide appropriate documentation including a report from a suitably qualified engineer to demonstrate the raised structure will not be at risk of failure from the forces of floodwaters and the provision of details such as landscaping and architectural enhancements which ensure that the resultant structure will not result in significant adverse impacts upon the amenity and character of an area.

e) Requirements for Concessional Development as listed in Appendix A.

9 WHAT INFORMATION IS REQUIRED WITH AN APPLICATION TO ADDRESS THIS CHAPTER?

1. Applications must include information which addresses all relevant controls listed above, and the following matters as applicable.

2. Applications for Concessional Development (see Appendix A) to an existing dwelling on Flood Prone Land shall be accompanied by documentation from a registered surveyor confirming existing floor levels to AHD.

3. Development Applications affected by this plan shall be accompanied by a survey plan showing:

a) The position of the existing building/s or proposed building/s

b) The existing ground levels to Australian Height Datum around the perimeter of the building and contours of the site; and

c) The existing or proposed floor levels to Australian Height Datum.

4. Applications for earthworks, filling of land and subdivision shall be accompanied by a survey plan (with a contour interval of 0.25m) showing levels in AHD and design plan showing design surface levels (also in AHD with 0.25m contour intervals).

5. For large scale developments, or developments in critical situations, particularly where an existing catchment based flood study is not available, a flood study using a fully dynamic one or two dimensional computer model is required. For smaller developments consideration may be given to the use of the existing flood study if available and suitable (e.g. it contains sufficient local detail), or otherwise a flood study prepared in a manner consistent with the Australian Rainfall and Runoff

1987 publication, Chapters E13 and E14 of this DCP and the Floodplain Development Manual (FDM), will be required. From this study, the following information shall be submitted in plan form for the pre-developed and post-developed scenarios:

a) Catchment plan;

b) Hydrologic calculations/analysis including model input and results files;

c) 2D model domain, grid size, boundary conditions, roughness layers;

d) Hydraulic structures and blockage factors applied

e) Survey data

f) Results (including depths, levels, FRP, hydraulic categories, velocity and hazard)

g) Impact maps

h) Water surface contours;

i) Velocity vectors;

j) Velocity and depth product contours;

k) Delineation of flood risk precincts relevant to individual floodplains; and

l) Flood profiles for the full range of events for total development including all structures and works (such as revegetation /enhancements).

6. Where the controls for a particular development proposal require an assessment of structural soundness during potential floods, the following impacts must be addressed:

a) Hydrostatic pressure;

b) Hydrodynamic pressure;

c) Impact of debris; and

d) Buoyancy forces.

7. Foundations need to be included in the structural analysis.

Appendix: A LAND USE CATEGORIES – WLEP(2009)

Essential Community Facilities	Critical Utilities	Subdivision	Residential
Emergency services facilities; public administration building that may provide an important contribution to the notification or evacuation of the community during flood events (e.g. SES Headquarters and Police Stations); Hospitals.	Community facility; telecommunications facility; institutions; educational establishments; child care centre; liquid fuel depot; public utility undertaking (including electricity generating works; sewerage treatment plant; sewerage system; telecommunications facility; utility installations and water treatment facility) which are essential to evacuation during periods of flood or if affected would unreasonably affect the ability of the community to return to normal activities after flood events; residential care facility; group home; school and seniors housing.	Earthworks; excavation; subdivision of land which involves the creation of new allotments with potential for further development.	Affordable housing; attached dwelling; backpackers' accommodation; caravan park (with permanent occupants i.e. other than short term sites)(1); dual occupancy; dwelling; dwelling house; exhibition home; farm stay accommodation; home business; home industry; home occupancy; home occupation (sex services); hostel; hotel or motel accommodation; moveable dwelling; multi dwelling housing; neighbourhood shop; permanent group home; residential accommodation; residential flat building; rural worker's dwelling; secondary dwelling; semi-detached dwelling; serviced apartments; tourist and visitor accommodation and transitional group home.

(1) As defined by the Local Government (Manufactured Home Estates, Caravan Parks, Camping Grounds and Moveable Dwellings) Regulation 2005

Note: Where the Environmental Planning Instrument (EPI) land use definition is not used, the bracketed text refers to the EPI land use definition.

Appendix: A LAND USE CATEGORIES (cont.)

Commercial or Industrial	Tourist Related Development	Recreation or Non-urban Uses	Concessional Development
Agricultural produce industry; air transport facility; airport; amusement centre; brothel; bulky goods premises; business premises; car park; cellar door premises; community facility (other than critical and sensitive uses and facilities); correctional centre; crematorium; depot; entertainment facility; exhibition village; feed lot, food and drink premises; freight transport facility; function centre; funeral chapel; funeral home; hazardous industry; hazardous storage establishment; health care professional; health consulting rooms; health services facility; heavy industry; heliport; highway service centre; industrial retail outlet; industry; light industry; liquid fuel depot; livestock processing industry; market; medical centre; mixed use development; mortuary; offensive industry; offensive storage establishment; office premises; passenger transport facility; place of public worship; pub; public administration building (other than critical uses and facilities); recreation facility (major); registered club; restaurant; restricted dairy; restricted premises; retail premises; rural industry; rural supplies; sawmill or log processing works; self-storage units; service station; sex services premises; shop; shop top housing; storage premises; take away food or drink premises; timber and building supplies; transport depot; truck depot; vehicle body repair workshop; vehicle repair station; vehicle sales or hire premises; veterinary hospital; warehouse or distribution centre; waste disposal facility; waste management facility; waste or resource management facility; waste or resource transfer stations; and wholesale supplies.	Camp site and caravan site – short term sites (1) only.	Agriculture; airstrip; animal boarding or training establishment; aquaculture; biosolid waste application; biosolids treatment facility; boat launching ramp; boat repair facility; boat shed; caravan park (with non-permanent occupants); charter and tourism boating facility; dairy (pasture based), environmental facility; environmental protection works; extensive agriculture; extractive industry; farm building: horticulture; helipad: information and education facility; intensive livestock agriculture; intensive plant agriculture; kiosk; jetty; landscape and garden supplies; marina; mine; mining; natural water-based aquaculture; port facilities; pond-based aquaculture; public utility undertaking (other than critical uses or facilities); recreation area; recreation facility (indoor); recreational facility (outdoor); research station; resource recovery facility; restriction facilities; roadside stall; stock and sale yard; tank-based aquaculture; turf farming; utility installations (other than critical uses and facilities); viticulture; water recreation structure; water recycling facility; and water storage facility.	(a) Redevelopment for the purposes of substantially reducing the flood risk to the existing building and its occupants; (b) Redevelopment within the existing footprint of approved structures. Existing elevated footings or crawl space must be maintained to allow floodwaters to flow beneath the structure. (c) Council may consider the construction of a single dwelling up to 250m^2 (external) within the high flood risk precinct on vacant land. Vacant land refers to residential allotments which was zoned residential and vacant prior to 2009. (d) In relation to an existing dwelling: (i) additions or alterations to the dwelling; and/or (ii) garages or outbuildings; and/or (iii) decks; provided that the total of: • the gross floor area from (i); and • the area of garages from (ii); and • the area of decks from (iii), approved since 7 February 2005, does not exceed: • 40m^2 in the Medium Flood Risk Precinct; or

			• 20m² in the High Flood Risk Precinct. (Note that for the purposes of this clause, the area of garages and the area of decks referred to above means the plan area measured to the external edge of the structure).

(1) As defined by the Local Government (Caravan Park and Camping Grounds) Transitional Regulation 1993.

Note: Where the Environmental Planning Instrument (EPI) land use definition is not used, the bracketed text refers to the EPI land use definition.

APPENDIX: A LAND USE CATEGORIES - TEMPORARY EVENTS

Temporary public events include markets, circuses music festivals, outdoor cinema's etc. When such events include temporary structures, public congregation areas or car parking areas within the 1% AEP flood extent, an event specific flood risk assessment and management plan is required. The risk assessment and management plan must be prepared by a suitably qualified engineer with relevant experience in floodplain management.

The risk assessment must include the depth, velocity and timing of inundation in a 20% and 1% event. The management plan must demonstrate how the flood risk will be managed.

In areas of flash flooding, which includes the majority of the Wollongong LGA (except Lake Illawarra floodplain), it is often not possible to provide an appropriate flood response during an event due to the fast rate of rise of floodwaters and limited response time. Therefore, the only way to mitigate the flood risk in flash flood areas is to include provisions in the event management plan that require monitoring of weather forecasts in the days leading up to the event, and a requirement that the event be cancelled if there is a risk of flooding and/or a forecast for heavy or prolonged rainfall.

Appendix: B FLOOD COMPATIBLE MATERIALS

BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL
Flooring and Sub-floor **Structure**	• Concrete slab-on-ground monolith construction. • Suspended reinforced concrete slab.
Floor Covering	• Clay tiles. • Concrete, precast or in situ. • Concrete tiles. • Epoxy, formed-in-place. • Mastic flooring, formed-in-place. • Rubber sheets or tiles with chemical-set adhesives. • Silicone floors formed-in-place. • Vinyl sheets or tiles with chemical-set adhesive. • Ceramic tiles, fixed with mortar or chemical-set adhesive. • Asphalt tiles, fixed with water resistant adhesive.
Wall Structure	• Solid brickwork, blockwork, reinforced, concrete or mass concrete.
Roofing Structure (for Situations Where the Relevant Flood Level is Above the Ceiling)	• Reinforced concrete construction. • Galvanised metal construction.
Doors	• Solid panel with water proof adhesives. • Flush door with marine ply filled with closed cell foam. • Painted metal construction. • Aluminium or galvanised steel frame.
Wall and Ceiling Linings	• Fibro-cement board. • Brick, face or glazed. • Clay tile glazed in waterproof mortar. • Concrete.

BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL
	• Concrete block. • Steel with waterproof applications. • Stone, natural solid or veneer, waterproof grout. • Glass blocks. • Glass. • Plastic sheeting or wall with waterproof adhesive.
Insulation **Windows**	• Foam (closed cell types). • Aluminium frame with stainless steel rollers or similar corrosion and water resistant material.
Nails, Bolts, Hinges and Fittings	• Brass, nylon or stainless steel. • Removable pin hinges. • Hot dipped galvanised steel wire nails or similar.
Electrical and Mechanical Equipment	For dwellings constructed on land to which this chapter applies, the electrical and mechanical materials, equipment and installation should conform to the following requirements. • Main power supply Subject to the approval of the relevant authority the incoming main commercial power service equipment, including all metering equipment, shall be located above the relevant flood level. Means shall be available to easily disconnect the dwelling from the main power supply. • Wiring All wiring, power outlets, switches, etc., should, to the maximum extent possible, be located above the relevant flood level. All electrical wiring installed below the relevant flood level should be suitable for continuous submergence in water and should contain no fibrous components. Earth core leakage systems (or safety switches) are to be installed. Only submersible-type splices should be used below the relevant flood level. All conduits located below the relevant designated flood level should be so installed that they will be self-draining if subjected to flooding. • Equipment All equipment installed below or partially below the relevant flood level should be capable of disconnection by a single plug and socket assembly. • Reconnection

BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL
	• Should any electrical device and/or part of the wiring be flooded it should be thoroughly cleaned or replaced and checked by an approved electrical contractor before reconnection.

Appendix: C PRESCRIPTIVE STANDARDS - SPECIFIC FLOODPLAINS

- Schedule 1 –Towradgi Creek Floodplain;
- Schedule 2 – Hewitts/Slacky/Woodlands/Tramway/ Thomas Gibson Creeks Floodplain;
- Schedule 3 – Minnegang Creek Floodplain;
- Schedule 4 – Allans Creek Floodplain;
- Schedule 5 – Fairy and Cabbage Tree Creeks Floodplain;
- Schedule 6 – Mullet/Brooks Creeks Floodplain;
- Schedule 7 – Wollongong City Floodplain;
- Schedule 8 - Whartons, Collins, Farrahars Creeks, Bellambi Gully and Bellambi Lake Floodplains ;
- Schedule 9 – Lake Illawarra Floodplain;
- Schedule 9a – Lake Illawarra - Windang Peninsula; and
- Schedule 10 – All other floodplains.

SCHEDULE 1: PRESCRIPTIVE CONTROLS – TOWRADGI CREEK FLOODPLAIN

	Flood Risk Precincts (FRP's)																							
	Low Flood Risk								Medium Flood Risk								High Flood Risk (& Interim Riverine Corridor)							
Planning Consideration	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										2,7	2 or 5	2	1	2,4 6							1	2,4 6
Building Components		2										1	1	1	1	1							1	1
Structural Soundness		3		2		3						2	2	3	2	2							1	1
Flood Affectation		2	2		2	2					1	1 or 2	1	1	1	2							1	1
Evacuation		2, 4	5	3, 4	4	3, 4					5	3,4	1,4	3,4	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																						

Note:

a. Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications.

b. 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.

c. ***Freeboard*** equals an additional height of 500mm.

Floor Level

1 All Floor Levels to be equal to or greater than the 5% AEP flood level plus freeboard unless justified by site specific assessment.

2 *Habitable floor* levels to be equal to or greater than the 1% AEP 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 flood planning 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 flood planning level as practical. Where below the flood planning level, more than 30% of the floor area to be above the flood planning level or premises to be flood proofed below the flood planning level.

6 Garage floor level to be no lower than 300mm above finished adjacent ground.

7 Garage and all other non-habitable internal flood levels to be no lower than the 1% AEP flood level minus 300mm or 300mm above finished adjacent ground (whichever is the greater).

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 1% AEP flood level plus freeboard.

2 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a 1% AEP flood level plus freeboard , *PMF* plus *freeboard* if required to satisfy evacuation criteria (see below).

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, includes medium & high density residential proposals.

2 The impact of the development on flooding elsewhere to be considered, includes low density residential.

Note: When assessing *flood* affectation the following must be considered:

1. Loss of storage in the *floodplain*.

2. Changes in *flood* levels & velocities caused by alteration of conveyance of *flood* waters.

Evacuation

1 *Reliable access* or *refuge* 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 20 m^2 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.

5 Applicant to demonstrate that evacuation of potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

Management and Design

1 Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

2 *Site Emergency Response Flood plan* required (except for single dwelling-houses) where floor levels are below the *flood planning level*.

3 Applicant to demonstrate that area is available to store goods above the 1% AEP *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 *flood planning level* which may cause pollution or be potentially hazardous during any *flood*.

SCHEDULE 2: PRESCRIPTIVE CONTROLS – HEWITTS CREEK FLOODPLAIN

	Flood Risk Precincts (FRP's)																							
	Low Flood Risk								Medium Flood Risk								High Flood Risk (& Interim Riverine Corridor)							
Planning Consideration	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, 7	2 or 5	2, 7	1	2,4 ,6							1	2,4 6
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	1 or 2	2	2	2	2							1	1
Evacuation		2, 4	5	3, 4	4	3, 4					5	3,4	1,4	3, 4	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

Note:

a. Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications.

b. For the Hewitts Catchments it is recommended that filling in floodplain areas east of the South Coast Railway Line embankment be permitted, if 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 Engineer's report is provided that certifies that the development will not increase flood affectation elsewhere.

c. 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.

d. ***Freeboard*** equals an additional height of 500 mm.

Floor Level

1 All Floor Levels to be equal to or greater than the 5% AEP *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 flood planning 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 flood planning level as practical. Where below the *flood planning level*, more than 30% of the floor area to be above the *flood planning level* or premises to be flood proofed below the *flood planning level*.

6 Garage floor level to be no lower than 300mm above finished adjacent ground.

7 Garage and all other non-habitable internal flood levels to be no lower than the 1% AEP flood level minus 300mm or 300mm above finished adjacent ground (whichever is the greater).

Building Components & Method

1 All structures to have *flood compatible building components* below or at the 1% AEP *flood* level plus *freeboard*.

2 All structures to have *flood compatible building components* below or at the *PMF* level plus *freeboard*.

Structural Soundness

1 Engnieer's report to certify that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a 1% AEP *flood* plus *freeboard*.

2 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a 1% AEP *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 Engineer's report required to certify that the development will not increase *flood* affectation elsewhere, includes medium & high-density residential proposals.

2 The impact of the development on flooding elsewhere to be considered, includes low density residential.

Note: When assessing *flood* affectation the following must be considered:

1. Loss of storage in the *floodplain*.
2. Changes in *flood* levels & velocities caused by alteration of conveyance of *flood* waters.

Evacuation

1 *Reliable access or refuge required during a 1% AEP 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 20sqm 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.

5 Applicant to demonstrate that evacuation of potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

Management and Design

1 Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

2 *Site Emergency Response Flood plan* required (except for single dwelling-houses) where floor levels are below the *flood planning level*.

3 Applicant to demonstrate that area is available to store goods above the 1% AEP *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 *flood planning level* which may cause pollution or be potentially hazardous during any *flood*.

SCHEDULE 3: PRESCRIPTIVE CONTROLS – MINNEGANG CREEK FLOODPLAIN

	Flood Risk Precincts (FRP's)																							
	Low Flood Risk								Medium Flood Risk								High Flood Risk (and Interim Riverine Corridor)							
Planning Consideration	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										2,6	2 or 5	2.6	1	2,4							1	2,4
Building Components		2										1	1	1	1	1							1	1
Structural Soundness		3		2		3						2	2	2	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	
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															

Notes:

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. 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 5% AEP *flood* level plus *freeboard* unless justified by site specific assessment.

2 *Habitable floor* levels to be equal to or greater than the 1% AEP *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 flood planning level as practical and no lower than the existing floor level when undertaking alterations or additions.

5 Floor levels of shops to be as close to the flood planning level as practical. Where below the *flood planning level*, more than 30% of the floor area is to be above the *flood planning level* or premises to be flood-proofed below the *flood planning level*.

6 Garage and all other non-habitable internal flood levels to be no lower than the 1% AEP flood level minus 300mm or 300mm above finished adjacent ground (whichever is the greater).

Building Components and Method

1 All structures to have *flood compatible building components* below or at the 1% AEP *flood* level plus *freeboard*.

2 All structures to have *flood compatible building components* below or at the *PMF flood* level plus *freeboard*.

Structural Soundness

1 Engineer's report to certify that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP *flood* plus *freeboard*.

2 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP *flood* plus *freeboard*.

3 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a *PMF* flood plus *freeboard*.

Flood Affectation

1 Engineer's report required to certify that the development would 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 in the *floodplain*.

2. Changes in *flood* levels and velocities caused by alteration of conveyance of *flood* waters.

Evacuation

1 *Reliable access or refuge required during a 1% AEP 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 flood* level, or a minimum of 40% of the gross floor area of the dwelling to be above the *PMF flood* 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 *flood planning level*.

3 Applicant to demonstrate that area is available to store goods above the 1% AEP *flood* level plus *freeboard*.

4 Applicant to demonstrate that area is available to store goods above the *PMF flood* level plus *freeboard*.

5 No external storage of materials below the *flood planning level* which may cause pollution or be potentially hazardous during any *flood*.

SCHEDULE 4: PRESCRIPTIVE CONTROLS – ALLANS CREEK FLOODPLAIN

	Flood Risk Precincts (FRP's)																							
	Low Flood Risk^								Medium Flood Risk^								High Flood Risk^ (& Interim Riverine Corridor)							
Planning Consideration	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, 6	1, 2 or 5	2,6	1	2,4					1		1	2,4 6
Building Components		2										1	1	1	1	1					1		1	1
Structural Soundness		3		3		3						3	2	3	2	2					1		1	1
Flood Affectation		2	2		2	2					1	1	1	1	1	2					1		1	1
Evacuation		2, 4	*	3, 4	4	3, 4					*	3, 4	1,4	3,4	1						*		1	
Management & Design		4, 5	1								1		2,3 5	2,3 5	2,3 5,6	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

Industrial Only, Commercial Not Permitted

Floor Level

1 For industrial land use only – All Floor Levels to be equal to or greater than the 1% AEP flood unless justified by site specific assessment.

2 Habitable floor levels to be equal to or greater than the 1% AEP flood level plus 0.5m (freeboard).

3 All Floor Levels to be equal to or greater than the PMF flood level plus 0.5m (freeboard).

4 Floor levels to be as close to the flood planning 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 flood planning level as practical. Where below the *flood planning level*, more than 30% of the floor area to be above the *flood planning level* or premises to be flood proofed below the *flood planning level*.

6 Garage and all other non-habitable internal flood levels to be no lower than the 1% AEP flood level minus 300mm or 300mm above finished adjacent ground (whichever is the greater).

Building Components & Method

1 All structures to have flood compatible building components below or at the 1% AEP flood level plus 0.5m (freeboard).

2 All structures to have flood compatible building components below or at the PMF level plus 0.5m (freeboard).

Structural Soundness

1 Engineer's report to certify that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus freeboard.

2 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus freeboard, or a PMF plus freeboard if required to satisfy evacuation criteria (*see below*).

3 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a PMF flood plus freeboard.

Flood Affectation

1 Engineers report required to certify that the development will not increase flood affectation elsewhere, includes medium and high density residential proposals.

2 The impact of the development on flooding elsewhere to be considered, includes low density residential.

Evacuation

1 Reliable access or refuge required during a 1% AEP 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 20sqm of the dwelling/premises to be above the PMF level.

4 The development is to be consistent with any relevant flood evacuation strategy or similar plan.

5 Applicant to demonstrate that evacuation of potential development as a consequence of a subdivision proposal can be undertaken in accord with this 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 chapter.

2 Site Emergency Response Flood plan required (except for single dwelling-houses) where floor levels are below the PMF.

3 Applicant to demonstrate that area is available to store goods above the 1% AEP flood level plus 0.5m (freeboard).

4 Applicant to demonstrate that area is available to store goods above the PMF plus 0.5m (freeboard).

5 No external storage of materials below the *flood planning level* which may cause pollution or be potentially hazardous during any flood.

* adapted from this chapter for Towradgi Creek and modified for the Allans Creek Floodplain.

^ Flood Risk Precinct Definitions for Allans Creek – see Section 3.

Any proposed development will also need to be consistent with other Council requirements.

SCHEDULE 5: PRESCRIPTIVE CONTROLS – FAIRY CABBAGE TREE CREEK FLOODPLAIN

	Flood Risk Precincts (FRP's)																							
	Low Flood Risk								Medium Flood Risk								High Flood Risk (& Interim Riverine Corridor)							
Planning Consideration	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										2,7	2 or 5	2	1	2,4 6							1	2,4 6
Building Components		2										1	1	1	1	1							1	1
Structural Soundness		3		2		3						2	2	3	2	2							1	1
Flood Affectation		2	2		2	2					1	1 or 2	1	1	1	2							1	1
Evacuation		2, 4	5	3, 4	4	3, 4					5	3,4	1,4	3,4	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																						

Note:

a. Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications.

b. 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.

c. ***Freeboard*** equals an additional height of 500mm.

Floor Level

1 All Floor Levels to be equal to or greater than the 5% AEP flood level plus freeboard unless justified by site specific assessment.

2 Habitable floor levels to be equal to or greater than the 1% AEP 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 flood planning 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 flood planning level as practical. Where below the *flood planning level*, more than 30% of the floor area to be above the *flood planning level* or premises to be flood proofed below the *flood planning level*.

6 Garage and all other non-habitable internal flood levels to be no lower than the 1% AEP flood level minus 300 mm or 300 mm above finished adjacent ground (whichever is the greater).

Building Components & Method

1 All structures to have flood compatible building components below or at the 1% AEP flood level plus freeboard.

2 All structures to have flood compatible building components below or at the PMF level plus freeboard.

Structural Soundness

1 Engineer's report to certify that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a 1% AEP flood plus freeboard.

2 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a 1% AEP flood plus freeboard, PMF plus freeboard if required to satisfy evacuation criteria (see below).

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 Engineer's report required to certify that the development will not increase flood affectation elsewhere, includes medium & high-density residential proposals.

2 The impact of the development on flooding elsewhere to be considered, includes low density residential.

Note: When assessing *flood* affectation the following must be considered:

1. Loss of net storage of flood waters in the *floodplain*. Compensatory cut to fill earthworks in the floodplain may be a means to ensure no net loss of flood water storage.
2. Changes in *flood* levels and velocities caused by alteration of conveyance of *flood* waters.

Evacuation

1 Reliable *access or refuge required during a 1% AEP flood*.

2 Reliable *access* for pedestrians and vehicles required during an 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 20 m^2 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.

5 Applicant to demonstrate that evacuation of potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

Management and Design

1 Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

2 *Site Emergency Response Flood plan* required (except for single dwelling houses) where floor levels are below the *flood planning level*.

3 Applicant to demonstrate that area is available to store goods above the 1% AEP 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 *flood planning level* which may cause pollution or be potentially hazardous during any flood.

SCHEDULE 6: PRESCRIPTIVE CONTROLS – MULLET AND BROOKS CREEK FLOODPLAIN

	Flood Risk Precincts (FRP's)																							
	Low Flood Risk								Medium Flood Risk								High Flood Risk (& Interim Riverine Corridor)							
Planning Consideration	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										2,7	2 or 5	2	1	2,4 6							1	2,4 6
Building Components		2										1	1	1	1	1							1	1
Structural Soundness		3		2		3						2	2	3	2	2							1	1
Flood Affectation		2	2		2	2					1	1 or 2	1	1	1	2							1	1
Evacuation		2, 4	5	3, 4	4	3, 4					5	3,4	1,4	3,4	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																							

Note:

a. Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications.

b. 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.

c. ***Freeboard*** equals an additional height of 500mm.

Floor Level

1 All Floor Levels to be equal to or greater than the 5% AEP *flood* level plus *freeboard* unless justified by site specific assessment.

2 *Habitable floor* levels to be equal to or greater than the 1% AEP *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 flood planning 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 flood planning level as practical. Where below the *flood planning level*, more than 30% of the floor area to be above the *flood planning level* or premises to be flood proofed below the *flood planning level*.

7 Garage and all other non-habitable internal flood levels to be no lower than the 1% AEP flood level minus 300mm or 300mm above finished adjacent ground (whichever is the greater).

Building Components & Method

1 All structures to have *flood compatible building components* below or at the 1% AEP *flood* level plus *freeboard*.

2 All structures to have *flood compatible building components* below or at the *PMF* level plus *freeboard*.

Structural Soundness

1 Engineer's report to certify that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a 1% AEP *flood* plus *freeboard*.

2 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a 1% AEP *flood* plus *freeboard, PMF* plus *freeboard* if required to satisfy evacuation criteria (see below).

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 Engineer's report required to certify that the development will not increase *flood* affectation elsewhere, includes medium & high-density residential proposals.

2 The impact of the development on flooding elsewhere to be considered, includes low density residential.

Note: When assessing *flood* affectation the following must be considered:

1. Loss of storage in the *floodplain*.
2. Changes in *flood* levels & velocities caused by alteration of conveyance of *flood* waters.

Evacuation

1 *Reliable access or refuge required during a 1% AEP 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 20sqm 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.

5 Applicant to demonstrate that evacuation of potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

Management and Design

1 Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

2 *Site Emergency Response Flood plan* required (except for single dwelling-houses) where floor levels are below the *flood planning level*.

3 Applicant to demonstrate that area is available to store goods above the 1% AEP *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 *flood planning level* which may cause pollution or be potentially hazardous during any *flood*.

SCHEDULE 7: PRESCRIPTIVE CONTROLS – WOLLONGONG CITY FLOODPLAIN

	Flood Risk Precincts (FRP's)																							
	Low Flood Risk								Medium Flood Risk								High Flood Risk (& Interim Riverine Corridor)							
Planning Consideration	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		8	8	8		8				2, 7	1,2 or 5	2	1	2,4							1	2,4 6
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	1	1	1	1	2							2	1,2
Evacuation		2, 4	*	3, 4	4	3, 4					*	3, 4	1,4	3,4	1	4							1	4
Management & Design		4, 5	1								1		2,3 5	2,3 5	2,3 5,6	2,3 5							2, 3 5	2,3 5

	Not Relevant		Unsuitable Land Use	*	Refer to 'Management & Design' planning consideration for subdivision

Note:

a. Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications.

b. 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.

c. ***Freeboard*** equals an additional height of 500mm

Floor Level

1 All Floor Levels to be equal to or greater than the 5% AEP *flood* level plus *freeboard* unless justified by site specific assessment.

2 *Habitable floor* levels to be equal to or greater than the 1% AEP *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 flood planning 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 flood planning level as practical. Where below the *flood planning level*, more than 30% of the floor area to be above the *flood planning level* or premises to be flood proofed below the *flood planning level*.

7 Garage and all other non-habitable internal flood levels to be no lower than the 1% AEP flood level minus 300mm or 300mm above finished adjacent ground (whichever is the greater).

8 Habitable flood level to be a minimum of 300mm above finished adjacent ground level.

Building Components & Method

1 All structures to have *flood compatible building components* below or at the 1% AEP *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 1% AEP *flood* plus *freeboard*.

2 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a 1% AEP *flood* plus *freeboard, PMF* plus *freeboard* if required to satisfy evacuation criteria (see below).

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, includes medium & high density residential proposals.

2 The impact of the development on flooding elsewhere to be considered, includes low density residential.

Note: When assessing *flood* affectation the following must be considered:

1. Loss of storage in the *floodplain*.
2. Changes in *flood* levels & velocities caused by alteration of conveyance of *flood* waters.

Evacuation

1 *Reliable access or refuge required during a 1% AEP 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 20sqm 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 accord with this Plan.

2 *Site Emergency Response Flood plan* required (except for single dwelling-houses) where floor levels are below the *flood planning level*.

3 Applicant to demonstrate that area is available to store goods above the 1% AEP *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 *flood planning level* which may cause pollution or be potentially hazardous during any *flood*.

SCHEDULE 8: PRESCRIPTIVE CONTROLS – COMBINED CATCHMENTS OF WHARTONS, COLLINS AND FARRAHARS CREEKS, BELLAMBI GULLY AND BELLAMBI LAKE FLOODPLAINS

	Flood Risk Precincts (FRP's)																							
	Low Flood Risk								Medium Flood Risk								High Flood Risk (& Interim Riverine Corridor)							
Planning Consideration	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, 7	2 or 5	2	1	2,4 6							1	2,4 6
Building Components		2										1	1	1	1	1							1	1
Structural Soundness		3		3		3						2	2	3	2	2							1	1
Flood Affectation		2	2		2	2					1	1 or 2	1	1	1	2							1	1
Evacuation		2, 4	*	3, 4	4	3, 4					*	3,4	1,4	3,4	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		

Notes:

*

a. Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications..

b. 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.

c. Freeboard equals an additional height of 500mm.

Floor Level

1 All Floor Levels to be equal to or greater than the 5% AEP *flood* level plus *freeboard* unless justified by site specific assessment.

2 *Habitable floor* levels to be equal to or greater than the 1% AEP *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 flood planning 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 flood planning level as practical. Where below the *flood planning level*, more than 30% of the floor area to be above the *flood planning level* or premises to be flood proofed below the *flood planning level*.

7 Garage and all other non-habitable internal flood levels to be no lower than the 1% AEP flood level minus 300mm or 300mm above finished adjacent ground (whichever is the greater).

Building Components & Method

1 All structures to have *flood compatible building components* below or at the 1% AEP *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 1% AEP *flood* plus *freeboard*.

2 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a 1% AEP *flood* plus *freeboard, PMF* plus *freeboard* if required to satisfy evacuation criteria (see below).

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, includes medium & high density residential proposals.

2 The impact of the development on flooding elsewhere to be considered, includes low density residential.

Note: When assessing *flood* affectation the following must be considered:

1. Loss of storage in the floodplain.
2. Changes in *flood* levels & velocities caused by alteration of conveyance of flood waters.

Evacuation

1 *Reliable access or refuge required during a 1% AEP 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 20sqm 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 accord with this Plan.

2 *Site Emergency Response Flood plan* required (except for single dwelling-houses) where floor levels are below the *flood planning level*.

3 Applicant to demonstrate that area is available to store goods above the 1% AEP *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 *flood planning level* which may cause pollution or be potentially hazardous during any *flood*.

SCHEDULE 9: PRESCRIPTIVE CONTROLS – LAKE ILLAWARRA FLOODPLAIN

	Flood Risk Precincts (FRP's)																							
	Low Flood Risk								Medium Flood Risk								High Flood Risk (& Interim Riverine Corridor)							
Planning Consideration	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										2,6 or 7	2 or 5	2	1	2,4 6							1	2,4 6
Building Components		2		2								2	1	2	1	1							1	1
Structural Soundness		3		3		3						3	2	3	2	2							1	1
Flood Affectation		2,3			2,3	2,3						2,3	2,3	2,3	2,3	2							1,3	1,3
Evacuation		2,4		3,4	4	3,4						3,4	1,4	3,4	3,4								1	
Management & Design		4,5											2,3 5	2,3 5	2,3 5	2,3 5							2,3 5	2,3 5

Not Relevant | Unsuitable Land Use | Concessional development to use the 1% AEP including Medium Sea Level Rise (0.4m - 2050), all other development to use the 1% AEP including High Sea Level Rise (0.91m - 2100).

Floor Level

1 All floor levels to be equal to or greater than the 5% AEP *flood* level plus freeboard unless justified by site specific assessment.

2 Habitable floor levels to be equal to or greater than the 1% AEP flood level plus 0.5m freeboard.

3 All floor levels to be equal to or greater than the PMF.

4 Floor levels to be as close to the flood planning level as practical and no lower than the existing floor level when undertaking alterations or additions.

5 Floor levels of shops to be as close to the flood planning level as practical. Where below the *flood planning level*, more than 30% of the floor area to be above the *flood planning level* or premises to be flood proofed below the *flood planning level*.

6 Garage floor level to be no lower than 300mm above finished adjacent ground.

7 Garage and all other non-habitable internal flood levels to be no lower than the 1% AEP flood level minus 300mm or 300mm above finished adjacent ground (whichever is the greater).

Building Components and Method

1 All structures to have flood compatible building components below or at the 1% AEP flood level plus freeboard.

2 All structures to have flood compatible building components below or at the PMF.

Structural Soundness

1 Engineers report to certify that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus 0.5m freeboard.

2 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus 0.5m freeboard.

3 Engineers report to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a PMF event.

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.

3 No wholesale filling of sites around the foreshore of the lake is permitted, unless supported by a sensitivity analysis indicting that there is no significant impact on flood levels. Also, filling that impacts on active flow areas in the stream networks feeding Lake Illawarra will not be supported. However, filling within existing building areas is permitted. Filling of depressions outside of the existing building areas may be permitted subject to it being demonstrated that there is no loss of flood storage across the site in all events up to the PMF.

Evacuation

1 Reliable access or refuge required during a 1% AEP flood.

2 Reliable access for pedestrians and vehicles required during a PMF event.

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, or a minimum of 20m² 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.

5 Applicant to demonstrate that evacuation of potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

Management and Design

1 Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

2 Site Emergency Response Flood plan required (except for single dwelling-houses) where floor levels are below the *flood planning level*.

3 Applicant to demonstrate that area is available to store goods above the 1% AEP flood level plus 0.5m freeboard.

4 Applicant to demonstrate that area is available to store goods above the PMF.

5 No external storage of materials below the *flood planning level* which may cause pollution or be potentially hazardous during any flood.

SCHEDULE 9a: PRESCRIPTIVE CONTROLS – LAKE ILLAWARRA – WINDANG PENINSULA

	Flood Risk Precincts (FRP's)																															
	Low Flood Risk								Medium Flood Risk								High Flood Risk (& Interim Riverine Corridor)								Isolation Risk -Applies to the entire Windang Peninsula as shown in Figure 9a. -These controls apply in addition to those applied in flood risk precincts.									
Planning Consideration	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	Essential Community Facilities	Critical Utilities	Subdivision	Residential	Commercial & Industrial	Tourist Related Development	Recreation & Non-Urban	Concessional Development
Floor Level		3										2,6 or 7	2 or 5	2	1	2,4 6							1	2,4 6								
Building Components		2		2								2	1	2	1	1							1	1								
Structural Soundness		3		3		3						3	2	3	2	2							1	1								
Flood Affectation		2,3			2,3	2,3						2,3	2,3	2,3	2,3	2							1,3	1,3								
Evacuation		2,4		3,4	4	3,4						3,4	1,4	3,4	3,4								1				3,4	4	3,4			
Management & Design		4,5											2,3 5	2,3 5	2,3 5	2,3 5							2,3 5	2,3 5			1		1			

Not Relevant | Unsuitable Land Use | Concessional development to use the 1% AEP including medium level sea level rise, all other development to use the 1% AEP including high sea level rise.

Floor Level

1 All floor levels to be equal to or greater than the 5% AEP *flood* level plus freeboard unless justified by site specific assessment.

2 Habitable floor levels to be equal to or greater than the 1% AEP flood level plus 0.5m freeboard.

3 All floor levels to be equal to or greater than the PMF.

4 Floor levels to be as close to the flood planning level as practical and no lower than the existing floor level when undertaking alterations or additions.

5 Floor levels of shops to be as close to the flood planning level as practical. Where below the *flood planning level*, more than 30% of the floor area to be above the *flood planning level* or premises to be flood proofed below the *flood planning level*.

6 Garage floor level to be no lower than 300mm above finished adjacent ground.

7 Garage and all other non-habitable internal flood levels to be no lower than the 1% AEP flood level minus 300mm or 300mm above finished adjacent ground (whichever is the greater).

Building Components and Method

1 All structures to have flood compatible building components below or at the 1% AEP flood level plus freeboard.

2 All structures to have flood compatible building components below or at the PMF.

Structural Soundness

1 Engineers report to certify that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus 0.5m freeboard.

2 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus 0.5m freeboard.

3 Engineers report to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a PMF event.

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.

3 No wholesale filling of sites around the foreshore of the lake is permitted, unless supported by a sensitivity analysis indicting that there is no significant impact on flood levels. Also, filling that impacts on active flow areas in the stream networks feeding Lake Illawarra will not be supported. However, filling within existing building areas is permitted. Filling of depressions outside of the existing building areas may be permitted subject to it being demonstrated that there is no loss of flood storage across the site in all events up to the PMF.

Evacuation

1 Reliable access or refuge required during a 1% AEP flood.

2 Reliable access for pedestrians and vehicles required during a PMF event.

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, or a minimum of 20m² 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.

5 Applicant to demonstrate that evacuation of potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

Management and Design

1 Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

2 Site Emergency Response Flood plan required (except for single dwelling-houses) where floor levels are below the *flood planning level*.

3 Applicant to demonstrate that area is available to store goods above the 1% AEP flood level plus 0.5m freeboard.

4 Applicant to demonstrate that area is available to store goods above the PMF.

5 No external storage of materials below the *flood planning level* which may cause pollution or be potentially hazardous during any flood.

SCHEDULE 10: PRESCRIPTIVE CONTROLS – OTHER FLOOPLAINS

	Flood Risk Precincts (FRP's)																							
	Low Flood Risk								Medium Flood Risk								High Flood Risk (& Interim Riverine Corridor)							
Planning Consideration	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, 7	2 or 5	2	1	2,4 6							1	2,4 6
Building Components		2										1	1	1	1	1							1	1
Structural Soundness		3		2		3						2	2	3	2	2							1	1
Flood Affectation		2	2		2	2					1	1 or 2	1	1	1	2							1	1
Evacuation		2, 4	5	3, 4	4	3, 4					5	3,4	1,4	3,4	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																						

Note:

a. Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications.

b. 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.

c. ***Freeboard*** equals an additional height of 500mm.

Floor Level

1 All floor levels to be equal to or greater than the 5% AEP *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 *flood planning level* as practical and no lower than the existing floor level when undertaking alterations or additions.

5 Floor levels of shops to be as close to the *flood planning level* as practical. Where below the *flood planning level*, more than 30% of the floor area to be above the *flood planning level* or premises to be flood proofed below the *flood planning level*.

6 Garage floor level to be no lower than 300mm above finished adjacent ground.

7 Garage and all other non-habitable internal flood levels to be no lower than the 1% AEP flood level minus 300mm or 300mm above finished adjacent ground (whichever is the greater).

Building Components and Method

1 All structures to have flood compatible building components below or at the 1% AEP 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 and buoyancy up to and including a 100 year flood plus freeboard.

2 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100 year flood plus freeboard, or a PMF plus freeboard if required to satisfy evacuation criteria (*see below*).

3 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a PMF flood plus freeboard.

Flood Affectation

1 Engineers report required to certify that the development will not increase flood affectation elsewhere, includes medium and high density residential proposals.

2 The impact of the development on flooding elsewhere to be considered, includes low density residential.

Note: When assessing flood affectation the following must be considered:

1. Loss of storage in the floodplain.

2. Changes in flood levels and 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 20m² 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.

5 Applicant to demonstrate that evacuation of potential development as a consequence of a subdivision proposal can be undertaken in accord with this Plan.

Management and Design

1 Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accord with this plan.

2 Site Emergency Response Flood plan required (except for single dwelling-houses) where floor levels are below the *flood planning 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 *flood planning level* which may cause pollution or be potentially hazardous during any flood.

Part E – General Controls – Environmental Controls

Chapter E14: Stormwater Management

Contents

Figures

1 INTRODUCTION

1. This chapter of the DCP details Council's requirements for stormwater drainage design and on-site stormwater detention for all developments within the City of Wollongong Local Government Area (LGA). Stormwater drainage design and on-site stormwater detention must be carried out in accordance with this chapter. Adherence to the requirements contained in this chapter of the DCP will help facilitate the expeditious processing of applications involving engineering related issues.

2. This chapter of the DCP should be read in conjunction with:

   a) Wollongong Local Environmental Plan;

   b) Wollongong City Council DCP Chapter E13: Floodplain Management;

   c) Wollongong City Council DCP Chapter E15: Water Sensitive Urban Design;

   d) Australian Rainfall and Runoff (1987 and 2019 versions);

   e) Sydney Water Guidelines for Building over or Adjacent to Stormwater Assets;

   f) Austroads; and

   g) Other relevant local and state guidance.

3. This chapter of the DCP embraces the concept of the "Major/Minor" approach. The minor system includes the gutter and underground pipe network. The major system refers to the overland flow paths/stormwater routes that are to be designed to convey major storm flows when the capacity of the minor system is exceeded.

1.1 OBJECTIVES

1. The objectives of this chapter are to:

   a) Achieve a uniform standard of stormwater drainage design for all developments;

   b) Reduce peak flows from sites into Council's stormwater drainage system;

   c) Reduce the probability of downstream flooding;

   d) Minimise the potential impacts of new development and redevelopment in areas affected by local overland stormwater run-off or flooding, such that no increase in stormwater peak flows occurs downstream;

   e) Minimise stormwater run-off volumes;

   f) Reduce peak run-off flows from urban developments and minimising impervious areas, wherever practicable;

   g) Minimise the drainage infrastructure cost of development; and

   h) Increase public convenience and public safety as well as protection of property.

2 DEFINITIONS / TECHNICAL TERMS

For the purposes of this chapter of the DCP, the following definitions and technical terms apply:

Absorption Trench	An excavation that has been filled with material or prefabricated void units that are conducive to the drainage of stormwater and which are designed to drain vertically or side-ways, into adjacent sub-surface in-situ void or fill material.
***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. Example, if a peak flood discharge of 500 m3/s has an AEP of 1%, it means that there is a 1% chance (that is one-in-100 chance) of a 500 m3/s or larger event occurring in any one year.
AHD	Australian Height Datum: National reference datum for level.
Alluvium	Material eroded, transported and deposited by streams.
Antecedent	Pre-existing conditions (e.g. wetness of soils).
Areal	Variation over an area of a particular parameter.
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.
ARR1987	Australian Rainfall and Runoff: 1987 published by the Institute of Engineers, Australia
ARR2019	Australian Rainfall and Runoff 2019, published by the Commonwealth of Australia (Geoscience Australia).
Backwater Profile	Longitudinal profile of the water surface in a stream where the water surface is raised above its normal level by a natural or artificial obstruction.
Basement Car parking	A car parking area generally below ground level or above natural ground level but enclosed by bunding, where inundation of the surrounding areas may raise water levels above the entry level to the basement, resulting in rapid inundation of the basement to depths greater than 0.8 metres. Basement car parks are areas where the means of drainage of accumulated water in the car park has an outflow discharge capacity significantly less than the potential inflow capacity. Car parks not at risk of inundation (i.e. their entrance is above the PMF) are not subject to the requirements of this Chapter.
Catchment	Area draining into a particular creek system, typically bounded by higher ground around its perimeter.
Conveyance	A measure of the carrying capacity of the channel section. Flow is directly proportional to conveyance for steady flow. From Manning's equation, the proportionality factor is the square root of the energy slope.
Cover	Type and distribution of vegetation on catchment.
Critical Depth	If discharge is held constant and the water depth allowed to decrease, as in the case of water approaching a free overfall, velocity head will increase, pressure head will decrease, and total energy will decrease toward a minimum value

	where the rate of the decrease in the pressure head is just counterbalanced by the rate of increase in velocity head. This is the critical depth. More generally, the critical depth is the depth of flow that would produce the minimum total energy head, and it depends on cross section geometry and water discharge.
Critical Flow	The state of flow where the water depth is at the critical depth and when the inertial and gravitational forces are equal. When Froude Nº = 1.0.
Culvert	An enclosed conduit (typically pipe or box) that conveys stormwater below ground.
Discharge	The flow rate of water.
DPIE	Department of Planning Infrastructure and Environment
Escarpment	A cliff or steep slope, of some extent, generally separating two level or gently sloping areas.
Flood	A 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.
Freeboard	The factor of safety expressed as the height above the design flood level. Freeboard provides a factor of safety to compensate for uncertainties in the estimation of flood levels across the floodplain, such as wave action, localised hydraulic behaviour and impacts that are specific event related, and other effects such as "greenhouse" and climate change.
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 crust.
Gradient	Slope or rate of fall of land/pipe/stream.
Gully	Narrow ravine, small valley.
Headwall	Wall constructed around inlet or outlet of a culvert.
Hydrology	A term given to the study of rainfall and runoff processes as relates to the derivation of flood discharges.
Hyetograph	A graph of rainfall intensity against time.
Hydrograph	A graph of flood flow against time.
Hydraulic	A term given to the study of water flow, as relates to the evaluation of flow depths, levels and velocities.
Ha	Hectare. (Area = 10,000m^2)
IFD	Intensity - Frequency – Duration Rainfall parameters used to describe rainfall at a particular location.

Isohyets	Lines joining points of equal rainfall.
FSL	Flood Surface Level.
FPL	Flood Planning Level
FPDM	Floodplain Development Manual: Guidelines for the management of flood liable land published by NSW State Government, April 2005.
Km	Kilometre. (1 km distance = 1,000m)
M	Metre.
M^2	Square Metre.
M^3/sec	Cubic Metre per Second.
Major/Minor Stormwater System	Refer under GENERAL.
Manning's n	A measure of channel or pipe roughness.
Minor Development	Developments discharging less than 55L/S and discharging to kerb.
Normal Depth	The depth that would exist if the flow were uniform.
NWC	Natural Water Course: A small creek or channel in its natural condition.
Orographic	Pertaining to changes in relief, i.e. mountains.
Orthophoto	Aerial photograph with land contours, boundaries or reference grids added.
Pluviograph	An instrument that records rainfall collected as a function of time.
PMF	Probable Maximum Flood: Flood calculated to be the maximum ever likely to occur.
PMP	Probable Maximum Precipitation: Rainfall calculated to be the maximum ever likely to occur.
Receiving Waters	A river, lake or the ocean.
RCP	Reinforced Concrete Pipe.
Run-off	Stormwater running off a catchment during a storm on the catchment.
Scour	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 rising up of the bed of a watercourse or channel by deposited silt.

Spurs	Secondary ridges typically occurring at right angles to a main ridgeline, formed by stream erosion of the slopes of the main ridge.
Stormwater	Surface runoff generated from rainfall events.
Stratigraphy	Depositional sequence of deposited sand, clays rocks and other material.
Sub-critical Flow	The state of flow where the water depth is above the critical depth. Here, the influence of gravity forces dominates the influences of inertial forces, and flow, having a low velocity, is often described as tranquil.
Surcharge Flow	Unable to enter a culvert or exiting from a pit because of inadequate capacity.
Supercritical Flow	The state of flow where the water depth is below the critical depth, inertial forces dominate the gravitational forces, and the flow is described as rapid or shooting.
Suitably Qualified Civil Engineer	A civil engineer who is included in the National Professional Engineers Register, Australia administered by the Institution of Engineers Australia or is eligible for membership of Engineers Australia.
Topography	The natural surface features of a region.
Transpiration Pit	An excavation which has been filled with material conducive to the drainage of stormwater and which is designed to drain sideways, into the atmosphere, via a retaining medium.
Trunk Drainage	High capacity channels or networks which carry runoff from local street drainage systems to receiving waters and forms part of the major system as defined in ARR2019 Book 9.
Urbanisation	The change in land use from natural to developed state.
Watercourse	Any river, creek, stream or chain of ponds, whether artificially modified or not, in which water usually flows, either continuously or intermittently, in a defined bed or channel, but does not include a waterbody (artificial).
Yr	Year.
Zone of Influence (ZOI)	The area around an asset (both at ground level and below the ground) that may impact on an asset

3 AVERAGE RECURRANCE INTERVAL

3.1 Minor System ARI

1. The design average recurrence interval for the gutter and piped stormwater (minor) system is:

   a) Road Drainage (Longitudinal)

For all land use types including rural residential, urban residential, commercial and industrial, the ARI must be 10 years. In new residential subdivisions where overflow paths are provided in accordance with Section 7 of this Chapter and are capable of safely discharging stormwater flows into receiving waters the ARI may be reduced to 5 years.

   b) Stormwater Within Development Sites

For all land use types including rural residential, urban residential, commercial and industrial, the ARI must be 10 years. Section 10 details the requirements for on-site detention (OSD).

3.2 Major System ARI

1. The major system includes "escape routes" or overland flow routes for flows in excess of the piped system capacity must be designed and or checked to a 100 year ARI event. The major system includes the road profile, overland flow paths and trunk drainage networks. The major system aims to ensure the safety of pedestrians and vehicle traffic whilst avoiding property damage and risk to life.

3.2.1 Trunk Drainage

1. Trunk drainage networks must be designed to a 100 year ARI. Spillways of detention basins must designed to safely pass the PMF.

3.2.2 Road Culverts

1. Culverts under local/collector roads must be designed in combination with an overflow route.

2. Overtopping of roads may be permitted, provided the following criteria are adopted when designing road crossings:

   a) The road crossing must be designed such that the peak overtopping depths and velocity are within H2 in a 100 year event as shown in Figure 3.

   b) The appropriate blockage factor is applied in accordance with Chapter E13 Section 6.2.

   c) The road section must be able to withstand such overtopping without scour.

4 PRELIMINARY LAYOUT OF PROPOSED STORMWATER SYSTEM

1. A field survey is required to determine stormwater paths. Existing stormwater systems must be analysed using either reliable work-as-executed plans or alternatively, if these are not available, a site and field survey.

2. A proposed stormwater layout is plotted taking into account rainfall data applicable to the site, times of concentration, gutter and pit capacities.

3. A procedure for locating pits is detailed in Section 6 of this chapter.

4. Catchment areas for each pit can then be defined once the pipe layout has been established. A site inspection should be carried out to determine the effect of features that could alter the assumed catchment boundaries and flow paths such as existing or proposed fencing, retaining walls or other structures.

5 HYDROLOGY

a) All parameters used in hydrologic models must be selected in accordance with those values adopted as part of Council's catchment wide flood studies or FRMS.

b) For unstudied catchments, ARR1987 IFDs and hydrologic procedures will be used until Council has investigated the implications of ARR2019 for the Wollongong LGA through catchment wide FRMS.

5.1 Hydrologic Models

a) Figure 1 indicates the likely range of effectiveness for different hydrologic models against flood magnitude and model scale. The applicant must justify the appropriateness of any selected hydrologic model selected for the estimation of minor and major system flows.

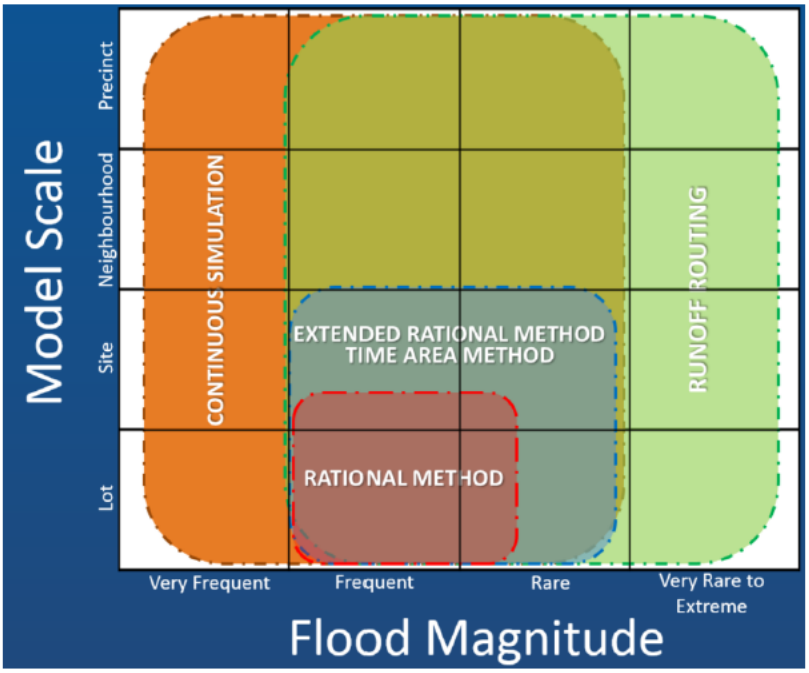


Figure 1 Types of Urban Hydrologic Models and their Application Range (ARR2019, Book 9, Chapter 6)

5.2 Conveyance

a) Overland flow times must be determined using the Kinematic Wave Equation or an appropriate computer model.

b) Table 1 shows the retardance coefficient "n*" to be used in the calculation of overland flow time times when using the Kinematic Wave Equation. Note the retardance coefficient "n*" is not to be confused with Manning's "n".

Table 1: *Surface Retardance Coefficients*

Land Use	Retardance Coefficients (n*)
Road/Paved Areas	0.01
Parkland – Grassed	0.17
Open Space (Natural Bushland)	0.30

5.3 Runoff Coefficient

a) The runoff coefficient to be adopted for design must be determined from Figure 2.

b) The runoff coefficient must be estimated separately for each land use. Table 2 estimates the percentage impervious area for various types of land uses. Actual percentages of impervious area may be used as long as they take into account the ultimate development of the site.

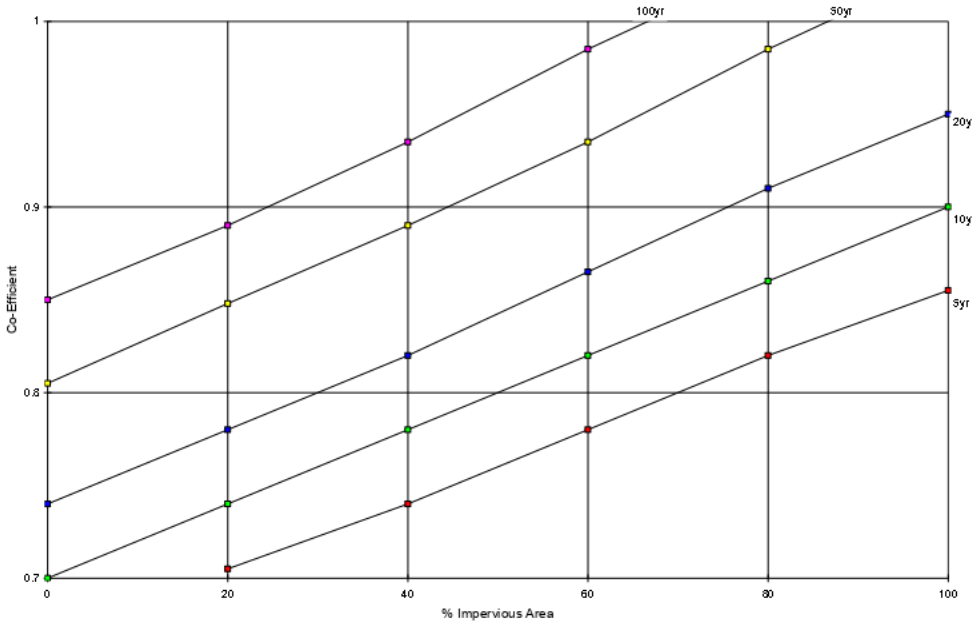


Figure 2: Determination of Runoff Coefficient

Table 2: Percentage Impervious Area for Land use type

Land Use	Percentage Impervious Area
Normal Residential Lots	60%
Half Width Road Reserve	95%
Medium Density Residential Lots	80%
Commercial Areas	100%
Industrial Areas	100%
Public Recreation Areas	25%

6 MINOR SYSTEM

6.1 Pit Location

For the minor system ARI, kerb inlet pits must be located in the following positions:

a) At the upstream tangent point of the kerb return (i.e. at an intersection);

b) Where the gutter flow width exceeds 2.5 metres;

c) Where the gutter flow depth exceeds the top of kerb;

d) At each low point of the kerb and gutter. Where serious flooding could result if the main pit was 50% blocked then an auxiliary pit must be provided such that the combined system caters for the minor system flowrate without overtopping;

e) Clear of driveways, access ways and pedestrian pram ramps;

f) Where spacing between pits exceeds 80m;

g) In line with common lot boundaries;

h) Such that the depth of flow in the low side kerb and gutter does not exceed the crest level of driveways to properties below road level.

6.2 Inlets and their Capacities

a) The capacity of any type of inlet involves determining the quantities and characteristics of the flow approaching the inlet.

b) The blockage factors to be used in the analysis of pits are:

- Sag pits – 50%
- On grade pits – 20%

c) All new work must use combined galvanised grates with lintels. For slopes greater than 5%, deflectors shall be incorporated into the design

6.3 Hydraulic Design – Minor System

1. The hydraulic design of the minor system must be carried out using the hydraulic grade analysis in accordance with Chapter 5 of Book 9 ARR2019. Suitable computer software (e.g. Drains, 12D) should be used. For simple systems, (e.g. less than 10 pits) hand or spreadsheet calculations are accepted.

2. A hard copy of the results as well as a summary table showing all relevant information must be submitted with the application. The following information must be taken into account:

   a) Pipe Friction

Table 3 provides the recommended pipe friction coefficients.

Table 3: Recommended Pipe Friction Coefficients

Pipe Material	Manning's "n"	Colebrook-White "k" (mm)
Concrete	0.012	0.6
Fibre Reinforced Concrete	0.01	0.15
UPVC	0.009	0.05

   b) Downstream Control Points

For the design of a new system and the checking of an existing system, the following control points apply:

i) For a submerged outlet discharging into tidal water, the tail water level must be RL 1.28m AHD. This level is based on the 1-year ARI storm surge tide that is assumed to coincide with the runoff peak from the design recurrence interval storm on the catchment.

The pipe invert must be above RL 0.00m AHD or above siltation level, whichever is higher.

ii) For an outlet draining the local system and discharging into an open channel or body of water serving a catchment of comparable size to the local catchment, the tailwater in the channel immediately downstream of the outlet must be determined by using Manning's Equation to find the normal depth. This water level becomes the control point, unless there is an obvious downstream control that makes it necessary to perform a backwater analysis.

iii) For an outlet draining the local system and discharging into an open channel serving a catchment much larger than the local catchment, the determination of the tailwater shall be based on a hydrograph analysis, which has considered phase differences between the two catchments.

iv) For a free outlet, the control point is taken as the greater of tailwater depth or

$$Control\,point = \frac{d_c + D}{2}$$

where d_c = critical depth in pipe, and D = diameter of pipe.

v) If a new system connects to an existing system, the existing system must be checked to assess its adequacy in carrying the increased discharge. The proponent must also consider the potential of other new connections to the existing system and demonstrate the existing system can maintain its current (2019) service level.

c) Pit Loss Factors

Either the Missouri Charts or Hare Charts may be used in calculating hydraulic losses in pits. Benching in pits may be used to assist in reducing pit losses where desirable.

d) Drop Pits

Drop pits occur where there is a substantial difference between the invert of the inlet and obvert of the outlet. Usually, this results in the water losing all of its forward velocity and momentum. Very large head losses can be expected due to the need to accelerate the water from rest and due to the turbulence caused by the incoming water.

When the obvert of the outlet pipe is at or greater than Do/4 (Do = diameter of outlet pipe) below the invert of the upstream pipe, the inflow must be regarded as grate flow.

e) Pipe deflection and Mitre Bends

Pipe manufacturer's allowable pipe deflection angles and mitre bends may be used for changes in direction in the horizontal plane only where the use of junction pits are not required. Appropriate head losses are to be taken into account.

f) Pit Freeboard

A zero freeboard may be adopted.

g) Pipe Velocities

The maximum and minimum velocities for reinforced concrete pipes must be 8m/s and 0.6m/s respectively, or as recommended in the manufacturer's specifications. For all other pipe types, refer to the manufacturer's specifications.

h) Minimum/Maximum gradients for Pipes

The minimum and maximum gradients to be adopted for pipes must be in accordance with the relevant Australian Standards or as recommended in the manufacturer's specifications.

i) Anchor Blocks

Where the grade of the pipe exceeds 15%, concrete anchor blocks must be provided as a minimum at every third collar or as recommended in the manufacturer's specifications.

j) Pipe Class, Cover and Joints

The class of pipe used must be compatible with the loading it will be subjected to.

- The calculation of working loads and methods of installation of buried concrete pipes must be in accordance with AS3725 "Loads on Buried Concrete Pipes". Table 4 also provides minimum cover for pipes (excluding pipes discarding to the kerb).
- Cover over pipelines must comply with the relevant Australian Standards, but generally should not be less than 300mm in landscaped areas and 450mm in areas subjected to vehicle loads, with the exception of pipelines laid under the footpath which connect to a kerb.
- Rubber ring jointed concrete pipes must be used for all road stormwater applications. Pipelines shall have a minimum diameter of 375 mm when used for road drainage applications.

Table 4: Minimum Cover Over Pipes

Location	Minimum cover (mm)	
	Rigid type pipes e.g. concrete, FRC	Flexible type pipes e.g. plastic, thin metal
Residential private property, and parks not subject to traffic	300	450
Private property and parks subject to occasional traffic	450	450
Footpaths	450	600
Road pavements and under kerb and channel	600	600

- For special cases, and with the agreement of Council, cover can be reduced by using a higher-class pipe, special bedding, concrete protection or a combination of these.
- Where pipes are to be laid under the footpath consideration should be given to the possibility of future road widening, both in respect of the reduced cover that might result from the widening and vehicle loading.

k) Hydraulic Design Calculations

Technical Note 9 of ARR 1998 details the recommended methods for hydraulic design calculations. Alternatively, a computer model may be used, providing the input parameters and assumptions are clearly described and justified.

A hard copy of the results as well as a summary table showing all relevant information must be submitted with the application. Council may also request the electronic model files input and results files.

7 MAJOR SYSTEM

a) Major system flows are flows in excess of the minor system capacity. Major system flows shall be catered for by providing suitable escape routes such that they do not present a danger to life and property. These overland flow paths (i.e. escape routes) shall have a capacity to carry major system flows up to the 100 year ARI flow.

b) The following overland flow paths may be used to act as major system flow routes:

i) Roadways including footpath;

ii) Pathways; and

iii) Parkland or open space.

7.2 Major System Flows - Continuity

a) Consideration must be given to continuity of the overland flow path and as such where, for example, a roadway acting as an overland flow path discharges stormwater to a pathway, park, stormwater reserve, etc. the footpath must have a reverse cross fall to facilitate the overland flow. Other obstructions, such as fences, must not traverse these flow paths.

b) Consideration should also be given to low points near kerb returns. The grading of the kerb return should be such that water flows around the return and away before it breaks over the top of the kerb at the low point.

7.3 Road Reserve Flow Capacity

a) The capacity of the roadway must be determined and the results showing all relevant information must be submitted with the application.

7.4 Trunk Drainage

a) Trunk drainage carries runoff from local street drainage systems to receiving waters. Trunk drains and networks include the following elements:

i) Natural watercourses or artificial open channels. For the purpose of this document, the term "natural watercourse" is considered a defined path which stormwater follows and includes channels and any overbank flow path. The provision of channel lining or enclosure by pipes or channel filling etc. does not in any way diminish the fact that the flow path is a natural route for water. In areas of uncertainty, Council will determine if a flow path is a watercourse.

ii) Culverts and road crossings exceeding 900 mm in diameter or 0.6m^2;

iii) Naturally occurring ponds and lakes exceeding 1000 m3 capacity;

iv) Artificial detention/retention storages exceeding 1000m3 capacity.

7.4.2 Detention/Retention Basins

Detention/retention basins must be designed to cater for the 1% AEP event. The basin spillway must be designed to cater for the PMF event. The appropriate blockage factor must be applied to the outlet in accordance with Chapter E13 Section 6.2.

7.5 Watercourses and Open Channels

7.5.1 Hydraulic Design - Estimation of Design Flood Level

a) An appropriate computer model must be used for hydraulic design and analysis.

b) The data required for the hydraulic design or analysis including channel cross sections, hydraulic properties (e.g. roughness), dimensions of controls, obstructions, etc, shall be obtained by the proponent. This data shall be documented clearly and reflect both the existing and proposed hydraulic characteristics of the watercourse of open channel. All assumptions must be documented.

c) A sufficient number of cross-sections selected at appropriate locations both within the site and extending sufficiently upstream and downstream of the site shall be analysed in order to reflect flow behaviour. This would normally require that the model extend to a boundary condition at the hydraulic control downstream of the site.

d) In the hydraulic design of watercourses (which includes modified stream channels and floodway systems), a freeboard of 0.5 metres to habitable floor level shall be provided above the 100 year ARI flood water surface level. The proponent must liaise with the NSW Department of Industry (Former NSW Office of Water) if modifications are required to the creek channel or floodplain or if the proposal involves activities with 40 metres of the top of the creek bank. A controlled Activity Approval under the Water Management Act 2000 may be required.

7.5.2 Flow Velocities

a) Maximum flow velocities in channels and overland flow paths that are grass-lined must be restricted to 2m/s. Designs must ensure that flow is subcritical. Supercritical flow must be avoided, however, where this cannot be prevented as in the case of an existing open channel, fencing

which would not obstruct overtopping flow, must be provided for the length of the open channel where supercritical flow occurs.

7.5.3 Scour Protection

a) Adequate scour protection must be designed for all discharge points into and out of the channel. It must also be provided at any point along the channel where there is a significant change in flow conditions.

7.5.4 Batter Slopes

a) Side slopes of grassed channels and detention basins should be relatively flat. The desirable batter slope must not be greater than 1 vertical to 6 horizontal. However 1 vertical to 4 horizontal may be considered where scour and erosion can be managed.

7.5.5 Modifications to Watercourses

a) Modifications to natural watercourses are generally not permitted, as they adversely impact on a number of issues including:

- Hydraulic function
- Channel pattern and form
- Long-term channel stability
- Aesthetic appearance
- Aquatic and bankside habitat diversity
- Water quality

b) Any proposals involving modifications to watercourses will require the submission of a detailed hydraulic assessment as well as a thorough environmental impact assessment of the prepared watercourse modification. Modifications to watercourses will only be considered where no other alternative exists, such as when scour within the watercourse threatens the stability of a dwelling or other high value asset. The reduction of development potential as a result of not modifying a watercourse will not be considered justification for such modification.

Note: lodgement of an Integrated Development Application will be required for any involving modified to a watercourse since the concurrence of the NSW Department Water and Energy will be required pursuant to the requirements of the Water management Act 2000.

c) Buildings will not be permitted over watercourses.

8 SAFETY IN DESIGN

1. The design of minor and major system flow paths and structures must consider how public safety and risk will be managed. The following will be considered in assessment of proposals. This list is not exhaustive and requirements will vary from site to site:

a) Overland flow paths must be designed with consideration to with the flood hazard categories shown in Figure 3. The anticipated public use of the flow path (e.g. roadway, public reserve, no public access etc.) must consider the food hazard curves shown in Figure 3. The design of the flow path shall ensure that flow characteristics within the flow path are within the safe range for the anticipated potential users of the flow path (e.g. vehicles, people, children, elderly, etc.). Where flow characteristics are proposed that are unsafe for potential end users, details shall be provided of how access to those users will be prevented (e.g. fencing, signage, etc.).

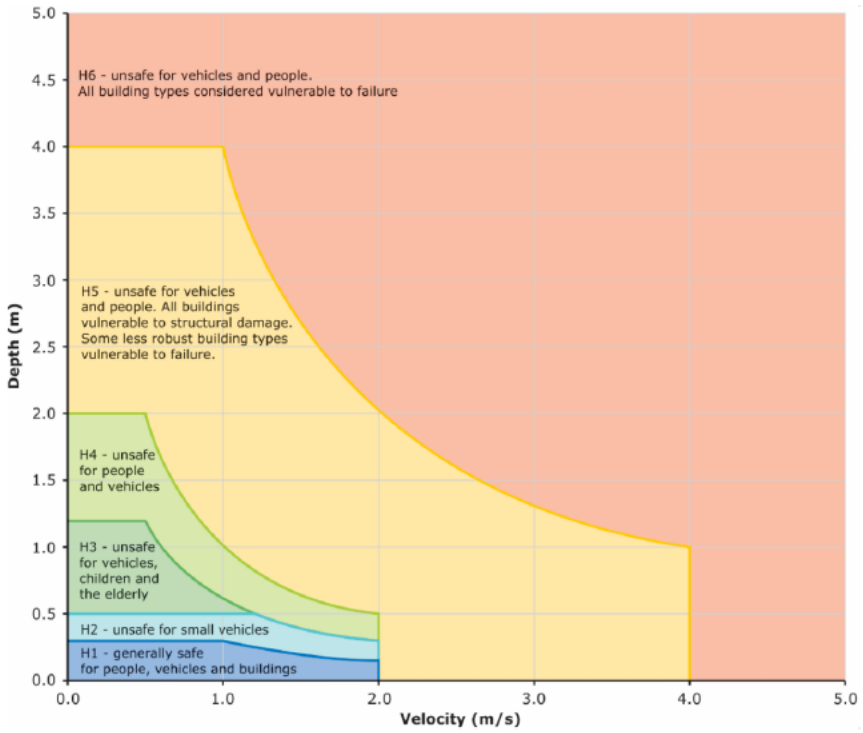


Figure 3: Combined Flood Hazard Curves (Smith et al., 2014)

b) Access to underground pipe and pit systems which are large enough for children to enter must be prevented through design. The design must be informed by the risk-based procedures detailed in the Queensland Urban Drainage Manual (QUDM).

c) Safer by Design and Crime Prevention through Environmental Design principles and Protocols must also be considered. System elements and vegetation which may provide opportunities for concealment adjoining pedestrian areas must be avoided.

9 MANAGEMENT OF STORMWATER FROM DEVELOPMENT

9.1 General

1. The guidelines contained within this Section must apply to all developments within the City of Wollongong.

2. The responsibility for the submission of satisfactory details as required in these guidelines must rest solely with the applicant.

3. Detailed plans showing the proposed method of stormwater disposal are to be submitted to Council with the Development Application, and are to be shown on the plans prepared in support of the Construction Certificate, as approval will not be granted for any work commencing on site until the stormwater disposal system has been approved.

4. The guidelines that follow are grouped into sub-sections, each dealing with separate issues. At the end of each sub-section, the information, which must be submitted to Council, is outlined.

5. Generally, all stormwater designs/investigations must be prepared in accordance with all relevant sections in this chapter. To prevent delays in assessment, the applicant should ensure that all necessary details included in this chapter are submitted.

9.2 Other Stormwater Designs

1. The design of all stormwater drainage systems must be carried out by a suitably qualified civil engineer, with the exception of stormwater systems conveying 55 L/s or less in the 100-year ARI storm event where OSD is not required.

9.3 Disposal of Stormwater from Development Sites

9.3.1 Control of Peak Discharge

a) A consequence of increasing urbanisation and intensification of development, without proper safeguards, is an increase in stormwater runoff. This increase can overload existing drainage systems, both major and minor, with resulting nuisance and potential damage to existing properties.

b) One of the methods adopted by Council to alleviate the problem is to require developers to include detention storage in developments.

c) Detention storage is the provision of depressed areas or specific storages in paved or landscaped areas that are provided with relatively small stormwater outlets, to detain a volume of water for a short duration, during more intense storms. This prevents or mitigates any increase in peak stormwater flow rates from development and delays the peak volume of runoff. Section 10 of this chapter outlines Council's requirements for on-site stormwater detention.

9.3.2 Amplification of Council's Stormwater Drains

a) The capacity of the stormwater system into which stormwater from the development discharges into must be checked in accordance with Section 6.3. If part of the stormwater system is found to not have the required capacity, then that part must be augmented/ amplified to take the additional flow.

9.3.3 Discharge of Stormwater to a Watercourse

a) Stormwater may be discharged to a watercourse. The watercourse to which it is proposed to discharge stormwater must be well defined, having defined bed and banks. Depressions in landforms are not considered to be watercourses.

b) If there are no other means of disposal, and a defined watercourse is not in the immediate vicinity of the site, the disposal must be by a suitably designed and constructed pipeline to a point where the watercourse is clearly defined. Note: stormwater must not be discharged at the top of the bank of the watercourse.

9.3.4 Discharge of Stormwater to the Kerb

a) Where the total minor system discharge from a development site does not exceed 55 litres per second, it may be discharged into the street gutter under gravity by means of one or more pipes of 100mm diameter. A maximum of two 100mm diameter pipes will be permitted at each end of the site. A maximum of two 150mm x 100mm galvanised steel pipes may be used as an alternative if greater capacity is required, with the 150mm dimension being parallel with the road surface. In cases where this is impractical, Council may consider the use of flow converters. Note: charged stormwater lines will not be permitted.

9.3.5 Discharge of Stormwater to Council's Drains

a) Where the total minor system discharge from a development site exceeds 55 litres per second, the disposal of all roof and surface discharge must be by means of a single pipeline connected directly into an existing Council stormwater pipeline and include a junction pit.

b) Where no pipeline exists in the immediate vicinity of the development, disposal must be by a suitably designed and constructed pipeline to the nearest available Council gully pit. The minimum pipe size must be 375mm in diameter and must be of reinforced concrete. The reinforced concrete pipe must be located immediately behind the line of the back-of kerb in the carriageway of the street.

9.3.6 Discharge of Stormwater through Downstream Properties

a) Where a site proposing a new development falls away from the road reserve, an easement must be obtained through downstream or adjacent properties, to enable stormwater from the development site to drain in the same direction as it would in the pre-developed state. Therefore the submission of documentary evidence is required at the lodgement of the Development assessment which confirms that the downstream property owner agrees to the provision of a drainage easement through their property.

b) Table 5 provides minimum widths required for drainage easements.

Table 5 Minimum Width of Drainage Easements

Nominal Pipe Diameter (mm)	Easement Width (m)
150 & 225	1.0
300 to 400	1.5
525	2.5
>525	Width required for maintenance, but not less than the width of conduit plus 2m

c) The minimum diameter of pipe to be placed within the easement is 150mm.

d) Evidence that the easement has been created must to be submitted to the Principal Certifying Authority prior to the activation of the Development Application consent.

e) Some sites that fall away from the road still discharge some stormwater to the street. This may be due to some portion of the land draining to the street; an existing building that has piped stormwater flow draining to the street or existing raised landscape areas that drain to the street. In such cases, an equivalent stormwater flow rate, as that which occurs in the pre-development case will be permitted to drain to the street post-development.

f) In all cases, it must be clearly demonstrated that the post-developed flow rates and flow concentrations from the development site are not greater than the pre-development condition.

9.3.7 Discharge of Stormwater into Swales

a) In areas where no pipeline or kerb and gutter exists within the road reserve to which discharge is proposed, then discharge may be permitted within stormwater swales alongside the pavement.

The swale shall be designed against scour and shall have a cross section adequate to convey the minor system flow rate. Discharge into swales is only permitted for small developments including single developments and dual occupancies.

9.3.8 Interallotment Drainage

a) Interallotment drainage must be provided to drain lots within proposed subdivisions where roof water and surface water from future development cannot be discharged directly into the street drainage system. Interallotment drainage must be provided in the form of a minimum 150mm diameter PVC Class SH single pipeline collecting runoff from properties through which the pipeline traverses and discharging to an appropriate point of discharge. Refer to sections 9.3.3 and 9.3.5

b) Interallotment drainage shall be designed for a 10 year ARI event unless noted otherwise. The pipeline must generally be located parallel to and within 1 metre from the rear or side boundary inside the allotment to be serviced.

c) A minimum 1.0 metre wide easement shall be created over all interallotment drainage pipelines and reflected on the subdivision linen plan and 88B instrument.

9.3.9 Discharge of Stormwater through Public Reserves

a) When a public reserve downstream of the development site must be traversed with a stormwater pipeline in order to reach an appropriate point of discharge, an easement issued by Council must be applied for under section 46 (1) of the Local Government Act.

b) Alternatively, an absorption or transpiration pit may be used to capture and drain stormwater from development sites where they naturally drain to public reserves. Such pits must be constructed wholly within the development site and should not be used as storage to control peak discharge of stormwater from the development site. Development Application must be accompanied by an engineer's certificate certifying that the proposed absorption pit will not adversely affect flood conditions in public reserves or on adjacent properties. In this case, the use of such pits will not be permitted. Refer to Section 9.3.12 for further details on absorption and transpiration pits.

9.3.10 Discharge of Stormwater to the Ocean

a) Individual stormwater outlets from a development site to the ocean are generally not permitted. Rather, proposed outlets are to be connected to existing outlet to minimise environmental and visual impacts. Evidence must be provided demonstrating that the sharing of common stormwater outlets from existing developments or public infrastructure (such as reserves and roads) has been exhausted, before the creation of a new separate outlet will be considered by Council. In the event that there is no alternative the applicant must provide details of the method of stormwater disposal at the ocean outfall/cliff face. In this regard the applicant must address the aesthetic qualities and environmental impacts of the method of stormwater disposal. Geotechnical considerations along the length of and at the point of discharge must also be taken into account. This may require stormwater from the development being piped and/or channelled to the foot of the outfall/cliff face with appropriate scour protection and energy dissipating elements incorporated into the design.

9.3.11 Pump Systems

a) Pump systems will not be permitted to discharge stormwater from sites grading away from the roadway, except for the specific purpose of draining underground/basement car parks The water to be pumped from a basement car park shall be limited to sub-soil drainage, vehicle wash water and runoff from the driveway that drains towards the basement. Water to be extracted from the basement car park should be pumped to a pit inside the property boundary then gravity feed to street.

b) Drainage of stormwater runoff from roof and ground surfaces using submersible pumps is not permitted, with the exception of the above.

9.3.12 Absorption and Transpiration Disposal Systems

a) The objective of an absorption and transpiration system is to dispose of roof water from the subject dwelling to either an underground system or over the existing ground surface by replicating natural overland flows and without adversely impacting upon the subject or downslope properties/ buildings.

b) an absorption disposal system or "soakaway" is the preferred method of disposing stormwater from a single dwelling only where site gradients do not allow for street gutter disposal or disposal via an interallotment drainage pipeline.

i) Note: Absorption disposal systems shall not to be used as storage facilities to control peak discharge of stormwater from development sites.

c) Also, absorption disposal systems should not be used for sites having steep gradients, low hydraulic soil conductivity or slope instability unless supported by further detailed engineering advice.

d) Further information on absorption disposal systems can be sourced from Council's website: https://www.wollongong.nsw.gov.au/development/planning-and-development-policies/flooding-stormwater-and-development/domestic-stormwater-drainage-systems

e) A transpiration disposal system or "level spreader" is an alternative method of disposing stormwater from a single dwelling only where site gradients do not allow for street gutter disposal or disposal via an inter-allotment drainage pipeline and where an absorption system is not otherwise considered suitable.

f) The location of an absorption or transpiration disposal system must be across the gradient of the site, and situated a minimum of 3 metres from property boundaries, 5 metres minimum distance from all buildings and 1-metre minimum from vehicular pavement areas. A zero setback from the downslope property boundary may be considered where the property is public reserve.

g) The minimum offset between an absorption/transpiration system and a new building may be reduced if the footings of the new building are designed to ensure they will not be impacted by the adjacent absorption/transpiration disposal system. Structures must not be built over the absorption or level spreader system.

h) The design of any absorption or transpiration disposal system shall be undertaken in accordance with Council's *'Domestic Stormwater Drainage Systems'* fact sheet. The design of the chosen system, including all calculations and supporting documentation shall be submitted with the Development Application for the proposed development.

i) Absorption and transpiration disposal systems will not be permitted for developments, with the exception of single residential dwellings, detached garages, and/or granny flats, in older subdivisions or the provisions of Section 9.3.9

j) Absorption systems on unstable land must take into consideration the recommendations of a geotechnical report.

9.3.13 Minimum Pipe Size Connecting to Council's Drains

a) Where connection must be made to Council's underground stormwater system, the minimum pipe size crossing the footpath directly in front of the allotment must be 150mm in diameter.

9.3.14 Method of Connection to Council's Drains

a) Where connection is to be made to Council's underground stormwater system, the type of connection to be used must be as shown in Council's Engineering Standard Drawings, available on Councils website.

b) Where pipes larger than 150mm in diameter are to be connected to Council's stormwater system, a junction pit must be constructed. The lid of the junction pit must be level with the road surface. The cover over the junction pit must be of a type and of the same material as that surrounding the pit. The covers must be designed to withstand the appropriate vehicle loading.

9.3.15 Drainage Work in Footpath/Carriageway

a) Any drainage works proposed within the footpath or carriageway must comply with Section 138 of the Roads Act 1993 and will be at the expense of the developer.

b) Prior to undertaking the works, the developer shall obtain a permit and arrange inspections with Council.

9.3.16 Services

a) The depth and location of all services (i.e. Stormwater, gas, water supply, sewer, electricity, telephone, traffic lights, etc.) which may affect the drainage design must be confirmed prior to the submission of final working drawings with the Construction Certificate application.

9.3.17 Flow from Adjacent Properties

c) No obstruction to the overland flow of stormwater runoff from adjacent properties is permitted. Allowance must be made for this overland flow component and adequately catered for on the subject property. In calculating this component, the entire catchment upstream of the subject property must be taken into account.

d) The diversion of this overland flow to the street, the rear of the subject property or in any other direction other than that in which it would naturally flow will not be permitted.

9.3.18 Sumps and Inlet Pits

a) Sumps and inlet pits must conform to the standards shown in Appendix 8. Alternatives to cast-in-situ concrete may be acceptable subject to approval from Council

b) Heavy-duty cast iron or galvanised and lockable steel grates must be provided on all surface inlet pits in areas with vehicular traffic.

c) The base of pits must be graded or benched to the outlet pipe. Weepholes in the base of pits are not permitted unless a suitably qualified engineer provides written evidence that justifies the suitability of the site for this system.

d) Paved areas and driveways falling towards Council's footpath must be provided with a full driveway width grated box drain at the property boundary, draining into the internal system and of minimal internal dimension of 200mm wide x 100mm deep.

e) Where affected by proposed driveways, existing kerb inlets must be replaced. The existing lintel must be removed and replaced with a new lintel, within the property frontage, upslope if possible at the developer's expense.

f) Access to existing properties fronting the drainage works must be maintained at possible times during construction. It would be prudent to provide some form of notification to the affected

properties prior to commencement of works. This is particularly the case if any disruption to access will be required as a consequence of the works.

9.4 Conditions for Building over Common Stormwater Lines and Stormwater Easements

9.4.1 General

a) This section provides Council's requirements for the erection of buildings/structures over and adjacent to common stormwater lines and stormwater easements.

9.4.2 Definitions

Common Stormwater Line	A conduit that is located within an allotment and conveys stormwater from one or more other allotments.
Common Stormwater Easement	An easement that is registered over an allotment in favour of one or more other allotments for the installation, conveyance, or maintenance of stormwater drainage serving those allotments, including but not limited to: • easement to drain water; • drainage easement; • easement for drainage; • easement for drainage and detention storage; and • any other easement that relates to stormwater/drainage installation, maintenance, access, conveyance, overflow, overland flow, and/or detention storage.
Owner	Means registered owner of a property or registered body corporate.

9.4.3 Common Stormwater Lines/Easements

Council requires the following conditions to be met in the construction of buildings over common stormwater lines/easements:

(a) Encroachments

i) Generally, no structure of a permanent nature will be allowed on a common stormwater line or easement, except in special circumstances and subject to the approval of Council.

ii) In such cases, written approval is required by all owners benefited by the common stormwater line or easement on the upstream side of the proposed encroachment.

iii) No encroachment will be permitted where that encroachment occurs within an overflow path

(b) Loads on Conduit

i) Any structural component of the building, plant or machinery and fixtures is to be so constructed so as not to impose any dead or live loads on the stormwater pipeline and to permit excavation of the line without affecting the structural stability of the building. Any building and footings must be constructed outside of the Zone of Influence (ZOI). See Sydney Water (2015) for further information.

ii) Where required by Council, the building is to be supported on stable foundations carried at least to the invert level of the pipeline.

(c) Design of Adjacent Footings

i) The footings and floor slabs required by (b) above must be designed by a Structural Engineer and submitted to Council for approval.

(d) No part of the structure, including footings, eaves and gutter overhang will be permitted to encroach into the drainage easement, except in special circumstances and subject to the approval of Council.

(e) Access Pits

i) Access pits are to be provided at points immediately upstream and downstream of the building on the stormwater line and any intermediate pits as may be required.

ii) Pits are to conform to Wollongong City Council Standards or an approved alternative.

(f) Obstruction of Free Flow

i) No work shall be carried out which will or is likely to inhibit or obstruct the free flow of waters through the stormwater pipeline and/or overland flow path.

ii) Joints on Easement Boundary.

(g) Where a reinforced concrete slab is provided for any purpose over the easement or pipeline, a construction joint shall be formed on the easement boundary.

9.4.4 Building Over or Adjacent to Council's Easement

a) Building over Council stormwater easements is generally prohibited. However, Council may consider the construction of extremely light structures such as carports, pergolas, or other like minor structures over easements, subject to the approval of Council.

b) In the event that access to the easement/pipeline is required, the cost of removal and restoration of any structures over the easement will be borne by the property owner.

c) No construction over Council stormwater easements will be permitted where the easement contains an overflow path.

d) Any building must be constructed outside of the ZOI. See Sydney Water (2015) for further information.

e) Footings Close to an Easement

i) Where it is proposed to construct footings or foundations near a stormwater easement, Council may impose such conditions, as it considers necessary to protect the structural stability of the existing or proposed stormwater infrastructure.

ii) The walls of any structure adjoining the easement boundary must be designed by a suitably qualified Engineer to withstand all forces should the easement be excavated to existing pipe invert level. This may require foundations to be designed such that they are set to a minimum of 300mm below pipe invert level or founded on sound rock.

iii) There must be no loss of support of the land contained within the drainage easement as a result of excavation within the site.

iv) No part of the structure, including footings, eaves and gutter overhang will be permitted to encroach into the easement to drain water / drainage easement.

f) Concrete Slabs Over Easement

i) Where approval has been given to construct a concrete slab over a piped drain within a stormwater easement (such as a concrete driveway) it will be necessary for the applicant to submit structural drawings showing slab thickness, reinforcement and jointing details and address all relevant items in section 9.4.3.

g) Structural Design

Details of the design of piers, beams and footings prepared by a qualified Civil (or Structural) Engineer must be submitted for approval with the application.

10 ON-SITE STORMWATER DETENTION

10.1 Application of On-Site Stormwater Detention

10.1.1 Developments to which OSD Applies

a) OSD requirements generally apply to all types of development and redevelopment on both flood prone and flood free sites. However, the storage requirement is reduced in flood prone areas (Refer Section 10.2.2).

b) Developments covered by this Policy include the following:

i) Development as follows (unless the development meets the exclusion criteria of section 10.1.2):

- Subdivisions – it is recommended that wherever practicable, the OSD system be a single storage unit, either as a tank or an above-ground "community basin";
- Single dwellings including extensions, additions and improvements to existing dwellings;
- Dual occupancies; Townhouses, villas, residential flat building development;
- Tennis courts;
- Roads, carparks and other sealed areas;
- Public buildings; and
- Any other development not listed in and Section 10.1.2

c) The methodology for calculating PSD and SSR values stipulated in Section 10.2.4 of this chapter is not appropriate for tributary areas exceeding 2ha. OSD facilities for tributary areas exceeding 2ha must be designed using an appropriate runoff routing hydrologic and hydraulic analyses in accordance with the relevant sections of this chapter and Chapter E13 of this DCP

10.1.2 Developments to Which OSD Does Not Apply

a) The OSD policy does not apply to:

i) Development that increases the impervious surface area of a site by less than 100m^2. No more than one such application for exclusion shall be permitted on a particular lot.

ii) Development that lies within the 5 year ARI flood extents (Refer Section 10.2.2).

iii) Subdivisions of existing dual occupancies where no increase in the impervious surface area is proposed.

iv) Boundary adjustments and consolidations of allotments where no additional lots are created.

v) Change of use where no increase in the impervious surface area is proposed.

vi) Building additions or internal alterations where they lie within the footprint (plan area) of the existing dwelling.

vii) New developments in subdivisions where OSD has already been provided for the entire subdivision.

viii) Buildings in rural/non-urban areas including RU1, RU2, RU3, RU4, RU6, E2, E3 and E4.

ix) In addition, OSD may not be required where development is located in the lower reaches of a catchment where OSD does not provide downstream benefits and where it can be demonstrated that runoff from the site can be conveyed through intervening property to 'receiving waters' without adversely impacting flooding of these properties. Areas where OSD would not benefit downstream flooding are shown on the plans of Appendices A1.

x) Should the location of the proposed development relative to the concession zone boundary or potential application of this concession to the development be unclear, please contact Councils Drainage Duty Officer for clarification.

10.1.3 Tributary Area Draining to OSD Basin

1. The full area draining to the proposed OSD basin post development shall be used as the tributary area in calculations for OSD. This area includes:

   a) All impervious site surfaces on the developing site, and

   b) All pervious areas part of the developing site draining to the basin post development, and

   c) Any existing pervious or impervious surfaces external to the site where runoff from these surfaces cannot be arranged to bypass the basin.

2. In general, every effort should be made to:

   a) Minimise the area of land, unchanged by the development, draining to the basin.

   b) Minimise the area of land draining to the basin from outside of the site.

10.2 Design requirements

1. All of the developing site's impervious area is to drain to the OSD system. The minimum level of impervious surface to be used in the calculation of SSR for the post development land use is that

provided in Table 4 below, unless detail plans for the proposed development are available from which actual impervious surface levels can be calculated.

Table 6: Percentage Impervious Area for Land Use Type

Land Use	Percentage Impervious Area
Normal Residential Lots	60%
Half Width Road Reserve	95%
Medium Density Residential Lots	80%
Commercial Areas	100%
Industrial Areas	100%
Public Recreation Areas	25%

2. Natural catchment boundaries are to remain unaltered. In situations where proposed impervious areas straddle natural catchment boundaries, multiple separate OSD systems shall be provided. Runoff from pervious areas that do not naturally drain to the OSD storage should, wherever possible, be designed to bypass the OSD system.

3. OSD needs to be considered and incorporated into a development as early as possible to ensure a holistic and economical design. The entire site drainage system needs to be considered during the design of a development to ensure that all runoff from impervious surfaces (roofs, gutters, paved yard areas and driveways, etc) is designed to flow into the OSD facility. In addition, a deliberate overland flow path must be created to convey these flows to the facility in the event of blockage or overload, free of obstructions such as fences, buildings, etc.

4. Detention storage is to be located at a level that is above the 5Yr ARI flood level. OSD systems are to be designed using a catchment wide approach, with a Permissible Site Discharge (PSD) and Site Storage Requirement (SSR) calculated in accordance with the procedures set out in this document.

5. Designs shall be prepared by a suitably qualified Civil Engineer in accordance with these requirements. The OSD system should be designed to take into account principles of good aesthetics and landscaping. Long term viability and maintenance of the storage area must also be considered.

10.2.1 Freeboard – Above OSD

a) Table 7 provides the minimum freeboard for the floors of any new structures above 100 Year ARI water surface level or water storage level in the OSD facility.

Table 7: Minimum Freeboard

Minimum Freeboard	
Dwelling/commercial (habitable floors)	+300mm
Garage Floors	+100mm
Industrial Floors	at 100YR ARI water level

a) The proposed drainage works shall not reduce the freeboard of any adjacent buildings.

b) Where roof storage is proposed, freeboard requirements are not applicable.

c) It should be noted that Council's minimum requirements for development on floodplains in which habitable floors are to be set at least 500mm above the 100Yr ARI mainstream flood level may lead to a requirement for a higher floor level than that set out in .

10.2.2 Flood Prone Land

a) As all land inundated in a 5Yr ARI flood event is effectively impervious once flooded, development on such land is excluded from this Policy, irrespective of its location in the catchment.

b) Where a Floodplain Management Plan has been prepared for the catchment, specific requirements for flood detention and/or storage within that Plan shall have precedence over this Policy.

10.2.3 Design Basis

a) The design objective of this section is the control of post development discharges, at all points in a catchment, to pre-development levels. This control is to be implemented by introducing small basins (OSD basins) on each developing site that serve to delay and reduce peak runoff from the site such that post-development discharges do no exceed pre-development levels anywhere in the catchment. Key to the design of these basins are two parameters, the permissible site discharge (PSD l/sec) and the site storage requirement (SSR m3). The PSD is the discharge limit for runoff from a development site, and SSR is the storage associated with this PSD, required to ensure that there is no increase in flood peak discharges anywhere in the catchment, for all storm frequencies and durations.

b) Two PSD and SSR values are used to describe a particular facility. PSD5 represents the peak discharge permissible in a 5 year ARI storm event and SSR5 the associated storage volume of the basin at that discharge. PSD100 represents the peak discharge in a 100 year event and SSR100 the corresponding basin volume at that discharge. Note SSR100 includes SSR5.

c) High early discharge pits (HED) are not permitted under this policy.

10.2.4 Determination of PSD and SSR for a Developing Site

a) The method described in this section is only applicable to tributary areas smaller than 2 Ha. For tributary areas exceeding 2 Ha, OSD must be designed using hydrologic and hydraulic analysis an accordance with Section 7**Error! Reference source not found.** of this chapter and Section 6 of C hapter E13.

b) As set out in section 10.1.3, the tributary area to be used in the calculation of PSD and SSR for the OSD basin required to manage runoff from the developing site is:

- 100% of the impervious site area determined from Table 6 or detail plans for the development proposed on the site,

  plus

- Any pervious area draining naturally to the OSD facility from within or from above the site,

  plus

- Any existing impervious area draining naturally to the OSD facility from above the site

Calculation of OSD requirements for a developing site is a two-step process involving:

- **Step 1**: The OSD requirements for a site transitioning from the existing condition to the post development condition are calculated.

- **Step 2:** Step 2 is only needed if the tributary area to the proposed OSD facility contains existing impervious surfaces. If there are areas of existing impervious surfaces present in the tributary area, the OSD requirements for a site transitioning from an undeveloped natural condition to the present (partly developed) existing condition are calculated and the SSR calculated in Step 1 are reduced by the SSR calculated in Step 2.

c) In detail these steps involve:

STEP 1

a) The OSD requirements are calculated for the post-development tributary area draining to the OSD basin reflecting the impervious area ultimately proposed. The PSD is calculated recognising the impact of any existing impervious area within this tributary area, on existing discharges (refer F1 in App A3). If under existing conditions the tributary area is not wholly natural (un-developed), F1 will be greater than 1, recognising the increased PSD of the existing (partly developed) tributary area relative to the PSD of a natural tributary area). Note that the existing impervious area used in the calculation of PSD is only the existing impervious area falling within the tributary area draining to the OSD basin.

b) The permissible site discharges from the post development basin are calculated from the rainfall isohyets, and tributary area as follows:

PSD_5 = $F1_5$ x F2 x 2.67 x (Area/10,000) x I_1^{50} (l/sec) eq 1.4.4.1

PSD_{100} = $F1_{100}$ x F2 x 4.67 x (Area/10,000) x I_1^{50} (l/sec) eq 1.4.4.2

Where ***PSD_5*** *is the permitted peak discharge from the basin in a 5Yr ARI event*

PSD_{100} *is the permitted peak discharge from the basin in a 100Yr ARI event*

I_1^{50} *(mm/hr) is the one hour 50Yr ARI rainfall intensity at the site (refer App A2)*

$F1_5$ and $F1_{100}$ *are the factors for existing impervious cover(refer App A3)*

F2 *is the factor reflecting variations in area from a 1Ha base (refer App A4)*

Area *(m^2) is the tributary area draining to the OSD basin*

Note both $F1_5$ and $F1_{100}$ will be 1.00 if the existing tributary area is wholly

Undeveloped

c) The SSR volumes (m3) for the basin are then calculated from the above PSD values as follows.

SSR_5 = F3 x F4 x 2.25 x PSD_5/F2 (m^3) eq 1.4.4.3

SSR_{100} = F3 x F4 x 2.25 x PSD_{100}/F2 (m^3) eq 1.4.4.4

Where:

***SSR_5** is the facility storage at a discharge of PSD_5*

***SSR_{100}** is the facility storage at a discharge of PSD_{100}*

***F3** is the factor reflecting post development impervious cover (refer App A5)*

***F4** is the factor reflecting variations in area from the 1Ha base(refer App A6)*

d) If there are no existing impervious surfaces in the tributary area, this completes the basin sizing calculations.

STEP 2

(Only required if there are existing impervious surfaces in the tributary area)

a) In this second step, The PSD and SSR values are recomputed for the previously defined tributary area to the OSD basin assuming it was initially in a natural state and was then developed to the existing (pre-development) state. In this scenario F1 will be 1.00 as the existing (pre-development) case is then natural. The existing impervious surface area used in step 1 then becomes the 'post-development' impervious area included in Step 2

b) The PSD's and SSR's for this scenario are then calculated as in STEP 1

c) The final PSD's are those from STEP 1 (STEP 2 PSD's are ignored) and the final SSR's are the Step 1 SSR's minus the Step 2 SSR's.

10.2.5 Internal Drainage System

a) The stormwater drainage system (including surface gradings, gutters, pipes, surface drains and overland flowpaths) for the property must:

i) Be able to collectively convey all runoff from the tributary area to the OSD system in a 1 in 100 year ARI rainfall event with a duration equal to the time of concentration of the site.

ii) Ensure that the OSD storage is by-passed by all runoff from non-tributary areas in storms up to and including the 1 in 100 year ARI event.

10.2.6 Discharge Control

a) While the OSD facility is to operate across the storm spectrum from a 5 to 100 Yr ARI event, design has been simplified by requiring the facility to explicitly meet these requirements only at the upper and lower limits of the design spectrum. The facility is therefore designed as a two stage structure with the basin filling to the SSR_5 level in a PSD_5 discharge event and to the SSR_{100} level in a PSD_{100} discharge event. The first stage is controlled by an orifice, the maximum diameter of which is to be sized using the value of PSD_5 when under a head of SSR_5 m^3 of stored water. A second stage

outlet must also be provided either in the form of a pipe or weir which permits a maximum discharge equal to PSD_{100} when subject to a head of SSR_{100} m^3 of stored water.

10.2.7 Safety Fences

a) Surface storages should be constructed so as to be easily accessible, with gentle side slopes permitting walking in or out. A maximum gradient of 1:4 (1 vertical to 4 horizontal) will be required on at least one side to permit safe egress in an emergency. Where steep or vertical sides are unavoidable, due consideration should be given to safety aspects such as the need for fencing, both when the storage is full and empty.

10.2.8 Standardised Products

a) Where practical, use may be made of precast or prefabricated items to reduce the cost.

10.3 Implementation of OSD requirements

10.3.1 Development Approvals for Subdivisions

a) In general, the OSD requirements are imposed at the subdivision stage as shown below:

b) Development Application – submission and approval of a concept layout of the OSD system. (Stormwater Concept Plan)

c) Submission of Engineering Plans – submission and approval of the detailed design including calculations and construction plans and details.

d) Release of Subdivision Certificate/Linen Plans – submission and approval of work-as – executed drawings, certificates of hydraulic compliance and legal instruments on property titles protecting the OSD system.

10.3.2 Development Approvals and Construction Certificates

a) When the OSD requirements are implemented through the development approval and construction certificate process, the approval is in three stages as follows:

b) Development Application – submission and approval of a concept layout of the OSD system (Stormwater Concept Plan)

c) Construction Certificate – submission and approval of the detailed design including calculations and construction plans and details

d) Final Approval – submission and approval of work-as-executed drawings, certificates of hydraulic (and structural if required) compliance and legal instruments protecting the OSD system

Figure 4 summarises the steps involved in the process.

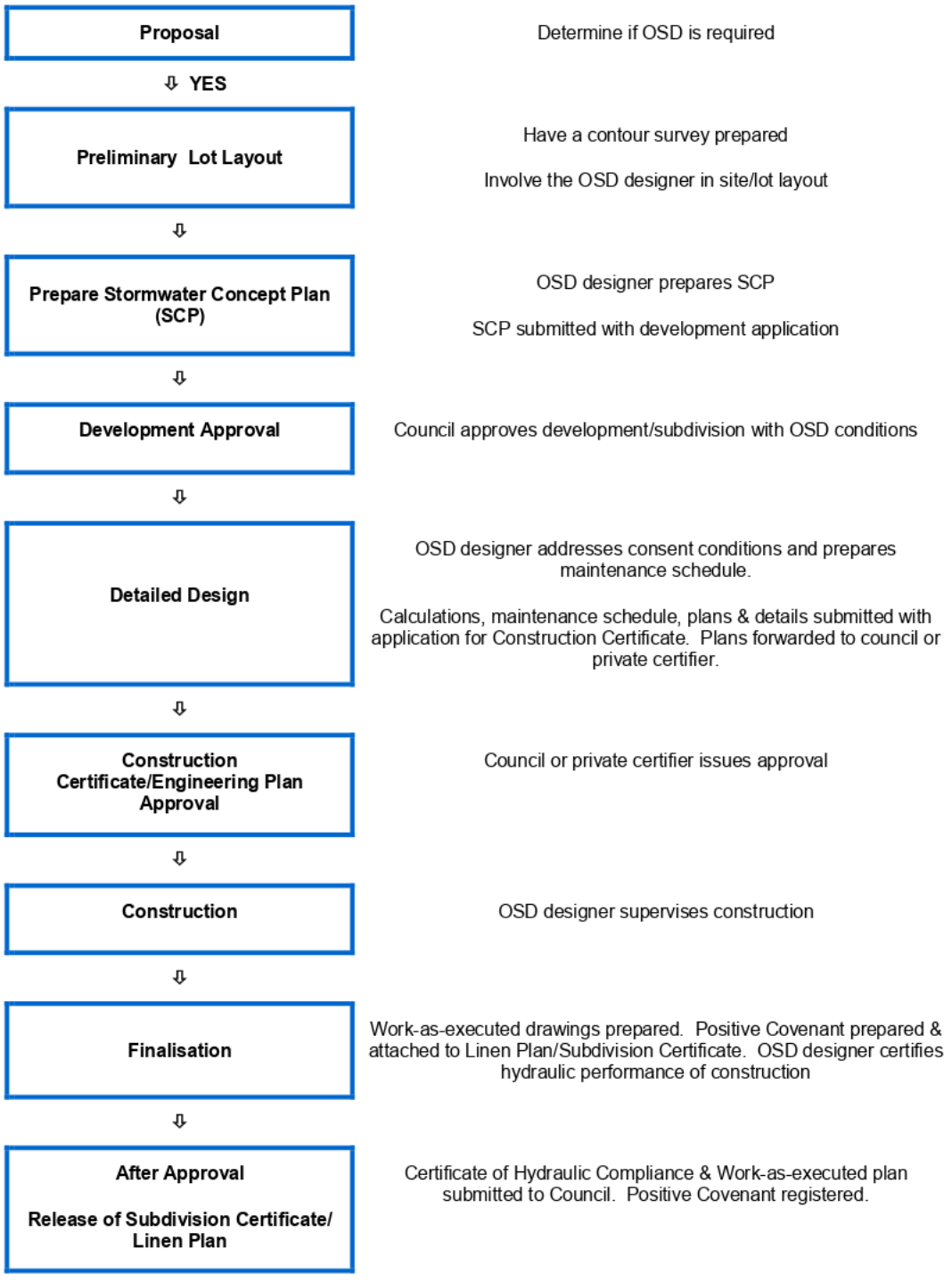


Figure 4: OSD Approval Process

10.4 Development Approval Process

OSD is best considered as early as possible in the development process so that the most efficient and effective system can be designed and installed. There are a number of issues to be addressed at the conceptual stage that will have a significant impact on the final solution:

a) In multi lot subdivisions, a common OSD system should be constructed on one lot rather than a separate system on each individual lot;

b) Every attempt should be made to maximise surface storage and minimise the amount of underground storages. Surface storage reduces the cost of the system and improves accessibility for maintenance

c) Overland flows from adjacent properties should , wherever possible, be diverted past the OSD storage

d) The site should be shaped to ensure all of the site's impervious areas drain to the OSD basin

e) In multi lot subdivisions, the OSD basin is to be constructed at the time of subdivision and not be deferred until buildings are constructed.

10.4.1 Stormwater Concept Plan

a) The objectives of the Stormwater Concept Plan (SCP) are to:

i) Emphasise that the OSD and drainage requirements need to be considered in the initial planning stages of the development;

ii) Simplify the detailed design by identifying adequate storage areas, surface flow paths and treatments, easements (if required) and site constraints in the planning stage;

iii) Reduce project costs by maximising the use of proposed landscape and architectural features as part of the OSD system;

iv) Allow the cost of development consent conditions relating to OSD to be determined at the planning stage; and

v) In the case of larger developments, assist in addressing the concerns of the local community regarding drainage and flooding issues.

10.4.2 Detailed Design

a) The objectives of a detailed OSD design are to:

i) Ensure that all components of the OSD system are functional;

ii) Simplify construction of OSD systems by providing detailed design plans;

iii) Increase owner awareness and improve maintenance standards by simply outlining the necessary maintenance practices; and

iv) Encourage storages to be accessible and maintainable.

10.4.3 Minimum data requirements

a) The following information must be included in a detailed design submission:

iii) Calculations for each storage, finalising the storage volumes and discharge rates;

iv) Calculations verifying that flow paths/floodways and internal drainage systems have sufficient capacity (if necessary);

v) Design plans and details which include the:

- Location and extent of each storage;
- Locations and details of each discharge control device;
- Catchment area draining to each storage;
- Maximum water surface levels in each storage;
- Overflow structures and surcharge paths;
- Levels and location of the discharge points for each storage;
- Internal drainage system;
- Existing contours and final design levels;
- Final site/lot layout; and
- Location and extent of any floodway/flow path.

b) Cross-sections through the storages.

c) A maintenance schedule that sets out, in plain English:

(i) What maintenance is required;

(ii) How the maintenance will be done;

(iii) Who should carry out the maintenance; and

(iv) When the maintenance will be done.

d) Structural certification for components of the OSD system (if necessary).

e) Completed Detailed Design checklist (refer Appendix 2).

f) Consideration needs to be given to how occupiers will be affected by the design and any construction variations thereby reducing/preventing alterations later (e.g. disabled access).

10.4.4 Free Discharge from an Outlet Pit

a) The orifice discharge equation is:

$$Q = CA\,(2gh)^{0.5}$$

Where Q is the discharge in m^3/sec

C is the coefficient of discharge

A is the orifice area in m^2

g is the acceleration due to gravity

h is the depth of water above the centre of the orifice in metres

b) This equation relies on:

A circular sharp edged orifice; and free discharge from the orifice.

c) Free discharge is not achieved when the outlet from the pit is affected by tailwater levels in the downstream drainage system. In this instance, full hydraulic calculations will be required to ensure early surcharge of the system does not occur.

10.4.5 Storages

a) Where possible, storages should be achieved through surface storage. Underground storages are:

(i) more difficult to inspect for silt and debris accumulation;

(ii) more difficult to maintain; and

(iii) can be dangerous to work in and may be unsafe for property owners to maintain.

10.4.6 Surface storages

a) For surface storages, the following minimum requirements are set, however designers are encouraged to apply innovative techniques to utilise the topography of the site and other methods of achieving design requirements.

b) In the interests of safety and amenity, ponded water depths are not to exceed:

	Maximum
Parking/Paved Areas	0.2 m
Landscaping	0.6 m
Covered/Fenced Storage	No Limit
Roof Area	As required by structural integrity

c) In the event that these limits are exceeded, it shall be demonstrated that due consideration has been given to the method of addressing the increased hazard.

d) The minimum surface slope for the base is 1.5%. Sub-soil drainage shall be provided around the outlet to prevent the ground becoming saturated.

10.4.7 Underground storages

a) The following design considerations must be taken into account for underground storages:

(i) Access openings to all underground storage tanks must be secured with a grate or cover, and fastened such that children are not able to remove them. However, as residents/owners must be able to inspect critical parts of the storage, heavy concrete covers should be avoided.

(ii) Openings must be wide enough to allow easy entry to a storage, i.e.:

- 600 x 600 (storages up to 600 mm deep)
- 900 x 900 (storages greater than 600 mm deep)

(iii) A continuous fall on the floor of the storage of at least 1% must be provided to the storage outlet to minimise ponding in the storage.

(iv) The minimum clearance height for accessible tanks is 900 mm. Where this cannot be achieved due to level or other constraints, the following internal heights can be considered:

- Commercial/Industrial developments 750 mm
- Residential developments 500 mm.

provided that:

(i) All grates accessing the tank are a minimum of 900 mm x 900 mm, and a maximum lifting weight of 20 kg; and

(ii) Grates are placed at the extremities of the tank with a maximum distance of 3 m from any point in the tank to the edge of the nearest grate.

b) The build-up of noxious odour in storages without a grated access can create problems. If the storage is sealed, vents should be provided.

10.4.8 Overflow

a) Provision needs to be made in the design of a storage for overflows from storms more severe than the design storm or for blockages in the system. Overflows should be directed to a flowpath through the development so that buildings are not inundated nor are flows concentrated on an adjoining property.

10.4.9 Orifice plates

a) Orifice plates are to be manufactured in corrosion-resistant plate to a minimum thickness of 3 mm (5 mm thick where the orifice exceeds 150 mm) with a clean-cut circular hole.

10.4.10 Debris control

a) To reduce the likelihood of the outlet being blocked by debris, the outlet opening shall have a minimum internal diameter or width of at least 50 mm and shall be protected by a mesh screen, generally in accordance with Appendix 3. Discharge outlet pits must be fitted with an internal screen. The screen needs to:

(i) Protect the orifice from blockage;

(ii) Create static conditions around the orifice which helps to achieve predictable discharge coefficients; and

(iii) Retain litter and debris that would degrade downstream water quality.

10.4.11 Identification System

a) An Identification System is required for all OSD systems, usually in the form of a corrosion resistant plaque. The plaque shall be on or close to the OSD system and is to indicate:

(i) The structure is an OSD facility, part of the stormwater drainage network;

(ii) Its Identification Number, provided as part of the Development Approval process ;

(iii) It is not to be tampered with; and

(iv) Any specialist maintenance requirements e.g. confined spaces warning.

10.4.12 Maintenance

a) Maintenance must be considered as part of the design process and proof of this will be required. A maintenance schedule is required to be submitted which sets out the routine maintenance necessary to retain the OSD system's viability. The resident/owner of the property shall receive a copy of this schedule on approval of the development and it will form an integral part of the Positive Covenants and Restrictions on Use of Land (see Section 10.4.21). The schedule should be signed to indicate that it has been received and understood. A copy of the signed schedule shall also be submitted to Council.

b) This schedule should contain information on the following issues:

(i) Where the storages are located;

(ii) Which parts of the system need to be accessed for cleaning and how access is obtained;

(iii) A description of any equipment needed (such as keys and lifting devices) and where they can be obtained;

(iv) The location of grates/covers and how they can be removed for cleaning;

(v) Who should do the maintenance; and

(vi) How often should it be done?

c) An example of such a schedule is attached to this policy (Appendix 4).

d) OSD systems should be designed such that specialist personnel (e.g., confined spaces certified) are not required to perform ongoing maintenance.

10.4.13 Construction and Final Approval

a) The objectives of the construction supervision and certification arrangements are to:

(i) Encourage supervision of critical stages of construction by the OSD designer to improve construction standards;

(ii) Minimise delays and additional expenditure on rectification works by ensuring adequate construction supervision;

(iii) Increase community acceptance of OSD by eliminating nuisances created by poor construction; and

(iv) Enable Council to inspect and insist on essential maintenance of the system.

10.4.14 Supervision

a) Construction supervision is essential in achieving a properly working OSD system. OSD construction is often multi-disciplined with many tradesmen (such as bricklayers, landscapers and concrete finishers) who may be unfamiliar with stormwater drainage, being responsible for constructing critical features of the system. OSD systems require closer attention to set-out and levels than a conventional drainage system. Without adequate supervision during construction, expensive and time consuming rectification works are often necessary before a Certificate of Hydraulic Compliance (see Appendix 5) can be issued by the OSD designer.

10.4.15 Work-as-Executed plans

a) Work-as-Executed (WAE) plans prepared by a Registered Surveyor or the OSD designer must be submitted. A general set of guidelines for preparation of WAE plans is provided below. However, in some projects there will be site-specific features that will require additional details. The OSD designer should therefore be consulted before preparing these plans. As the OSD designer is responsible for the Hydraulic Compliance Certificate, it is important that the WAE plans provide the designer with sufficient information to ascertain that the as-constructed system will function in accordance with the approved design. Note that any changes to the top water level in the storage or depth of storage may alter the required orifice diameter. Calculations should be submitted to show that the orifice diameter is correct if the approved design water level has been changed.

10.4.16 Storage

a) The following details of the OSD storage should be provided:

(i) Type of storage - roof, above ground, below ground or combination;

(ii) Detailed calculations of the actual volume achieved for each storage;

(iii) The diameter of the orifice plate and verification that it has been fitted correctly;

(iv) Verification that a screen has been fitted, as well as its location, dimensions and the minimum distance from the orifice;

(v) Level and location of any overflow structures (e.g. spillways, weirs);

(vi) Sufficient levels and dimensions to verify storage volumes – as a minimum, WAE plans should give the constructed level of all design levels shown on approved plans;

(vii) Any changes to storage depth or top water level and whether the orifice size is affected; and

(viii) Internal diameter of the outlet pipe.

10.4.17 Internal drainage

a) The following information on the internal drainage system is to be included:

(i) Pit surface levels;

(ii) Invert levels and diameters of pipes;

(iii) Location and levels of any floodways and/or overland flowpaths; and

(iv) Sufficient spot levels to show site gradings and extent of areas not draining to the storage(s).

10.4.18 Freeboards

a) The finished floor levels of adjacent structures on the property such as garages and dwellings are to be shown to ensure they are sufficiently above the maximum storage water surface levels and water levels on overland flowpaths.

10.4.19 Certificates of Hydraulic Compliance

a) Certificates of Hydraulic Compliance are required to confirm that the drainage and On-site Stormwater Detention (OSD) works have been carried out in accordance with the approved design.

b) To avoid delays in obtaining certification, developers and builders are encouraged to have the OSD designer supervise and certify the construction of these systems. This certification is for the Certificates of Hydraulic Compliance only, not the Certification of the Development required under Section 109 of the Environmental Planning and Assessment Act. Defects are expensive to repair once the development is completed.

c) Certificates of Hydraulic Compliance are to be attached to the Work-As-Executed plans and submitted to Council prior to the release of Subdivision Certificate linen plans, certificates of occupation and/or Occupation Certificate. A separate structural certification will be required for any structural elements. The Certificate of Hydraulic Compliance needs to:

(i) State that the system will function in accordance with the approved designs, subject to satisfactory maintenance;

(ii) Identify any variations from the approved design; and

(iii) State that these variations will not impair the performance of the OSD system.

d) Alternatively, where variations are identified that impair the performance of the OSD system, the OSD designer will need to complete an Outstanding Works Form. This form shall list the variations from the approved design and the required remedial works. Where significant remedial works are necessary, discussions should be held with the relevant Council officers and arrangements made to have these works carried out prior to the issue of a Certificate of Hydraulic Compliance by the OSD designer or final approval by Council.

e) The Certificate of Hydraulic Compliance is the principal means by which adequate construction standards are ensured and certification needs to be conducted in a professional manner. Whilst

the Certificate will be based on the WAE plans, the OSD designer will need to inspect the site to check critical design features.

f) Some of the important considerations to be addressed when certifying hydraulic compliance are:

(i) Storage:

- Actual storage volumes achieved are adequate;
- A plate with a sharp-edged orifice of the correct diameter and the specified material has been securely fitted;
- The orifice is screened and the screen is properly fixed, located and able to be removed for cleaning;
- Outlet pipes from the discharge outlet pit are the correct size, level and grade to ensure there is free discharge through the orifice;
- The levels of the top water surface and storage invert are such that the design discharge from the storage is achieved;
- The actual top water surface level of the storage will not cause either unintended surcharge of the internal drainage system or inundation of/or inadequate freeboards to finished floor levels; nor will it alter the storage depth sufficiently to impact on the required orifice size;
- The base of the storage is well graded and drains to the discharge outlet pit; and
- Spillways and overflow paths are the correct level and free from obstructions.

(ii) Internal drainage:

- Site gradings are correct;
- The internal drainage lines are of a sufficient size, level and grade to convey flows to the storage;
- If a blockage occurs or the internal drainage lines cannot convey all runoff in a 100 year rainfall event, the site is graded to direct surcharging flows to the storages;
- Storages cannot be by-passed by overflows from the internal drainage system or by overflows from any surface area designed to drain to the storages;
- Flowpaths designed to divert upstream flows around the basin have been properly constructed and will function as designed; and
- General workmanship is adequate to prevent long-term failure of the system.

(iii) Freeboards

- The levels of structures (such as garages, factories, offices and dwellings) are sufficiently above the as-constructed maximum water surface levels in the storage and flowpaths; and
- An emergency spillway or overflow path is provided to ensure that surcharge of the drainage system and storage (even in the event of an extreme storm or accidental blockage of pits, pipes etc.) will not cause stormwater to enter buildings where significant damage would occur.

g) Sample Standard Certificate of Hydraulic Compliance Forms and Outstanding Works forms are attached in Appendix 5.

10.4.20 Structural certification

a) Due to hydrostatic loadings, certain OSD storage components may require specific structural certification for design and construction. The following list is typical but not exhaustive. This

certification should be provided by a qualified, practising structural engineer, except where the components match the standard designs.

b) Free standing walls

(i) These are subject to hydrostatic loads when a storage is full or filling. The significance will depend on the maximum ponding depth.

c) Retaining walls

(i) In addition to the normal earth and hydrostatic loadings, it may be necessary to consider the possibility of saturated sub-soil conditions.

d) Underground storages

(i) These may be subject to a combination of earth pressures, hydrostatic loadings, traffic loadings and buoyancy forces.

10.4.21 Legal Protection of OSD Systems

a) OSD systems are structures intended to control site discharges over the entire life of the development. To guarantee the system's continued operation, it needs to be protected from alteration and regularly maintained.

b) Prior to the issue of final approval, the OSD system and associated floodways and flowpaths need to be legally protected. This is achieved by applying a restriction on the use of the land and a positive covenant over the lot in favour of the local council. These can be imposed either by submitting a suitable Request Form to the Land Titles Office or in conjunction with the registration of a plan showing the new lots to be created. An explanation of the process involved, sample instruments, standard terms and conditions, a copy of the Land Titles Office Information Bulletin 14 and sample forms 13PC and 13RPA, are included in Appendix 6, and as listed below.

- F.1 Explanatory notes on the preparation and registration of Positive Covenants and Restrictions on Use of Land.
- F.2 Forms for use under Section 88E(3) of the Conveyancing Act where there is no subdivision of land involved and the covenant and restriction on use are being imposed on an existing parcel of land.
- F.3 Terms and conditions for Restriction on Use of Land and Positive Covenant.
- F.4 Sample Restriction on Use of Land and Covenant where a deposited plan is being registered together with a Section 88B instrument.
- F.5 A copy of Information Bulletin No 14 (dated September 1998), prepared by the Land Titles Office,
- *A Guide to the Preparation of a Section 88B Instrument to:*
- *Create Easements, Profits à Prendre, Restrictions on the Use of Land or Positive Covenants, Release Easements or Profits à Prendre*
- F.6 Sample Covenant used where a deposited plan is being registered together with a Section 88B instrument and construction of the OSD system is being deferred.

  Note: Council will only permit deferral of the construction of the OSD systems in exceptional circumstances.

10.5 Record System

1. A database of all OSD systems is to be maintained by Wollongong City Council. This database will include information on:

   a) Site location

   b) Catchment

   c) Type of development

   d) Design details (area, PSD, SSR, storages);

   e) Location of WAE drawings;

   f) Details and location of maintenance schedules; and

   g) Identification Number

2. This database will be accessible by relevant officers to ensure that any changes to a property approved at a later date are considered with reference to the OSD system.

10.6 Inspections

1. A program of random audits of infrastructure will be implemented by Wollongong City Council. This will involve:

   a) Notification of the owners of an inspection due to take place;

   b) An inspection of the system, comparing the structure with the WAE drawings and completing a checklist of maintenance items; and

   c) Issuing owners with a record of the inspection noting what items need to be followed up, and specifying the timeframe in which this needs to be done.

11 INFORMATION REQUIREMENTS (TO BE SUBMITTED BY APPLICANT)

11.1 Development Application Stage

1. The following information will be required:

   a) A site stormwater layout (1:100 scale). This plan must also show how the proposed stormwater system is integrated with the proposed landscape plan for the site. For larger sites, an overall site stormwater layout shall be provided at a scale of 1:200 in addition to the above requirement;

   b) The extent and area (in plan) of any upstream catchment for external flows entering the site;

   c) Hydrologic and hydraulic calculations, including calculations of velocities and flows leaving the site both prior and after development;

   d) Information relating to proposed overflow paths must include contours of the land within which the overflow path will be located, the capacity of the overflow path, details of any bed reinforcement such as grass;

e) SID

f) Except for minor developments (refer to Glossary), longitudinal section of pipelines showing calculated flows, velocity, size and class of pipe, grade, invert levels, services and ground levels;

g) Where connection is to be made to an existing underground stormwater system, a hydraulic grade line analysis must be carried out and the pressure line plotted on the longitudinal section;

h) Details, dimensions and location of pits, grates, on-site detention storage, weirs, orifice plates, outlet structures and scour protection;

i) The location and extent of any floodways, flowpaths or stormwater concentrations affecting the site;

j) Flood study if applicable;

k) Proposed point/s of discharge;

l) Fencing location and type;

m) Written agreement from downstream property owners to provide an easement to drain water if applicable;

n) Survey of the development site and surrounding areas, to provide sufficient information in order to assess the Application, which includes lot boundaries, contours/spot levels, buildings, easements, services, landscaped areas, site area, roadways etc;

o) Plan (1:100 scale) showing proposed and existing floor, ground and pavement levels to AHD;

p) Plans of any proposed earth works including cut and fill drawings. Cut and fill drawings to be at shown at 0.25m contours.

Note: Sufficient contours and spot levels must be shown on the plan to enable its proper construction. It is insufficient to show arrows to indicate a fall in the pavement. All levels to be related to Australian Height Datum (AHD);

2. Where on-site detention is proposed, the following additional information will be required:

a) The location and extent of the detention storage.

b) The location and levels of discharge points for the storage.

c) Preliminary estimates on the SSR and PSD values.

d) The location and area of any portion of the site unable to drain to the storage.

e) The final disposal point, where the runoff from the site is unable to drain to the storage, together with justification that this runoff will not cause any adverse effects to the development site or neighbouring properties.

11.2 Construction Certificate Stage

1. The following information will be required:

a) If applicable, evidence to show that the creation of an easement to drain water over downstream properties has occurred.

b) Where applicable, evidence that all Development Application conditions have been incorporated into the plans.

c) Sufficient set-out information to allow the development to be constructed in accordance with the Development Consent and the intent of the Development Application plans.

d) Location of all services in the vicinity of the proposed development.

2. Where on-site detention is proposed, refer to Section 10 for the information required.

11.3 Prior to Final Occupation Stage

1. Where a work-as-executed (WAE) plan and engineer's certification is required as a condition of development consent, it must include at least the following. The sections in italics are to be included on the certification:

a) A statement certifying that "all stormwater drainage and related work has been constructed in accordance with the approved plans". A statement that the work is in accordance with the intent, character, principle or key aspects of the plan for example, will not be accepted.

b) A statement certifying that the work-as-executed survey plan has been prepared by a registered surveyor. Further, the surveyors' name and organisation are to be clearly shown on the plan.

c) A statement certifying that "the stormwater infrastructure has been constructed in accordance with the development consent. A statement that the work is in accordance with the intent, character, principle or key aspects of this chapter for example, will not be accepted.

2. Where on-site detention was required as part of the development approval, refer to sections 10.4.15 and 10.4.16 with respect to the provision of a work-as-executed plan, hydraulic compliance certificate, restriction on use and positive covenant.

Note: Under normal circumstances, Council will require demolition of any structure which has not been constructed in accordance with the approved plans and which is considered likely to exacerbate or cause problems related to stormwater drainage. Any variations from the approved plans will need to be documented and will need to be certified by the Certifying Authority as not affecting the performance of the designed system.

11.4 At Development Application Stage (Where No Construction Certificate Is Required)

1. The following information will be required:

a) A site stormwater layout (1:100 scale). This plan must also show how the proposed stormwater system is integrated with the proposed landscape plan for the site. For larger sites, an overall site stormwater layout shall be provided at a scale of 1:200 in addition to the above requirement;

b) The extent and area (in plan) of any upstream catchment for external flows entering the site;

c) Where a flood study is required as part of a Development Application, the consultant shall provide as a minimum the following information:

(i) Catchment plan 1:4000.

(ii) Hydrologic and hydraulic calculations.

(iii) A section detailing investigations carried out to determine the potential for upstream diversions affecting the site and reporting the findings.

(iv) A section detailing recorded flood levels used or information from local residents used in calibrating the model.

(v) Survey of the site showing all necessary features, along with creek cross-sections drawn to a suitable scale and which adequately reflect the existing characteristics of the channel and floodplain. Cross-sections are to be taken perpendicular to the flow for the particular flood event being considered. Where roadways and/or driveways are used as weirs, detailed survey must be provided. Water surface profiles for both pre and post development conditions drawn to a suitable scale.

(vi) Extent of inundation for both pre and post development conditions.

(vii) Floor levels of proposed and existing buildings on the development site and other affected properties.

(viii) Velocity and depth product contours.

(ix) Delineation of flood risk precincts relevant to individual floodplains.

(x) Channel and overbank velocities for both pre and post development conditions.

(xi) An assessment of the need for scour and/or erosion protection along bed, banks or discharge points.

11.5 Standard of Engineering Submission

1. Both Development and Construction Certificate Applications must be prepared in accordance with the Australian Technical Drawing Standard AS1100.

2. Flood studies must be clearly and concisely presented.

3. Calculations to be clearly presented in a logical sequenced manner. Calculations will not be accepted on disc without hard copy attached.

11.6 Computer Programs

1. Prior to the use of in-house developed computer programs for hydrologic/hydraulic analysis, the consulting engineer must supply to Council a flowchart showing the steps and formulae involved in the execution of the program. The limits of applicability must also be defined.

2. Computer output from programs developed in-house without having been previously approved by Council will not be accepted.

3. Where a computer program has been used for stormwater analysis, a copy of the model input files and results output may need to be provided to Council for assessment.

12 REFERENCES

Australian Rainfall and Runoff. A Guide to Flood Estimation (1998) Institution of Engineers, Australia.

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) Australian Rainfall and Runoff: A Guide to Flood Estimation, © Commonwealth of Australia (Geoscience Australia), 2019.

Coombes, P., and Roso, S. (Editors), 2019 Runoff in Urban Areas, Book 9 in Australian Rainfall and Runoff - A Guide to Flood Estimation, Commonwealth of Australia, © Commonwealth of Australia (Geoscience Australia), 2019.

Floodplain Development Manual. (2005) New South Wales Government.

AS/NZS 3500.3:2003. Plumbing and Drainage – Stormwater Drainage.

Smith, G.P., Davey, E.K. and Cox, R.J. (2014), Flood Hazard UNSW Australia Water Research Laboratory Technical Report 2014/07 30 September 2014.

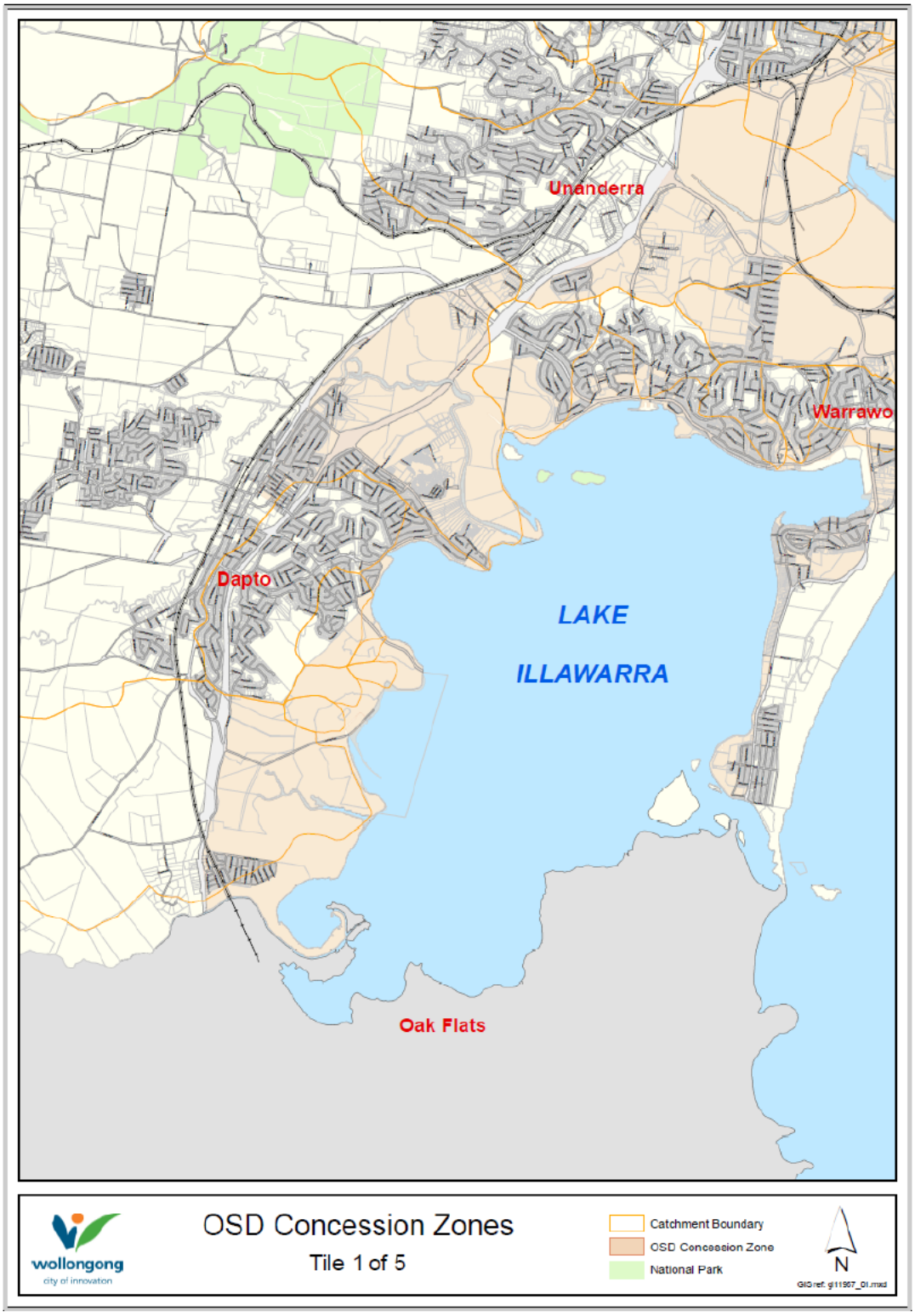
Sydney Water (2015). Building Over or Adjacent to Sydney Water Stormwater Assets.

APPENDIX 1 - OSD DESIGN

CONTAINING:

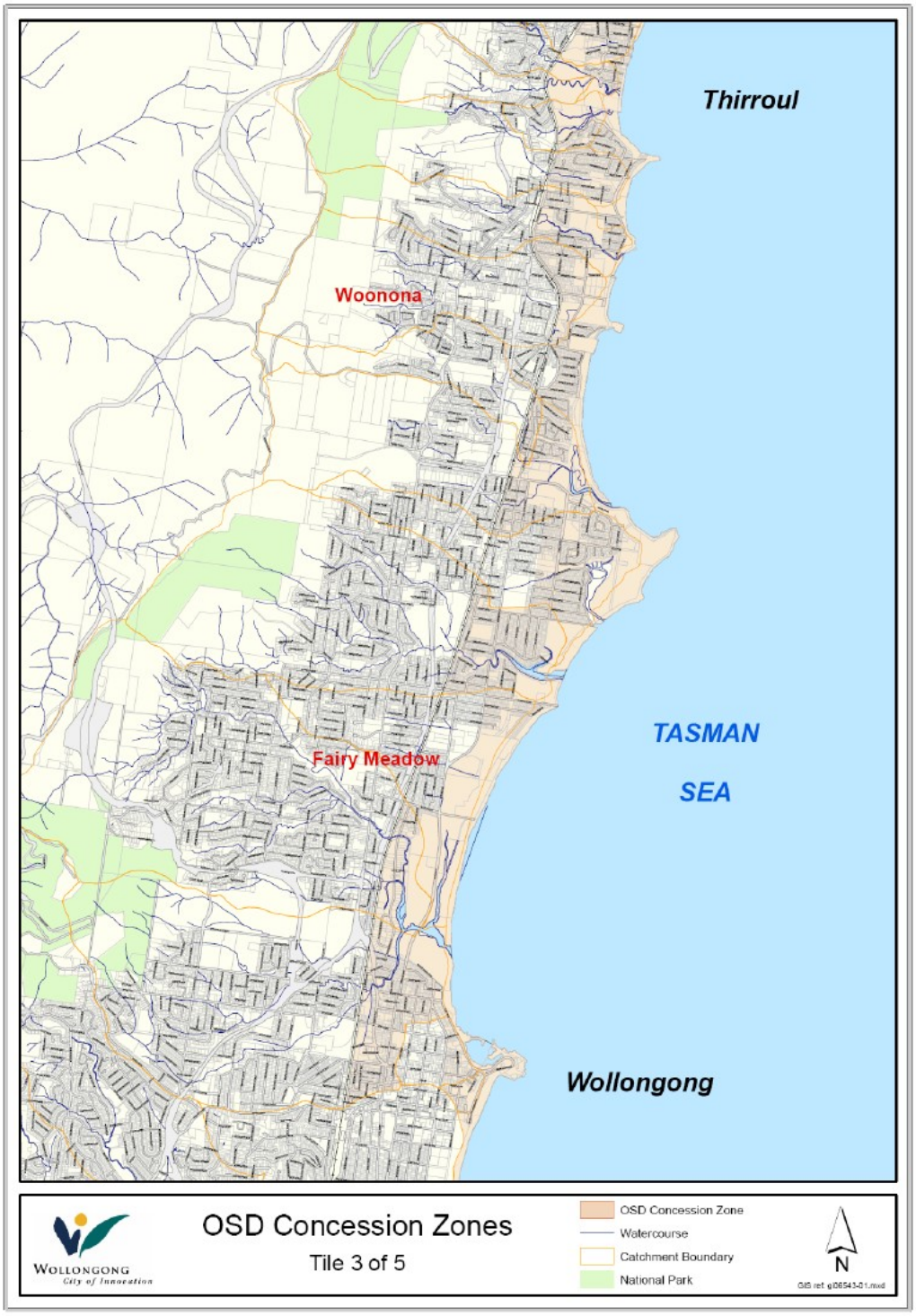
(i) Appendix A1. Concessional OSD Zones
(ii) Appendix A2. Wollongong Rainfall Isohyets
(iii) Appendix A3. F1 –v- %imp
(iv) Appendix A4. F2 –v- Area
(v) Appendix A5. F3 –v- %imp
(vi) Appendix A6. F4 –v- Area
(vii) Appendix A7. OSD Basin Sizing Examples

APPENDIX 1A: Concessional OSD Zones


Unanderra
Warrawo
Dapto
LAKE
ILLAWARRA
Oak Flats
wollongong
city of innovation
OSD Concession Zones
Tile 1 of 5
Catchment Boundary
OSD Concession Zone
National Park
N


Wollongong
TASMAN
SEA
Unanderra
Port Kembla
Warrawong
LAKE
ILLAWARRA
wollongong
city of innovation
OSD Concession Zones
Tile 2 of 5
Catchment Boundary
OSD Concession Zone
National Park
N


Thirroul
Woonona
Fairy Meadow
TASMAN
SEA
Wollongong
TASMAN
SEA
wollongong
city of innovation
OSD Concession Zones
Tile 3 of 5
Catchment Boundary
OSD Concession Zone
National Park
N
GIS ref: g11967_01.mxd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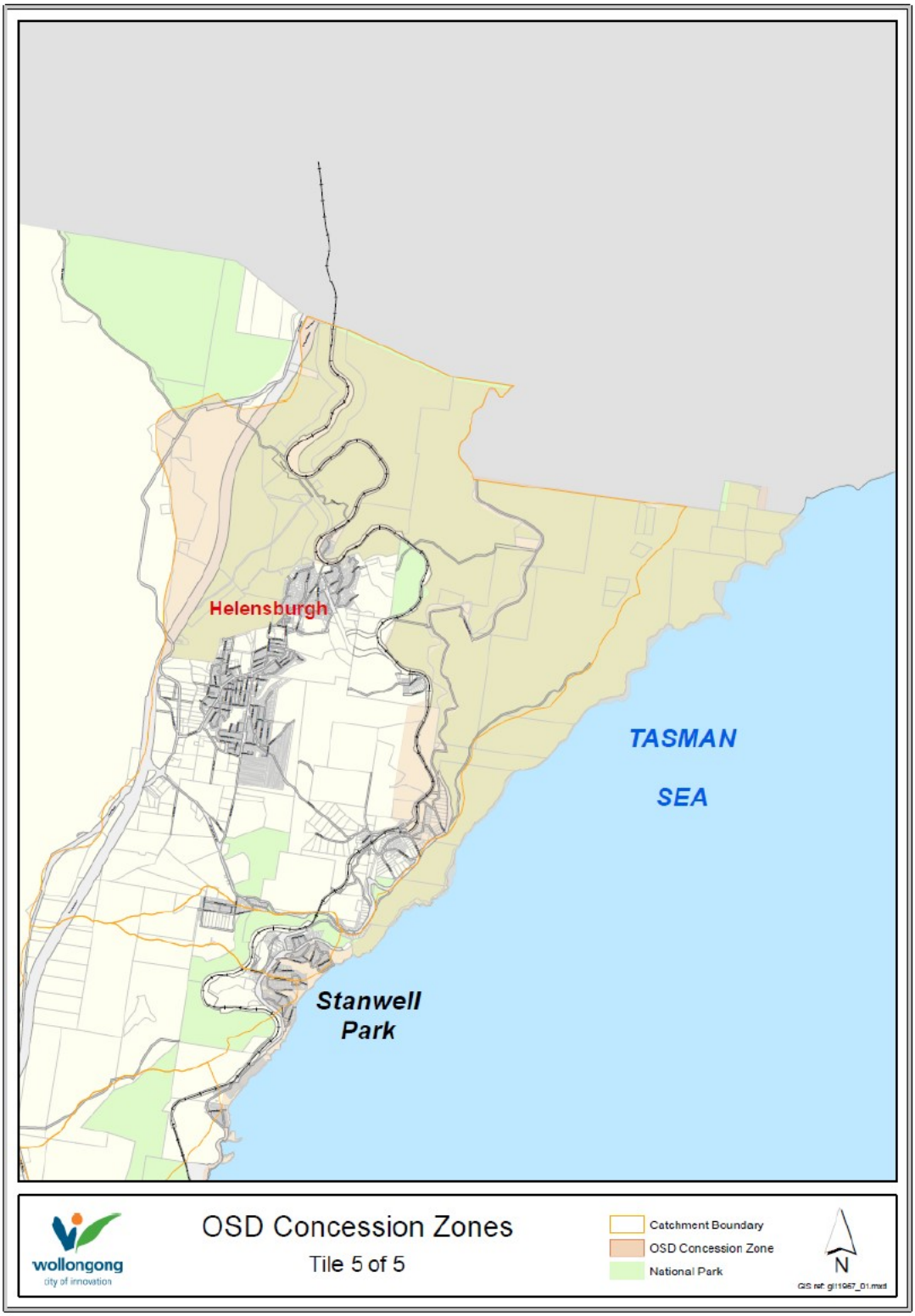
Woonona
Fairy Meadow
TASMAN
SEA
Wollongong
OSD Concession Zones
Tile 3 of 5
OSD Concession Zone
Watercourse
Catchment Boundary
National Park
N


Darkes Forest
Stanwell Park
TASMAN SEA
Coledale
Thirroul
Woonona
wollongong
city of innovation
OSD Concession Zones
Tile 4 of 5
Catchment Boundary
OSD Concession Zone
National Park
N


Helensburgh
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SEA
Stanwell
Park
wollongong
city of innovation
OSD Concession Zones
Tile 5 of 5
Catchment Boundary
OSD Concession Zone
National Park
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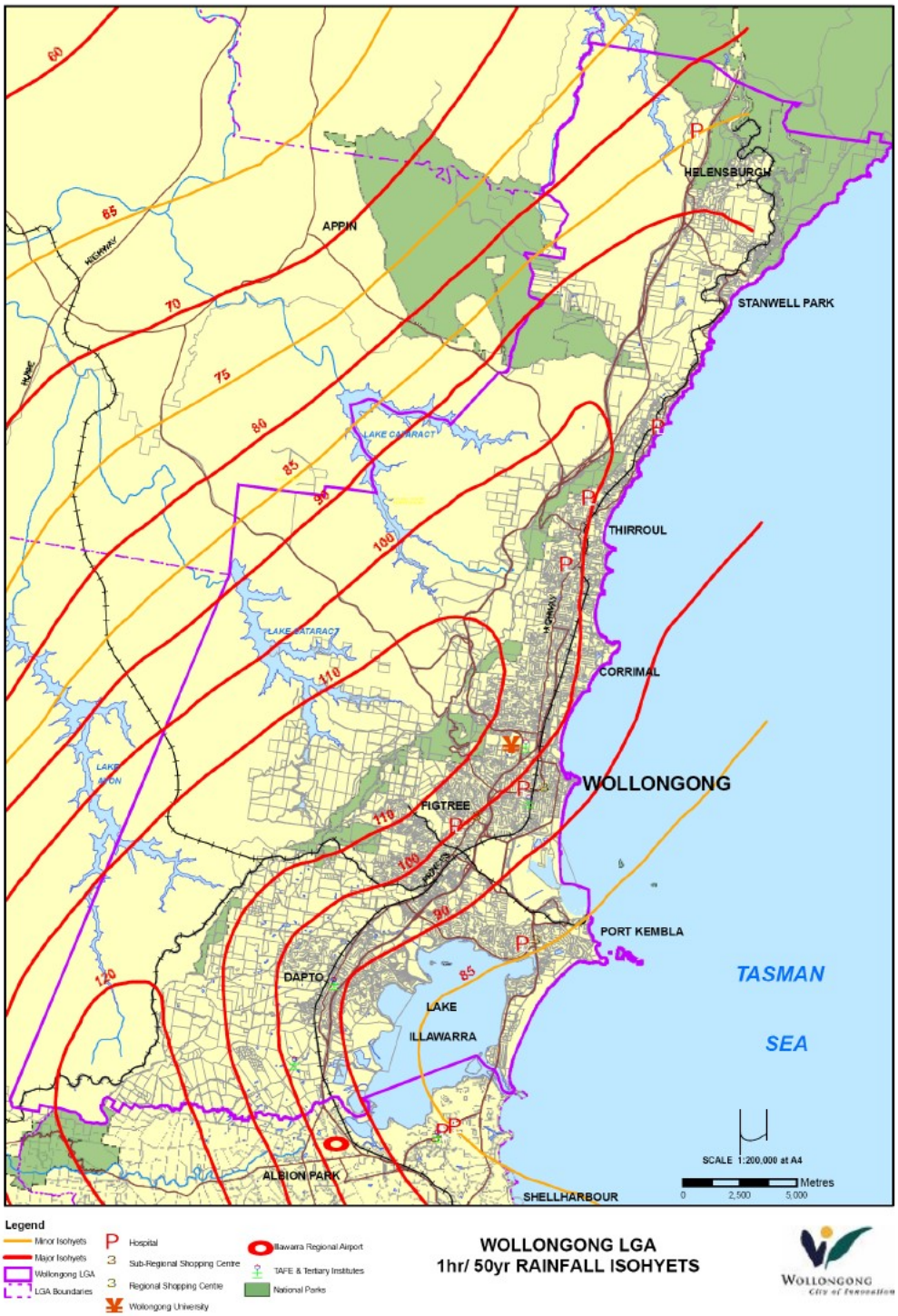
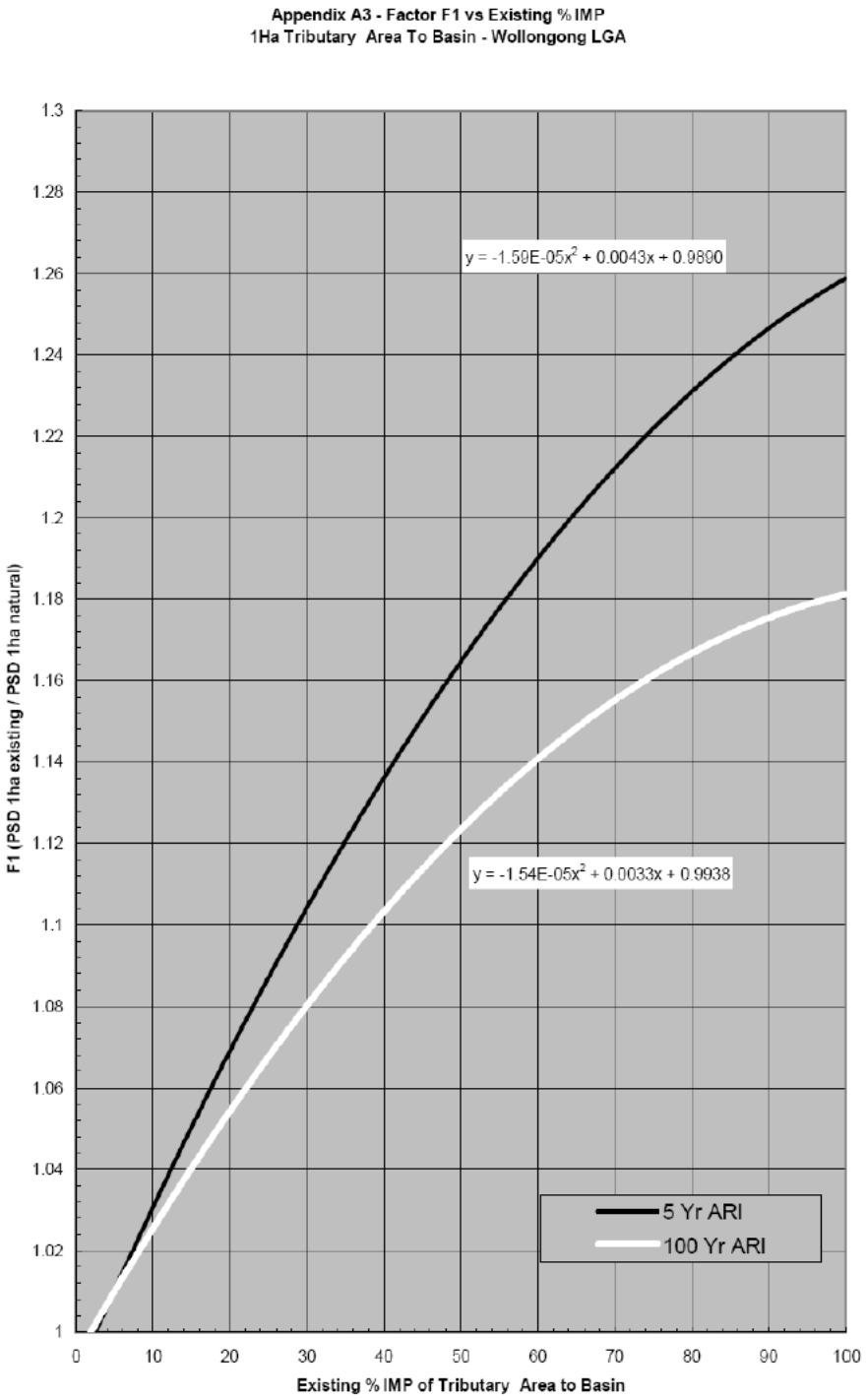
GIS ref: gi11967_01.mxd

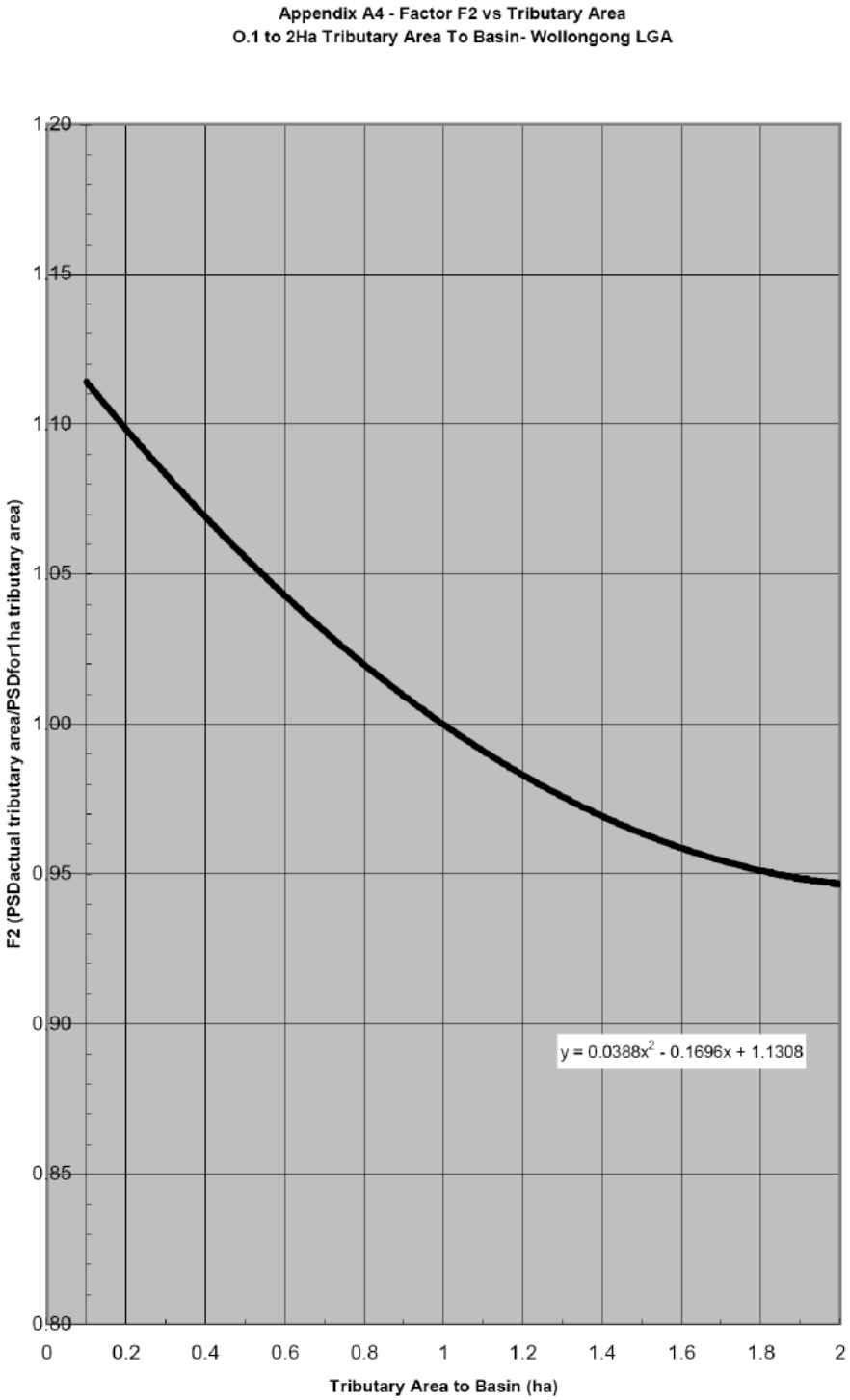
APPENDIX A2: Wollongong Rainfall Isohyets



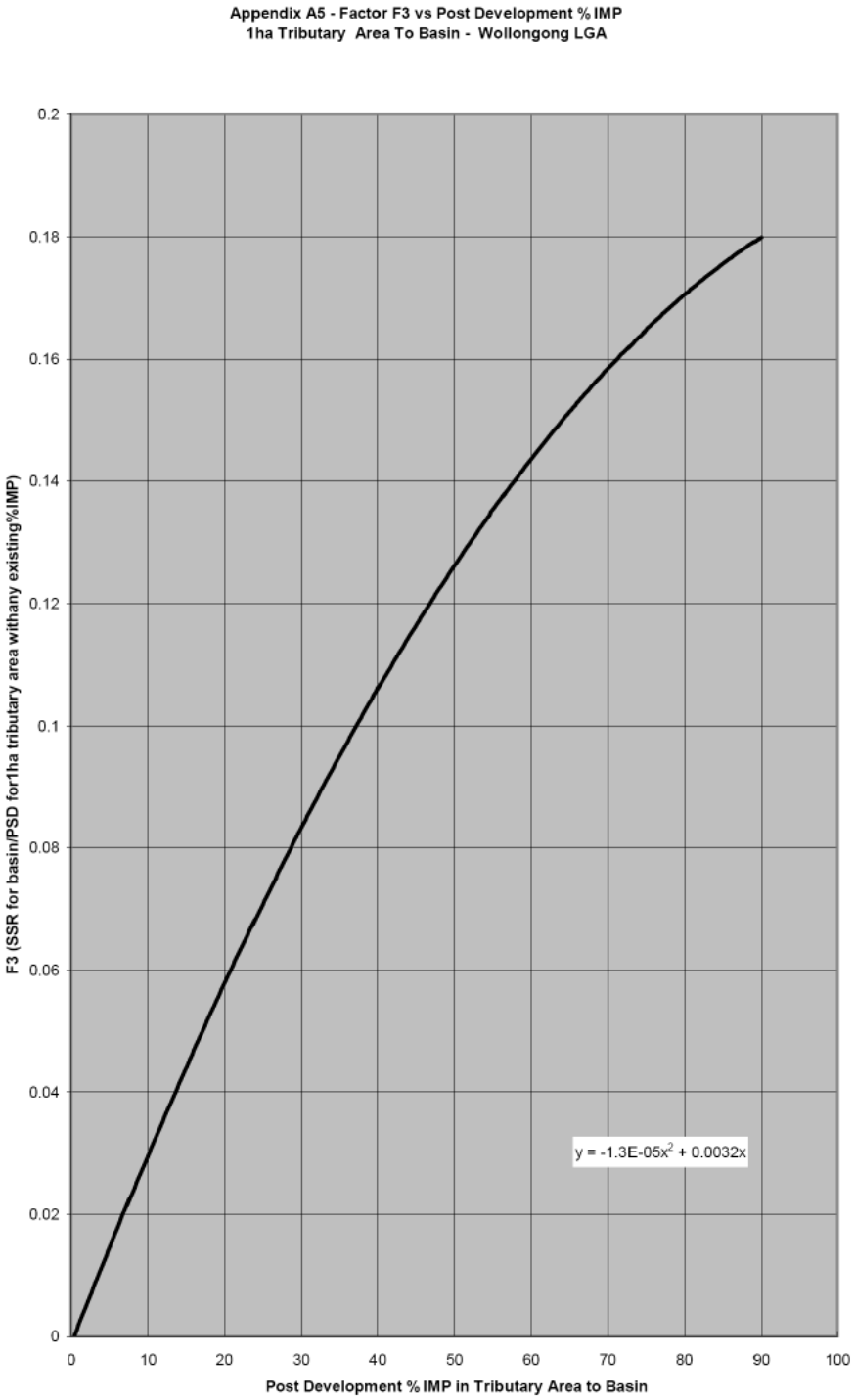
APPENDIX A3: F1 –v- %Imp



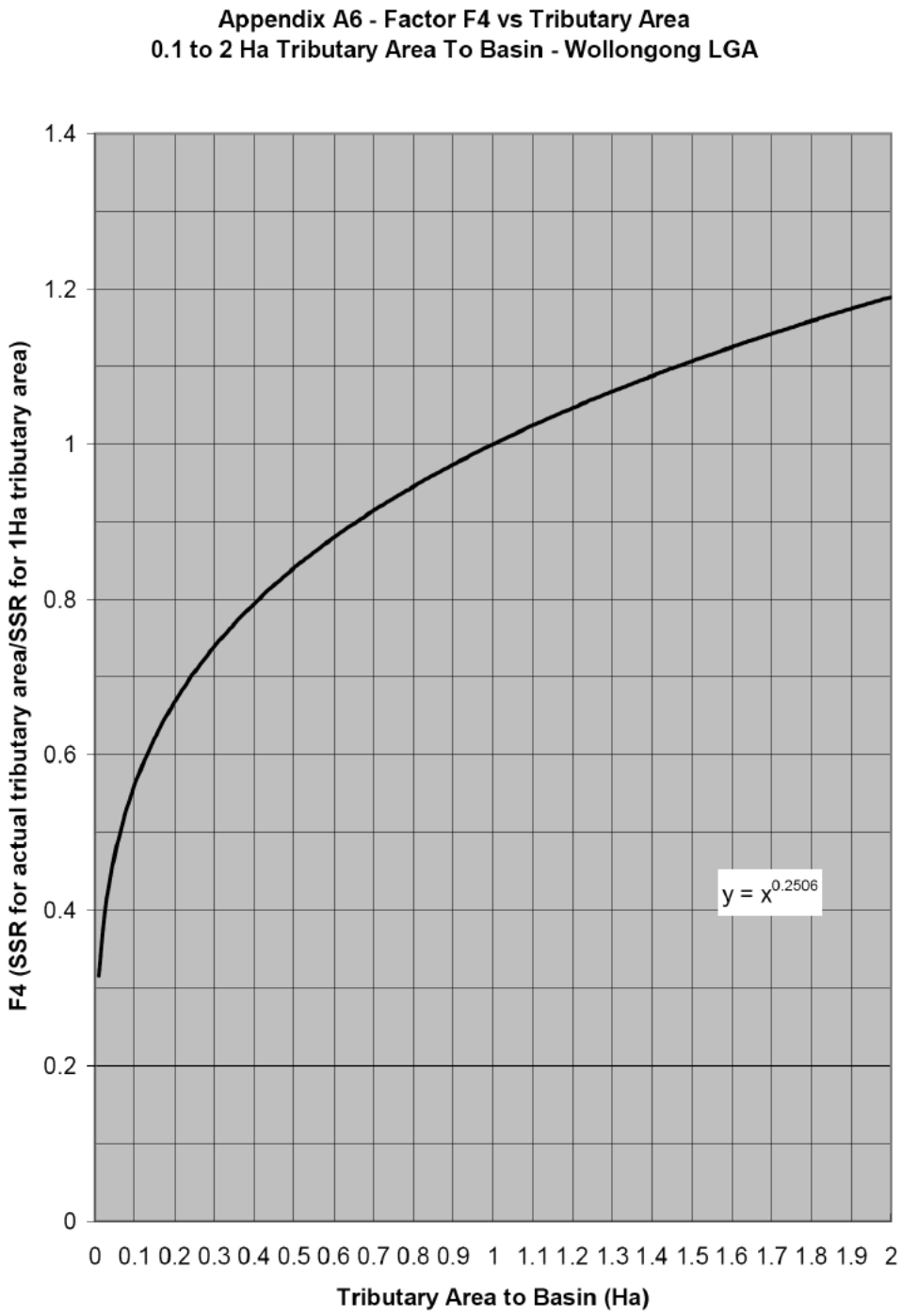
APPENDIX A4 F2 –v- Area



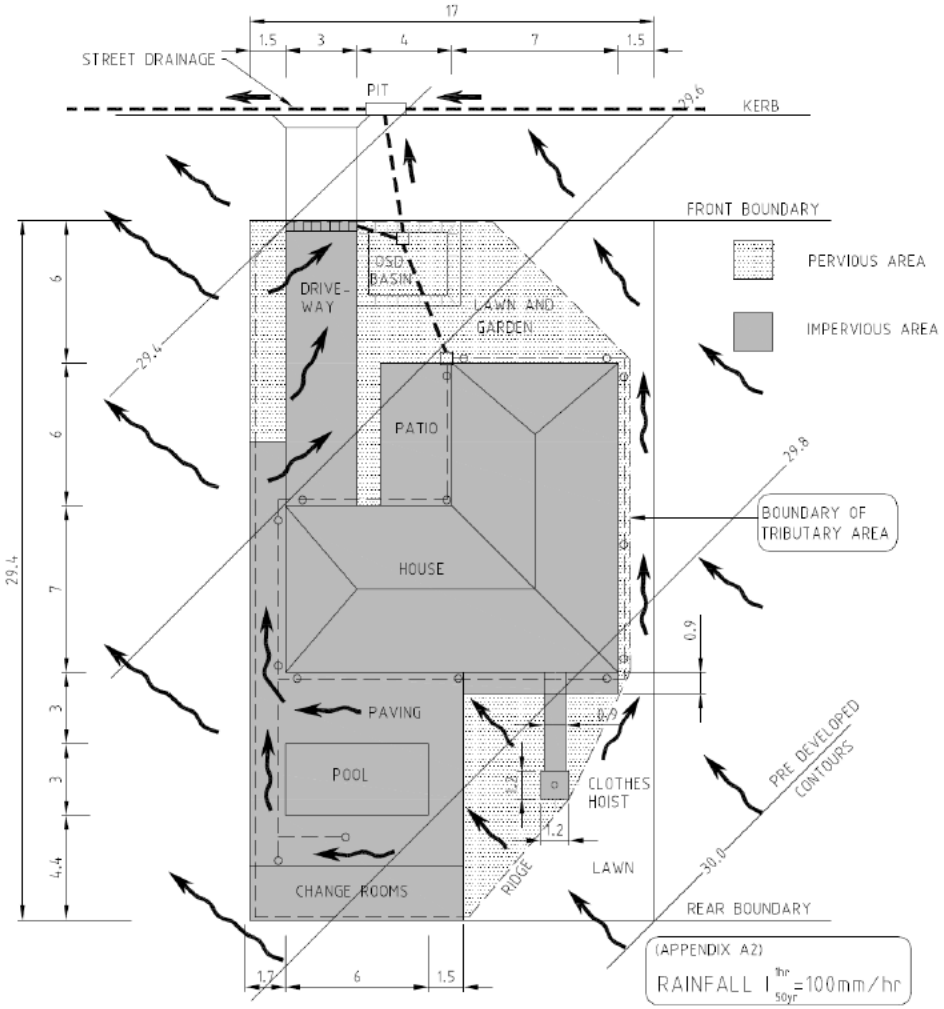
APPENDIX A5: F3 –v- %Imp



APPENDIX A6: F4 –v- Area



APPENDIX A7: Examples



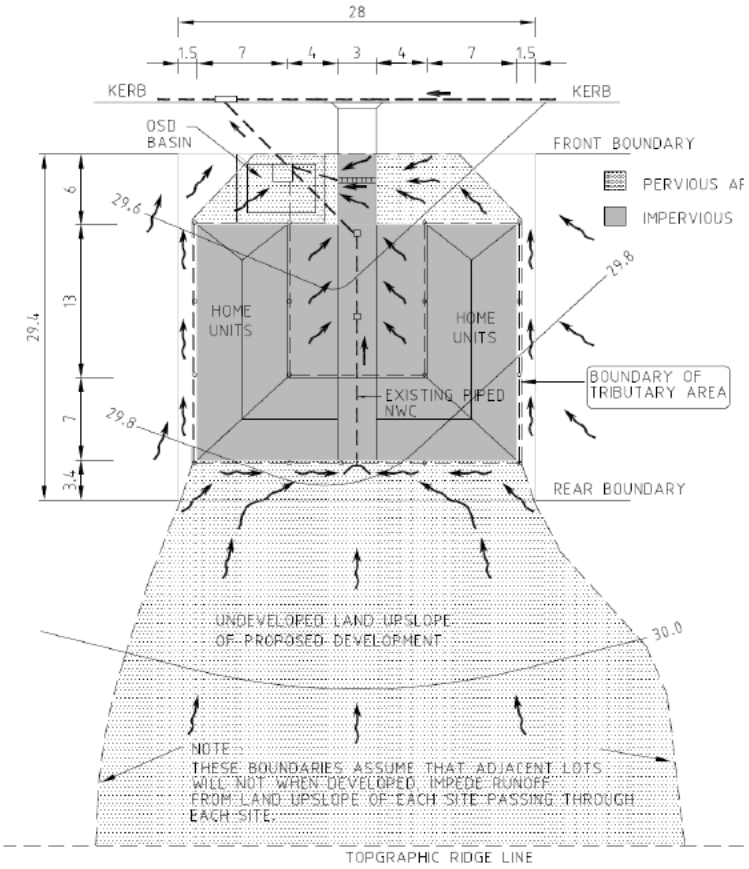
EXAMPLE 1 - NEW DWELLING ON UNDEVELOPED SITE
(TRIBUTARY AREA WITHIN SITE)

PLAN DATA	
SITE AREA (m^2)	500
TRIBUTARY AREA (m^2)	414
EX. IMPERVIOUS AREA (m^2)	0
DEV. IMPERVIOUS AREA (m^2)	316

NOTE : EXISTING CONDITION OF THE TRIBUTARY AREA IS 'NATURAL' (F1 = 1)

GRAPHS	
(APPENDIX A3) $F1_5$	1.00
(APPENDIX A3) $F1_{100}$	1.00
(APPENDIX A4) F2	1.12
(APPENDIX A5) F3	0.17
(APPENDIX A6) F4	0.45

OSD REQD		
PSD_5 (l/sec)	(1x1.12x2.67x(414/10,000)x100)	(EQ 1.4.4.1.)
	12.4	
PSD_{100} (l/sec)	(1x1.12x4.67x(414/10,000)x100)	(EQ 1.4.4.2.)
	21.7	
SSR_5 (m^3)	(0.17x0.45x2.25x12.4/1.12)	(EQ 1.4.4.3.)
	1.91	
SSR_{100} (m^3)	(0.17x0.45x2.25x21.7/1.12)	(EQ 1.4.4.4.)
	3.33	



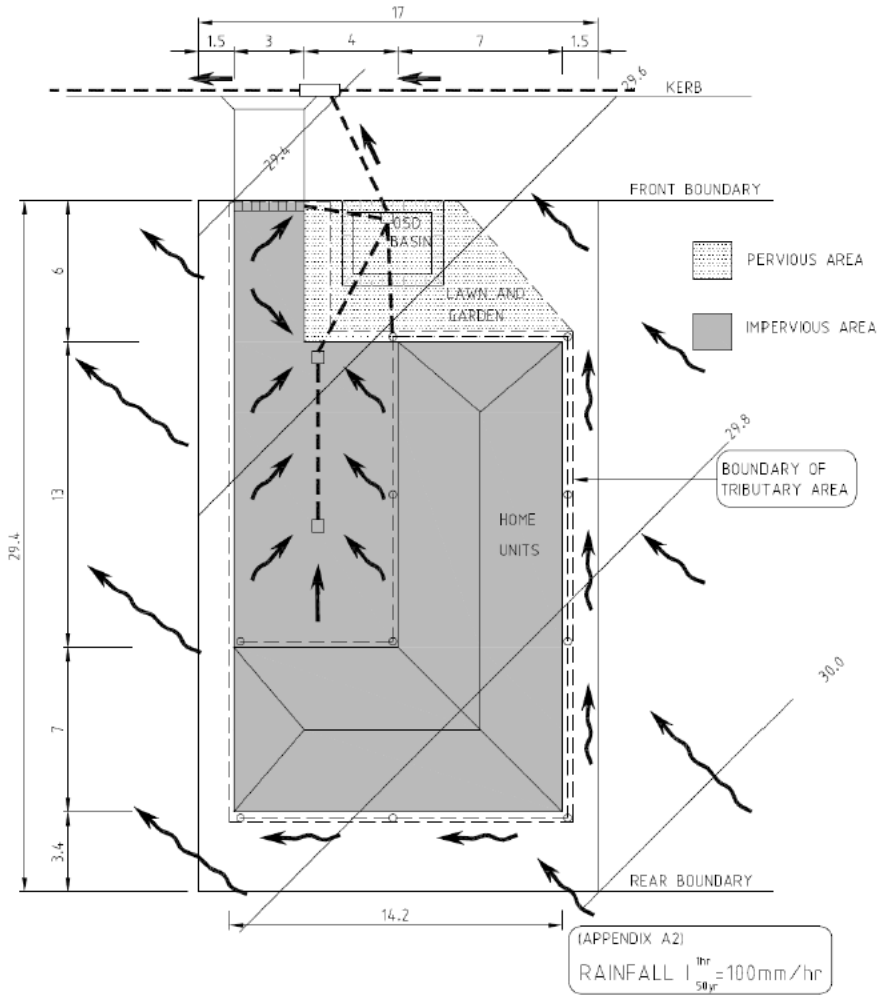
EXAMPLE 2 – NEW UNITS ON UNDEVELOPED SITE
(TRIBUTARY AREA BEYOND SITE)

PLAN DATA	
SITE AREA (m^2)	823
TRIBUTARY AREA (m^2)	1901
EX. IMPERVIOUS AREA (m^2)	0
DEV. IMPERVIOUS AREA (m^2)	518

NOTE : EXISTING CONDITION OF THE TRIBUTARY AREA IS 'NATURAL' (F1 = 1)

GRAPHS	
(APPENDIX A3) $F1_5$	1.00
(APPENDIX A3) $F1_{100}$	1.00
(APPENDIX A4) F2	1.10
(APPENDIX A5) F3	0.08
(APPENDIX A6) F4	0.66

OSD REQD		
(1x1.10x2.67x(1901/10,000)x100) PSD_5 (l/sec)	55.8	(EQ 1.4.4.1.)
(1x1.10x4.67x(1901/10,000)x100) PSD_{100} (l/sec)	97.7	(EQ 1.4.4.2.)
(0.08x0.66x2.25x55.8/1.10) SSR_5 (m^3)	6.03	(EQ 1.4.4.3.)
(0.08x0.66x2.25x97.7/1.10) SSR_{100} (m^3)	10.55	(EQ 1.4.4.4.)



EXAMPLE 3 (fig 1) - NEW UNITS ON PREVIOUSLY DEVELOPED SITE (TRIBUTARY AREA WITHIN SITE) (STEP 1)

PLAN DATA	
SITE AREA (m^2)	500
TRIBUTARY AREA (m^2)	372
EX. IMPERVIOUS AREA (m^2)	118 [1]
DEV. IMPERVIOUS AREA (m^2)	300

1. REFER FIG 1 FOR PROPOSED DEVELOPMENT TRIBUTARY AREA PLAN

GRAPHS	
(APPENDIX A3) $F1_5$	1.12
(APPENDIX A3) $F1_{100}$	1.09
(APPENDIX A4) F2	1.12
(APPENDIX A5) F3	0.17
(APPENDIX A6) F4	0.44

FINAL OSD REQD		
(1.12x1.12x2.67x(372/10,000)x100) PSD_5 (l/sec)	12.46	(EQ 1.4.4.1.)
(1.09x1.12x4.67x(372/10,000)x100) PSD_{100} (l/sec)	21.21	(EQ 1.4.4.2.)
(0.17x0.44x2.25x12.46/1.12) SSR_5 (m^3)	1.87	(EQ 1.4.4.3.)
(0.17x0.44x2.25x21.21/1.12) SSR_{100} (m^3)	3.19	(EQ 1.4.4.4.)
(1.87-0.88) SSR^*_5 (m^3)	0.99	
(3.19-1.55) SSR^*_{100} (m^3)	1.67	

NOTE : SSR^* REQUIRED IS EQUAL TO SSR FOR PROPOSED DEVELOPMENT LESS SSR FOR EXISTING DEVELOPMENT CALCULATED IN FIG 2.

EXAMPLE 4 - 17 LOT GREENFIELD SUBDIVISION (STAGE 3)
(TRIBUTARY AREA BEYOND SITE)

(APPENDIX A2)
RAINFALL I^{1hr}_{50yr}=100mm/hr

PLAN DATA	
SITE AREA (m^2)	13,290
TRIBUTARY AREA (m^2)	19,967
EX. IMPERVIOUS AREA (m^2)	0
DEV. IMPERVIOUS ROADS AREA (m^2) (2621@ 95%)	2,490
DEV. IMPERVIOUS LOTS AREA (m^2) (10,669@60%)	6,402
DEV. TOTAL IMPERVIOUS AREA (m^2)	8,892

GRAPHS	
(APPENDIX A3) $F1_5$	1.00
(APPENDIX A3) $F1_{100}$	1.00
(APPENDIX A4) F2	0.95
(APPENDIX A5) F3	0.12
(APPENDIX A6) F4	1.19

OSD REQD		
(1x0.95x2.67x(19,967/10,000)x100) PSD_5 (l/sec)	506	(EQ 1.4.4.1.)
(1x0.95x4.67x(19,967/10,000)x100) PSD_{100} (l/sec)	886	(EQ 1.4.4.2.)
(0.12x1.19x2.25x506/0.95) SSR_5 (m^3)	171	(EQ 1.4.4.3.)
(0.12x1.19x2.25x886/0.95) SSR_{100} (m^3)	300	(EQ 1.4.4.4.)

DETAILED DESIGN CHECKLIST

OSD DETAILED DESIGN CHECKLIST

NOTE This checklist is specific to the OSD requirements of a proposed development

It should be read in conjunction with Council's current Drainage Design Code

and included with the detail drainage design submission documents

ITEM	DESIGNER		COUNCIL REVIEW	
	YES	NO	YES	NO
1. A Stormwater Concept Plan (SCP) has been approved				
2. The site is within the OSD 'Concession' zone and flows can be conveyed to a 'registered' watercourse without adversely impacting others If YES - refer supporting calculations (OSD not required) If NO - OSD is required – (remainder of list to be completed)				
3. The site is (whole or partly) inundated in a 5 year ARI event If YES - see Plan No ..... for 5Yr flood extents				
4. The tributary area to the basin is shown on Plan No				
5. The tributary area to the basin is currently in a natural condition If NO – see Plan No ..... For details of existing development				
6. Surface floodways/flowpaths of sufficient capacity to contain and convey the 100Yr discharge to the basin are shown on Plan No				
7. Buildings are not inundated and have the required freeboard				
8. Flows are not increased or concentrated on an adjoining property				
9. Ground levels/contours extending into adjoining properties sufficiently to quantify bypass flow hydraulics are shown on Plan No.				
10. The invert level of the storage is not less than ground level (or top of kerb) at the point of connection to external stormwater system If YES, see Plan No. ..... If NO, refer attached hydraulic analysis confirming potential impact of downstream control				
11. The discharge outlet pit design is consistent with the policy principles				
12. The discharge outlet pit design is consistent with the policy. If YES, see Plan No ..... for details of: Orifice plate geometry, matl and fixing screen type, matl fixing, area and orientation, confirmation that all inflows to the discharge control pit are on the upstream side of the screen protecting the orifice If NO refer separate explanatory attachment.				
13. If an above ground/landscaped storage is specified, answer Q13(a) to Q13(g), otherwise move to Q14.				

ITEM	DESIGNER		COUNCIL REVIEW	
	YES	NO	YES	NO
13(a) Where the depth of ponding exceeds 600 mm, consideration has been given to whether there are steep drops, and/or a need for steps or 'walk-in' 'walk-out' batters, etc. when deciding if fencing and/or warning signs are required				
13(b) The landscaping treatment within the storage area is such that it does not limit storage volumes or provide a significant source of debris loading.				
13(c) The minimum surface slope is consistent with the policy				
13(d) Subsoil drainage is provided in areas subject to frequent ponding and around the outlet				
13(e) If the design includes a retaining wall, has it been structurally checked?				
13(f) Does the system have the correct storage? If YES, see stage-storage calculations attached If NO, refer separate explanatory attachment.				
14. If a driveway/car-park storage is specified, answer Q14(a) to Q14(b), otherwise move to Q15				
14(a) The maximum depth is less than or equal to 200mm				
14(b) The minimum transverse slope is 1.5%				
15. If a structural/underground storage is specified, answer Q 15(a) to Q 15(f), otherwise move to Q16				
15(a) The dimensions of openings are consistent with the policy				
15(b) The storage floor has a minimum slope of 0.7%				
15(c) There are sufficient access points for flushing purposes				
15(d) There are sufficient grated openings for ventilation purposes				
15(e) All access points have light weight covers				
16. The distribution of storage minimises inconvenience				
17. The OSD plans have been checked for consistency against the architectural and landscaping plans				
18 The OSD Design Summary details are consistent with the engineering plans				
19. The OSD Design Summary & Plans are consistent with the approved SCP				
20 The OSD Design Summary is attached				
21. A maintenance schedule has been prepared				

Name of Designers Organisation ……

Signature of Authorised Designer …… …../…../……

Signature of Reviewing Officer …… …./…../…..

TECHNICAL DATA – MESH SCREENS

Technical Data – Mesh Screens

Discharge outlet pits must be fitted with an internal screen. The screen needs to:

(a) Protect the orifice from blockage

(b) Create static conditions around the orifice which helps to achieve predictable discharge coefficients

(c) Retain litter and debris which would degrade downstream waterways.

i.Screen type

A small aperture-expanded steel mesh, such as Maximesh Rh3030, is recommended for orifices less than 150 mm in diameter. This type of screen retains relatively fine material

(e.g. cigarette butts and grass clippings) while maintaining the performance of the orifice under heavy debris loading. For orifices larger than 150 mm, the screen area necessary for a fine mesh screen can make it difficult to fit in a discharge outlet pits. A grid mesh, such as Weldlok F40/203, may be used for these larger orifices. Where the grid mesh is used, a fine mesh screen should be installed upstream of the discharge outlet pits, for areas likely to collect litter or debris.

ii.Screen area

The minimum recommended area (including blocked area) for an internal screen in a discharge outlet pits is:

(a) 50 times the orifice area where a fine mesh screen is used (egg. Maximesh Rh3030)

(b) 20 times the orifice area where a grid mesh is used (e.g. Weldlok F40/203).

iii.Screen orientation

The inlet pipe to a discharge outlet pits should direct inflows parallel (or at a small angle) to the screen. Perpendicular inflows drive debris into a mesh screen making it difficult to dislodge.

When inflows are directed parallel to the screen, the debris is layered on the screen but is blown off when the inflow exceeds approximately 2-3 times the PSD. The performance of the orifice and screen is influenced by the orientation of the screen. To assist in shedding debris, the screen should be positioned as close to vertical as possible. This allows debris to fall off once the water level in the discharge outlet pits drops. However, the screen must fit securely to the pit to avoid debris floating over or around the screen and blocking the orifice. The screen should be placed no less than 60 degrees to the horizontal.

iv.General

To prevent blockages, Maximesh screens must be positioned so that the long axis of the oval shaped holes is horizontal, the protruding lip is uppermost and above the hole and the screen is tilted downstream (See Figure 5). Blockages can occur if the screen is accidentally placed upside down. Fitting a handle to the screen not only reduces the chance of incorrect placement but also makes removal for cleaning easier. Fixings need to be selected to suit the screen and to promote easy removal for maintenance. Reducing the screen size also facilitates cleaning by reducing the weight. Proprietary screens may be considered to achieve this end. After being cut to size, Maximesh screens need to be 'hot dipped' galvanised to prevent corrosion. All mesh screens deflect under high inflows and heavy debris loading and should be braced to stop debris being carried around the screen.

MAXI-MESH
RH3030

Figure 5: Maximesh Screen

(Source: UPRCT OSD Design Handbook)

SAMPLE MAINTENANCE SCHEDULE

DRAFT MAINTENANCE SCHEDULE **(for guidance only)**			
MAINTENANCE ACTION	**FREQUENCY**	**PERFORMED BY**	**PROCEDURE**
Inspect & remove any blockage of orifice	Six monthly	Owner	Remove grate & screen to inspect orifice. See plan for location of discharge outlet pit.
Inspect screen and clean	Six monthly	Owner	Remove grate and screen if required to clean it.
Inspect flap valve & remove any blockage	Six monthly	Owner	Remove grate. Ensure flap valve moves freely and remove any blockages or debris.
Inspect pit sump & remove any sediment/sludge	Six monthly	Owner	Remove grate and screen. Remove sediment/sludge build-up and check orifice and flap valve clear.
Inspect grate for damage or blockage	Six monthly	Owner	Check both sides of grate for corrosion, (especially corners and welds) damage or blockage.
Inspect & remove any debris/litter/mulch etc blocking grates of return pit	Six monthly	Owner	Remove blockages from grate and check if pit blocked.
Inspect storage areas & remove debris/mulch/litter etc likely to block screens/grates	Six monthly	Owner	Remove debris and floatable material likely to be carried to grates.
Check attachment of orifice plate to wall of pit (gaps less than 5 mm)	Annually	Maintenance Contractor	Remove grate and screen. Ensure plate mounted securely, tighten fixings if required. Seal gaps as required.
Check orifice diameter correct and retains sharp edge	Five yearly	Maintenance Contractor	Compare diameter to design (see Work-as-Executed) and ensure edge is not pitted or damaged.
Check attachment of screen to wall of pit	Annually	Maintenance Contractor	Remove grate and screen. Ensure screen fixings secure. Repair as required.
Check screen for corrosion	Annually	Maintenance Contractor	Remove grate and examine screen for rust or corrosion, especially at corners or welds.

Inspect overflow weir & remove any blockage	Six monthly	Maintenance Contractor	Remove grate and open cover to ventilate underground storage if present. Ensure weir clear of blockages.
Empty basket at overflow weir (if present)	Six monthly	Maintenance Contractor	Remove grate and ventilate underground storage chamber if present. Empty basket, check fixings secure and not corroded.
Inspect pit walls (internal and external, if appropriate) for cracks or spalling	Annually	Maintenance Contractor	Remove grate to inspect internal walls. Repair as required. Clear vegetation from external walls if necessary and repair as required.
Inspect outlet pipe & remove any blockage	Six monthly	Maintenance Contractor	Remove grate and screen. Ventilate underground storage if present. Check orifice and remove any blockages in outlet pipe. Flush outlet pipe to confirm it drains freely. Check for sludge/debris on upstream side of return line (if relevant).
Check step irons for corrosion	Annually	Maintenance Contractor	Remove grate. Examine step irons and repair any corrosion or damage.
Check fixing of step irons is secure	Six monthly	Maintenance Contractor	Remove grate and ensure fixings secure prior to placing weight on step iron.
Inspect internal walls of return pit (and external, if appropriate) for cracks or spalling	Annually	Maintenance Contractor	Remove grate to inspect internal walls. Repair as required. Clear vegetation from external walls if necessary and repair as required.
Compare storage volume to volume approved. (Rectify if loss > 5%)	Annually	Maintenance Contractor	Compare actual storage available with Work-as Executed plans. If volume loss is greater than 5%, arrange for reconstruction to replace the volume lost. Council to be notified of the proposal.
Inspect storages for subsidence near pits	Annually	Maintenance Contractor	Check along drainage lines and at pits for subsidence likely to indicate leakages.

CERTIFICATE OF HYDRAULIC COMPLIANCE &

OUTSTANDING WORKS FORM

FORM X.XX

WOLLONGONG CITY COUNCIL

ON-SITE STORMWATER DETENTION SYSTEM

CERTIFICATE OF HYDRAULIC COMPLIANCE

JOB NO: _____ DA NO: _____

PROJECT:
_____

LOCATION:
_____

CONSTRUCTION

DESIGNED BY: _____ CERTIFIED BY:_____

QUALIFICATIONS: _____ TELEPHONE: _____

1.0 WORKS CONSTRUCTED IN ACCORDANCE WITH DESIGN. (Delete if not applicable)

I _____ of _____ (accredited professional being competent to practice in the field of stormwater drainage design) have inspected the above on-site stormwater detention system and certify that the works have been constructed in accordance with the approved design details for the above mentioned project.

Signature: _____ Date: _____

2.0 CONSTRUCTION VARIATIONS NOT AFFECTING DESIGN PERFORMANCE. (Delete if not applicable)

I _____ of _____ (accredited professional being competent to practice in the field of stormwater drainage design) have inspected the above on-site stormwater detention system and certify that the works have been constructed in accordance with the approved design details for the above mentioned project, except for the variations listed below which do not affect the performance of the system, subject to satisfactory maintenance.

Variations:

_____

_____

_____

Signature: _____ **Date:** _____

3.0 AUTHORITY TO RELEASE PLANS TO FUTURE OWNERS OF THE PROPERTY

As the copyright owner of the drainage plans, I hereby authorise release of the approved plans/attached sketch plan to future owners of the property to assist in the maintenance of the On-site Stormwater Detention system.

Signature: _____ **Date:** _____

Name: _____(Print)

FORM X.XX

WOLLONGONG CITY COUNCIL

ON-SITE STORMWATER DETENTION SYSTEM

LIST OF OUTSTANDING WORKS

JOB NO: _____ DA NO: _____

PROJECT:

_____

LOCATION:

_____

CONSTRUCTION

DESIGNED BY: _____ CERTIFIED BY: _____

QUALIFICATIONS: _____ TELEPHONE: _____

1.0 CONSTRUCTION VARIATIONS AFFECTING DESIGN PERFORMANCE.

I _____ of _____ (accredited professional being competent to practice in the field of stormwater drainage design) have inspected the above on-site stormwater detention system and the following variations to the approved design. The listed remedial works will be necessary to make the system function according to the approved design.

Signature: _____ **Date:** _____

LEGAL PROTECTION OF OSD SYSTEMS

F.1 Explanatory notes on the preparation and registration of Restrictions on Use of Land and Positive Covenants

Private developers within the area administered by Wollongong City Council are required to construct On-site Stormwater Detention (OSD) facilities as part of their development consent in accordance with Section 10 of this DCP.

OSD systems consist of a storage area, an outlet and a collection network. The collection network directs stormwater flow to the storage. The collection network includes those surfaces which are sloped so as to direct flow to the storage, as well as the more obvious devices such as roof gutters, downpipes, drainage lines and pits. In effect, the whole lot is part of the OSD system.

All the components of an OSD system need to be kept intact and maintained so that the overall system continues to function as it was intended for the life of the development. To ensure that the OSD system is not altered during the life of the development, a Restriction on Use of the land is created. This prevents owners making changes to any of the site drainage components which would alter the way the facility works, without the permission of their local council. To ensure that the OSD system is adequately maintained, a Positive Covenant is registered on the title of the property, placing the responsibility for this maintenance on the owner of the land. By registering the covenant and restriction on the property title, the obligations can be transferred to future owners. The Positive Covenant will be established to benefit the local Council.

A sketch plan showing the location of the different components of the OSD system and a copy of the Maintenance Schedule must be included as attachments to the Positive Covenant. This will ensure future owners are aware of their maintenance obligation.

If no new lot is being created, the cheapest and quickest way to register the Positive Covenant and Restriction on Use on the title of Torrens Title land is through:

Form 13PC for a Positive Covenant, and

Form 13RPA for a Restriction on Use.

For Old System land the covenant and restriction should be imposed with a suitable deed.

A copy of forms 13PC and 13RPA is included in Appendix F.2.

The covenant and restriction on use may also be imposed under Section 88B of the Conveyancing Act, 1919 in conjunction with the creation of a new lot or lots. The Positive Covenant will be in favour of the local council but, because the land is privately owned, the covenant and restriction will be imposed through Section 88E of the Act.

A copy of Information Bulletin No 14, prepared by the Land Titles Office (LTO), *A Guide to the Preparation of a Section 88B Instrument to:*

· *Create Easements, Profits à Prendre, Restrictions on the Use of Land or Positive Covenants*

· *Release Easements or Profits à Prendre*

is included below.

The terms and conditions of the covenant and restriction must be shown in part 2 of the Section 88B Instrument or be attached to the forms 13PC and 13RPA. A copy of suitable wording for the terms and conditions is below. The local Council has the right to release, vary or modify the terms and conditions of the covenant and restriction.

F.2 Blank Copy of Forms 13RPA AND 13PC

These forms for a Restriction on Use of Land and Positive Covenant are required by the Lands Titles Office where there is no subdivision of land, and the covenant and restriction are being imposed on an existing parcel of land.

A plan should be attached showing the location and various components of the On-site Stormwater Detention system. This should be accompanied by the Maintenance Schedule. (See Appendix D)

Form: 13RPA
Licence: 98M111
Edition: 9906

RESTRICTION ON THE USE OF LAND BY A PRESCRIBED AUTHORITY

New South Wales

Section 88E(3) Conveyancing Act 1919

Land Titles Office use only

Do not affix additional pages here: use the left-hand corner

(A) **TORRENS TITLE**

(B) **LODGED BY**

LTO Box	Name, Address or DX and Telephone	CODE
	Reference (optional):	R

(C) **REGISTERED PROPRIETOR**

Of the above land

(D) **LESSEE MORTGAGEE or CHARGEE**

Of the above land agreeing to be bound by this restriction on land

Nature of Interest	Number of Instrument	Name

(E) **APPLICANT**

A prescribed authority

The applicant, being a prescribed authority within the meaning of section 88E(1) of the Conveyancing Act 1919, imposes on the above

(F) land a restriction on the use of land in the terms set out in annexure hereto, applies to have it recorded in the Register and

(G) certifies this application correct for the purposes of the Real Property Act 1900. **DATE:**

Signed in my presence by the an **authorised officer of the prescribed authority** who is personally known to me.

Signature of witness: Signature of authorised officer:

Name of witness: Name of authorised officer:

Address of witness: Position of authorised officer:

Signed in my presence by the **registered proprietor of the land** who is personally known to me.

Signature of witness: Signature of registered proprietor:

Name of witness:

Address of witness:

(H) I, the **lessee/mortgagee/chargee** under lease/mortgage/charge No. , agree to be bound by this restriction.

Signed in my presence by the above lessee/mortgagee/chargee who is personally known to me.

Signature of witness: Signature of lessee/mortgagee/chargee:

Name of witness:

Address of witness:

All handwriting must be in block capitals.
A set of notes on this form (13RPA-2)
is available from the Land Titles Office.

Page 1 of _____

Checked by (LTO use):

13RPA-2 (9909)

Restriction on the Use of Land by a Prescribed Authority form 13RPA: Instructions for Completion

Note: This form is to be used only where the restriction is imposed by a prescribed authority on land in private ownership.

1. Complete the form in dense black or dark blue ink. If handwriting, use block capitals only.
2. Do not use an eraser or correction fluid to make alterations: rule through rejected material and initial the left-hand margin.
3. If the space provided at any point is insufficient, insert "See Annexure" at that point and include the required material on sheets of white A4 paper at least 80gsm (ordinary copier paper satisfies these requirements) using one side only. Insert a heading beginning "Annexure to …" and specifying the type of form, the date and the parties to the transaction. Identify the material included, where possible by referring to the relevant marginal heading on the form. In the case of signatures which could not be fitted in the space provided, reproduce the text and layout used on the form. Number all pages in sequence with the form using the format "Page … of …", the number to be placed at the foot of the form in the centre. The first and last pages must be signed by the parties and any witness. Securely attach the additional pages to the upper left-hand corner of the form: a Nalclip is preferred; stapling should be avoided.
4. Insert the total number of pages, including any additional pages (see above), in the space provided at the foot of the form.
5. Lodge the completed form by hand at the Land Titles Office, Queens Square, Sydney (adjacent to Hyde Park Barracks). Lodgment of the certificate of title is optional.
6. The following instructions relate to the marginal letters on the form.

(A) TORRENS TITLE
Insert the number of the folio of the Register for the property affected. If the restriction affects only part of the land, add a description of the part, for example, "… part formerly comprised in Lot 1 in DP123456".

(B) LODGED BY
This section must be completed by the person or firm lodging the form at the Land Titles Office. If the party lodging does not have a Land Titles Office delivery box, leave this panel blank. Provision of a reference is optional.

(C) REGISTERED PROPRIETOR
Insert the full name of the registered proprietor of the land subject to the restriction. Address and occupation are not required.

(D) LESSEE, MORTGAGEE or CHARGEE
Insert the details of any lessee, mortgagee or chargee who agrees to be bound by the restriction.

(E) APPLICANT
The applicant must be a prescribed authority within the meaning of section 88E(1) of the Conveyancing Act 1919.

(F) Specify the annexure containing the terms of the restriction.

(G) EXECUTION
The completed form must be executed by an authorised officer of the prescribed authority, and by or on behalf of the registered proprietor of the land and any lessee, mortgagee or chargee who agrees to be bound by the restriction. Any witness must be an adult who is not a party to the application and knows the person executing. Where the form is executed—
By an individual on his/her own behalf The signature must be witnessed.
By an attorney The power of attorney must be registered at the Land Titles Office. In addition to the attorney's signature, a statement in the following format must be added: "John Smith by his attorney Jane Smith pursuant to power of attorney Book 1234 No. 567". The signature must be witnessed.
By a receiver or delegate Use the format given in "By an attorney" suitably modified. The signature must be witnessed.
By a corporation The form of execution must include reference to the power or authority relied on by the signatories, for example, "Executed by ABC Pty Ltd ACN 123456 by a director and secretary".
Note The application may not be executed by a solicitor or licensed conveyancer on behalf of the registered proprietor of the land or any lessee, mortgagee or chargee who agrees to be bound by the restriction.

(H) Rule through the inapplicable words and insert the number of the relevant instrument. If this section of the form does not apply rule it through.

If you have any questions, please call Land Titles Office Client Services on 02 9228 6713.

Form: 13PC
Licence: 98M111
Edition: 9909

POSITIVE COVENANT

New South Wales
Section 88E(3) Conveyancing Act 1919

Land Titles Office use only
Do not affix additional pages here: use the left-hand corner

(A) **TORRENS TITLE**

(B) **LODGED BY**

LTO Box	Name, Address or DX and Telephone	CODE
	Reference (optional):	PC

(C) **REGISTERED PROPRIETOR**

Of the above land

(D) **LESSEE MORTGAGEE or CHARGEE**

Of the above land agreeing to be bound by this positive covenant

Nature of Interest	Number of Instrument	Name

(E) **APPLICANT**

A prescribed authority

The applicant, being a prescribed authority within the meaning of section 88E(1) of the Conveyancing Act 1919, imposes on the
(F) above land a positive covenant in the terms set out in annexure hereto, applies to have it recorded in the Register and
(G) certifies this application correct for the purposes of the Real Property Act 1900. **DATE:**

Signed in my presence by the **authorised officer of the prescribed authority** who is personally known to me.

Signature of witness: Signature of authorised officer:

Name of witness: Name of authorised officer:

Address of witness: Position of authorised officer:

Signed in my presence by the **registered proprietor of the land** who is personally known to me.

Signature of witness: Signature of registered proprietor:

Name of witness:

Address of witness:

(H) I, the **lessee/mortgagee/chargee** under lease/mortgage/charge No. , agree to be bound by this positive covenant.

Signed in my presence by the above lessee/mortgagee/chargee who is personally known to me.

Signature of witness: Signature of lessee/mortgagee/chargee:

Name of witness:

Address of witness:

All handwriting must be in block capitals.
A set of notes on this form (13PC-2) is available from the Land Titles Office.

Page 1 of ____

Checked by (LTO use):

13PC-2 (9909)

Positive Covenant form 13PC: Instructions for Completion

1. Complete the form in dense black or dark blue ink. If handwriting, use block capitals only.
2. Do not use an eraser or correction fluid to make alterations: rule through rejected material and initial the left-hand margin.
3. If the space provided at any point is insufficient, insert "See Annexure" at that point and include the required material on sheets of white A4 paper at least 80gsm (ordinary copier paper satisfies these requirements) using one side only. Insert a heading beginning "Annexure to ..." and specifying the type of form, the date and the parties to the transaction. Identify the material included, where possible by referring to the relevant marginal heading on the form. In the case of signatures which could not be fitted in the space provided, reproduce the text and layout used on the form. Number all pages in sequence with the form using the format "Page ... of ...", the number to be placed at the foot of the form in the centre. The first and last pages must be signed by the parties and any witness. Securely attach the additional pages to the upper left-hand corner of the form: a Nalclip is preferred; stapling should be avoided.
4. Insert the total number of pages, including any additional pages (see above), in the space provided at the foot of the form.
5. Lodge the completed form by hand at the Land Titles Office, Queens Square, Sydney (adjacent to Hyde Park Barracks). Lodgment of the certificate of title is optional.
6. The following instructions relate to the marginal letters on the form.

(A) TORRENS TITLE
Insert the number of the folio of the Register for the property affected. If the positive covenant affects only part of the land, add a description of the part, for example, "... part formerly comprised in Lot 1 in DP123456".

(B) LODGED BY
This section must be completed by the person or firm lodging the form at the Land Titles Office. If the party lodging does not have a Land Titles Office delivery box, leave this panel blank. Provision of a reference is optional.

(C) REGISTERED PROPRIETOR
Insert the full name of the registered proprietor of the land subject to the positive covenant. Address and occupation are not required.

(D) LESSEE, MORTGAGEE or CHARGEE
Insert the details of any lessee, mortgagee or chargee who agrees to be bound by the positive covenant.

(E) APPLICANT
The applicant must be a prescribed authority within the meaning of section 88E(1) of the Conveyancing Act 1919.

(F) Specify the annexure containing the terms of the positive covenant.

(G) EXECUTION
The completed form must be executed by an authorised officer of the prescribed authority, and by or on behalf of the registered proprietor of the land and any lessee, mortgagee or chargee who agrees to be bound by the positive covenant. Any witness must be an adult who is not a party to the application and knows the person executing. Where the form is executed—
By an individual on his/her own behalf The signature must be witnessed.
By an attorney The power of attorney must be registered at the Land Titles Office. In addition to the attorney's signature, a statement in the following format must be added: "John Smith by his attorney Jane Smith pursuant to power of attorney Book 1234 No. 567". The signature must be witnessed.
By a receiver or delegate Use the format given in "By an attorney" suitably modified. The signature must be witnessed.
By of a corporation The form of execution must include reference to the power or authority relied on by the signatories, for example, "Executed by ABC Pty Ltd ACN 123456 by a director and secretary".
Note The application may not be executed by a solicitor or licensed conveyancer on behalf of the registered proprietor of the land or any lessee, mortgagee or chargee who agrees to be bound by the positive covenant.

(H) Rule through the inapplicable words and insert the number of the relevant instrument. If this section of the form does not apply rule it through.

If you have any questions, please call Land Titles Office Client Services on 02 9228 6713.

B.4-2

F.3 Terms and Conditions for Restriction on Use of Land and Positive Covenant

This appendix contains standard clauses for the Terms and Conditions to be applied in Restrictions on Use of Land and or Positive Covenants in relation to OSD systems. Appendix F.4 contains a sample instrument which shows how these terms and conditions are applied.

Both the Restriction on Use and the Positive Covenant will normally be required, however in cases where only the Positive Covenant is used, the definition of the OSD system (given in clause 1 of the Restriction on Use) should be included in the Positive Covenant.

Restrictions on Use of Land for OSD Systems

1. The registered proprietor of the lot burdened must not make or permit or suffer the making of any alterations to any on-site stormwater detention system on the lot(s) burdened without the prior consent in writing of the authority benefited. . The expression "on-site stormwater detention system" shall include all ancillary gutters, pipes, drains, walls, kerbs, pits, grates, tanks, chambers, basins and surfaces designed to temporarily detain stormwater as well as all surfaces graded to direct stormwater to those structures.

   Name of authority having the power to release, vary or modify the restriction referred to is Wollongong City Council.

2. The registered proprietor of the lot burdened must not erect or permit the erection of or permit to remain any dwelling house or other structure on the lot burdened unless the registered proprietor has constructed an on site stormwater detention system on the said lot burdened, in accordance with the requirements of Wollongong City Council. The expression "on-site stormwater detention system" shall include all ancillary gutters, pipes, drains, walls, kerbs, pits, grates, tanks, chambers, basins and surfaces designed to temporarily detain stormwater as well as all surfaces graded to direct stormwater to those structures.

   Note: Clause 2 is only necessary when construction of the OSD system is being deferred, which will only be permitted by Council in exceptional circumstances.

Positive Covenants

1. The registered proprietor of the lot burdened must in respect of the on site stormwater detention system on the lot burdened:
   (a) keep the system clean and free from silt, rubbish and debris
   (b) maintain and repair the system so that it functions in a safe and efficient manner
   (c) permit the prescribed authority or its authorised agents from time to time and upon giving reasonable notice (but at any time and without notice in the case of an emergency) to enter and inspect the land for the compliance with the requirements of this covenant; and
   (d) comply with the terms of any written notice issued by the prescribed authority in respect of the requirements of this covenant.
2. Under Section 88F(3) of the Conveyancing Act 1919 the Prescribed authority has the following additional powers:
   (a) If the registered proprietor fails to comply with the terms of any written notice issued by prescribed authority under part 1(d) above the prescribed authority may enter the land with all necessary materials and equipment and carry out any work which the prescribed authority in its discretion considers necessary to comply with that notice .
   (b) the prescribed authority may recover from the registered proprietor of the burdened lot in any court of competent jurisdiction:
      (i) any expense reasonably incurred by it in exercising its powers under part 2(a) above including reasonable wages for the prescribed authorities employees engaged in carrying out and supervising and administering the work and the costs of materials, machinery, tools and equipment used to carry out the work.

      (ii) legal costs on an indemnity basis for issue of the notices for recovery of the costs and expenses for registration of a covenant charge under section 88F of the Act for providing any certificate required under section 88G of the Act and for obtaining any injunction under section 88H of the Act.

Name of authority having the power to release vary or modify the positive covenant

referred to is Wollongong City Council.

F.4 Sample Restriction on Use of Land and Covenant where a Deposited Plan is being registered together with a Section 88B instrument.

In this case the On-Site Detention system is provided with Development Approval involving subdivision of land.

A Plan of the OSD system and a copy of the Maintenance Schedule should be attached to the Instrument.

INSTRUMENT SETTING OUT TERMS OF RESTRICTION ON THE USE OF LAND AND POSITIVE COVENANT INTENDED TO BE CREATED PURSUANT TO SECTION 88E OF THE CONVEYANCING ACT 1919.

(Sheet .. of ... sheets)

Plan: Subdivision of Lot .....D.P.....

Covered by Council Clerk's

Certificate No. .....

Of .....

Full name and address

.....

Of proprietor of the land

.....

.....

...

PART 1

( ) Identity of restriction..... Restriction on use under Section 88E of the Conveyancing Act 1919 referred to in abovementioned plan

SCHEDULE OF LOT(S), ETC. AFFECTED

Lot(s) Burdened	Authority Benefited
.....	*Insert name of Council*

( ) Identity of Positive Covenant referred to in above-mentioned plan — Positive Covenant under Section 88E of the Conveyancing Act 1919

SCHEDULE OF LOT(S), ETC. AFFECTED

Lot(s) Burdened	Authority Benefited
.....	*Insert name of Council*

PART 2

TERMS OF RESTRICTION ON USE ..... REFERRED TO IN THE ABOVE-MENTIONED PLAN

The registered proprietor shall not make or permit or suffer the making of any alterations to the on-site stormwater detention system which is constructed on the lot(s) burdened without the prior consent in writing of .....(*Insert name of Council*). The expression "on-site stormwater detention system" shall include all ancillary gutters, pipes, drains, walls, kerbs, pits, grates, tanks, chambers, basins and surfaces designed to temporarily detain stormwater as well as all surfaces graded to direct stormwater to the temporary storage. Any on-site stormwater detention system constructed on the lot(s) burdened is hereafter referred to as "the system".

Name of Authority having the power to release, vary or modify the Restriction ..... referred to is .....(*Insert name of Council*).

TERMS OF POSITIVE COVENANT ……..……REFERRED TO IN THE ABOVE-MENTIONED PLAN

1. The registered proprietor of the lot(s) hereby burdened will in respect of the system:
   (a) keep the system clean and free from silt, rubbish and debris
   (b) maintain and repair at the sole expense of the registered proprietors the whole of the system so that if functions in a safe and efficient manner
   (c) permit the Council or its authorised agents from time to time and upon giving reasonable notice (but at any time and without notice in the case of an emergency) to enter and inspect the land for the compliance with the requirements of this covenant
   (d) comply with the terms of any written notice issued by the Council in respect of the requirements of this covenant within the time stated in the notice.

2. Pursuant to Section 88F(3) of the Conveyancing Act 1919 the Council shall have the following additional powers:
   (i) in the event that the registered proprietor fails to comply with the terms of any written notice issued by the Council as set out above the Council or its authorised agents may enter the land with all necessary materials and equipment and carry out any work which the Council in its discretion considers reasonable to comply with the said notice referred to in part 1(d) above

   (ii) The Council may recover from the registered proprietor in a Court of competent jurisdiction:

   (a) any expense reasonably incurred by it in exercising its powers under subparagraph (i) hereof. Such expense shall include reasonable wages for the Council's employees engaged in effecting the work referred to in (i) above, supervising and administering the said work together with costs, reasonably estimated by the Council, for the use of materials, machinery, tools and equipment in conjunction with the said work.

   (b) legal costs on an indemnity basis for issue of the said notices and recovery of the said costs and expenses together with the costs and expenses of registration of a covenant charge pursuant to section 88F of the Act or providing any certificate required pursuant to section 88G of the Act or obtaining any injunction pursuant to section 88H of the Act.

Name of Authority having the power to release vary or modify the Positive Covenant

…….. referred to is ……(*Insert name of Council*).

F.5 Land Titles Office Information Bulletin September 1998 Number: 14

A Guide to the preparation of a Section 88B Instrument to:

· Create Easements, Profits à Prendre, Restrictions on the Use of Land or Positive Covenants

· Release Easements or Profits à Prendre

Note: This bulletin should be read in conjunction with the following:

· **Information Bulletin No. 43** - 'Creating an Easement over a Track in Use'

· **Information Bulletin No. 56** - 'Property Legislation (Easements) Amendment Act 1995.'

1. Introduction:

A Section 88B Instrument is the part of a deposited plan which upon registration

- ❖ creates Easements, Profit à Prendre, Restrictions on the Use of Land, and Positive Covenants [clause 27 Conveyancing (General) Regulation 1998]
- ❖ releases Easements and Profits à Prendre [clause 28 Conveyancing (General) Regulation 1998]

Note: Restrictions on the use of land and Positive Covenants cannot be varied or released by a Section 88B instrument. The Instrument must be drawn in accordance with Approved Form 10 **(Annexures 2 and 3)**.

The original instrument must be lodged as part of the plan. Stamp Duty is not payable.

Identification of easements:

Easements must be identified on the face of the plan using 'alpha' symbols. A specimen plan is attached as **Annexure 1.**

It is necessary to identify easements with the same expression:

(a) In the statements of intention panel on the plan

(b) In the Section 88B Instrument and

(c) On the face of the plan

Note: Where a Section 88B Instrument, includes height limitations to define the stratum of an easement, profit à prendre, restriction or positive covenant, the accompanying deposited plan must comply with clause 47 of the Surveyors (Practice) Regulation 1996.

2. Preparation of a Section 88B Instrument:

A Section 88B instrument comprises three parts:

Part 1: Identifies each easement, profit à prendre, restriction or positive covenant to be created.

Part 1A: Identifies each easement or profit à prendre to be released.

Examples of the Schedules of lots burdened and benefited in Parts 1 and 1A are shown in **Annexure 4**

Part 2: Sets out the terms and conditions of easements profits à prendre, restrictions or positive covenants referred to in Part 1). Part 2 may not be required see **Para.3.1**

3. Creating easements:

Easements may be created with or without terms and conditions shown in Part 2 of the section 88B instrument.

3.1 Terms and conditions not required:

In order to simplify the creation of easements, the statutory form of easements may be used. Statutory easements adopt the terms and conditions specified in Schedule 4A (easements in gross) and Schedule 8 (easements having a dominant tenement) Conveyancing Act 1919.

The terms and conditions of an easement cannot refer to persons empowered to release vary or modify the easement. (see sec. 88[1](c) Conveyancing Act 1919). Following is a list of statutory easements (referred to as short form easements) set out in the Schedules that do not require terms and conditions to be included in Part 2 of the instrument:

(a) Right of Carriage Way

(b) Right of Foot Way

(c) Easement to Drain Water

(d) Easement to Drain Sewage

(e) Easement for Repairs

(f) Easement for Batter

(g) Easement for Drainage of Sewage

(h) Easement for Drainage of Water

(i) Easement for Electricity Purposes

(j) Easement for Overhang

(k) Easement for Services

(l) Easement for Water Supply

(m) Easement to permit Encroaching Structure to remain

(n) Right of Access

Note: The use of these expressions does not prevent the inclusion in Part 2 of variations of the terms and conditions referred to in the Schedules. Such variations may be by way of addition, exception, qualification or omission.

3.2 Terms and conditions required

Alternatively, an easement may be created for another purpose. In this case relevant terms and conditions must be shown in Part 2 of the instrument

4. Creating Profits à Prendre, Restrictions on Use of Land.

Terms and conditions of profits à prendre and restrictions on the use of land must always be shown in Part 2 of the instrument.

The terms and conditions of a Restriction on the Use of Land may state the person(s) empowered to release, vary or modify the restriction. (sec. 88[1](c) Conveyancing Act 1919)

Note: The sites of Restrictions and Profits à Prendre and are only identified on the face of the plan if they affect part of a lot.

5. Creating Positive Covenants

Terms and conditions of Positive Covenants must always be shown in Part 2 of the instrument. They may be created in favour of:

(a) Prescribed authorities (sections 88D & 88E Conveyancing Act 1919) or

(b) Privately owned land, where the covenant relates to maintenance or repair of an easement to be created by the instrument.

The site of the Positive Covenant is only shown on the face of the plan if it affects part of a lot.

Note:

A Section 88B Instrument cannot be used to create a Positive Covenant over an existing easement.

To record an interest relating to maintenance and repair of the site of an **existing easement** over:

(a) Torrens title land, a Request (97-11R) should be registered containing the terms of the covenant or

(b) Old System land, a deed containing the terms of the covenant should be registered in the General Register of Deeds.

6. Releasing Easements or Profits à Prendre

Section 88B Conveyancing Act 1919 provides for the release of easements and profits à prendre by the registration of a plan.

The identity of easements and Profits à Prendre to be released must be set out in:

- Part 1A of the instrument and
- the statement of intention panel of the plan.

An example is shown in **Annexure 3.**

7. Signatures and Consents

Where an easement, profit à prendre, restriction or positive covenant is being created the plan and Section 88B instrument must be signed by:

(a) The registered proprietor

(b) Mortgagee

(c) Chargee or

(d) Covenant chargee and

Written consents must be furnished by any

(a) Caveator,

(b) Lessee, or

(c) Judgement creditor under any writ

in accordance with Section 195D Conveyancing Act 1919.

Note: Written consents may be dispensed with if the caveator, lessee or judgement creditor signs the plan and instrument.

Where an Easement or Profit à Prendre is being released:

The signatures and consents of all the parties relating to the dominant tenement

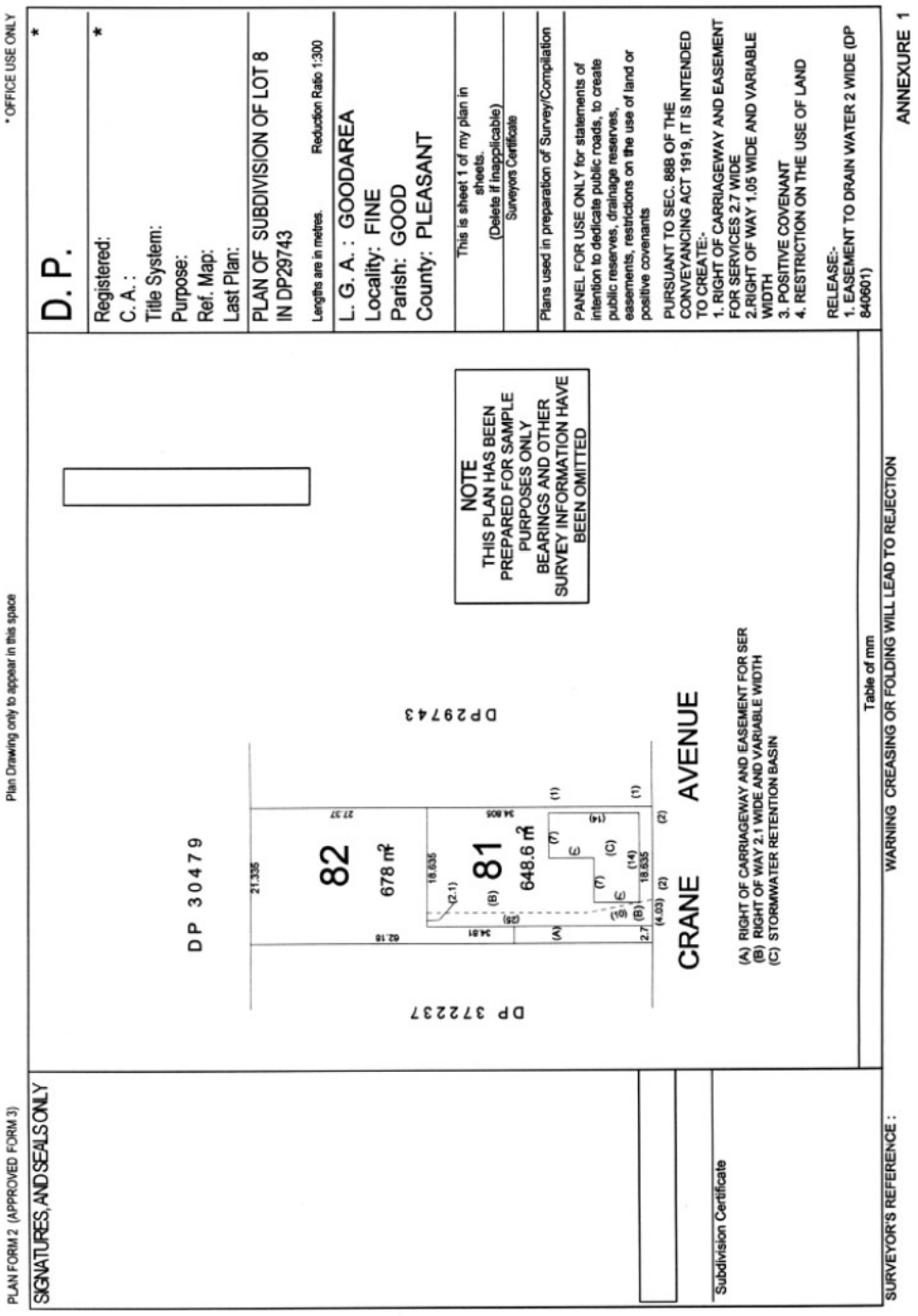
should be furnished.

Inquiries on all matters related to plans and associated dealings should initially be made in person at Customer Services Branch, second level, Land Titles Office, Queens Square, Sydney or by contacting the Telephone Inquiry Service on (02) 9228 6713.

David Mulcahy

Director of Land Titles and Registrar General First issued July 1987

Annexure 1


PLAN FORM 2 (APPROVED FORM 3)
Plan Drawing only to appear in this space
*OFFICE USE ONLY
D. P. *
Registered: *
C.A.:
Title System:
Purpose:
Ref. Map:
Last Plan:
PLAN OF SUBDIVISION OF LOT 8 IN DP29743
Lengths are in metres. Reduction Ratio 1:300
L. G. A. : GOODAREA
Locality: FINE
Parish: GOOD
County: PLEASANT
This is sheet 1 of my plan in sheets.
(Delete if inapplicable)
Surveyors Certificate
Plans used in preparation of Survey/Compilation
PANEL FOR USE ONLY for statements of intention to dedicate public roads, to create public reserves, drainage reserves, easements, restrictions on the use of land or positive covenants
PURSUANT TO SEC. 88B OF THE CONVEYANCING ACT 1919, IT IS INTENDED TO CREATE:-
1. RIGHT OF CARRIAGEWAY AND EASEMENT FOR SERVICES 2.7 WIDE
2.RIGHT OF WAY 1.05 WIDE AND VARIABLE WIDTH
3. POSITIVE COVENANT
4. RESTRICTION ON THE USE OF LAND
RELEASE:-
1. EASEMENT TO DRAIN WATER 2 WIDE (DP 840601)
ANNEXURE 1
SIGNATURES, AND SEALS ONLY
Subdivision Certificate
SURVEYOR'S REFERENCE :
Table of mm
WARNING CREASING OR FOLDING WILL LEAD TO REJECTION
NOTE
THIS PLAN HAS BEEN PREPARED FOR SAMPLE PURPOSES ONLY
BEARINGS AND OTHER SURVEY INFORMATION HAVE BEEN OMITTED
DP 30479
DP297443
DP 372237
82
678 m²
81
648.6 m²
CRANE AVENUE
(A) RIGHT OF CARRIAGEWAY AND EASEMENT FOR SER
(B) RIGHT OF WAY 2.1 WIDE AND VARIABLE WIDTH
(C) STORMWATER RETENTION BASIN

Annexure 2

Instrument setting out Terms of Easements/Profits à Prendre intended to be created or released and of Restrictions on the Use of Land and Positive Covenants intended to be created pursuant to Section 88B of the Conveyancing Act 1919.

Plan:	Subdivision of Lot 8 D.P.29743 covered by Subdivision Certificate No. 98/200 of 9/7/1998
Full name and address of the owner of the land	Grace Mary Brothers 4 Crane Avenue Fine NSW 2775

Part 1

1. Identity of easement, profit à prendre, restriction or positive covenant to be created and firstly referred to in the plan	Right of Carriage Way and Easement for Services 2.7 wide

Schedule of Lots etc. Affected

Lots Burdened	**Lots Benefited**
82	81

2. Identity of easement to be created and secondly referred to in the plan	Right of Way 2.1 wide and variable width

Schedule of Lots etc. Affected

Lots Burdened	**Lots Benefited**
81	82

3. Identity of positive covenant thirdly referred to in the plan	Positive Covenant

Schedule of Lots etc. Affected

Lots Burdened	**Lots Benefited**
81	Goodarea Council

4. Identity of restriction fourthly referred to in the plan	Restriction on the Use of Land

Schedule of Lots etc. Affected

Lots Burdened	Lots Benefited
81	Goodarea Council
82	Goodarea Council

Annexure 2

Instrument setting out Terms of Easements/Profits à Prendre intended to be created or released and of Restrictions on the Use of Land and Positive Covenants intended to be created pursuant to Section 88B of the Conveyancing Act 1919.

Plan:	Subdivision of Lot 8 D.P.29743 covered by Subdivision Certificate No. 98/200 of 9/7/1998
Part 1A	
1. Identity of easement to be released and firstly referred to in the plan	Easement to Drain Water 2 wide (DP 840601)

Schedule of Lots etc. Affected

Lots Burdened	**Lots Benefited**
8/29743	9/29743

Part 2

Note: The terms for the positive covenant and restriction on the use of land, set out in Part 2, are included for the purposes of illustration only.

1. Terms of Right of Way 2.1 wide and variable secondly referred to in the plan.

(Insert terms and conditions).

2. Terms of Positive Covenant thirdly referred to in the plan

The Proprietor of the land hereby burdened (herein called 'the Proprietor') shall at all times in respect of the land hereby burdened, identified on the plan as 'stormwater retention basin' (herein called 'the basin'): ..... (*Insert terms and conditions*).

3. Terms of Restriction on the Use of Land fourthly referred to in the plan

a. Not to erect or suffer to permit any building, structure or erection on the whole or in part of the land hereby burdened identified on the plan as 'stormwater retention basin' (herein called 'the basin') except: ..... (*Insert terms of restrictions*).
b. No alteration is to be made to the retention levels ..... (*Insert terms of restrictions*).

Name of authority empowered to release, vary or modify positive covenant and restriction thirdly and fourthly referred to in the plan.

Goodarea Council.

Annexure 2

Instrument setting out Terms of Easements/Profits à Prendre intended to be created or released and of Restrictions on the Use of Land and Positive Covenants intended to be created pursuant to Section 88B of the Conveyancing Act 1919.

Plan: Subdivision of Lot 8 D.P.29743 covered by Subdivision Certificate No. 98/200 of 9/7/1998

Signed in my presence by Grace Mary Brothers who is personally known to me.

Signature of witness — Grace Mary Brothers

Name of Witness (Block Letters)

Address and Occupation of Witness

Signed in my presence by Francis Richard Drake (registered proprietor of dominant tenement 9/29743) who is personally known to me.

Signature of Witness — Francis Richard Drake

Name of Witness (Block Letters)

Address and occupation of Witness

Annexure 3

Copy of Approved Form 10

Instrument setting out Terms of Easements/Profits à Prendre intended to be created or released and of Restrictions on the Use of Land and Positive Covenants intended to be created pursuant to Section 88B of the Conveyancing Act 1919 .

Plan: (*Please leave 26 mm to allow for plan number and heading of plan*) Plan of (heading of plan) covered by Subdivision Certificate No. (*add reference as appropriate*)

Full name and address of the owner of the land:

Part 1

1. Identity of easement, profit à prendre, restriction or positive covenant to be created and firstly referred to in the plan. (*Brief description in same terms as used in relevant statement in the plan*).

Schedule of Lots etc. affected

Lots burdened	**Lots, relevant roads, bodies or prescribed authorities benefited.**

(*Set out vertically in numerical sequence of lot numbers. Title details should be added if the land referred to is outside the plan*).

(*Continue above pattern until all easements, profits à prendre, restrictions, or positive covenants to be created and referred to in the plan have been dealt with*).

Part 1A

1. Identity of easement, profit à (*Brief description in same terms as used*

prendre, restriction or positive covenant to be created and firstly referred to in the plan.	*in relevant statement in the plan*).
Lots burdened by existing prescribed easement, , profit à prendre	**Lots, relevant roads, bodies or authorities benefited by existing easement.**

(*Set out vertically in numerical sequence of lot numbers. Title details should be added if the land referred to is outside the plan*).

(*Continue above pattern until all easements, profits à prendre, restrictions, or positive covenants to be created and referred to in the plan have been dealt with*).

Annexure 3

Part 2

Terms of easement, profit à prendre, restrictions or positive covenant("firstly", or as the case may be) referred to in the plan.

(*Continue the above pattern until all easements, profits à prendre, restrictions or positive covenants to be created and referred to in the plan have been dealt with*)

Name of person empowered to release, vary or modify restriction or positive covenant ("firstly", or as the case may be) referred to in the plan:

(*Not required where it is intended that the restriction may only be released, varied or modified by the owners for the time being of all lots benefited, or by order of the Supreme Court*)

Annexure 4

Examples of the Schedule of Lots Burdened and Benefited

The following examples show recommended formats for the scheduling of lots burdened and benefited in Parts 1 and 1A of a Section 88B Instrument.

Lots burdened	**Lots benefited**
1	2, 3 & 4

2	3 & 4
3	4
or	or
Each lot except lot 6 **(see note)**	Every other lot except lot 6 **(see note)**
or	or
Each of the lots 1 to 4 inclusive the part of lot 5 designated (A) in the plan and lot 6	Every other lot and the Council of .....
or	or
Each lot	Any prescribed authority

Note: This format should be used only for Restrictions on the Use of Land. The current title details and parcel identity must be shown for each lot or parcel of land burdened and/or benefited by the easement, profit à prendre, restriction, or positive covenant. The reference to title need only be referred to once throughout the instrument.

F.6 Sample instrument when OSD is deferred

Sample 88B Instrument for use when the On-Site Detention system is not provided at the time of subdivision but is deferred until construction of a building development on the land.

This situation has caused considerable difficulties for new home builders in the past and will only be permitted by Council in exceptional circumstances.

INSTRUMENT SETTING OUT TERMS OF RESTRICTION ON THE USE OF LAND INTENDED TO BE CREATED PURSUANT TO SECTION 88E OF THE CONVEYANCING ACT 1919.

(Sheet .. of … sheets)

Plan: Subdivision of Lot …….D.P……

Covered by Council Clerk's

Certificate No. ……..

Of ……

Full name and address

……

Of proprietor of the land

……

……
…

PART 1

( ) Identity of restriction…….. referred to in abovementioned plan — Restriction on use under Section 88E of the Conveyancing Act 1919

SCHEDULE OF LOT(S), ETC. AFFECTED

Lot(s) Burdened	Authority Benefited
……	*Insert name of Council*
( ) Identity of Positive Covenant referred to in above-mentioned plan	Positive Covenant under Section 88E of the Conveyancing Act 1919

SCHEDULE OF LOT(S), ETC. AFFECTED

Lot(s) Burdened	Authority Benefited
……	*Insert name of Council*

PART 2

TERMS OF RESTRICTION ON USE …….. REFERRED TO IN THE ABOVE-MENTIONED PLAN

(i) The registered proprietor shall not erect or suffer the erection of any dwelling house or other structure on the lot(s) hereby burdened unless the registered proprietor has first constructed or has made provision for the construction of an on site stormwater detention system on the

said lot(s), in accordance with the design, construction and/or provision requirements of the ……(Insert name of Council) and to the satisfaction of the …… (Insert name of Council). The expression "on-site stormwater detention system" shall include all ancillary gutters, pipes, drains, walls, kerbs, pits, grates, tanks, chambers, basins and surfaces designed to temporarily detain stormwater as well as all surfaces graded to direct stormwater to the temporary storage.

PART 2 (Continued)

(ii) The registered proprietor shall not make or permit or suffer the making of any alterations to any onsite stormwater detention system which is, or shall be, constructed on the lot(s) burdened without the prior consent in writing of ……(*Insert name of Council*) . The expression "on-site stormwater detention system" shall include all ancillary gutters, pipes, drains, walls, kerbs, pits, grates, tanks, chambers, basins and surfaces designed to temporarily detain stormwater as well as all surfaces graded to direct stormwater to the temporary storage. Any on-site stormwater detention system constructed on the lot(s) burdened is hereafter referred to as "the system". Name of Authority having the power to release, vary or modify the Restriction …… referred to is ……(*Insert name of Council*).

TERMS OF POSITIVE COVENANT ……REFERRED TO IN THE ABOVE-MENTIONED PLAN

3. The registered proprietor of the lot(s) hereby burdened will in respect of the system:
   (a) keep the system clean and free from silt, rubbish and debris
   (b) maintain and repair at the sole expense of the registered proprietors the whole of the system so that if functions in a safe and efficient manner
   (c) permit the Council or its authorised agents from time to time and upon giving reasonable notice (but at any time and without notice in the case of an emergency) to enter and inspect the land for the compliance with the requirements of this covenant
   (d) comply with the terms of any written notice issued by the Council in respect of the requirements of this covenant within the time stated in the notice.
4. Pursuant to Section 88F(3) of the Conveyancing Act 1919 the Council shall have the following additional powers:
   (iii) in the event that the registered proprietor fails to comply with the terms of any written notice issued by the Council as set out above the Council or its authorised agents may enter the land with all necessary materials and equipment and carry out any work which the Council in its discretion considers reasonable to comply with the said notice referred to in part 1(d) above
   (iv) The Council may recover from the registered proprietor in a Court of competent jurisdiction:

   (a) any expense reasonably incurred by it in exercising its powers under subparagraph (i) hereof. Such expense shall include reasonable wages for the Council's employees engaged in effecting the work referred to in (i) above, supervising and administering the said work together with costs, reasonably estimated by the Council, for the use of materials, machinery, tools and equipment in conjunction with the said work.

   (b) legal costs on an indemnity basis for issue of the said notices and recovery of the said costs and expenses together with the costs and expenses of registration of a covenant charge pursuant to section 88F of the Act or providing any certificate required pursuant to section 88G of the Act or obtaining any injunction pursuant to section 88H of the Act.

Name of Authority having the power to release vary or modify the Positive Covenant

…… referred to is ……(*Insert name of Council*)

Public Exhibition of Chapters E13 and E14 -WDCP 2009

(25 November 2019 to 20 January 2020)

Submissions and Council's response Action

Comment Number	DCP Section	Submission Comments	Council Response/Action
1	Section 6.3, 3rd paragraph	Propose that new specifically design buildings on piers or double slabs which has been design in a way to bypass flood waters, to be allowed to model as layered flow constriction. Sometimes this is the only means of achieving a compliant development of the site, therefore dedicated void under the building could be the only way to develop. This may require some additional assessment to undertake, such as blockage. Also, such dedicated flood relief structure could be clearly marked with appropriate signage to avoid future modifications. This may be an exception and could be assessed in case by case basis as a last resource. But closing this option completely may limit some future developments of commercials/larger buildings.	Representing proposed or existing buildings on piers or suspended slabs using Layered Flow Constrictions in TUFLOW will be permitted if the opening is modelled as both open and 50% blocked for flood impact assessment. A restriction will be placed on the title to ensure the opening is maintained. Section 6.3 of Chapter E13 updated.
2	Section referenced as 6.7 in change log (actual section in E13 is 6.6).	Would suggest to apply the worst case scenario where it is unclear weather its an overland or mainstream flooding (rather than leaving decision to council for case by case basis). This would make a bit clearer regulation, rather than requesting council to interpret every single "grey" area between overland and mainstream flooding. Also would ease the process of development and decrease unnecessary work for council when most of the outcome would probably be to apply more conservative free board.	Council is unsure how this approach would remove grey areas. No action required.

Comment Number	Section	Comments	Summary	Response
2.1	Definitions - Floodways	Although many of the additional definitions are helpful in clarifying the intent of the DCP, the definitions for floodways and freeboard are at odds with the NSW Government's Floodplain Development Manual (FDM). The definition of a floodway is contradictory. The first part of the definition aligns with FDM Appendix L which defines floodways as 'those areas where a significant volume of water flows during floods and are often aligned with obvious natural channels. They are areas that, even if only partially blocked, would cause a significant increase in flood levels and/or a significant redistribution of flood flow, which may in turn adversely affect other areas. They are often, but not necessarily, areas with deeper flow or areas where higher velocities occur'. The second part of the definition gives far more explicit delineation of floodway areas as areas where the velocity x depth product exceeds 0.4 m2/s where not mapped in an adopted Flood Study or FRMS (noting that Council's Flood Studies use similar depth and velocity criteria to define floodways). This is at odds with the FDM which advises that 'it is impossible to provide explicitly quantitative criteria for defining floodways and flood storage areas, as the significance of such areas is site specific'. It is also contradictory with respect to the first part of the definition in that use of the proposed mathematical formula to identify floodways captures numerous backwater areas that carry little flow, so they can't be floodways. The new definition for freeboard also omits important parts of the FDM definition (§K5), which indicates that one of the main purposes of freeboard is to allow for the cumulative effect of subsequent infill development of existing zoned land. The new definition also includes other examples from the FDM generalised characterisation of floodways that are of little relevance to the Wollongong LGA such as the settlement of levees. It would also be worth clarifying the status of prescriptive controls and performance criteria in the definitions. The original author of DCP Chapter E13, Paul Grech, has advised (pers. comm.) that the intent of the document and the wording of Chapter E13 (in his view) make it clear that use of the applicable prescriptive controls automatically demonstrates conformity with objectives and performance criteria. This however is not	Don't be prescriptive with floodway definition	More flexibility included to define floodways

		the view of Council's development assessment staff who frequently ask that it be separately demonstrated that objectives and performance criteria are satisfied even when prescriptive controls are followed. The original author's comments notwithstanding, the current definition of prescriptive controls would benefit from clarification as the second sentence can be interpreted in different ways. The current definition reads: The prescriptive controls are preferred ways of achieving the outcome. While adherence to the prescriptive controls may be important, it is paramount that the objectives and the performance criteria are clearly satisfied. The original author interprets the second sentence, when read in context with the first sentence, as meaning that if the prescriptive controls are not utilised (even though they represent the preferred way of achieving the desired outcomes), other ways of achieving the desired outcomes are acceptable provided that the objectives and the performance criteria are satisfied. Some of Council's development assessment staff however interpret the second sentence as a stand-alone requirement mandating separate consideration objectives and the performance criteria even when there is full adherence to the prescriptive controls. This interpretation however sits oddly with the first sentence and would appear not to be the intent of the original document. It is suggested the definition is amended as follows: The prescriptive controls are preferred ways of achieving the outcome. While adherence to the prescriptive controls is desirable, it is paramount that the objectives and the performance criteria are clearly satisfied if alternative measures are proposed. There is also reference to prescriptive standards in DCP Chpt E13. It would be helpful for the reader if a further definition for this term is provided showing how prescriptive standards differ from prescriptive controls. If they are one and the same thing, it is suggested to use the same term for both.		
2.1	Definitions - Presciptive controls and objectives	The prescriptive controls are preferred ways of achieving the outcome. While adherence to the prescriptive controls is desirable, it is paramount that the objectives and the performance criteria are clearly satisfied if alternative measures are proposed.		Agree

2.2	Objectives a) and B)	2.2. Objectives It is suggested that the terminology 'maintain or improve' is used in objectives (a) and (b). There are existing situations where conveyance is compromised by poorly conceived development of the past, and where new development can potentially be used to improve such legacy situations. Similarly, with respect to greenfields development, it is often beneficial to modify floodways and flood storage areas to achieve better urban design outcomes. Local Illawarra examples include Tullimbar and Calderwood, both of which developments were the subject of LEC proceedings and the respective judgments held that modification/relocation of floodways and flood storage areas were justified to achieve optimal urban design outcomes. It would therefore be desirable to build in flexibility to the DCP objectives to enable a floodplain manager to make merit-based decisions where there is an opportunity to reduce existing risk or attain improved sustainability outcomes for new development.	maintain or <u>improve</u>	Agree however the definition in the Draft DCP is consistent with the LEP. Council supports proposed developments which improve flood affectation. Regarding greenfields development, Council believes optimal urban design is achieved without the need for significant floodway (or floodplain) modification.

2.3	Conveyance and Floodways	Significant concern is expressed over the proposed default mathematical formula for defining floodways (velocity x depth > 0.4 m2/s) and the floodway maps in Council's recent catchment-wide flood studies which are based on similar subjectively derived mathematical formulae that in some cases have been disavowed by the original authors as not fit for purpose (such as with the Howell Method). Floodways are an important concept in floodplain management but miscategorising them can unnecessarily sterilise development opportunities, particularly in view of Council's LEP (Clause 7.3) which requires any development located in a floodway area to be 'not incompatible' with the flow conveyance function of the floodway. Sub-optimal outcomes can result when one-size-fits-all approaches are used to define floodways and appraise their conveyance function. More flexible ways of identifying floodways are warranted that consider the natural variability of conveyance as well as recognising the different demands of greenfield development compared to the management of legacy subdivisions where innovative thinking is required to achieve the best outcomes. Council's flood function maps based on the modified Howell method result in floodways being identified in locations inconsistent with the FDM definition. For example, some of the 'floodways' identified in the 2019 Allans Creek Flood Study, in O'Donnell Drive Figtree and in the low-lying land behind the houses on the eastern side of O'Donnell Drive, are in areas of obvious backwater and carry little flow so can't be floodways. Similarly at Corrimal, in the vicinity of Rothery Rd west of Memorial Drive, there are numerous large residential lots with old houses that are potentially sterilised from redevelopment as they would be classified as floodway using the modified Howell method, even though they are only inundated to a depth of no more than 200 to 300mm and where it is only the adjacent public roads that are floodways based on FDM criteria. Taken literally, the draft DCP clauses on floodways mean that any road embankment in a new greenfields subdivision associated with a culvert encroaching in a floodway is unsupportable, even when it is the case that the increase in flood levels is of no material significance given the land affected is in the same ownership. The FDM advises that it is impossible to provide explicitly quantitative criteria for defining floodways and flood storage areas, as the significance of such areas is site specific. The Manual does however give guidance to help assess the extent of floodways.	Ensure developments near floodways cause: No significant adverse impacts on flood levels on adjoining properties if held under different ownership. • No significant adverse impacts on flood velocities, that may cause scour and erosion. • No loss of flood storage with respect to river stage • No additional isolation risk or adverse effects on	More flexibility inlcuded to define floodways

		This is done in an indirect way, in that it offers two criteria to define flood storage/flood fringe areas, from which floodways can then be identified (ie, since the remainder of the flooded area is floodway by definition). The FDM criteria for flood storage areas are 'those areas which lie outside floodways, which if completely filled with solid material would cause: (i). peak flood levels to increase anywhere by more than 0.1 m and/or (ii). would cause the peak discharge to increase by more than 10%.' Despite the attractiveness of simplistic mathematical definitions for floodways in terms of regulatory convenience, the delineation of floodways is subjective. The FDM advice that it is impossible to provide explicitly quantitative criteria for defining floodways supports the case for flexibility in identifying floodways and interpreting their relevance in floodplain risk management. It is recommended that the draft DCP be refined such that: • The identification of floodways is based on the FDM guidance rather than by mathematical velocity/depth formulae. • It is recognised that the conveyance of floodways can be modified by vegetation changes and/or bulk earthworks, including their relocation where justifiable on a merit-based assessment of individual circumstances. Rather than focusing on the precise location of floodways, it is suggested that development in the vicinity of floodways is best appraised by the following criteria: • No significant adverse impacts on flood levels on adjoining properties if held under different ownership. • No significant adverse impacts on flood velocities, that may cause scour and erosion. • No loss of flood storage with respect to river stage • No additional isolation risk or adverse effects on evacuation routes from any relocation or realignment of floodways.	evacuation routes from any relocation or realignment of floodways.	

2.4	Blockage	The proposal to adoption Risk Management rather than Design blockage factors is questioned given it is inconsistent with the fundamental philosophy of the national guidelines which are based on a probability-neutral approach, rather than applying a series of probability-distorting assumptions during the flood estimation process. It will also obviate the need to change the LEP, which uses the level of a "1:100 ARI (average recurrent interval) flood event plus 0.5 metres freeboard" (sic) to define the flood planning level. Using probability-distorting Risk Management blockage factors produces calculated flood levels rarer than those normally experienced in a 100-year ARI flood, and will therefore not correspond to the flood level referred in the LEP definition. It is preferable therefore that Design blockage factors are used and then, if Council considers a more conservative approach is warranted in some areas, specify additional freeboard at specific locations (consistent with the relevant Floodplain Risk Management Study & Plan) to achieve an additional degree of conservatism. This also aligns with the recommendation of the WMAwater 2016 report which suggested Risk Management factors for the purpose of deriving variable freeboard. The national guidelines emphasise that the degree of blockage experienced at any individual waterway structure depends on debris availability, mobility and transportability as well as waterway geometry and other site-specific features. The national guidelines also describe numerous methods that can be used to reduce the propensity of blockage of individual culvert/bridge structures, yet the draft DCP implicitly assumes that all the poorly performing culverts and bridges will remain that way no matter what methods are implemented to reduce the probability of blockage. It is recommended that the draft DCP includes more flexibility in determining blockage factors in line with the philosophy of the ARR 2019 national guidelines, rather than hard-wiring them. Numerous researchers (including community-group NEFRAG) have flagged shortcomings with the hard-wired blockage factors, which include: (a) The implicit assumption that blockages occur at start of a flood instead of closer to its peak, whereas more realistic blockage timing criteria are suggested in the latest ARR guidelines (eg, consider adopting the recommended timing for a porous plug blockage (TOTB/SA), when flow first overtops the stream's banks in the source area reaches the structure). (b) Clunky culvert size class categories. Sophisticated statistical analysis carried out by	• Use design factors or ARR2016 method •Apply blockage more realistically (e.g. other methods apart from TUFLOWs outside-in blockage) •Allow flexibility	Council considers the WMAWater Report the best blockage information currently availed to Council. Through the collaborative Illawarra-Shoalhaven Smart Water Management Project Council is aiming to better monitor manage and ultimately model conduit blockage. For most flood affected areas in the LGA, the difference in flood level between the design and risk blockage factors is minimal.

		NEFRAG for waterway structures between 4.5m and 6m warrants further refinement of culvert classes. This would also provide a less abrupt change in codified blockage behaviour between Class 3 and Class 4 culverts. There is only a relatively small difference between blockage factors for Classes 2 and 3, but a large difference when moving from Class 3 to Class 4. Splitting Class 3 into two would help eliminate the abrupt increase in blockage factors occurring between Classes 3 and 4. (c) The way in which the blockage factor is applied by 'moving in' the culvert sidewalls. Whilst this is a good approach in most cases, it is not logical when there is a long culvert operating under outlet control (such as the American Creek culvert under the M1). In such an instance it would be appropriate to move in the side walls for the first 5 metres and then leave the culvert in its original state for the remaining length. This would far more accurately replicate actual blockage behaviour in such instances. (d) Site-specific factors affecting degree of hydraulic blockage at individual culvert locations. This is the key matter highlighted in the original Rigby & Silveri research paper which spawned Council's 2002 blockage policy. That is, developing a procedure to accommodate low blockage potential sites in instances where historical evidence indicated minimal occurrence of blockage. It is suggested that flexibility be introduced to allow the ability to vary the culvert class applying to a culvert at a particular site with respect to other site-specific factors that affect the propensity for blockage. These include adverse skew; underslung services; brick arch culverts through railway embankments typically between 2.4 m and 2.9 m diameter for which there is minimal historical evidence of blockage; defacto settling basins which can drop out debris a long way from the culvert in question or the existence of a smaller culvert a short distance upstream that would in effect act as an efficient debris trap. The culvert under the Masters Road southbound ramp at Figtree is a good example of this last factor. It is a Class 3 culvert with another (slightly smaller) Class 3 culvert a very short distance upstream, with a large concrete channel linking them with limited additional debris sources in-between. It is inconceivable that each culvert has the same propensity for blockage. This is an aspect highlighted in the latest ARR Blockage Guidelines, which state: 'It is noted however, that once blockage occurs at a given structure, the debris source area for the next downstream structure may be much less than that of the upstream structures source area'.		Where there are significant differences in flood levels between the design and risk factors: • Using different blockage factors to determine impact and planning levels is inequitable to the impacted lot. • The impact cannot be accommodated within the 500 mm freeboard.

		It would be desirable for the DCP to allow flexibility to adopt amended blockage factors where supported by further research and/or assessment of specific sites		

2.5	Debris Control Structrues	The draft DCP is silent on debris traps and other debris control measures. It is suggested as illogical to argue on one hand that a blockage factor increases from 15%-blocked for a culvert with a diagonal opening of 6.1m to 60%-blocked for a culvert with a slightly smaller diagonal opening of 5.9m, yet on the other hand to argue that implementing a suite of debris control measures make nil difference to the probability of a culvert blocking. If increasing the diagonal width by 3% can reduce the degree of blockage from 60% to 15%, then surely it is logical to accept that well-designed debris control measures can have a similar effect. It is recommended that the draft DCP be amended to countenance reduced blockage factors based on engineering assessment, which would take into account different types of debris traps (which can range from simple on-line trash racks which are prone to blockage, to well-engineered debris traps combined with large settling basins immediately upstream and high flow bypasses which are far less resistant to blockage). Well-designed debris traps have the potential to deliver significant flood mitigation benefits at a small fraction of the cost of bridge or multi-cell culvert upgrades, so it is important to assess their positive effects.	Allow reduced blockage factors based on engineering assessment which may include debris control structures	No - Councils considers the best available information is the WMAWater report
2.6	Modifications to watercourses	It is desirable in the section on Modifications to Watercourses to recognise that numerous natural watercourses in the Wollongong LGA have already been modified, creating many of the negative issues mentioned in the DCP. Where such modifications have already been undertaken then it would be desirable for the draft DCP to support proposals to restore the stream to its original form and location where feasible or to implement measures that ameliorate negative legacy aspects. To encourage merit-based management of the floodplain, it is further suggested that the draft DCP is amended to state 'The reduction of development potential is not be considered justification for waterway modification, unless accompanied by other positive environmental/ecological rehabilitation features that result in a net positive benefit'. [suggested additional text underlined] Such flexibility would also serve to facilitate new development that reduces existing risk faced	Allow restoration of natural flow regime Merit based assessment of flooding impacts	Agree, would require a level of discretion from assessment staff, which is not the preference of development assessment

2.7	Permissible flood impacts	It is suggested that the proposed permissible flood impact depths be nominated as a guide only and that merit-based assessment is to be applied, particularly in the case of larger impacts that are contained within the site or where adjoining landowner consent is obtained accepting the impacts, except where it results in increased over-floor flooding. If Council is the adjoining owner, then such consent should not be unreasonably withheld.	Allow impacts when the adjacent land owner agrees	Council does not agree with this suggestion and believes it could lead to poor outcomes for existing and future property owners
2.8	Filling	guidance on loss of flood storage from filling in the PMF event. The notes in the change log indicates that no loss of storage in the PMF event is acceptable, but this does not appear to be specified in the draft DCP. It is suggested as desirable to allow some small loss of storage in the PMF event where justified by merit-based assessment. In this regard it is noted that there is natural variation in floodplain storage due to sediment deposited on floodplains and vegetation changes (such as with seasonal effects). Zero loss of flood storage in a PMF event is considered an unnecessarily high bar when it can be otherwise demonstrated that there are no significant adverse impacts on flood levels or flood velocities, and no additional isolation risk or adverse effects on evacuation routes from a development proposal	Allow some loss of storage in a PMF event	Draft Chapter E13 updated to permit filling above the 1% AEP event if can be demonstrated there are no adverse impacts in rare events (e.g. 0.2%, 0.5%, PMF)
2.9	Cumulative Implications	The DCP requires cumulative impacts to be considered with respect to flood levels, loss of storage from filling, stormwater quality and native bushland vegetation. This is suggested as being unworkable. The applicant has no idea as to what development or redevelopment may or may not take place in the future and it is a matter of conjecture as to how far upstream or downstream such cumulative development scenarios should extend. It is more appropriate that cumulative effects are addressed in Council's own catchment-wide flood studies, as called for in the FDM.	Cumulative impacts should be assed through floodplain risk management studies	This requirement has not changed from the previous version of the DCP. Agree this is best investigated through a

				Flood Risk Management Study (FRMS). However not all flood prone land in the LGA is covered by a FRMS. Historically, when Council has asked developers to model cumulative impact, the modelling has demonstrated adverse impacts.
3.1	Definitions	The draft DCP proposes to amend the definition of a suitably qualified Engineer in order to allow Council to engage consultants who are not on the NER. This is suggested as short-sighted at a time when Opal Tower and Mascot Towers have led state government into creating reforms to professional standards. As evident from the EA website (12/1/2019), 'Engineers Australia and the community support compulsory registration of professional engineers working across all industries in NSW. NSW has not one, but two bills before Parliament that would require engineers to be registered to practice'. It is suggested that if Council engages a consulting engineer who is not on the NER, then arrangements should be made for one of Council's own registered engineers to review the work produced.		Any relevant NSW legislation will supersede the DCP definition. The proposed definition also accommodates APEA members.

3.2	Objectives	It is unclear how objective (e) can be achieved by Chpt E14. OSD may reduce peak flows, but runoff volumes will not be affected. Reducing runoff volumes by limiting the extent of impermeable areas is covered under Council's other controls such as FSR and is not considered a relevant objective for Stormwater Management. It is however worth acknowledging that Council has declared a Climate Change Emergency and to consider its implications in the context of the draft DCP for Stormwater Management. There is a large amount of embodied greenhouse gases in cement manufacture, creating approximately 8% of worldwide man-made emissions. It is desirable therefore for the draft DCP to include an objective to encourage ways to reduce greenhouse gas emissions attributable to the use of concrete, not only in Council's civil works but also in the works it requires of developers. A recent example of unnecessary use of concrete is with a project in Figtree where Council's Asset Management staff called for a concrete maintenance track through a riparian corridor to be able to 'maintain' a small natural creek, even though DPI-Water was opposed to the track and could not envisage any circumstance where it would be necessary to access the creek with trucks or earthmoving machinery. Additional consideration of environmental factors is warranted in such circumstances rather than decision-making aimed solely at reducing Council's maintenance costs. Another example is with Council requesting an unnecessary extension of a concrete drainage line serving a new subdivision to bypass an existing GPT which would have otherwise provided protection to a coastal lake from plastic wastes, on the basis that this avoided increasing Council's maintenance liabilities from having to clean the trap more regularly.		OSD has not been reviewed. Council will initiate a compressive review of the OSD policy as a stand alone project in the future.

3.3	OSD	It is worth reviewing and updating the OSD chapter which is based on limited modelling undertaken about 12 years ago using less sophisticated models than currently available. As a result, the OSD Concession line is not accurately defined, also being based on modelling for only a handful of catchments and engineering judgement. More detailed studies undertaken subsequent to adoption of the current OSD Policy have shown that provision of OSD in some areas upstream of the Concession line aggravate flooding downstream and is less desirable that providing no OSD at all. Ideally, it would be desirable for the Concession line to be reviewed as part of each catchment wide Floodplain Risk Management Study. It is also worth countenancing the payment of OSD-in-lieu charges in recognition of local features in Wollongong catchments that detract from the theoretical performance of OSD systems. Greater Taree City Council accepts payments in lieu where it is impractical to provide storage on site and 7 | P a g e there are no serious deficiencies in the downstream drainage system. Even in areas of Wollongong where OSD is nominally justified, its performance in practice is much below theoretical expectations due to the extensive tree cover in many suburbs which results in accumulation of leaf litter in gutters, even when leafless gutter systems are provided. Combined with the modern trend to install gutters with little or no fall for aesthetic reasons, overflowing gutters are commonplace during intense rainfall which results in a substantial amount of roof runoff bypassing the OSD storage. Similarly, orifice plates are also prone to clogging with twigs and leaf litter and there is anecdotal evidence showing people remove the orifice plates when they find blocked OSD pits, not appreciating their function. Very few house owners read the complicated technical instructions on OSD maintenance in the 88B instrument and it is impractical to police such matters. There are numerous examples where Council has required OSD for small infill developments in the Concession Zone where discharging to Council's piped drainage system in an existing public road even though often located a short distance from the nearby creek. The loss of service to the road drainage system is often negligible, and out of proportion to the capital and maintenance costs of multiple large reinforced concrete OSD pits (and the impacts on greenhouse gas emissions from their manufacture). OSD-in-lieu charges would provide the flexibility to produce better environmental outcomes	Consider reviewing. Consider payment in lieu of OSD. Greater Taree Council have such an arrangement.	OSD has not been reviewed. Council will initiate a comprehensive review of the OSD policy as a stand alone project in the future.

		and would also facilitate the delivery of more effective stormwater management works elsewhere using the additional funds collected.		

3.4	Related DCP Chapters	It would be worth updating DCP Chapters E15 and E23 at the same time. There are several aspects of these chapters that interface with matters covered in Chapter E14. For instance, in regard to Chapter E15, a city-wide coordinated plan for GPTs would deliver maintenance benefits for Council (compared to GPT locations determined in an ad-hoc way on the basis of MUSIC modelling for fragmented sub-catchments pertaining to individual subdivision DAs) and would also help ensure funds spent on GPT maintenance derive the maximum environmental benefits in terms of keeping plastic out of the marine ecosystem. It would also be desirable to update Chapter E23 to reflect DPI-Water 2012 guidelines and the Biodiversity Conservation Act 2016.	Review other DCP chapters	Agree -E23 is currently under review DPI-Water 2012 guidelines and the Biodiversity Conservation Act 2016 have been considered in the reviewed chapter. E23 is planned to be on public exhibition in mid 2020. Chapter E15 - Water Sensitive Urban Design will be reviewed in the future following the completion of ongoing water quality management studies.

3.5	Drawings	Drawings – Standard Sumps & Inlet Pits The draft DCP refers to standards for sumps and inlet pits in 'Appendix 8'. This Appendix is not included in the draft document. It is suggested that a better option is to provide a link to standard drawings for sumps and inlets (and kerb types, vehicular crossings etc) on Council's website where they can be readily updated as appropriate.	Remove reference to Appendix 8 and place standard drawings on website	Agree. Updated.

Comment Number	Section	Comments	Summary	Response
1A	Medium Risk Precinct	1A. Council's DCP currently defines the Medium Risk Precinct as land subject to low-hydraulic hazard in the 1%AEP event, and below the 1%AEP + 500mm level. I strongly recommend that this be revised to be in-line with other Sydney LGA definitions, to be the 1%AEP low-hydraulic area (and remove the + 500mm clause). I note that: · The 1%AEP+500mm surface is a hypothetical surface that is not derived directly from modelling, is difficult to objectively map, and results in non-sensical results, refer following point; · In most of the flood studies I have undertaken to date in the Wollongong LGA, the Medium Risk precinct typically extends past the PMF extent. Thus, this definition regularly causes properties or parts of properties to be flagged as Medium Flood Risk when they are in fact outside of the floodplain. This is non-sensical. The PMF peak flowrate is typically 3 or 4 times the 1%AEP peak flowrate; thus, the 1%+500mm surface (often) corresponds to a flowrate that is massively larger (in the order of 300-400% larger) than the 1%AEP flowrate. I believe this staggeringly large factor of safety is unnecessary. · As a suggested compromise, the Medium Risk Precinct could perhaps be classed as the "1%AEP low hazard" area where the 1%AEP flowrates are factored upwards by some nominal amount (for instance, 10%). This could be readily undertaken in hydraulic models and give a (sensible) buffer for model uncertainties.	Remove 500mm freeboard. MRP often extends beyond the PMF. Suggest MRP could be classed as the 1%AEP low hazard and flow rates factored up (say by 10%)	1% plus 0.5m is the flood planning area, as defined by the department of planning. The 500mm freeboard allows for uncertainty. Regardless of the PMF level, the flood planning level is the 1% plus 500mm freeboard (for mainstream flooding). Therefore, properties beyond the floodplain maybe coded as MRP. For overland flow, Council proposes to allow 300mm freeboard.

1B	High Hazard	I understand Council are considering classifying the High-Risk precinct to correspond to 1%AEP High Hazard areas or areas classed as floodway. I suggest that the floodway definition correspond to a VD product of 0.6, in line with the ARR hazard definition for H3.	Including floodway - Use H3 =VD = 0.6	Agree
1C	High Hazard	1C. The current '10m from top-of-bank' definition for High-Risk precincts has similar problems to the "1%AEP + 500mm" definition noted above; for instance, land outside of the PMF extents can be classed as "High Flood Risk". I suggest that this clause be removed, and Council request (on a case by case basis), bed shear stress analysis for sites subject to erosion issues. I believe a site inspection can readily identify areas of waterways that are problematic with respect to bank slippage and/or erosion.	10m top of bank included in HRP. Remove. Council request bed shear stress analysis. A site inspection can readily identify areas of waterways that are problematic with respect to bank slippage and or/erosion.	Disagree. The 10m zone serves two purposes: 1. Allow for the reestablishment of riparian corridors. If creeks are built out to the banks, riparian corridors will never re-establish. 2. Provide a buffer for bank failure: Following the August 1998 floods, sections of Cabbage, Fairy, Towradgi, Hewitts and others were severely eroded. Engineered sections (Concrete lined and gabion) also failed and eroded. How can a site inspection identify a concrete

				lined channel that will fail? Council may reduce the 10m requirement if a geotech or geomorphologic assessment (by a suitably qualified person) details the extent of likely bank failure.
2A	Blockage Policy	I believe that the currently adopted (revised in May 2016) blockage policy was a positive step with respect to AEP neutral blockage parameters. I understand that Council are considering removing the Design Blockage Factors and only adopting the Risk Blockage Factors. I am extremely concerned that this is a backwards step, will skew AEP neutrality, and (from a modelling perspective) saves very little time. I strongly recommend that the Design and Risk blockage factors be maintained in their current form.	Maintain Design and Risk Factors. Does not save much time from a modelling perspective	For most flood affected areas in the LGA, the difference in flood level between the design and risk blockage factors is minimal. Where there are significant differences in flood levels between the design and risk factors: • Using different blockage factors to determine impact and planning levels is inequitable to the impacted lot. • The impact cannot be accommodated

				within the 500 mm freeboard.
3A	Offsite Impacts	I understand Council's "Risk Averse" position with respect to offsite flood impacts, but I strongly recommend that Council consider the following: · Sutherland Council are considering implementing a framework for determining the overall net impact of a development on flooding. This framework would look at both positive and negative flood impacts and allow some determination to be made as to the overall outcome. That is, is the balance of the proposal negative or positive. For instance, a development may result in flood level decreases on several residential lots, but cause increases (with no hazard changes) on a local road reserve. Overall, the proposal should be viewed in a positive light, rather than rejected due to "some negatives".	Sutherland shire are implementing a framework to determine overall net impact to balance negative and positive impacts.	Will consider. Council are interested to see what Sutherland produce and how it is implemented. The challenge may be to ensure such a framework is implemented consistently. Section 4.15 3A EPA Act states Councils must be flexible on prescriptive controls provided the objectives are met. DCP Chapter A1, Section 8 states *Variation to development control will be considered on a case by case basis and will only be considered where written justification is provided to the satisfaction of Council, that the*

				objectives of the development control have been achieved. Section 5, point 3 of DCP Chapter E13: Floodplain Management, also supports flexibility
3A	Offsite Impacts	On some occasions I have seen Council insist on maintaining existing flood behaviour with no consideration for overall long-term outcomes. In particular, existing solid obstructions within the floodplain are maintained in order to 'keep the status quo'. For instance, a new development is proposed to be completely elevated to allow the free passage of floodwaters underneath, this reduces flood levels upstream but increases flood levels downstream as the shielding effect of the original obstruction is removed. Council subsequently reject this proposal due to the downstream effects. I note that the elevation in downstream water levels is simply the water returning to its pre-urban flow regime, and should be ENCOURAGED not DISCOURAGED. It is staggering and discouraging that such short-term thinking can be applied in 2020! If all developments were encouraged to increase the conveyance capacity of the floodplain (either by elevating solid obstructions or otherwise), substantive benefits will occur over the longer term. In fact, the localised downstream 'impacts' will eventually disappear as more and more developments are approved with flood friendly designs, with watercourses and flowpaths reverting to something closer to their pre-urban state.	Allow designs which will increase the conveyance capacity of the floodplain into the future (even if there are "short term" impacts)	The Wollongong LGA has many legacy issues related to flooding. Council implements voluntary house raising and voluntary purchase scheme. Permitting downstream impacts in such circumstances, regardless of the perceived strategic benefit, will lead to poor outcomes for downstream properties.

Comment Number	Section	Comments	Summary	Response
11 to 18	Floodways	Unworkable Classification of Floodway's, and the inclusion of Floodway's into the High Flood Risk Precinct	Floodway definition has not been tested/ Do not add floodway terminology to the dcp	
19 to 23	Objectives	Maintain flood regime	include maintain or improve	Agree however the definition in the Draft DCP is consistent with the LEP..
24 to 28	High Flood Risk Precint or Floodways	To prevent any intensification of the use of High Flood Risk Precinct or floodways, and wherever appropriate and possible, allow for their conversion to natural waterway corridors. No development can meet this objective. For example, let's say we have a suburb that is entirely flood-free, except for a sports field that is adjacent to a creek. This sports field is a High Flood Risk Precinct. Approving the higher, flood-free development still acts to intensify the use of the High Flood Risk Precinct. By approving 1,000 new homes in this suburb, there will be many more children using the playing field which intensifies the use.	Need to better define intensification	Agree - intensification is difficult quantify and there are a lot of grey areas including your example.
29 to 32	Unworkable class with LEP	Overland flow is now defined however clashes with the LEP.	The LEP definition overrides the DCP	Overland flow is not defined in the LEP however the controls placed on overland flow paths is broadly consistent with other LGAs (e.g. Northern

				Beaches, Inner West, City of Sydney)
33 to 46	Unworkable impacts	Spatial and temporal impacts not considered		Temporal impacts are not accounted for in the DCP, however all assessment it merit based. Section 4.15 3A EPA Act – Councils must be flexible the prescriptive controls provided the objectives are met. DCP Chapter A1: Section 8 states *variation to development control will be considered on a case by case basis and will only be considered where written justification is provided to the satisfaction of Council, that the objectives of the development control have been achieved*

				. Section 5, point 3 of DCP Chapter E13: Floodplain Management, also supports flexibility
33 to 46	Unworkable impacts	Ignores merit based approach e.g. - if a development was proposed that increased flood levels within a watercourse/riparian area by 100 mm, but those increases did not extend to any dwellings or infrastructure.		Section 4.15 3A EPA Act – Councils must be flexible the prescriptive controls provided the objectives are met. DCP Chapter A1: Section 8 states *variation to development control will be considered on a case by case basis and will only be considered where written justification is provided to the satisfaction of Council, that the objectives of the*

				development control have been achieved . Section 5, point 3 of DCP Chapter E13: Floodplain Management, also supports flexibility

47 to 60	Culvert Blockage	Risk factors are not AEP neutral. It remains the case that the adoption of 'risk management' blockage factors are technically unsupportable, and Council's own technical document underpinning the derivation of risk management factors is emphatically clear; these factors are not AEP neutral and do not produce a flood of the intended AEP. At the Industry Forum, it was said by Council that some testing was carried out on this matter, and that the difference between the peak flood levels resulting from the application of design or risk management factors was typically minor across the LGA. This being the case, Council says "why not" just adopt the risk management factors? The answer is clear. The DCP is an engineering document. There is no engineering merit attributable to the adoption of risk management factors. Adopting design factors has succinct engineering merit; as they are the closer of the two factors necessary to produce an AEP neutral flood surface.	Opposes Risk blockage factor	For most flood affected areas in the LGA, the difference in flood level between the design and risk blockage factors is minimal. Where there are significant differences in flood levels between the design and risk factors: • Using different blockage factors to determine impact and planning levels is inequitable to the impacted lot. • The impact cannot be accommodated within the 500 mm freeboard.
47 to 60	Culvert Blockage	Finally, even where the 'risk management' factors are adopted, they still need urgent review because they were determined from the ARR87 IFD data. No matter if the BOM 2019 IFD data is used, or the OEH 2018 IFD set that was specifically configured for our region, the IFD values are considerably lower than the ARR87 estimates and therefore will provide for lower blockage factors.		Disagree - blockage factors are based on observations from historic events. The AEP of these events is unlikely to change the blockage factors

Comment Number		Section	Comments	Summary	Response/Actions
	E13				
1		3 - Objectives	Ensure new development must, as far as practical, reduce the existing flood risk, and in no circumstances should the flood risk be worsened.' This is a vital aim in this draft and, hopefully, WCC will strictly enforce this clause.	Supports	
2		4 - Definitions	Comments related to William Street	Supports	May be considered in the Fairy Cabbage FRMS/P
3		6 - Flood Studies	Comments related to William Street	Supports	May be considered in the FRMS/P
4		6.2 - Conduit Blockage	Comments related to William Street	Supports	May be considered in the FRMS/P
5		6.3 - Modelling of Buildings	How will Council ensure that open areas under buildings are not enclosed in the future and open areas under the building do not become blocked from stored items and trapped debris?	Supports	The proposed modelling and restriction on title will prevent such a situation causing adverse impacts

6		Buildings including decks will not be permitted over watercourses'. This is a good, practical clause. However, what about buildings that have decks being permitted over flood prone land - could this be included also. One reason this needs consideration is the possible areas being used for storage areas or even being enclosed in the future.	Supports	Noted. No action required
7		Overland flow ……. . ……. Where a watercourse has been filled or piped, flooding resulting from overflows from the filled/piped watercourse is considered mainstream flooding and not overland flow.' If Council installed the pipes in the watercourse and the water going through the pipes is from overland runoff, will this still be mainstream flooding?	Supports	Noted. No action required
8		The prescriptive controls are preferred ways of achieving the outcome. While adherence to the prescriptive controls may be important, it is paramount that the objectives and the performance criteria are clearly satisfied.' This is certainly most important.	Supports	Noted. No action required

9		Development should not detrimentally increase the potential flood affectation on other development or properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain.' Incremental increase in water runoff and subsequent problems? Well done, Council, for including this clause.	Supports	Noted. No action required
10		Development should not result in impacts upon the amenity of an area by way of unacceptable - - - overshadowing-of adjoining-properties,privacy impacts (eg by unsympathetic house-raising) or bybeing incompatible with the streetscape or character of the locality.' Congratulations ajain to -- - - - - Council for including this clause.	Supports	Noted. No action required
11		Items 1 and 2 - It is pleasing to note that an 'Engineer's report is required to certify that the development will not increase flood affectation elsewhere, includes medium and high density residential proposals' and that 'The impact of the development on flooding elsewhere to be considered includes low density residential'.	Supports	Noted. No action required

12		Points 1 to 4 appreciated and particularly Point 5 where 'No external storage of materials below the flood planning level which may cause pollution or be potentially hazardousduring any flood.' Please see note on previous page under '6.3 Modelling of Building - page 10'.	Supports	Noted. No action required
	E14			
14		In this section it is again heartening to read that the objectives include 'Reducing the probability of downstream flooding; ....such that no increase in stormwater peak flows occurs downstream; Reduce peak run-off flows from urban developments by local detention basins and minimising impervious areas, wherever practicable.	Supports	Noted. No action required
		Several comments specific to William and Lang Street		May be considered in the FRMS
15		OSD requirements generally apply to all types of development and redevelopment on both flood prone and flood free sites. However, the storage requirement is reduced in flood prone areas (Refer Section 10.2.2).' I have read Section 10.2.2, but cannot see why storage requirement should be reduced in flood prone areas. I would have thought it would have been the opposite. Why would storage be reduced in flood prone areas? Would Council please explain why this is so, in case I have misread or misinterpreted this section.	Clarification wanted	OSD storages are ineffective in areas that are affected by frequent flooding. Also detaining stormwater runoff from a flood effected property may acaully worsen flooding by poternitally aligning flood peaks.

16		As all land inundated in a 5r ARI is effectively impervious once flooded, development on such land is excluded from this Policy, irrespective of its location in the catchment.' Does this mean that if land if flooded on average every five years, it cannot be built on, ie developed?	Clarification wanted	No, it means no OSD is not required on such land - other controls will control flood levels and permissible development,
17		This page summarises and sets out the steps involved in this process. With regard to the steps involving Detailed Design and Construction Certificate/Engineering Plan Approval, I would be much happier if private certifiers were not permitted to be involved in this and that only council certifiers were empowered to deal with and approve these steps.		Noted. No action required
18		Paragraphs a), b) and c) appear to be important points and also the very last paragraph under 'Note: Under normal circumstances .....' regarding Council requiring demolition of any unsuitable structures, etc and especially any variations from the approved plans. it would seem preferable 'to have any variations certified only by a Council engineer or similarly qualified Council officer.		Noted. No action required

19		Council officers are to be congratulated on the work and thought that has been put into this document. It is great to hear that Council will establish a current register of OSDs and carry out regular maintenance checks. As well as an ongoing register of OSDs, would it be possible to make up a register of OSDs that have been approved by Council in previous years. OSDs have been included in developments over a number of years and it could be that many of these now need maintenance on them before, if malfunctioning, they have an adverse effect on surrounding properties. - ' Thank you-again-for the-opportunity tp read through and comment on the E13 and E14 Chapters.		No the OSD policy has not changed. A register still needs to be established and maintained.

Comment	Section	Response
1	It is recommended that consideration of the affect of climate change on flood risk is addressed in the DCP in accordance with the NSW Floodplain Development Manual (FDM) and recommendations from WCC's Mullet and Brooks Creeks Floodplain Risk Management Study & Plan (2010).	Prescriptive controls from Mullet Creek and Brookes FRMS/P are incorporated into DCP and continue to be applied. An LGA wide approach to climate change will be incorporated into Stage Two of the DCP review as Council reviews all Floodplain Management Studies and Plans.
2	Exceptional circumstances for controls above the FPL is not reflected in WCCs Local Environmental Plan (LEP). It is recommended that WCC's LEP is updated to ensure such controls are not open to contention.	This review is only concerned with the DCP Chapters E13 and E14. Council understands DPIE is currently reviewing Flood prone Land Ministerial Direction. Council will update the LEP Clauses pending the reviewing Flood prone Land Ministerial Direction.
3	Section 2 1 Seemingly contradicts s1(c) which states controls are also applied above the FPA	Both apply to floodplain and land below the flood planning area.

4	Regarding Section 4 Definitions. The Floodway Areas defines the floodway as area above a DxV of 0.4m2/s. DPIE is in the process of writing a Floodway definition guide. It is recommended that WCC consider referencing this guide rather than specifying DxV value. As this guide has not yet been released, in the interim WCC could refer to the DPIE paper "Improving Guidance for Councils and Committees on Floodplain Management in NSW" (FMA Conference 2019).	More flexibility permitted to define floodways.
5	Section 6 Last paragraph - consider adding recommendation to calibrate to WCCs adopted FRMS&P or FS where available.	Included.
6	Section 6.2di – Consider changing wording from overland flow paths as this contradicts the definition and may cause confusion.	changes to flow paths.
7	Section 6.2 fii – Suggest moving weir from f) ii) into f) i).	Changed.
8	Section 7.3.3.aiii – Suggest specifying the relevant event for floodway definition. Suggest also including critical flood storage in High Flood Risk Precinct to allow consideration of any critical flood storages to be undertaken in future Flood Risk Management Study & Plans (FRMS&P's).	Floodways definition for unstudied catchments to be more flexible.
9	Section 7.3.4: a. Suggest replacing "rather than" with "as an alternative to" b. Suggest replacing "will transition…." With "may review how it considers flood risk in land use planning."	Amended.

10	Section 7.4.1 d – In order to strengthen both the objective 1b) of the DCP & Section 6.5 WCC could consider removing floodways and adding an additional dotpoint "To prevent any alteration of floodways and flow conveyance within floodways."	Council considers floodway controls strong: Floodways are included in the high flood risk precinct and further controls floodway controls are included in the LEP.
11	Table 2. It is recommended that WCC consider whether this allowance is enforceable for government infrastructure projects and if this is the appropriate planning mechanism to define them? Are these thresholds appropriate in all situations. It may be more appropriate to apply a merit-based approach.	A merit based approach is applied to all flood related matters. The DCP provides a guide only for these specific types of projects.
12	Section 8 1 – In order to strengthen both the objective 1b) of the DCP & Section 6.5 WCC could consider adding a new dot point (first dot point) "The area is outside of the floodway"	Council considers floodway controls strong: Floodways are included in the high flood risk precinct and further controls floodway controls are included in the LEP.
13	Section 8 2 – Suggest replacing levels with behaviour	Replaced.
14	Section 8 2 - How would this requirement be undertaken for an individual development? What trigger would enact this requirement? Is it a reasonable requirement for all levels of development? It is recommended that this type of assessment is undertaken on a catchment wide scale in future FRMS&P's.	Agree this should be undertaken FRMS&Ps however Council has many flood prone areas which are unstudied. While difficult to implement, Council considers this the only appropriate way to assess cumulative impact on unstudied catchments.
15	Prescriptive Control Matrices - In order to strengthen both the objective 1b) of the DCP & Section 6.5 WCC could consider adding a note to all matrices noting that "No alteration of floodways will be permitted."	Council considers floodway controls strong: Floodways are included in the high flood risk precinct and further controls floodway controls are included in the LEP.

16	Have SES been invited to comment on the DCP review? If not it is suggested that they are contacted for comment.	Yes.

Comment Number	Section	Comments	Response
1	All	At its meeting on Wednesday 11th December 2019 the Forum resolved to request Council to engage a suitably experienced locally-based consultant to review and report on necessary and proposed changes to DCP 2009 Chapters E13 & E14, and the report be placed on public exhibition to enable informed submissions by residents, and subsequently to assist Councillors in deliberating and deciding on changes to the DCP.	Council has consulted widely with industry and State Government. The proposed technical changes are considered relatively minor. The scope of such a review is unclear. Additionally Council believes suitably qualified local consultants may be conflicted as they generally work on private developments.