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Chapter 1

Introduction

1.1 Where the DCP applies

This Plan was adopted by Council on 26 April 2005 and applies to all land within the Ku-ring-gai Local Government Area and to all new development on private and public land that requires consent from Council and that, following consent, will involve the undertaking of physical work on a site.

1.2 Purpose of the Plan

This plan has been developed in order to clearly communicate Council's requirements for development with respect to water management so as to:

- facilitate the consistent and timely merit-based assessment of development proposals;
- provide certainty for the long-term viability of water management measures employed in Ku-ring-gai;
- facilitate attractive, sustainable and affordable development that relates well to the built and natural environments and that suits a range of needs;
- ensure the long-term viability of natural watercourses, ecosystems and habitats in Ku-ring-gai and beyond; and
- enhance the liveability of Ku-ring-gai.

1.3 Objectives of the Plan

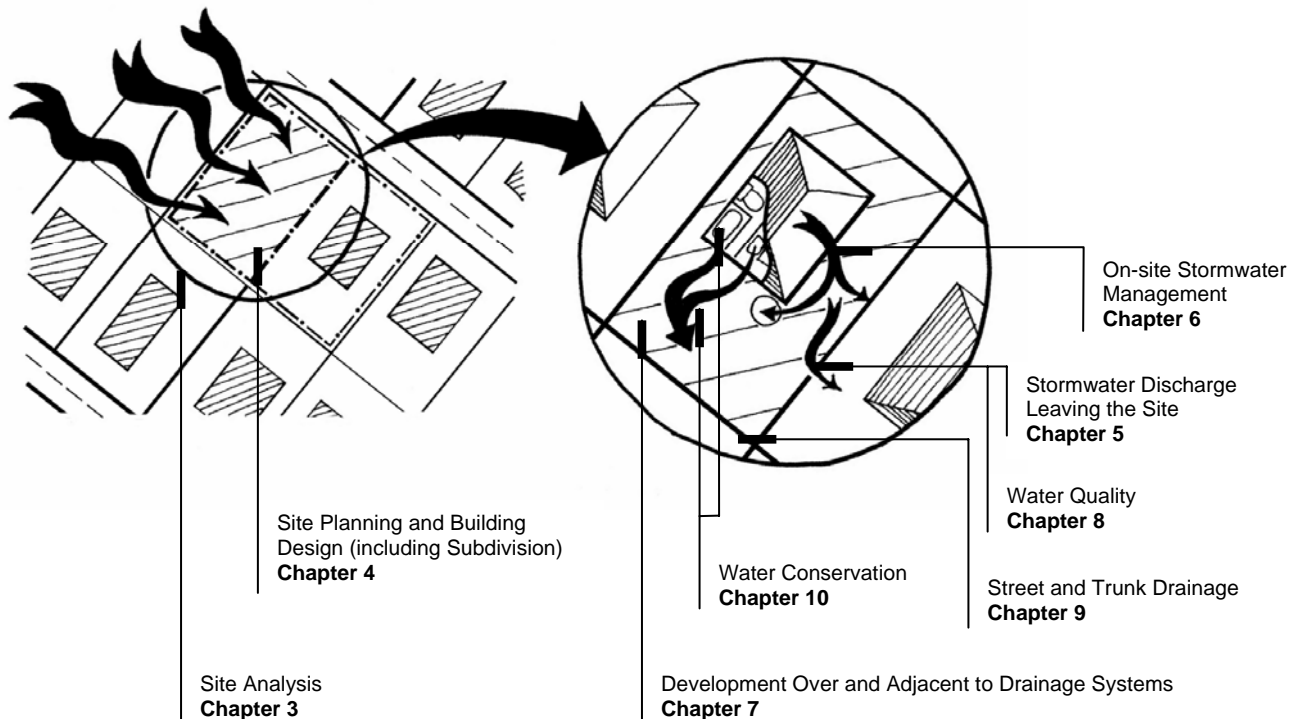
The objectives of this DCP are:

- A. Water management that is appropriate to the site and its surroundings and that is integrated into the overall design of the development.
- B. Sustainable management and use of water in Ku-ring-gai.
- C. Management and conservation of natural and built waterways and natural assets in the catchments.
- D. Maintenance or enhancement of the predominant landscape quality of Ku-ring-gai.
- E. An urban environment with a high standard of residential amenity and safety.
- F. Development application plans and documentation that are of a high standard.
- G. Development that meets all environmental, planning and Council requirements.

1.4 How to use the Plan

This Plan is designed to ensure that the water management techniques employed for any given development are appropriate to both the site and the works. The Plan therefore applies different controls to different situations and must be followed from the start of the design process.

For all development to which this DCP applies, the first requirement is an analysis of the site and surrounds as described in Council's *DA Guide*. The information obtained in the analysis of the site should then be used to work through Chapter 3. Chapter 3 is the key chapter of the DCP and the outcomes of decisions made in working through this chapter determine the way in which the remainder of the DCP is used.



1.5 Can the Plan be varied?

A development control plan contains requirements for development against which a proposal will be assessed when submitted to Council. Variations to the controls may be acceptable, provided the applicant is able to demonstrate compliance with the objectives of the Plan.

Council encourages innovative water management techniques where they are demonstrated to fulfil the DCP's objectives. Where the developer proposes an alternative method to that required by this DCP, Council will consider the proposal on its merits.

1.6 Relationship of this Plan to other documents

The provisions of this Plan should be read in conjunction with Council's principal environmental planning instrument, the *Ku-ring-gai Planning Scheme Ordinance*, together with any relevant site-specific Local Environmental Plan (LEP) or Development Control Plan (DCP) and any of the following DCPs, Codes and Policies that apply to the development proposed:

- Development Control Plan No. 38 - Ku-ring-gai Residential Design Manual
- Development Control Plan No. 40 – Construction and Demolition Waste Management
- Development Control Code 1/2003 – Housing for Older People and People with a Disability
- Dual Occupancy Development Control Code

- Development Control Plan No. 48 – Medium Density Development
- Car Parking Code
- Landscape Policy
- Weed Management Policy
- Subdivision Code
- Schools Development Control Code
- Development Control Plan No. 14 – Development in Business Zones
- DCP 55 – Ku-ring-gai Multi-unit Housing, Railway / Pacific Highway Corridor and St Ives Centre
- Childcare Centres DCP
- any relevant site-specific DCPs

Note: When undertaking a development or work, it is important to check with Council to ensure that all necessary LEPs, DCPs, codes and policies are identified. This information is available by obtaining a section 149 certificate from Council.

In the event of a conflict between any Council documents in matters relating to water management this document takes precedence.

1.7 Relationship to BASIX

The controls in this document have been developed so as to be consistent with the web-based assessment tool, Building Sustainability Index (BASIX), which has been developed by the State Government's Department of Infrastructure, Planning and Natural Resources. BASIX facilitates assessment of the sustainability of a development proposal in the context of a number of themes including water and stormwater.

This DCP is intended as a complementary document to BASIX.

1.8 Environmental values of Ku-ring-gai

Ku-ring-gai has one of the highest rainfalls in the Sydney Basin. This, coupled with a steeply dissected topography, means that stormwater in the upper catchments of Ku-ring-gai can achieve high flow velocities, which can easily lead to erosion of soils and other sediments.

Ku-ring-gai contains a range of different soils and vegetation communities, including three communities that are listed as 'endangered'. Stormwater in Ku-ring-gai's urban areas commonly passes through bushland (including National Parks).

These issues need to be considered when development is being designed in Ku-ring-gai.

1.9 Submission requirements

The information that must be submitted with a development application depends on the nature of the proposal and the site. A table showing submission requirements is included at Appendix 13.

Chapter 2

Dictionary of Definitions

Adjacent means adjoining.

Adjoining Land means land that has a boundary in common with the site on which the development is proposed or that is separated from the site by not more than a pathway, driveway, laneway, roadway or similar thoroughfare.

Afflux is the rise in water level in a stream, channel or flow path caused by a constriction or impediment downstream.

AHD stands for Australian Height Datum, which is the level from which heights in Australia are measured and which is based upon an approximation of mean sea level.

Aquatic Habitat means the natural home of marine or freshwater animals, plants or organisms.

ARI stands for Average Recurrence Interval.

Average Recurrence Interval means the long term average number of years between floods which will equal or exceed the selected event.

Backwater means that part of a stream, channel or flowpath where the water is kept back due to some controlling influence or obstruction downstream.

Bank refers, in this DCP, to the primary bank of a waterbody.

Building includes a structure or part of a permanent building or structure but not a manufactured home, a moveable dwelling or associated structure or part thereof.

Built-upon Area means impervious area generating runoff and is defined as the area of a site containing any built structure (whether covered or uncovered), any building, carport, terrace or pergola, hard-surface recreation area, swimming pool, tennis court, driveway, parking area or any likely structure, but excluding minor landscape features.

Bushland is land on which there is vegetation which is either a remainder of the natural vegetation of the land or, if altered, is still representative of the structure and flora of the natural vegetation.

Catchment means an area of land from which all runoff water flows to the same low point in a waterbody or drainage depression (creek, river, harbour, etc) and always relates to a specific location.

Conservation means the use, management and protection of resources so that they are not degraded, depleted or wasted and are available on a sustainable basis for present and future generations.

Cut and Fill means earthworks undertaken to alter the slope or level of the natural land.

DCP stands for Development Control Plan.

Drainage Easements are the legal rights attached to land whereby another parcel of land has the right to use part or all of the land for the purpose of draining water.

Drainage Reserves are the lands vested in Council for drainage purposes.

Dripline of a Tree means the horizontal extent of the canopy of the tree.

Dwelling means a room or suite of rooms occupied, used, constructed or adapted so as to be capable of being occupied or used as a separate domicile.

Erosion Control Devices are measures to assist in minimising erosion at a site and downstream sedimentation.

First Flush is the first rainfall after a dry period.

Flood means a relatively high stream flow that overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or overland runoff before entering a waterbody.

Flood Standard Conveyance Zone means the zone in a plan view of the 1:100 year flow through the property.

Footpath means the part of a road reserve that is set aside or formed as a path or way for pedestrian traffic.

Greywater is household wastewater that has not come into contact with toilet waste.

Gross Pollutant means litter and debris that is transported by urban runoff and that is not less than 5mm in diameter and/or is retained by a 5mm mesh screen.

Gross Pollutant Trap (GPT) is a structure that acts as a water pollution control measure by intercepting and retaining gross pollutants (coarse sediment, trash and debris).

Ground Level means the level of the site before development is carried out on the site under this Plan. This does not include any level that has been created without the approval of the Council where this would otherwise be required.

Holding Berm means a small bank for retaining water.

Hydraulics means the study of flow of fluid. In civil engineering, this concerns mainly flow of water in waterways – in particular, the changes in flow parameters such as water level and velocity.

Hydrology means the study of water as it relates to rainfall and the runoff process – in particular, catchment behaviour, flow rates and volumes.

Immediately Adjacent has the same meaning as 'adjacent'.

Impervious means land or material that is not readily penetrable by water.

Invert means the lowest point of a channel or gutter, or the internal base of a pipe.

Litter means all material of human origin that is capable of being mobilised by stormwater runoff.

Nutrients are substances that provide nourishment to another organism. In the context of stormwater, they consist primarily of Total Phosphorus (filterable phosphorus and particulate phosphorus) and Total Nitrogen (nitrates, nitrites, ammonium compounds and organically bound nitrogen compounds).

Obvert means the internal top of the pipe or other enclosed drainage system.

On-site Detention is a device used to control the rate of stormwater runoff in order to reduce peak discharges during storm events.

On-site Retention is a device that controls the rate and volume of stormwater runoff to reduce peak and total volume discharges during and after storm events by ensuring that water is reused on the site.

Orifice means a narrow opening into a pipe or cavity.

Peak Discharge means the maximum discharge occurring during a flood event.

Permitted Site Discharge is the controlled rate of runoff allowed from a site.

Pervious means land or material that is penetrable by water.

Planning for Bushfire Protection means the publication produced by the NSW Rural Fire Service and PlanningNSW to provide guidance to Councils, planners, fire authorities, developers and home owners with regard to bushfire protection strategies.

Pollutant means a substance that adversely affects the physical, chemical or biological properties of the environment.

Potable means drinkable.

Recognised Public Drainage System means a common stormwater drainage system that conveys public stormwater and that generally includes one or more of the following: street drainage comprising surface systems (formed and unformed kerb and gutter, earth channels); underground systems (pipes, road pits, headwalls, inlets and outlets); natural and constructed open channels.

Riparian Zone is the area of vegetation located on the bank of a natural watercourse, such as a river, where the flows of energy, matter, and species are most closely related to water dynamics.

Runoff is the rainfall that ends up as stormwater.

Sediment means solid material, either mineral or organic, that is in suspension, is being transported, or has been moved from its site of origin by air, wind, water or gravity.

Sewerage means the arrangement of pipes that transports sewage.

Site Area means the area of land contained within the title boundaries of the site or the area of the property on which the development is proposed to be carried out. Site area excludes an access corridor to the site such as the area of any access handle in the case of battle-axe (hatchet) shaped allotments.

Stormwater means untreated rain water that runs off the land onto which it falls.

Sydney Water means Sydney Water Corporation or any organization that replaces it.

Terrestrial Habitat means the natural habitat of organisms that live on land.

Total Suspended Solids are the inorganic and organic particles suspended in the water column. They can be defined as the filterable residue retained on a 2.0 µm pore size filter dried at 105°C.

Trunk Drainage is the stormwater drainage system that links property, interallotment and street drainage with the receiving waters.

Wastewater means sewage, and can be greywater or water that is contaminated by human or commercial processes, and includes water from a domestic pool.

Waterbody means a river (being a stream, whether perennial or intermittent, flowing in a natural channel, or in a natural channel that has been artificially modified, or in an artificial channel which has changed the course of a stream), a branch of the river, an estuary, tidal waters, a lake, a pond, an inlet, a bay, a lagoon or an artificial waterbody.

Chapter 3

Determining Development Type and Location

3.1 Site and development specific design

This Plan has been designed to ensure that water management techniques employed in any new development in Ku-ring-gai are appropriate both to the site and the type of development. Rather than proposing a standard set of controls to be applied to all development, the Plan recognises that the water management requirements will differ between developments and therefore proposes a different set of controls for each situation. This chapter helps to determine the Development Type (number) and Location (letter) that are required to use the DCP.

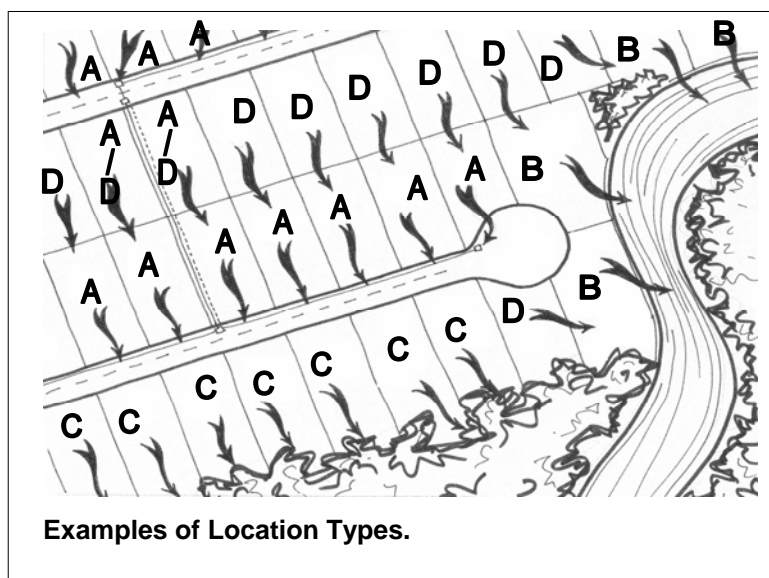
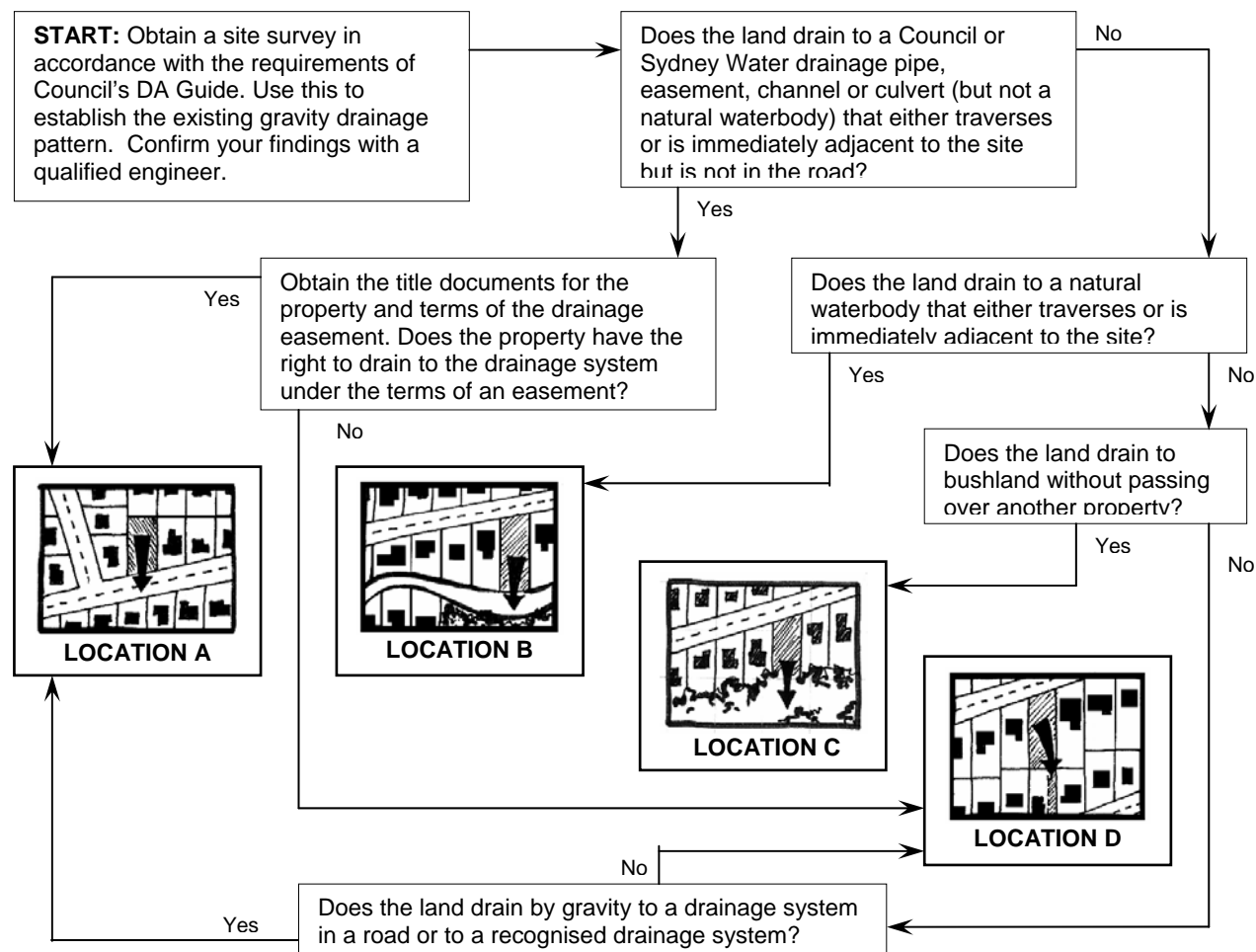
3.2 Development Type

The first step in determining the controls relevant to the development is to select the Type from those listed below (1-9) that best represents the development proposed. Note that Type 9 is for any other development type not listed in the previous eight categories. The majority of controls applicable to this type of development will be determined by Council on an individual basis in consultation with the developer.

- | | |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type 1 | Minor alterations and additions - any alteration or addition to a single detached dwelling where the net increase in built upon area is 100m ² or less. |
| Type 2 | Major alterations and additions - any alteration or addition to a single detached dwelling where the net increase in built upon area is more than 100m ² . |
| Type 3 | New single dwellings including replacement single dwellings. |
| Type 4 | Dual Occupancies - two dwellings on one allotment (either attached or detached), where either one or both of the dwellings are new. |
| Type 5 | Multi Unit Development - any development involving three or more dwellings on one allotment, regardless of the size of the allotment and regardless of whether the dwellings are attached or detached. Includes SEPP 5 housing and residential flat buildings. |
| Type 6 | Business, commercial or retail premises - any building to be used for business, commercial or retail purposes, including professional consulting rooms and mixed developments. |
| Type 7 | Open Space - land used exclusively for recreational purposes, whether passive or active recreation, including any buildings erected on the land, where the land is primarily permeable and landscaped. |
| Type 8 | Subdivision |
| Type 9 | Any Other Development |

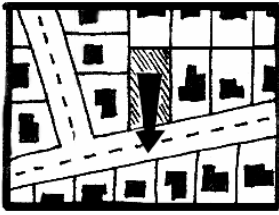
3.3 Location of Development

The next step is to determine which of the following situations (Locations A – D) described below most closely resembles the location of the development site with respect to the natural drainage direction of **stormwater**. You may determine this by working through the flow chart below and check against the example below and the full descriptions on the following page.



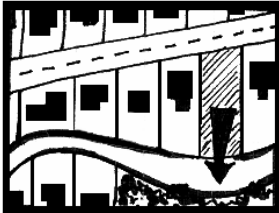
It is extremely important to determine accurately which Location category best describes the subject property, as this will affect the way you use this document. A full description of each of the Locations is provided on the following page.

Where determination of the Location is not straightforward, Council may require you to justify your determination on the Location category by providing documentation. If in doubt, refer to the Objectives of this DCP in Section 1.3.



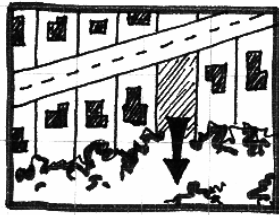
Location A

Land that drains directly to a Council or Sydney Water drainage system in the road or drainage reserve (including a gutter, pipe or road) without the need for stormwater runoff to pass over another private property. This includes land traversed by or immediately adjoining a trunk drainage system where a legal right to connect already exists.



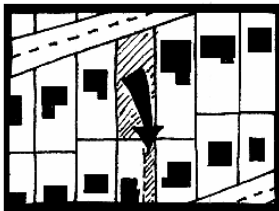
Location B

Land that drains directly to a natural waterbody (see Dictionary of Definitions) that traverses (crosses) or intersects the subject site. At least one bank of the waterbody must be located within or immediately adjacent to the subject site.



Location C

Land that drains directly to bushland.







Location D

Any other land, being land that must pass its stormwater over one or more intervening downstream private properties or public land to reach a recognised drainage system in a road reserve, drainage reserve or waterbody. This includes land where a private drainage easement is required (whether or not this has been obtained) and properties that are traversed by or immediately adjoining a trunk drainage system where there is no existing legal right to connect to the system.

3.4 Using the Development Type and Location determinations

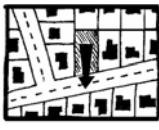



Most chapters in the DCP begin with a table such as the one below that shows you which sections of that chapter will be relevant to your development.

| |  A |  B |  C |  D |
|---------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Type 1 | sample table only | | | |
| Type 2 | | sample table only | | |
| Type 3 | | | sample table only | |
| Type 4 | | | | sample table only |
| Type 5 | sample table only | | | |
| Type 6 | | sample table only | | |
| Type 7 | | | sample table only | |
| Type 8 | | | | sample table only |
| Type 9 | sample table only | | | |

Chapter 4

Site Planning and Building Design

In this chapter, the following sections are relevant to your development (see Chapter 3 for explanation):

| |  A |  B |  C |  D |
|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Type 1 | all except 4.3 and 4.4.1 | all except 4.3 and 4.4.1 | all except 4.3 and 4.4.1 | all except 4.3 and 4.4.1 |
| Type 2 | all except 4.3 and 4.4.1 | all except 4.3 and 4.4.1 | all except 4.3 and 4.4.1 | all except 4.3 and 4.4.1 |
| Type 3 | all except 4.3 | all except 4.3 | all except 4.3 | all except 4.3 |
| Type 4 | all except 4.3 | all except 4.3 | all except 4.3 | all except 4.3 |
| Type 5 | all except 4.3 | all except 4.3 | all except 4.3 | all except 4.3 |
| Type 6 | all except 4.3 | all except 4.3 | all except 4.3 | all except 4.3 |
| Type 7 | all except 4.3 | all except 4.3 | all except 4.3 | all except 4.3 |
| Type 8 | all except 4.4 and 4.5 | all except 4.4 and 4.5 | all except 4.4 and 4.5 | all except 4.4 and 4.5 |
| Type 9 | all except 4.3 | all except 4.3 | all except 4.3 | all except 4.3 |

4.1 Designing with site opportunities and constraints

This chapter requires the developer to plan the site and design the buildings based upon the information obtained through site analyses in order to ensure that the development appropriately provides for water management with minimal adverse impact on the environment and residential amenity.

Good design is concerned with how development affects the lifestyles of residents and the surrounding natural and built environments. It recognises design problems and opportunities inherent in a given location and considers such issues as housing density, water and waste management and habitats at the earliest stages of the design process.

New development should have little adverse impact on the environment. To ensure this, the designer must use the site analysis information obtained in accordance with Council's *DA Guide* to create a good relationship between the development and the site and surrounds. The analysis information tells the designer which aspects of the site may be altered, eliminated, covered up or used. It is important to note that good design need not be expensive and can be cheaper for residents in the long term.

4.2 Chapter Objectives

1. Site planning and building design that preserve, enhance and complement existing environmental, social and aesthetic conditions within and external to the site.
2. Water management measures that are complementary to the proposed development.
3. Water management measures that support and enhance sustainability and improve the natural environment.

4.3 Subdivision planning and design

New subdivision in Ku-ring-gai should be designed so as to ensure that buildings and other development on the site will complement the natural and existing drainage systems. Good subdivision design entails taking into consideration the existing features of the site and, where possible, uses new built elements for multiple functions.

4.3.1 General controls for subdivision planning

The design and layout of the subdivision shall conform to the minimum lot size and other requirements contained in Council's adopted Subdivision Code 1972 (amended 1983) and shall ensure that:

- a) the drainage network relates to the existing topography of the site, but does not include any natural waterbodies;
Note: Relocation or realignment of a waterbody is not permitted.
- b) each allotment will protect the integrity of any natural riparian zone; and
- c) each allotment is able to drain by gravity to a recognised drainage system; and
- d) soil erosion, alterations to natural site drainage, land instability, the need for retaining walls, site excavation and cut and fill are minimised.

4.3.2 Controls for road layout and design

The design and layout of roads must minimise disturbance to landforms, natural watercourses and vegetation and will also incorporate effective stormwater management. In order to achieve this:





- a) carriageways shall be designed in accordance with Council's adopted Subdivision Code;
- b) roads shall not be constructed along natural drainage lines or within riparian zones;
- c) new road networks shall be designed so that all development fronts onto riparian land (rather than backing onto it);
- d) where possible, the road layout and streetscape design shall be recognised as part of the (artificial) drainage network and shall be designed so as to incorporate opportunities for storage and treatment of stormwater runoff;
- e) for the purposes of stormwater and bushfire management, where possible, perimeter roads shall be provided to open space areas;
- f) road segments will be minimised so as to reduce runoff length;
- g) roads will be aligned to avoid steep gradients so as to minimise runoff velocities;
- h) soil erosion, alterations to natural site drainage, land instability, the need for retaining walls, site excavation and cut and fill shall be minimised;
- i) the design of road cross-sections shall accommodate stormwater runoff events without increased risk of flooding on adjoining properties;
- j) the use of public roads for the purpose of stormwater management shall not impair the safety of vehicles or pedestrians;
- k) any drainage system that forms part of a road and trunk drainage system in proposed subdivision must cater for the 1:20 year storm;
- l) adequate provision must be made for the conveyance of the stormwater representing the difference between the 1:20 and 1:100 year storms;
- m) road design shall incorporate stormwater management techniques for the deceleration, detention, infiltration and cleansing of stormwater (as specified in elsewhere in this DCP); and
- n) new road and trunk drainage systems shall be designed in accordance with Chapter 9.

4.4 Designing the development

Good decision making about the location of a new development (or a new part of a development) and the actual design of the development requires a proper analysis of the site opportunities and constraints. In order to ensure a net positive impact on the environment (including social aspects), it is best that the designer works with the existing features and constraints of the site (rather than ignoring them or battling against them) to ensure a cohesive outcome.

4.4.1 Controls for maximum built-upon (impervious) area

One of the most important aspects of designing a development is ensuring that the built-upon area (impervious area generating runoff) is appropriate. Built-upon area refers to any area generating stormwater runoff – see also Chapter 2. The maximum built-upon area for development is:

| |  A |  B |  C |  D |
|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Type 1 | 60% unless otherwise stated in DCP 38 under built-upon area provisions | 60% unless otherwise stated in DCP 38 under built-upon area provisions | 35% or not greater than the existing, whichever is the greater | 60% unless otherwise stated in DCP 38 built-upon area provisions or in 5.7.7 of this DCP |
| Type 2 | | | | |
| Type 3 | | | 35% | |
| Type 4 | 60% except where Dual Occ Code requires less | 60% except where Dual Occ Code requires less | 35% | 60% except where Dual Occ Code requires less |
| Type 5 | 60% | 60% | 35% | 60% |
| Type 6 | 100% | 100% | 35% | generally 100% |
| Type 7 | determined on merit | determined on merit | 35% | determined on merit |
| Type 8 | not applicable | not applicable | not applicable | not applicable |
| Type 9 | determined on merit | determined on merit | 35% | determined on merit |

Note: Where development already exists on the site and is to remain in part or in full, the site analysis carried out prior to the design process (see Council's *DA Guide*) must identify the existing percentage built-upon area.

4.4.2 Controls for locating the development on the site

Buildings must be located on properties in accordance with the requirements of the *Ku-ring-gai Planning Scheme Ordinance* and other relevant DCPs and in accordance with the following listed controls:

- The development shall not be located so as to impede, divert or increase the rate or concentration of stormwater flow across a boundary onto adjoining private property (eg. by placing a solid wall along a boundary).
- Sufficient space must be allowed on the property for the installation and operation of water management measures as required in this DCP.**
- With the exception of development consistent with the controls in Chapter 7 of this DCP, no part of the development or associated services may be located within:
 - 50 metres of a Category 1 Environmental Corridor, or
 - 30 metres of a Category 2 Terrestrial and Aquatic Habitat, or

- iii) 10 metres of a Category 3 Bank Stability and Water Quality zone, as shown in Appendix 16.
- d) Where stands of remnant bushland are on or adjacent to a development site, a landscape buffer zone shall be established on the development site between the proposed development and the bushland. The width of the landscape buffer zone shall be determined having regard to:
 - i) the location of natural drainage lines;
 - ii) whether any endangered flora and/or fauna species or communities exist in the bushland (in which event the buffer zone must be a minimum of 25 metres); and
 - iii) the need for a fire protection zone, of which not more than 10m may be located in the riparian zone described in (c) above.

Note: If land is identified as bushfire prone land, any proposal for development on the land must comply with the requirements of *Planning for Bushfire Protection* and Australian Standard AS 3959 – Construction of buildings in bushfire prone areas.

- e) The development must not be located on or within a drainage depression, easement, floodway or piped drainage system.

Note: With the exception of single dwelling houses, dual occupancies, alterations and additions to single dwellings and certain ancillary development, development that includes an 'activity' being undertaken within 40 metres of the top of the bank or shore of 'protected waters' will generally be Integrated Development. Integrated Development requires consent from at least one public body other than Council. Contact Council prior to finalising the location if the development or any works associated with that development are located within 40 metres of a waterbody.

4.4.3 Controls for the design of buildings

Buildings must be designed in accordance with the requirements of the *Ku-ring-gai Planning Scheme Ordinance* and other relevant Council DCPs, Codes and Policies, as well as:

- a) occupy a smaller footprint than the allowable built-upon area (as specified in DCP 38 or other) so that the size of the building does not preclude the inclusion of other hard surface areas (including paved areas) on the property;
- b) allow sufficient space for the installation and operation of the stormwater management techniques to be employed in accordance with this DCP;
- c) reflect the existing slope of the land and, where practicable, enable the retention of the natural or pre-existing land surface beneath and surrounding the building; and
- d) ensure that existing ground levels within the dripline of all trees to be retained will be maintained (cut and fill within the dripline is not permitted).

4.5 Landscape

The landscape at the site, including native remnant bushland and any planted vegetation is subject to the following controls:

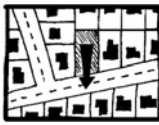



- a) Existing vegetation around drainage lines and watercourses shall be retained.
- b) In parts of the site where no works are proposed, existing vegetation, including undergrowth, is to be retained, except where the vegetation is identified as exempt under Council's Tree Preservation Order or identified as a weed species in Council's adopted Weed Management Policy.
- c) Where possible, landscape treatment shall be designed to remove some pollutants prior to discharge or runoff to receiving waters. (See also Chapters 5, 6 and 8.)

Note: Controls regarding vegetative stabilisation are included in Chapter 8 - Water Quality. It is important that any vegetative stabilisation undertaken does not compromise the long-term landscaping of the site.

Chapter 5

Stormwater Discharge Leaving the Site

In this chapter, the following sections are relevant to your development (see Chapter 3 for explanation):

| |  A |  B |  C |  D |
|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Type 1 | 5.1 – 5.4 only | 5.1 – 5.3 and 5.5 only | 5.1 – 5.3 and 5.6 only | 5.1 – 5.3 and possibly 5.7 |
| Type 2 | 5.1 – 5.4 only | 5.1 – 5.3 and 5.5 only | 5.1 – 5.3 and 5.6 only | 5.1 – 5.3 and 5.7 only |
| Type 3 | 5.1 – 5.4 only | 5.1 – 5.3 and 5.5 only | 5.1 – 5.3 and 5.6 only | 5.1 – 5.3 and 5.7 only |
| Type 4 | 5.1 – 5.4 only | 5.1 – 5.3 and 5.5 only | 5.1 – 5.3 and 5.6 only | 5.1 – 5.3 and 5.7 to 5.7.6 |
| Type 5 | 5.1 – 5.4 only | 5.1 – 5.3 and 5.5 only | 5.1 – 5.3 and 5.6 only | 5.1 – 5.3 and 5.7 to 5.7.6 |
| Type 6 | 5.1 – 5.4 only | 5.1 – 5.3 and 5.5 only | 5.1 – 5.3 and 5.6 only | 5.1 – 5.3 and 5.7 to 5.7.6 |
| Type 7 | 5.1 – 5.4 only | 5.1 – 5.3 and 5.5 only | 5.1 – 5.3 and 5.6 only | 5.1 – 5.3 and 5.7 to 5.7.6 |
| Type 8 | 5.1 – 5.4 only | 5.1 – 5.3 and 5.5 only | 5.1 – 5.3 and 5.6 only | 5.1 – 5.3 and 5.7 to 5.7.6 |
| Type 9 | 5.1 – 5.4 only | 5.1 – 5.3 and 5.5 only | 5.1 – 5.3 and 5.6 only | 5.1 – 5.3 and 5.7 to 5.7.6 |

5.1 Introduction

All drainage proposals submitted to Council will be assessed primarily in terms of the downstream impacts of the means of stormwater disposal.

To minimise impacts on adjoining land, stormwater must generally be directed to a public drainage system comprising gutters, streets, pipes, box culverts and channels owned and operated by the Council. Occasionally, stormwater discharge may be to a recognised open watercourse, directly to public land or to an on-site system. The most appropriate means of stormwater discharge from a development site will depend on a number of factors including the lie and type of the land and the scale of the development proposed.

5.2 Chapter Objectives

1. A high level of residential safety and amenity.
2. Conservation of the natural environment in Ku-ring-gai and beyond.
3. Stormwater runoff to neighbouring properties that does not have an increased adverse impact beyond that prior to the development.

5.3 Carrying out drainage works – general controls

Most developments require a drainage connection to a Council gutter or stormwater pipe located in an adjoining public road. Consequently, most development involves the carrying out of excavation or other work within the footway or carriageway of a public road (road reserve).

Work must not be carried out in a public road unless consent has been granted by the Council (or other relevant roads authority such as the Roads and Traffic Authority) under the *Roads Act 1993*. A person wishing to undertake such work must:

- obtain a Road Opening Permit from the Roads Authority, usually Council**, for routine works such as connection to a kerb and gutter across a nature strip for a single domestic drainage connection, or
- make special application to Council to obtain stamped approval plans issued by Council** for more involved works such as extension to or creation of new piped street drainage systems.
- Regardless of the controls set out in this section, any overriding requirements of the Roads Authority shall be met in accordance with the *Roads Act 1993*.

Note 1: In accordance with the *Roads Act 1993*, Approval must be obtained from the Roads Authority in relation to the work proposed

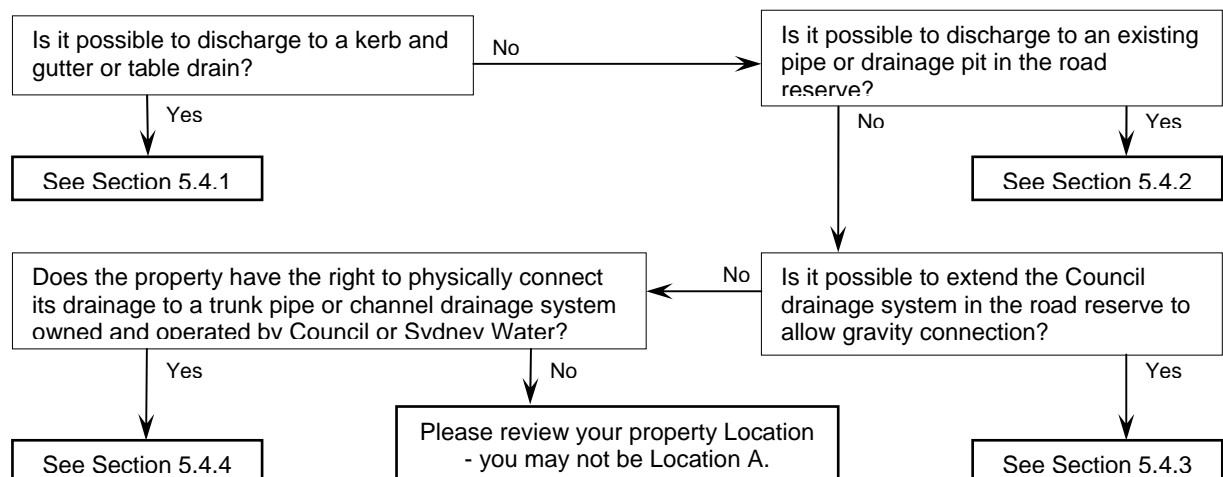
Note 2: Private accredited certifiers do not have authority to grant consent under the *Roads Act 1993*.

Note 3: Approval for carrying out works in a public road or footway is granted separately to development consent or a complying development certificate.

Note 4: The conditions of consent imposed on a DA approval will generally specify what form of approval is required.

5.4 Stormwater disposal from Location A properties

Use the flow chart below to determine which sections of 5.4 to consult regarding discharge from the site.



5.4.1 Discharge to kerb and gutter / table drain

- Piped drainage line crossings from the boundary line of the development to the street gutter or table drain shall have a minimum 1% longitudinal fall towards the street gutter.

- b) The total discharge from any development site to the street gutter or table drain shall not exceed 25 litres per second.
- Note:** Where this is not possible, stormwater shall be discharged to an enclosed system (pipe, box culvert, road pit). Alternatively, on-site detention may be required to lower the total discharge rate, or the built-upon area contributing to the discharge, reduced.
- c) For Development Types 1, 2 and 3 where piped drainage line crossings from the site boundary are to be employed:
- the piped drainage line crossing shall extend no further than 20 metres from the development site across the frontage of a neighbouring property (see note) except where the location of trees prevent such piped crossings;
 - the crossing line shall be at an angle not less than 45° from the line of the frontage of the neighbouring property;
 - the crossing line shall run directly behind, and parallel to the street kerb as far as the discharge point. Any necessary drainage line crossing of driveways shall be constructed in a trafficable grade, directly behind the layback and parallel to it, subject to Council approval. (These requirements may be varied by Council where they are demonstrated to be impracticable and where a suitable alternative route is demonstrated); and
 - the proposed piped crossing will not compromise existing or future vehicular access to the neighbouring property or to services, trees or similar.
- Note:** Details of the proposed route are to be provided to Council in the form of scale plans with all these features shown.
- d) For Development Types 4 - 9, piped drainage line crossings to the street drainage system must take place directly outside the frontage of that development and shall not encroach across the frontage of any neighbouring property.
- e) Connection to existing secondary footpath drainage systems, such as pipes beneath the concrete footpath, will not be permitted as they have limited capacity and block easily.
- f) Connections to concrete kerb and gutter shall comply with **Council Standard Drawing 82-024** (see Appendix 12) and shall employ one of the following means to convey the required design flows from the site:
- 100mm diameter sewer grade uPVC piping with kerb adaptor(s) where a minimum cover of 300mm can be provided in all locations over the pipe obvert subject to vehicular loading; or
 - 200mm x 100mm x 6mm thick Rectangular Hollow Section (RHS) galvanised pipes for all other situations; and
 - 2 or more kerb outlets separated by a minimum of 150mm.
- g) When discharge is proposed to an open table drain, the pipe outlet shall terminate flush with the property-side edge of the table drain and shall be fully encased in a minimum 100mm thick mass concrete for the final 300mm length of the pipe.
- Note:** Where the applicant cannot comply with any of the above requirements due to site constraints, an alternative method of connection may be proposed for consideration by Council.
- h) Drainage systems for stormwater disposal shall comply with AS3500 – 1998 – National Plumbing and Drainage Code or any standard replacing that standard.

5.4.2 Discharge to an existing Council pipe in the road reserve or a drainage reserve

Discharge to an existing piped (in-ground) drainage system in the road or a drainage reserve may be an option where:

- such a system exists in reasonable proximity to the site, and
- it is not possible to direct stormwater to a Council kerb and gutter or table drain, or
- the peak site discharge proposed exceeds 25 litres per second, and
- it can be demonstrated that the hydraulic grade line of the inground drainage system (to which connection is proposed) is lower than the outlet of the property drainage system during the 20 year ARI event.

Stormwater shall be discharged to an existing Council pipe in the road reserve in accordance with the following controls:

- a) For pipes of diameter up to 100mm, connection to the Council street drainage pipe shall comply with **Council Standard Drawing 82-024** (see Appendix 12).
- b) For pipes of diameter greater than 100mm, connection to the Council street drainage pipe shall, at Council's discretion, be undertaken in conjunction with the establishment of a grated gully (access) pit to Council standards. Details of new pits will need to be submitted to Council in accordance with Section 5.3 of this DCP.
- c) Drainage systems for stormwater disposal shall comply with AS3500 – 1998 – National Plumbing and Drainage Code or any standard replacing that standard.

5.4.3 Discharge to an extension of the in-ground piped system in the road reserve

It may be possible to extend an existing downstream in-ground street drainage system on either the property side or the opposite side of the street. This is only allowed where no other connection is possible. In such cases, the following controls apply:

- a) The in-ground drainage line shall be extended using a steel reinforced or fibre reinforced piped system to convey 1:20 year trunk flows (minimum of 375mm diameter rubber ring jointed reinforced or fibre reinforced concrete pipe), generally at gutter lip alignment.
- b) The extended drainage line must connect to a new Council standard grated gully pit that shall be established outside the development site.
- c) The feasibility of such a proposal must be established by a suitably competent qualified civil engineer eligible for membership to the Institution of Engineers Australia.
- d) A detailed design shall be prepared by a suitably competent qualified civil engineer eligible for membership to the Institution of Engineers Australia based on design criteria obtained from the roads authority (see Chapter 9).

Note 1: The full cost of such works shall be borne by the Developer.

Note 2: The design is subject to the approval of the roads authority (Council or other) under the *Roads Act 1993* and no work may be undertaken until approved.

Note 3: The feasibility of such a proposal shall be demonstrated with any DA submission.

5.4.4 Connection to a Council or Sydney Water formed channel or pipeline within or adjacent to the subject site

A 'formed channel' generally means a concrete or stone-lined channel located in a position that may not necessarily coincide with any historical waterbody. For example, a formed channel may have been constructed to convey runoff from a road to a nearby natural watercourse. In the event that a legal right to connect exists, the following controls apply (where no legal right exists, the property is likely to be Location D rather than Location A):

- a) The terms of any easement over the channel / pipe system to which connection is proposed must legally permit the subject site to discharge its stormwater into it and be demonstrated to Council.
Note: Ascertaining this may require independent legal advice.
- b) Where the formed channel / pipe system crosses intervening downstream properties before the next downstream area of road or drainage reserve, permission to convey the stormwater runoff from the development site by way of the formed channel / pipe must be established under the terms of an easement on the title of each affected downstream property.
- c) The formed channel/pipe must have sufficient hydraulic capacity to accept the additional flow from the post developed site. The hydraulic capacity shall be determined having regard to existing and cumulative future flow rates in that system.
- d) The outlet shall be designed to minimise backwater influence from the receiving system.
- e) Drainage systems for stormwater disposal shall comply with AS3500 – 1998 – National Plumbing and Drainage Code or any standard replacing that standard.

- f) Connection to a formed stormwater channel shall be made in accordance with Council Standard Drawing 82-024 (Appendix 12).
- g) Where connection is to a Sydney Water Corporation stormwater pipe, the design tailwater for a sealed pipe drainage system connecting to such a channel shall be the top of the channel unless otherwise specified by Sydney Water.
- h) Any other site-specific requirements of the Council / Sydney Water Corporation shall be satisfied.

Note: Council may require the establishment of an on-site detention system at the development site (regardless of whether this is required in accordance with Chapter 6).

5.5 Stormwater disposal from Location B properties

Disposal of stormwater from Location B properties shall be undertaken in accordance with the following:

- a) The receiving watercourse shall have sufficient capacity to cater for the additional flow without adversely affecting upstream or downstream flooding.
- b) The route of stormwater travel to the receiving waterbody and the point of discharge shall be selected so as to minimise damage to vegetation and erosion. This shall be achieved, where possible, by locating the discharge outside the dripline of trees and by locating the discharge point mid-way between bends in the waterbody.
- c) Where possible, any water quality improvement device required in accordance with Chapter 8 of this DCP shall be located outside the riparian zone of the waterbody.
- d) The outlet structure shall align flush with the stream bank at all points.
- e) Any pipes and culverts established shall rest on and be packed in by rip-rap and shall not be supported by a concrete headwall.
- f) Any scour apron shall be rip-rap with a cut-off provided and flanks shall be rip-rap and keyed in.
- g) Rip-rap shall consist of angular run-of-quarry durable rock placed over a 200mm layer of 140mm medium-sized angular cobbles over geotextile, with all rocks and cobbles packed with topsoil. Any gaps in rip-rap shall be planted with local provenance vegetation appropriate to that part of the waterbody.
- h) The bed of the waterbody and the opposite bank shall be scour-protected if scour would otherwise be likely to occur.
- i) The rock size requirements for the discharge structure shall be determined by calculating the tractive stresses generated from outlet structures and from bank full stream discharges.
- j) Measures employed shall be compatible with the existing riparian environment.
- k) Any areas within a riparian zone that are disturbed by establishment of the stormwater discharge measures shall be rehabilitated in accordance with the provisions of Section 8.3.2 of this DCP.
- l) Drainage systems for stormwater disposal shall comply with AS3500 – 1998 – National Plumbing and Drainage Code or any standard replacing that standard.

Note: Suitable disposal measures may include stilling weirs and scour protection (such as an energy dissipater) extending to the invert of the natural watercourse. Large sandstone rocks that are securely mortared to form a natural-looking headwall, apron and dissipation structure may also be considered.

5.6 Stormwater disposal from Location C properties

Urban stormwater flowing into bushland is the major factor that introduces, encourages and sustains weeds in these natural areas. Therefore, where alternatives exist, these should be pursued first. The following controls apply to Location C properties:

- a) The post-developed built-upon area shall comply with the applicable control at Section 4.4.1.
- b) For Development Types 4 and above the number of runoff days from the post development site during the 1:50 year storm shall not exceed the state of nature case during the 1:20 storm. This shall be achieved using an appropriate retention device installed in accordance with Chapter 6.
- c) Stormwater is to be managed on site in accordance with the controls in Chapter 6 before discharging into bushland.
- d) The developer must demonstrate to Council that all stormwater entering bushland will be dispersed sufficiently so as to not cause downstream erosion or scour. This may be achieved by using:
 - i) any appropriate method described in Appendix 6; and/or
 - ii) discharge of stormwater to an existing and recognised (perennial or transient) drainage system such as a grassed swale or channel that is within the subject site or a neighbouring property, that may have been formed through natural erosion processes,
Note: It may be necessary to obtain an easement to gain access to the system; and/or
 - iii) a slotted pipe or trench drain to practical depth (where site conditions prevent a deeper trench structure) established at the highest practicable level within the site, parallel to the site contours that is:
 - impervious along the base and slotted at the top so that runoff will be dispersed evenly across the width of the site;
 - sealed at each end;
 - covered in rock or otherwise designed to be less conspicuous but shall be designed to enable regular maintenance (ie, removal of fallen logs, twigs, leaves and the like);
 - established in materials low in phosphorus (ie, basalt / blue metal / road base is not appropriate);**Note:** Where the site is located within 15 metres of a watercourse or drainage path in the bush, it may be appropriate to discharge from a single point into the watercourse or drainage path using a means designed to ensure that erosion will not occur; and/or
 - iv) any other method, provided that the Objectives of this DCP and Chapter are met by the proposal.
- e) Where the subject bushland is National Park and stormwater is to be disposed into the bushland, established drainage path or watercourse within the subject bushland, the concurrence of National Parks and Wildlife Service shall be obtained, prior to submission of the proposal to Council, for the management of stormwater as proposed by the developer.

5.7 Stormwater disposal from Location D properties

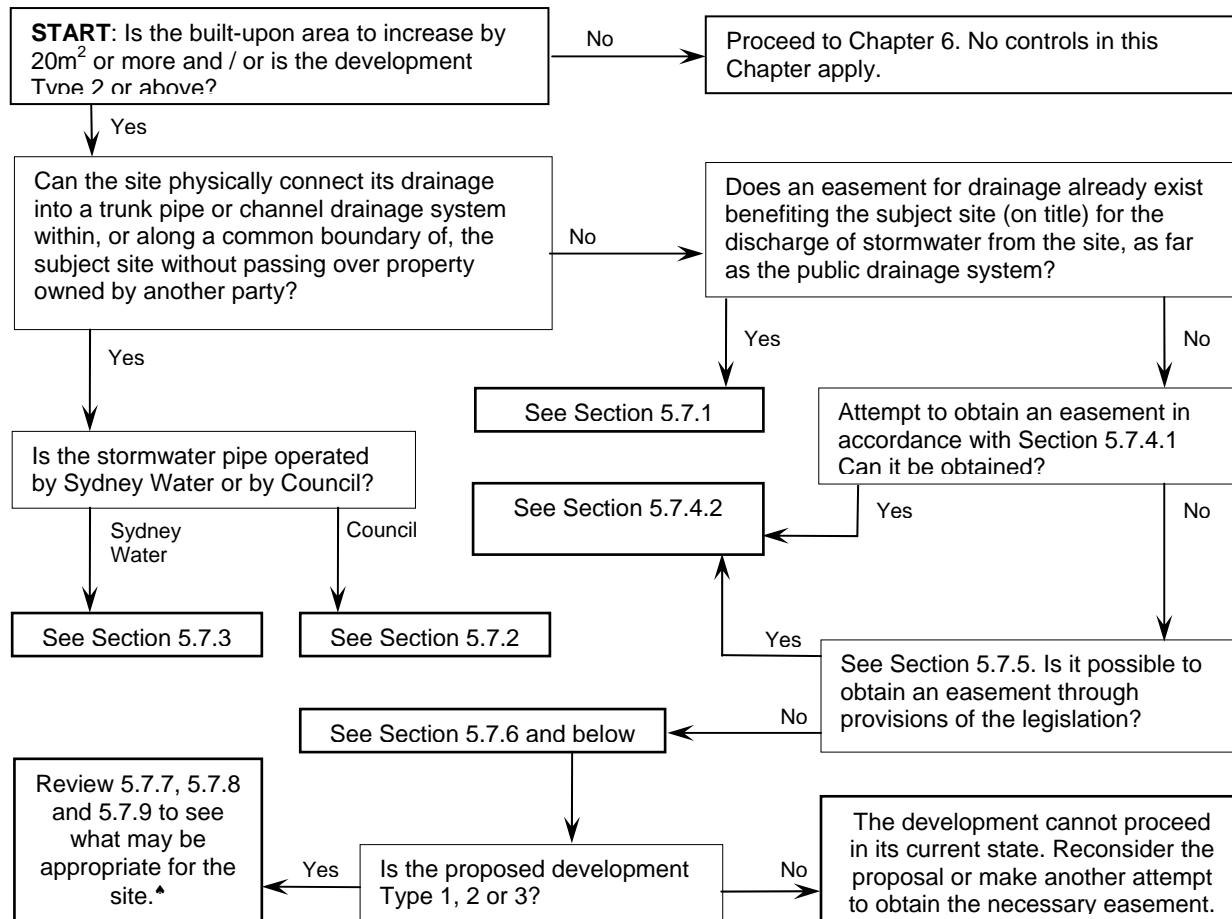
Council always prefers that stormwater is discharged from a site in a controlled manner under gravity to a recognised public drainage system. Accordingly, where this could be achieved but for the existence of another property downstream, Council will require that, where possible, an interallotment **easement for drainage** be utilised to legally provide a controlled gravity drainage solution as far as the nearest available recognised public drainage system.

The necessary easement for interallotment drainage as far as the recognised public drainage system may already exist on the title of the subject site (generally described as being appurtenant to, or benefiting, the site). **If not, it will be necessary for the owner of the subject site to attempt to obtain the necessary easement for drainage.** Properties over which an easement may be created include private properties and public parks and reserves.

It may also be possible to connect into a trunk drainage system traversing or directly adjacent to a subject site. (Where the legal right to do so already exists, the property is a Location A property – see Section 5.4). Where there is presently no legal right to connect to the trunk drainage system, Council may consider an application for a direct connection as necessary, depending on the physical condition

and capacity of the trunk system, the consent of the downstream owners, terms of the easement (where one exists) and the intent of the receiving trunk system.

Where the use of, or creation of, an easement for drainage is not possible, it may be possible to utilise other methods of disposal depending on the scale and type of development. The following flow chart explains how to determine the manner in which to dispose of stormwater from a Location D property:



*Exposed aerial drainage other than downpipes will not be approved by Council.

Note: Council strongly encourages the developer to seek the services of a conveyancing solicitor or experienced professional in order to clarify the standing of a site with respect to use of drainage easements. Council does not have in-house experts in property conveyancing matters.

5.7.1 Discharge to an existing interallotment drainage easement

The development application must:

- a) Demonstrate to Council the existence of the interallotment drainage easement that allows the site to drain by gravity as far as a recognised and appropriate public drainage system. This will require provision of the title documents of the affected properties and the subject property. Such title documents are available from the Land and Property Information NSW (within the NSW Department of Lands), and
- b) include either
 - i) documentation from a registered surveyor or qualified engineer demonstrating the existence of either suitable drainage infrastructure with the easement system to be utilised (capacity and condition), or

- ii) a scale plan showing the proposed drainage infrastructure to be placed in the existing easement to drain the subject site.

Note: In the event that the existing easement or piped system is not satisfactory in terms of capacity or length, Council will require the system to be upgraded or extended (see Appendix 7)

5.7.2 Connection to a formed channel or Council pipeline within the subject site

A 'formed channel' generally means a concrete or stone-lined channel located in a position that may not necessarily coincide with any historical waterbody. For example, a formed channel may have been constructed to convey runoff from a road to a nearby natural watercourse.

Permission to connect to such a formed channel or drainage pipe shall be granted by Council and at the discretion of Council only where it can be demonstrated that:

- a) **the terms of any easement over the channel / pipe system, to which connection is proposed, legally permit the subject site to discharge its stormwater into it and this can be demonstrated to Council;**
- b) the said channel / pipe is located within or directly adjacent to the development site;
- c) where the formed channel / pipe system crosses intervening downstream properties before the next downstream area of road or drainage reserve, permission to convey the stormwater runoff from the development site by way of the formed channel / pipe is established under the terms of an easement or easements on the title of all affected downstream properties;
- d) the pipe / formed channel has sufficient hydraulic capacity to accept the additional flow from the post developed site. The hydraulic capacity is determined having regard to existing and cumulative future flow rates in that system;
- e) the outlet is designed to minimise backwater influence from the receiving system;
- f) where it is found that an existing Council owned channel/pipe is present on site that is not within an easement, a suitable easement will be created over the drain in favour of Council, at no cost to the Council, or else the easement moved accordingly at no cost to Council.
- g) drainage systems for stormwater disposal complies with AS3500 – 1998 – National Plumbing and Drainage Code or any standard replacing that standard;
- h) connection to a formed stormwater channel is made in accordance with Council Standard Drawing 82-024 (Appendix 12); and
- i) any other site-specific requirements of the Council are satisfied.

The process for obtaining approval for connection into a Council easement is contained in Appendix 8. In certain cases, it may be possible to have an easement favouring Council (only) extinguished and then created to also benefit the subject site. Information on this process is also contained in Appendix 8.

Note: Where such a connection is permitted, Council may require the establishment of an on-site detention system at the development site (regardless of whether this is required in accordance with Chapter 6).

5.7.3 Connection to a Sydney Water Corporation stormwater pipe in an easement

The following controls apply:

- a) Written consent shall be obtained by the proponent from Sydney Water and submitted to Council.
- b) All necessary easements for drainage exist to benefit the subject site.
- c) All relevant requirements of Sydney Water shall be satisfied prior to development consent being granted by the Council.
- d) The design tailwater for a sealed pipe drainage system connecting to such a channel shall be the top of the channel unless otherwise specified by Sydney Water.

5.7.4 Procedure for obtaining a new private interallotment drainage easement

5.7.4.1 Approaching the downstream owners

Creation of a new interallotment drainage easement must be attempted for all Location D properties where the built-upon area is to increase by 20m² or more (where built-upon area will increase by less than this area, please proceed to Chapter 6). All attempts must be in accordance with the following steps:

- a) The developer must establish the most appropriate route between the subject site and point of connection to the downstream public drainage system, together with any alternate routes. This may be in a road reserve, a drainage reserve, or a natural watercourse. The developer should contact an appropriate engineer to make the necessary investigations where such a location is not apparent.
- b) After establishing the route, the developer must write to the owners of all the relevant downstream properties requesting an interallotment drainage easement as far as is necessary to connect into a recognised public drainage system. The letter may offer financial compensation and shall indicate that the burdened property owner would not be responsible for maintenance of the easement (see sample letter, Appendix 9).

Note 1: Appropriate financial compensation may be determined by a registered Valuer but will be subject to negotiations between both parties.

Note 2: It is necessary to retain a copy of all letters sent to downstream owners. In the event that an easement cannot be obtained in this manner, copies of the letter will be required by Council. See Section 5.7.6.)

Note 3: It is recommended that the services of a conveyancing solicitor be engaged in this process.

- c) The developer shall obtain a written response from the landowners of the properties approached in control (b). This will either consent to, or refuse, the creation of the necessary easement(s) for drainage. Where refusal occurs, refer to sections 5.7.5 and 5.7.6 of this chapter.
- d) **Where consent is given, the developer must provide a copy of the signed agreement(s) to Council with any development application lodged.**

Note: Where a signed agreement is obtained and submitted as part of DA documentation, the consent authority will impose a condition of consent requiring the legal registration and demonstration of the necessary easement. Alternatively, depending on the circumstances, Council may require registration of the easement on title prior to any DA consent being given. All costs associated with the registration of the easement on title shall be borne by the applicant

5.7.4.2 Registration of the interallotment drainage easement with Land and Property Information (LPI)

Where the downstream landowners agree to the creation of an easement, the following steps must be carried out:

- a) A survey plan, suitable for registration at Land and Property Information NSW (within the NSW Department of Lands), shall be prepared by a registered surveyor on behalf of the proponent showing the location of the easement. The necessary terms of the drainage easement shall be prepared.

Note: The width of the easement to be created shall have regard to the required size of pipe that will be placed in the easement and sufficient excavation width in the event of maintenance. Refer to Appendix 7 for the required widths and placement of easements.

- b) The survey plan, owners' written approval, application form and fees shall be lodged by the developer at the Land and Property Information NSW (within the NSW Department of Lands). **The Council shall be nominated in the Section 88B Instrument as a party whose consent is required to release, vary or modify an easement.**

- c) Written advice to the effect that the easement has been registered shall be obtained by the developer from the NSW Land and Property Information Service and supplied to the relevant landowners, the certifying authority as is necessary in the approval process and Council for its records.

Note: The services of independent professionals with related experience should be sought in this process. Council does not provide legal advice in this respect.

5.7.5 Using legislation to obtain a drainage easement

In the event that all reasonable attempts to obtain the consent of the relevant landowners for the creation of an interallotment drainage easement have failed, provisions of Section 88K of the *Conveyancing Act 1919* or Section 40 of the *Land and Environment Court Act 1979* may be utilised. Council does not encourage the use of these provisions and supports negotiation with adjoining property owners. However, Council does recognise that these provisions exist.

Note: Independent legal advice must be sought if either of these options are to be pursued.

5.7.6 Providing evidence that a legal interallotment drainage easement cannot be obtained

In the event that an easement cannot be obtained from one or more downstream parties, **the following documentary evidence must be submitted to Council in support of any Development Application:**

- a) A copy of **all** letters sent to landholders of neighbouring properties containing all feasible easement routes indicating an offer of appropriate financial compensation and explaining that the burdened property would not be responsible for maintenance of the easement.
- b) A signed copy of the letters received from owners of the neighbouring properties at which an interallotment drainage easement was sought, stating that an easement will not be granted.

Note 1: In the event that it is not possible to obtain such a letter, a written account of any response obtained from the property owners may suffice. This evidence will be subject to independent verification by Council.

Note 2: Some development will not be approved by Council where an easement cannot be obtained.

5.7.7 Discharge of stormwater within the site

On-site discharge of concentrated stormwater flows by infiltration/absorption into soils on the site is considered to be inadequate in most areas of Ku-ring-gai. This is because the majority of soils are clay-based and have a low to very low infiltration rate¹. **There are only a very limited number of sites in Ku-ring-gai that have soils that are sufficiently sandy to permit a satisfactory infiltration rate for stormwater.** The failure of on-site stormwater disposal methods due to inadequate infiltration rates can lead to detrimental impacts on downstream properties and/or infrastructure.

Discharge of stormwater within the site may involve:

- One or more **dispersal trenches** constructed at the point of disposal designed to disperse stormwater across a site in a sheet flow to provide an opportunity for water take-up by vegetation downstream from the trench.

¹ Specifically, the soils are mainly podsolis and red and yellow podsollics with USCS classifications CH and CL-CH. These soils generally consist of a 200mm to 300mm thick clay loam or sandy clay overlying a deep heavy clay or shallow soils overlying sandstone. In addition, clay soils in Ku-ring-gai are mainly kaolinitic and considerable swelling and shrinking occurs as the moisture content of the soil changes. Absorption drainage disposal will affect soil moisture content which can affect some types of building foundations and in most instances the absorption is not effective and may exacerbate local flooding.

- A series of **infiltration trenches** constructed on sandy soils where bedrock is not close to the surface (not generally feasible due to predominant clay soil types).
- Another method designed to ensure the infiltration / absorption of water into the site.

Discharge of stormwater within the site will only be permitted where all of the following conditions are satisfied:

- a) The development is Development Type 1, 2 or 3 only.
- b) It is demonstrated that direct drainage by gravity to the street drainage system, a public drainage system or recognised natural watercourse within the property or to a drainage easement is not possible.
- c) It is demonstrated that no drainage easement either exists over adjoining properties or are readily available through negotiation.
- d) It is demonstrated that all other alternatives have been comprehensively examined and demonstrated to be inappropriate or ineffective.
- e) It may be demonstrated that, for new single dwellings (Development Type 3), the maximum post developed built-upon area draining to the:
 - i) dispersal trench system does not exceed 30% of the total site area, or
 - ii) infiltration trench system does not exceed 35% of the total site area.
- f) It may be demonstrated that, for alterations and additions (Development Types 1 & 2), the post-development built-upon area draining to:
 - i) a dispersal trench system does not exceed the greater of
 - 30% of the total site area, or
 - the pre-developed built upon area.
 - ii) an infiltration trench system does not exceed the greater of
 - 35% of the total site area, or
 - the pre-developed built upon area.
- g) Where an infiltration trench system is proposed, its feasibility shall be demonstrated in a report based on a scientific test by a qualified geotechnical engineer that the soils and bedrock are appropriate for the employment of such a system.
- h) The design and construction of the system are undertaken in accordance with the relevant controls contained in Appendix 6.

5.7.8 Charged drainage systems

A charged drainage system is a sealed drainage system containing permanent ponded water that is forced out under pressure by the height of water above the outlet/discharge point.

Council does not readily encourage the use of charged drainage systems. This is because of their susceptibility to blockage by leaf debris and sediment and the requirement for a high maintenance regime that may not be met by new or uninformed owners. The failure of such systems results in roof gutter overtopping and the increased potential for flooding/damp problems within or adjacent to premises.

However, in certain cases, and providing the layout of the site and proposed building design permit, a charged drainage system may be used to aid in controlling stormwater disposal from a site. This may be useful where an easement for drainage cannot be obtained and it is necessary to limit the degree of on-site stormwater discharge that is undertaken in accordance with the controls set out in Section 5.7.7.

Discharge of stormwater from the site by way of a charged drainage system will only be permitted where all of the following controls are satisfied.

- a) The development is Development Type 1, 2 or 3 only.
- b) Not more than two charged downpipes from any one building are required.

- c) It is demonstrated that direct drainage by gravity to the street drainage system, a public drainage system or recognised natural watercourse within the property or to a drainage easement is not possible.
- d) It is demonstrated that no drainage easement exists either over adjoining properties or are readily available through negotiation.
- e) It is demonstrated that all other alternatives have been comprehensively examined and demonstrated to be inappropriate and ineffective.
- f) The design for the system shall be prepared by a qualified civil or hydraulic engineer.
- g) A stilling pit shall be provided at the property boundary from which the drainage line to the street gutter has positive fall by gravity to preclude the possibility of street water backflow.
- h) A minimum of 1.5 metre head (height) shall be available from the roof gutter to the invert of the inlet in the stilling pit.
- i) A maximum of 1.5 metre difference in level shall exist between the invert level of the inlet in the stilling pit and the base of the downpipe.
- j) Hydraulic grade line calculations shall be undertaken by a suitably qualified and experienced engineer that demonstrates that the proposed system will have sufficient operating head. A freeboard of at least 300mm is to be allowed between the roof gutter level and the hydraulic grade line at the top of the respective downpipe.
- k) The drainage line from the stilling pit to the street system shall be in accordance with Section 5.4.1.
- l) The property drainage system shall be fully sealed from the level of the roof gutter to the stilling pit.
- m) The charged system shall be a minimum uPVC sewer grade 100mm diameter.
- n) Leaf guards shall be established on all existing and proposed roof gutters.
- o) A grated cleanout pit shall be established adjacent to all system low-points in which is provided a screw-capped sealed extension of the respective main charged drainage line.
- p) An appropriate flap valve shall be established over the inlet pipes to the stilling pit in order to minimise mosquito nuisance.
- q) Drainage systems for stormwater disposal shall comply with AS3500 – 1998 – National Plumbing and Drainage Code.
- r) Exposed aerial drainage will not be approved by Council, except for guttering and vertical downpipes and diagonal lines where they are directly feeding a rainwater tank required under the controls in this DCP.

5.7.9 Pump-out systems

Council will only give consent to pump-out systems for development Types 1, 2 and 3 in rare instances and subject strictly to the applicant fully demonstrating compliance of a number of design controls. This is because of:

- the susceptibility of pumps to failure during power outages which commonly occur during storms of higher rainfall;
- the potential impact of a failed pumpout drainage system on the downstream properties;
- the necessity for a high maintenance regime that may not be met by new or uninformed occupants; and
- pumping water into an upstream or adjacent catchment can exacerbate existing flooding problems.

Stormwater disposal from a site by way of a pump-out system will only be permitted where it can be fully demonstrated that the owner or Council, in approving the pump-out system, could not reasonably be held liable for exacerbating or introducing a flooding problem in the immediate drainage system which is receiving the pumped runoff.

Pump-out systems must comply with the following controls:




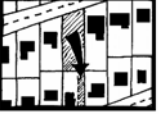
- a) The Development shall be type 1, 2 or 3 only.
- b) The applicant shall demonstrate in writing that no easement may be obtained for the discharge of stormwater from the site.
- c) The pump-out system shall not be the sole means of stormwater discharge from the site.
- d) The pump-out system shall be employed **only** as an additional means of stormwater discharge where a dispersal trench is proposed to operate in accordance with section 5.7.7, but where the impervious area to be drained exceeds 30% of total site area as defined in 5.7.7 (f).
- e) The total impervious area to be pumped shall not exceed 100m²
- f) The pump-out system must be used in conjunction with a dispersal trench system which drains a separate impervious area of 30% of the total site area as defined in 5.7.7 (f).
- g) Runoff pumped to the street frontage shall **not** enter an existing drainage system where flooding affects private and/or public property including parks and reserves. In this respect, it must be demonstrated by a suitably competent qualified civil engineer using suitable hydraulic analysis that:
 - i) there are no existing flooding issues causing damage or nuisance to property adjacent to or burdened by the drainage system which is receiving the pumped runoff, **and**
 - ii) increasing the volume of runoff in the receiving system would not create a new, or exacerbate an existing, drainage issue in any downstream private property, **and**
 - iii) the cumulative impact of pumping more than one property to the same receiving drainage system has been considered, **and**
 - iv) the drainage system that would receive the additional pumped runoff is of sufficient width and capacity to handle additional runoff as determined in (i), **or**
 - v) the drainage system immediately downstream at the nearest sag point receiving the pumped runoff drains directly to the bush via a formal drainage system without impacting upon private property.
- h) The pump-out system shall have a visible ponding area available for temporary storage during pump failure with **an absolute minimum** capacity for the 100 year, 2 hour event falling on the corresponding impervious area draining via the pump system.
- i) A duty and standby pump with alternating switches shall be provided within a sump in the ponding area, together with a fuel generator on site capable of operating the pump-out system when no power is available.
- j) A stilling pit shall be provided at the property boundary, with gravity drainage provided between the stilling pit and the discharge point in accordance with section 5.4.1. A non-return or flap valve must be placed at the point the rising main enters the stilling pit. If a stilling pit is impossible, some other form of cleanout/backflow prevention must be provided.
- k) Overflow from the ponding area of the pump-out system shall be formally drained to the site dispersal system.

Pump-out example, A Location D site of 600 m² proposing a new dwelling (Type 3) with hard surface area generating runoff (including roof, driveway and all other areas generating runoff) of 250 m² (42% of the total site area) proposed with access to an easement refused by the relevant owners. Under the controls of section 5.7.7, a maximum of 30% of the total site area, or 180m², could drain to an on-site dispersal trench system. However, **provided that it may be demonstrated by a competent qualified consulting civil/hydraulic engineer that the above pump-out controls are met in full**, a pump out system could be considered to pump the additional 70m² (12% of site area) proposed above the 30% threshold permitted by section 5.7.7. In this case, the applicant would need to provide a visible storage area of 8.7 m³ volume based on the 100 year 2 hour storm of 62mm/h falling on 70m². This would be in addition to any controls required under BASIX or this DCP.

Chapter 6

On-site Stormwater Management

In this chapter, the following sections are relevant to your development (see Chapter 3 for explanation):

| |  A |  B |  C |  D |
|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Type 1 | 6.4 only + Appendix 7 | 6.4 only + Appendix 7 | 6.4 only + Appendix 7 | 6.4 only + Appendix 7 |
| Type 2 | 6.4 and 6.5 + Appendix 7 | 6.4 and 6.5 + Appendix 7 | 6.4 and 6.5 + Appendix 7 | 6.4 and 6.5 + Appendix 7 |
| Type 3 | 6.1-6.4 6.6, 6.7 + App 7 | 6.1-6.4 6.6, 6.7 + App 7 | 6.1-6.4, 6.6, 6.8 + App 7 | 6.1-6.4, 6.6, 6.9 + App 7 |
| Type 4 | 6.1-6.4 6.6, 6.7 + App 7 | 6.1-6.4 6.6, 6.7 + App 7 | 6.1-6.4, 6.6, 6.8 + App 7 | 6.1-6.4, 6.6, 6.9 + App 7 |
| Type 5 | 6.1-6.4 6.6, 6.7 + App 7 | 6.1-6.4 6.6, 6.7 + App 7 | 6.1-6.4, 6.6, 6.8 + App 7 | 6.1-6.4, 6.6, 6.9 + App 7 |
| Type 6 | 6.1-6.4 6.6, 6.7 + App 7 | 6.1-6.4 6.6, 6.7 + App 7 | 6.1-6.4, 6.6, 6.8 + App 7 | 6.1-6.4, 6.6, 6.9 + App 7 |
| Type 7 | 6.1-6.4 6.6, 6.7 + App 7 | 6.1-6.4 6.6, 6.7 + App 7 | 6.1-6.4, 6.6, 6.8 + App 7 | 6.1-6.4, 6.6, 6.9 + App 7 |
| Type 8 | 6.1-6.4 6.6, 6.7 + App 7 | 6.1-6.4 6.6, 6.7 + App 7 | 6.1-6.4, 6.6, 6.8 + App 7 | 6.1-6.4, 6.6, 6.9 + App 7 |
| Type 9 | as determined by Council | as determined by Council | as determined by Council | as determined by Council |

6.1 Introduction

Stormwater is untreated rainwater that runs off the land onto which it falls. In natural areas, the majority of rainfall will generally be absorbed with only a small proportion running off as stormwater. In urban areas, where a high proportion of the land tends to be impervious, a greater proportion of the rainfall will run off, with as much as 90% of the rainwater becoming stormwater.

When impervious areas increase, the rate and volume of stormwater runoff from properties also increases. This can lead to:

- flooding of public and private properties;
- cross country water flows;
- changes in flow regime to bushland;
- erosion of creek beds, embankments and bushland areas;
- reduced water quality in creeks, rivers and harbours;
- transportation of gross pollutants, nutrients and chemical pollutants; and
- spread of weeds.

Effective stormwater management minimises these problems by using the water more efficiently and by controlling runoff appropriately. This chapter requires the design of an on-site stormwater management system that is appropriate to the development, site and site context.

While Council encourages the design of innovative stormwater management systems, it is important to note that soils in Ku-ring-gai are not generally appropriate for retention systems that involve infiltration. Proposals that involve infiltration must be justified by the designer with submission of calculations.

6.2 Chapter Objectives

1. Development that does not increase the impact of rainfall events.
2. Development that does not increase surface and sub-surface runoff to neighbouring properties.
3. Stormwater management design that demonstrates a consideration for the existing capacity of the public drainage system.
4. Development that does not adversely affect the integrity of natural waterways, groundwater and ecosystems.
5. Stormwater management that is integrated with the overall site design and that reflects the analysis of the site.
6. Stormwater management that is designed, constructed and maintained in accordance with best engineering practices.
7. Stormwater management measures that are functional and effective for the duration of their existence.
8. Efficient use of stormwater.

6.3 Principles of effective stormwater management

Effective stormwater management is about minimising the adverse impact of a development on downstream drainage systems, catchments and properties. There is no single technique that is effective for all development proposals. This means that an appropriate method must be designed for each new development that appropriately addresses the Objectives of the chapter and the DCP as a whole, together with all relevant controls. There are two primary means of managing stormwater on a development site: retention and detention.

On-site Retention (OSR) is a stormwater management system that keeps water on site to be used again in the hydrological cycle or as an alternative to mains water. OSR is used to control the volume of runoff during rainfall and storm events. Because the stormwater is not sent directly off the site, on-site retention reduces runoff draining to pipelines, minimises flood events, conserves water and helps to reduce the impact of development upon the natural water cycle. A number of different techniques may be employed including rainwater tanks, infiltration trenches, use of a dense native vegetation buffer strips, holding berms or walls, bioretention trenches and slotted ('ag') pipes or trench drains.

On-site Detention (OSD) works by holding back ('detaining') stormwater temporarily within a property and then releasing it at a controlled rate. It is used to control the rate of runoff and reduce peak discharges during storm events to minimise the load on pipelines and to minimise flood events. OSD does not alter the total volume of stormwater leaving the site and normally does not allow the stormwater to be used before it leaves the site.

In some cases use of OSD may be the most effective means of stormwater management while in others it can be detrimental. In many cases it may be appropriate to use a combination of OSD and OSR. In general, the factors that the designing engineer should take into account when determining the stormwater management technique for a site are as follows:

- The timing of peak flows from the site relative to those from the upstream catchment which drain to the same point. This is influenced by the time of concentration and the proximity of the site to the catchment point. Generally, in upper parts of the catchment it is necessary to detain water from leaving the site whereas in lower areas it may be preferable to allow most of the stormwater to leave the site immediately.
- The proximity of the subject property to environmentally sensitive areas such as bushland. Specifically, on-site detention can be problematic where a property drains to bushland as constant

seepage is a major cause of weed growth. Therefore other forms of stormwater management are preferable at such sites.

- The impact of any proposed stormwater management method on the streetscape and neighbouring properties, particularly in terms of aesthetics.

6.4 Mandatory rainwater tank requirements

For all Locations (A-D), at least one rainwater tank shall be established to capture all roof water from the primary building(s) on the property. The controls are as follows:

| Type | Description | Minimum Tank Storage Volume | Minimum Use of Retained Water |
|---------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Type 1 | Alts and Adds < 50m ² | a tank is desirable but not mandatory, unless BASIX overrides this requirement when introduced as a statutory requirement | |
| | Alts and Adds 50m ² – 100m ² | 2000L or as determined by BASIX when in force | garden irrigation only or as determined by BASIX when in force |
| Type 2 | Alts and Adds > 100m ² | 3000L and as required in Section 6.5, or as determined by BASIX when in force | garden irrigation only or as determined by BASIX when in force |
| Type 3 | Single Dwellings | as determined by BASIX | as determined by BASIX |
| Type 4 | Dual Occupancy – 1 new dwelling | as determined by BASIX for the new dwelling plus 5000 litres of storage for the existing dwelling to be retained | as determined by BASIX for new dwelling; garden irrigation for the existing dwelling to be retained |
| | Dual Occupancy – 2 new dwellings | as determined by BASIX for each dwelling | as determined by BASIX for each dwelling |
| Type 5 | Multi Unit Development | 1000L per unit or 20m ³ , whichever is the greater, or as determined by BASIX when in force | all irrigation, toilet flushing and laundry or as determined by BASIX |
| Type 6 | Business, Commercial, Retail | 1000L per 100m ² floor space or as determined by BASIX when in force | plumbed to all toilets and for garden irrigation, or as determined by BASIX when in force |
| Type 7 | Open Space | 2000L for every five toilets or part thereof in any building erected | for watering open space areas, as determined by Council |
| Type 8 | Subdivision | 5000L for any dwelling to be retained on a newly created lot | garden irrigation only |
| Type 9 | Any Other Development | as determined by Council, dependent on development type | |

Note 1: The mandatory rainwater tank volume requirement may be met using one or more tanks, as appropriate to the site and the required use of stormwater.

Note 2: Controls for the installation of rainwater tanks are contained in Appendix 6.

6.5 Additional requirements for Development Type 2

Until such time as BASIX is in force for alterations and additions, in addition to the mandatory rainwater tank, the design of the development shall include a proposal for **additional retention** of a minimum 2000L. This shall be achieved by

- a) for Locations A – C, increasing the volume of the mandatory rainwater tank or by proposing any other method of retention detailed in Appendix 6, or
- b) for Location D properties, increasing the volume of the mandatory rainwater tank(s) only.

Note: Other forms of retention are not desirable as seepage to neighbouring properties can occur.

6.6 General controls for on-site stormwater management

This section is based on the principles of effective stormwater management (Section 6.3) and contains the controls that will form the basis for assessing any stormwater management proposal.

- a) The proposed stormwater management system shall meet both the objectives of this chapter and of this DCP as a whole.
- b) The stormwater management system shall be designed so as to ensure the optimum outcome for both the catchment and the subject site.
- c) Where the design engineer is of the opinion that OSD would cause a lag in flows from the site that would coincide with peak flows in the receiving trunk drainage system, the engineer shall submit calculations using hydrological and hydraulic software modelling to demonstrate that OSD would be detrimental to the catchment. **NOTE:** Waiving of OSD shall be subject to Council approval.
- d) **For aesthetic purposes and to ensure the entire roof area is able to drain practicably via the rainwater tank system, no more than 10,000 litres rainwater tank storage shall be located above ground level.**
- e) The stormwater management system, as far as is practicable, shall be designed so as to also meet the objectives of Chapter 8 and assist in maintaining stream flow and recharge of groundwater.
- f) Where retention other than the mandatory rainwater tank is proposed, it is necessary to demonstrate that:
 - i) soils (existing or imported) to be utilised are appropriate to method proposed (infiltration, permeable paving, etc); and/or that
 - ii) all additional water to be retained will also be regularly used on site, for example to water a garden, flush a toilet or wash laundry so that the device is likely not to be full in the event of a storm.
- g) The design of the stormwater management system is to be based on either:
 - i) the maximum permissible built-upon area for the development specified in Section 4.4.2 (not including provisions of other Council documents referred to in the table), or
 - ii) the existing built-upon area, if this is to be retained,whichever is the greater. **NOTE: Where the proposed built-upon area is less than the maximum permissible built-upon area, the design must still be based upon the maximum permissible built-upon area.**

Note 1: For larger sites where development is obviously precluded from certain areas, a merits based assessment may be considered by Council for the basis of area calculations.
- h) The system proposed shall assist in maintaining stream flow and water quality, retardation of sediment and other gross and chemical pollutants and recharge of groundwater.
- i) All stormwater shall be conveyed in accordance with the controls contained in Appendix 7.

6.7 Stormwater management for Location A and B properties

As explained earlier in this chapter, it is the responsibility of the designing engineer to propose a stormwater management system that is appropriate to the development, site and site context. Provided that the Objectives of this chapter and the DCP as a whole are met and the stormwater management proposal can be justified, Council will consider all proposals on their merit.

6.7.1 Development Type 3

- a) The proposal must comply with the controls at Section 6.6.
- b) The mandatory rainwater tank as detailed at Section 6.4 must be included as part of the stormwater management system and shall comply with the installation specifications in Appendix 6.
- c) In areas where it is desirable that peak outflows from the subject site do not coincide with the peak flow for the catchment as a whole, the permitted site discharge and storage volume shall be calculated in the following manner:
 - i) Determine in which OSD drainage catchment the site is located (Appendix 1).
 - ii) Use the information in Appendix 2 and the calculation sheet at Appendix 3 to determine the permitted site discharge and minimum OSD storage volume required for the development.
 - iii) Deduct from the minimum OSD storage volume (SSR1 or SSR2 from Appendix 3)
 - the minimum volume of the mandatory rainwater tank required by BASIX, and
 - any *additional* rainwater tank volume proposed beyond the mandatory rainwater tank requirement of BASIX, and/or
 - any additional retention device volume proposed (other than a rainwater tank) as specified in Appendix 6.to determine the total OSD volume required.

Note: Where OSD is to be used, the permitted site discharge (PSD) shall remain as specified at Appendix 2. Where OSD is no longer required because full OSR is used, PSD is not applicable.
- d) The system shall be designed such that overflow from any rainwater tank installed on the site is captured by any other OSD / OSR devices employed on the site and disposed with in accordance with the relevant provisions of Chapter 5.

6.7.2 Development Types 4, 5 and 6

- a) The proposal must comply with the controls at Section 6.6.
- b) The mandatory rainwater tank as detailed at Section 6.4 must be included as part of the stormwater management system and shall comply with the installation specifications in Appendix 6.
- c) In areas where it is desirable that peak outflows from the subject site do not coincide with the peak flow for the catchment as a whole, the permitted site discharge and storage volume shall be calculated in the following manner:
 - i) Determine in which OSD drainage catchment the site is located (Appendix 1).
 - ii) Use the information in Appendix 2 and the calculation sheet at Appendix 3 to determine the permitted site discharge and minimum OSD storage volume required for the development.
 - iii) Deduct from the minimum storage volume (SSR1 or SSR2 from Appendix 3) the minimum volume of the mandatory rainwater tank required at Section 6.4 **up to an absolute maximum** for:
 - Type 4 -of 50% of the SSR determined in point (ii) above.
 - Type 5 and 6 -of 50% of the SSR determined in point (ii) above where not more than 8 units / dwellings are proposed, or
 - of 25% of the SSR determined in point (ii) above where nine or more units / dwellings are proposed.

Note: The permitted site discharge (PSD) shall remain as specified at Appendix 2.

- d) Except where it is demonstrably not practicable, the stormwater management system shall incorporate **at least two different devices / techniques** (including the rainwater tank detailed at Section 6.4) so as to reduce the risk of total system failure. **I.E., rainwater tanks may NOT be the sole means employed for on-site stormwater management.**
(Examples of means that may be acceptable to Council (depending on site circumstances) include: a rainwater tank and OSD; and a rainwater tank and a dispersal system.)
- e) The system shall be designed such that overflow from any rainwater tank installed on the site is captured by the OSD device(s) employed on the site and disposed with in accordance with the relevant provisions of Chapter 5.

6.7.3 Development Types 7, 8 and 9

- a) The proposal shall comply with the controls at Section 6.6.
- b) The stormwater management system shall be as determined by Council.
- c) For development Type 8 where construction of sealed driveways or roadways with an area greater than 200m² is proposed, an on-site detention system will be required to treat that area prior to discharge into the Council system. The SSR and PSD for this system shall be calculated using Appendix 2 and based upon the total impervious area to be constructed under the subdivision application.
- d) Tennis Courts must be constructed as on-site detention systems unless otherwise approved.

6.8 Requirements for Location C properties

The primary aim for Location C properties is to ensure minimal adverse impact to the natural environment. As specified in Chapter 5, stormwater disposal from Location C properties must involve devices that dissipate or retain flows that would otherwise be directed to bushland areas. The following specifications apply:

- a) The proposal must comply with the controls at Section 6.4 and 6.6.
- b) On-site detention (OSD) is **not required**.
- c) **In addition** to any mandatory rainwater tank specified in Section 6.4, the developer shall propose an on-site retention (OSR) system (using rainwater tanks and/or other devices) that retains either
 - the first 20mm of rainfall from all roof areas of the site, or
 - 5000L storage volume,whichever is the greater.
Note: If it is proposed to use retention other than a rainwater tank, the additional retention may comprise some or all of the discharge system specified in Chapter 5.
- d) The proposed OSR devices shall comply with the specifications contained in Appendix 6.
- e) The system shall be designed such that overflow from any rainwater tank installed on the site is captured by the other OSR devices employed on the site and disposed with in accordance with the relevant provisions of Chapter 5.

6.9 Requirements for Location D properties

As explained earlier in this chapter, it is the responsibility of the designing engineer to propose a stormwater management system that is appropriate to the development, site and site context. **Provided**

that the Objectives of this chapter and the DCP as a whole are met and the stormwater management proposal can be justified, Council will consider all proposals for OSD, OSR or a combination.

6.9.1 Development Types 1, 2 and 3 where no easement is available

- a) OSD is not required, however, a reduced built-upon area applies to the development in accordance with the provisions of Chapter 5.
- b) The proposal must comply with the controls at Section 6.4 and 6.6.
- c) The mandatory rainwater tank detailed at Section 6.4 must be included as part of the stormwater management system and must comply with the specifications in Appendix 6.
- d) **In addition** to the mandatory rainwater tank volume required, the first 20mm of all roof runoff on the site shall be captured in a rainwater tank (either a single tank for the site or more than one) which must be made available for toilet flushing.

Note 1: As specified in Chapter 5, Type 4 development and above are not permissible where no easement can be obtained.

Note 2: Retention other than rainwater tanks is not permissible in these circumstances as Council will not permit seepage to other properties.

6.9.2 Development Types 1, 2, and 3 where an easement is available

At properties where an easement for drainage is available and it is desirable that peak outflows from the subject site do not coincide with the peak flow for the catchment as a whole, the permitted site discharge and storage volume shall be calculated in the following manner:

- a) The proposal must comply with the controls at Section 6.4 and 6.6.
- b) The mandatory rainwater tank as detailed at Section 6.4 must be included as part of the stormwater management system and must comply with the specifications in Appendix 6.
- c) OSD is not required for development Types 1 and 2 unless it is required to control rates of runoff into existing interallotment systems which have a capacity less than the post-developed PSD on the site, and are not proposed to be reconstructed at greater capacity. These calculations shall be demonstrated to Council
- d) For Types 3 development and in areas where it is desirable that peak outflows from the subject site are controlled to not coincide with the peak flow for the catchment as a whole (i.e. on-site detention required), the permitted site discharge and storage volume shall be determined in the following manner:
 - i) Determine in which OSD drainage catchment the site is located (Appendix 1).
 - ii) Use the information in Appendix 2 and the calculation sheet at Appendix 3 to determine the permitted site discharge and minimum OSD storage volume required for the development.
 - iii) Deduct from the minimum storage volume (SSR1 or SSR2 from Appendix 3)
 - the minimum volume of the mandatory rainwater tank required by BASIX
 - any **additional** rainwater tank volume proposed beyond the mandatory rainwater tank requirement of BASIX,

to determine the total OSD volume required.

Note 1: Where OSD is to be used, the permitted site discharge (PSD) shall remain as specified at Appendix 2.

Note 2: Where OSD is no longer required because full OSR is used, PSD is not applicable, however the capacity of the drainage system within the easement must be adequate to handle uncontrolled runoff from the subject site.

6.9.3 Development Types 4, 5 and 6

An easement for drainage must be obtained for location D properties proposing development Types 4, 5 and 6 and above. In these cases the following applies:

- a) The proposal must comply with the controls at Sections 6.4 and 6.6.
- b) The mandatory rainwater tank as detailed at Section 6.4 must be included as part of the stormwater management system and shall comply with the installation specifications in Appendix 6.
- c) In areas where it is desirable that peak outflows from the subject site do not coincide with the peak flow for the catchment as a whole (i.e. where on-site detention is required), the permitted site discharge and storage volume shall be determined in the following manner:
 - i) Determine in which OSD drainage catchment the site is located (Appendix 1).
 - ii) Use the information in Appendix 2 and the calculation sheet at Appendix 3 to determine the permitted site discharge and minimum OSD storage volume required for the development.
 - iii) Deduct from the minimum storage volume (SSR1 or SSR2 from Appendix 3) the minimum volume of the mandatory rainwater tank required at Section 6.4 **up to an absolute maximum** for:
 - Type 4 -of 50% of the SSR determined in point (ii) above.
 - Type 5 and 6 -of 50% of the SSR determined in point (ii) above where not more than 8 units / dwellings are proposed, or
 - of 25% of the SSR determined in point (ii) above where nine or more units / dwellings are proposed.

Note: The permitted site discharge (PSD) shall remain as specified at Appendix 2 unless the capacity available in the downstream interallotment system requires further control.
- d) The system shall be designed such that overflow from any rainwater tank installed on the site is captured by the OSD device(s) employed on the site and disposed with in accordance with the relevant provisions of Chapter 5.

6.9.4 Development Types 7, 8 and 9

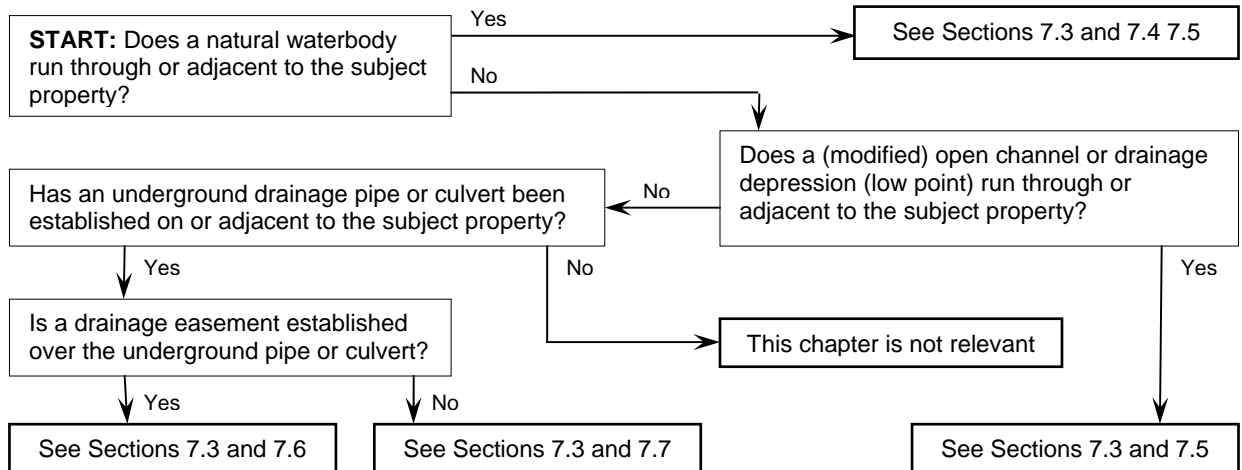
- a) The proposal shall comply with the controls at Section 6.6.
- b) The stormwater management system shall be as determined by Council.
- c) For development Type 8 where construction of sealed driveways or roadways with an area greater than 100m² is proposed, an on-site detention system may be required to treat that area prior to discharge into the Council system. The SSR and PSD for this system shall be calculated using Appendix 2 and based upon the total impervious area to be constructed under the subdivision application.

Note: The creation of new lots will not be approved unless adequate provision for **gravity** drainage is demonstrated for each of the lots to be created. This will include demonstration of the necessary easements as required.

Chapter 7

Development Adjacent to or Over Existing Drainage Systems

This chapter is only relevant where it is proposed to undertake development adjacent to or over an existing drainage system (including a natural waterbody). The following flow chart explains which parts of the chapter are relevant to the proposed development:



7.1 Introduction

Existing drainage systems including pipes, drainage easements, natural watercourses, open channels and drainage depressions convey stormwater runoff from their respective upstream catchments either by way of underground pipes or overland flow or a combination of these. The development needs to be kept clear of floodways and must not impede overland flows. Inappropriate development in close proximity to or over drainage systems can result in:

- increased incidences of flooding, and
- damage to property and belongings, and
- risk to life, and
- loss of environmental amenity and integrity, and
- difficulty in maintaining or upgrading an associated drainage system.

This chapter contains controls to ensure that development in such a location, where considered, is undertaken in an appropriate manner.

7.2 Chapter Objectives

1. Preservation of existing stormwater flow paths and drainage systems during all rainfall events.
2. Development that does not detrimentally affect neighbouring properties.
3. Preserved accessibility to existing and future underground piped drainage systems for maintenance and construction purposes.
4. Preserved integrity of existing open waterbodies.
5. Development that does not increase the impact of flood events.
6. Protection of new development from inundation or damage.

7.3 Flood studies and the design flood standard

A flood study is undertaken to identify the reach and depth of overland flows associated with drainage systems on or near a site and to assess the impact of development on such flows and vice versa. Drainage systems include underground pipes, natural watercourses, open channels and depressions.

Council reserves the right to request that a flood study be undertaken where it considers that a development proposal, associated with a nearby drainage system, may:

- Be subject to inundation from overland flows causing damage to property or belongings, and /or
- Be subject to structural damage from overland flows or debris associated with the overland flows, and/or
- Impede the passage of stormwater associated with the design flood standard to cause a rise (afflux) in the flood level upstream greater than 50mm, and/or
- Divert overland flows onto or into adjacent properties, and/or
- Increase the downstream velocities of flow for the design flood standard.

The flood study shall be prepared in accordance with Appendix 11.

The design flood standard shall be calculated based on either:

- the overland flow associated with the 100 year ARI storm event with any above-ground channels and underground pipes / culverts operating at a maximum of 50% capacity, **or**
- the overland flow associated with the 5 year ARI storm event with any above-ground channel or underground pipes / culverts fully blocked,

whichever is the greater.

Note: Council may require the adoption of a longer recurrence interval design storm such as the Probable Maximum Flood (PMF) where it is considered that the proposed works pose a greater than usual risk to persons and/or property.

7.4 Development over or adjacent to a natural waterbody

Any development that includes an 'activity' being undertaken within 40 metres of the top of the bank or shore of 'protected waters', with the exception of waters administered by the NSW Waterways Authority and in certain identified circumstances, is Integrated Development. Integrated Development requires consent from at least one public body other than Council. Contact Council prior to finalising the location if the development or any works associated with that development are located within 40 metres of a waterbody.

The following controls apply to development over or adjacent to a natural waterbody:

- a) No works shall be undertaken on or near a natural waterbody that would cause straightening, relocation, widening, narrowing, piping, lining or reprofiling of the natural waterbody.

Note: Council may require, as a condition of consent, that a restriction-on-use be placed over the riparian zone, the terms of which do not permit any works or development including excavation, fill, construction, landscaping, loss of vegetation or changes to the waterbody channel without the written concurrence of Council.

- b) Where works are proposed to be undertaken adjacent to the design flood standard conveyance zone associated with a watercourse, and Council considers necessary, a flood study shall be prepared in accordance with Appendix 11 to demonstrate that the development will not:
- i) be subject to inundation from flows associated with the watercourse causing damage to property or belongings, and /or

- ii) be subject to structural damage from flows associated with the watercourse or debris associated with the flows, and/or
 - iii) impede the passage of stormwater associated with the watercourse to cause a rise (afflux) in the flood level upstream greater than 50mm, and/or
 - iv) divert flows associated with the watercourse onto or into adjacent properties, and/or
 - v) increase the downstream velocities of flow for the design flood standard.
- c) Where the design flood standard is less than $20\text{m}^3/\text{s}$, the minimum floor level of all enclosed areas and structures, including all habitable floor areas, shall be either
- i) 300mm above the design flood standard level, or
 - ii) 300mm above the highest natural ground level along the associated overland flow path, whichever is the greater, except in the case of **garages**, where the minimum height shall be 150mm instead of 300mm, and **in-ground swimming pools**, which shall be designed in accordance with the provisions of Section 7.10.
- d) **Walkways, cycleways and general access points** may be established within the buffer zone only where the impact of the development is minimised by using ecologically informed design principles.
- e) **Safety fencing** that is required to reduce hazard to persons to acceptable limits may be installed in any areas that are subject to overland flow. Safety fencing must be able to withstand a velocity x depth maximum of 0.4m/s , not impede flows or debris, and meet the minimum requirements of AS1926.1-1993 *Fencing for Swimming Pools*. If fencing is not feasible, other suitable measures shall be provided to restrict access to area which exceed this limit.
- f) **Crossings (ie, bridges)** must maintain riparian connectivity, retain natural stream bed and bank profile, prevent scour and erosion of the stream bed or banks during storm events and not restrict bankfull or floodplain flows or inhibit natural sediment transport. This is to be achieved by:
- i) minimising the number of crossings,
 - ii) minimising the width of the crossings,
 - iii) establishing the crossings at right angles to the flow rather than at an oblique angle, and
 - iv) minimising disturbance to existing native riparian vegetation.
- Note:** To achieve the above outcomes, DIPNR recommends the use of full span bridges, even for minor watercourses, with piered (not filled) approaches for the full width of the riparian zone or a structure with an equivalent function.
- g) Parking areas shall not be established in areas where vehicles would become buoyant in an overland flow zone, and hence unstable. A maximum velocity x depth of $0.6\text{m}^2/\text{s}$ to $0.7\text{m}^2/\text{s}$ applies in these instances in accordance with section 14.10.4 of AR & R.

7.5 Development over or adjacent to an open channel or drainage depression

- a) No works, either permanent or temporary, shall be undertaken within the design flood standard conveyance zone associated with the open channel / drainage depression, with the exception of bridges, where:
- i) the underside of the structure, including any attached utility services, is not less than 300mm above the level of the design flood standard,
Note: Lower level bridges may be considered subject to demonstration that they are structurally adequate, will not impact upon stormwater flows (including backwater affecting upstream property) and will enable dry access during storm events up to the 20 year ARI.
 - ii) the existing velocity of water in the watercourse would not be affected,
 - iii) not more than one bridge is established per property, and
 - iv) the watercourse and banks beneath the bridge are stabilised by rock lining or equivalent to prevent erosion that would otherwise result from reduced plant growth due to restricted solar access.

- b) Where works are proposed to be undertaken adjacent to the design flood standard conveyance zone associated with an open channel or drainage depression, and where Council considers it to be necessary, a flood study shall be prepared in accordance with Appendix 11 to demonstrate that the development will not:
- be subject to inundation from flows associated with the channel or depression causing damage to property or belongings, and /or
 - be subject to structural damage from flows associated with the channel or depression or debris associated with the flows, and/or
 - impede the passage of stormwater associated with the design flood standard to cause a rise (afflux) in the flood level upstream greater than 50mm, and/or
 - divert overland flows onto or into adjacent properties, and/or
 - increase the downstream velocities of flow for the design flood standard
- c) Where the design flood standard is less than $20\text{m}^3/\text{s}$, the minimum floor level of all enclosed areas and structures, including all habitable floor areas, shall be either
- i) 300mm above the design flood standard level, or
 - ii) 300mm above the highest natural ground level along the associated overland flow path, whichever is the greater, except in the case of **garages**, where the minimum height shall be 150mm instead of 300mm, and **in-ground swimming pools**, which shall be designed in accordance with the provisions of Section 7.10.
- d) Where the design flood standard exceeds $20\text{m}^3/\text{s}$, the minimum floor level for all enclosed areas, including all habitable floor areas, shall be 500mm above the design flood standard level, except in the case of **garages**, where the minimum floor level may be 300mm, and **in-ground swimming pools**, which shall be designed in accordance with the provisions of Section 7.10.

Note: Council may require, as a condition of consent, that the following burdens be placed on the title of the subject property over the following areas of the property:

- A restriction-on-use over the determined design flood standard conveyance zone for an overland flowpath associated with an open channel or drainage depression, the terms of which do not permit the placement of any structures within that zone which may impede the design flood standard.
- A drainage easement to the benefit of Council and/or upstream properties as applicable.

7.6 Development where a drainage easement is established

NOTE: In the event that works need to be carried out in the easement, the costs of removal and replacement of any structure permitted under this section will NOT be borne by Council.

- a) The exact location of any drainage line within (or out of) the drainage easement shall be established by a registered surveyor, including size, depth to obvert from ground levels and changes in direction. This information shall be presented to Council.
- b) Notwithstanding the controls contained in this section, development is not permitted over or adjacent to a drainage easement and/or pipe unless it also meets the requirements of Section 7.5 (b) to (d).
- c) No structure shall either encroach upon or be located within a drainage easement, with the exception of:
- **carports and other open-faced structures**, where
 - i) existing overland flow paths are maintained, i.e there is no substantial alteration to existing ground levels;
 - ii) the pipe within the subject easement does not exceed 525mm;
 - iii) all sides of the structure are open-faced to not less than 300mm above the top water level of any overland flow path,
 - iv) the structure has a minimum 2.5 metres head clearance along the length of the easement,
 - v) footings do not encroach into the easement and are not located where they would cause any structural loading on an underground pipe,

- vi) velocity x depth profiles of associated overland flows do not exceed 0.4 m²/s, and
 - vii) the structure is readily removable and would not compromise future access to the in-ground drainage system for maintenance or upgrade. Parking stands to be paved as set out below.
 - **paving**, where finished ground levels over the easement will not be substantially altered, where existing overland flow paths will be maintained and where a suitable full-depth expansion joint or equivalent measure is provided along the easement boundaries. Paving is readily removable for future maintenance or upgrade;
 - **eave overhangs** where a minimum 2.5 metres head clearance to ground level is provided;
 - **tennis courts and other sporting surfaces** in accordance with Section 7.8; and
 - **fences**, where construction does not, either partly or fully, obstruct any existing overland flowpath and which comply with Section 7.9.
- NOTE: The approval of such structures shall be the discretion of Council**
- d) Where any structure is to be located within a drainage easement in accordance with the controls listed at (b), a written agreement to the activity shall be obtained from all beneficiaries of the easement.

7.7 Development where an underground drainage system exists without a corresponding easement

The following controls apply where an underground drainage system exists but where no drainage easement has been established:

NOTE: In the event that works need to be carried out on Council drainage systems for private developments, the costs of removal and replacement of any structure permitted under this section will NOT be borne by Council.

- a) The exact location of the underground system shall be ascertained by a registered surveyor and shown on a scaled drawing.
- b) Notwithstanding the controls contained in this section, development is not permitted over or adjacent to a drainage pipe unless it also meets the requirements of Section 7.5 (b) to (d).
- c) No structure shall be located within a 1.5 metre wide zone either side of an underground drainage system, except:
 - **carports and other open-faced structures**, where
 - i) the pipe size does not exceed 525mm,
 - ii) the structure has a minimum 2.5 metres head clearance along the length of the pipeline,
 - iii) all sides of the structure are open-faced to not less than 300mm above the top water level of any overland flow path,
 - iv) footings are not located so as to cause any structural damage to the underground system,
 - v) the structure is readily removable and would not compromise future access to the in-ground drainage system for maintenance or upgrade. Parking stands to be paved as set out below,
 - vi) there is no substantial alteration to existing ground levels, and
 - vii) existing overland flow paths are maintained, or within the 1.5 metre zone specified in c) above.
 - **paving**, where finished ground levels over the pipe will not be substantially altered, where existing overland flow paths will be maintained and where a suitable full-depth expansion joint or equivalent measure is provided 1.5 metres from the centreline, and paving is readily removable;
 - **eave overhangs** where a minimum 2.5 metres head clearance to ground level is provided;
 - footings that extend to at least the depth of the invert of the associated pipe or that are placed on competent bedrock;
 - **tennis courts and other sporting surfaces** in accordance with Section 7.8; and
 - **fences**, where construction does not, either partly or fully, obstruct any existing overland flowpath and which comply with Section 7.9.

- d) Where underground drainage lines exist within private property without the benefit of an easement, Council may require the creation of an appropriate easement at no cost to Council as a condition of approval for any Development Application for the subject land.

7.8 Tennis courts and other sporting surfaces

Tennis courts will not generally be permitted over drainage systems. However, in certain limited circumstances, Council may consider such a proposal acceptable. A tennis court in such a location must comply with the following controls:

- a) No part of the tennis court shall be constructed over or within a designated riparian zone of any watercourse.
- b) Where the tennis court is to be inundated by overland flow, an easement shall be created to the benefit of Council, at no cost to Council, over the entire area of the tennis court, the terms of which
 - i) indemnify Council against any future costs that may arise due to the presence of the tennis court such as damage or placement of debris caused by floodwaters or surcharge, or the removal and reinstatement of the tennis court and associated structures to permit access to the drainage system,
 - ii) permit the tennis court to be used for the purposes of drainage and overland flow, and
 - iii) restrict any future improvements to the court that may impede overland flow.

7.9 Fences

- a) No fence of any construction type may be established within the cross-section of the main flow channel associated with watercourses.
- b) No fence of solid construction may be established over a natural watercourse, open channel or drainage depression.
- c) Fences, whether located at boundaries or within a property, shall not obstruct any overland flowpath associated with a watercourse, open channel, easement or drainage depression.
- d) Any fence located within an overland flowpath as defined by the flood design standard shall be of open construction to at least 300mm above the flood design standard level.

7.10 Swimming Pools and Spas

- a) Swimming pools, spas and associated equipment shall be located not less than 1.5 metres from any outer edge of an underground drainage system operated by Council, regardless of whether an easement has been created for the drainage system.

Note: This is to ensure that Council will be able to maintain the system without compromising the pool structure (e.g. lifting plant).

- b) Where it is proposed to establish a pool adjacent to the design flood standard conveyance zone associated with an overland flow path, watercourse, channel or drainage depression, a flood study shall be prepared in accordance with the provisions of Section 7.3 and Appendix 11 to ascertain that the design flood standard and demonstrate that the pool structure will:
 - i) not impede the flow of stormwater associated with the design flood standard so as to cause a rise (afflux) in the flood level upstream greater than 50mm; and





- ii) not increase the downstream velocities of flow for the design flood standard; and
- iii) not be subject to structural damage associated with the conveyance of the design flood standard (water) or the impact of debris transported by the flows.
- c) Where the design flood standard flow is **less** than $20\text{m}^3/\text{s}$, the minimum finished level of the swimming pool or spa coping is to be not less than 200mm above the design flood standard level.
- d) Where the design flood standard flow is **greater** than $20\text{m}^3/\text{s}$, the minimum finished level of the swimming pool or spa coping level is to be not less than 300mm above the design flood standard level.
- e) No swimming pool or spa shall be established where it will be subject to inundation from the calculated design flood standard.

Note 1: The presence of silt, debris and other pollutants in overland flows can severely compromise the life of the pool, spa and associated equipment where they are inundated. In this respect, covenants or similar which place the onus for maintenance of the swimming pool or spa on the property owner where it is known that they will be inundated will **not** be considered by Council.

Note 2: Council will not permit the discharge of pool chemicals and the like into downstream drainage systems.

Chapter 8 Water Quality

In this chapter, the following sections are relevant to your development (see Chapter 3 for explanation):

| |  A |  B |  C |  D |
|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Type 1 | 8.1 and 8.2 | 8.1 and 8.2 | 8.1 and 8.2 | 8.1 and 8.2 |
| Type 2 | 8.1 and 8.2 | 8.1 and 8.2 | 8.1 and 8.2 | 8.1 and 8.2 |
| Type 3 | 8.1 and 8.2 | 8.1 and 8.2 | 8.1 and 8.2 | 8.1 and 8.2 |
| Type 4 | 8.1 and 8.2 | 8.1 and 8.2 | 8.1 and 8.2 | 8.1 and 8.2 |
| Type 5 | whole chapter | whole chapter | whole chapter | whole chapter |
| Type 6 | whole chapter | whole chapter | whole chapter | whole chapter |
| Type 7 | whole chapter | whole chapter | whole chapter | whole chapter |
| Type 8 | whole chapter if physical works are to be undertaken, otherwise none relevant | | | |
| Type 9 | as determined by Council | as determined by Council | as determined by Council | as determined by Council |

8.1 Chapter Objectives

1. Protection of aquatic and terrestrial environments.
2. Minimal disturbance to neighbouring and downstream properties.
3. Regular rainfall events that do not adversely affect water quality.
4. Compliance with legislation.

8.2 Stormwater quality control during construction

Allowing pollutants (including sediment) to enter any waterway is an offence under the *Protection of the Environment Operations Act 1997*. Construction sites on which soil, water and materials are not properly managed have the potential to significantly affect water quality and to degrade the natural environment.

Construction management for the control of water quality concerns both erosion and sediment control as well as management of other materials including wastes, chemicals and fuel.

8.2.1 Erosion and sediment control

Wind, rainfall and construction activity on a construction site can accelerate erosion on land that has been disturbed. Where this occurs, sediment may be spread beyond the development site, resulting in increased levels of turbidity and sediment in the waterways, spread of harmful nutrients, increased incidence of flooding, streambank erosion, reduced aesthetic quality, reduced potability of water, habitat loss and increased levels of salinity.

The main principles of erosion and sediment control are to:

- minimise the extent of disturbance,
- rapidly stabilise disturbed areas,
- divert clean runoff around work areas, and
- trap eroded sediment as close to the source as is practical.

In order to minimise the likelihood of erosion occurring during development, the following measures are necessary when any work is carried out on public or private land:

- a) All activities that have the potential to pollute must comply with the requirements of the *Protection of the Environment Operations Act 1997* (POEO Act 1997).
- b) Excavation of the site shall be limited to the immediate construction area.
- c) All vegetation not in the immediate works area shall be retained.

Note: Vegetation is a very effective barrier against erosion, helping to absorb the impact of rain on the land, reducing the volume and rate of stormwater runoff, binding the soil with roots and protecting the soil from wind erosion.

- d) Where, at the site, there are stockpiles of material that have the potential to erode (topsoil, spoil, subsoil, sand or otherwise):
 - they shall be located at least two metres from any hazard area, including surfaces with grades greater than 15 per cent, zones of concentrated stormwater flow, driveways and temporary vehicular accessways, footpaths, nature strips, kerbline gutters, open swales and the drip zones of trees; and
 - sediment fencing shall be installed downslope of all stockpiles; and
 - they shall be covered with geofabric or tarpaulin that is held down firmly at all corners and sides or otherwise stored and protected in a position where erosion of stockpiled materials will not occur.
- e) Any topsoil stripped from the site shall be stockpiled at the site for re-use (for example, to landscape the site). The stockpile shall be located away from any stormwater flowpath and protected from erosion as at control (d).
- f) Waste (including skip bins) and construction materials, equipment and sediment barriers shall at no time be placed in public walkways, verges, Council roads or road reserves unless a permit has been obtained from Council, the prescribed fee has been paid to Council and the materials are stored subject to public liability insurance cover to the order of \$20 million.

Note: Under the *Roads General Regulation 2000*, significant fines apply to the placing on the road (including footpath) of a thing likely to restrict / endanger road use.

- g) Erosion and sediment control barriers shall:
 - be in place prior to the commencement of any earth works at the site;
 - where possible, be located within property boundaries;
 - not consist of hay or straw bales unless wrapped completely in geotextile fabric and, if used on a soft surface, are dug into the ground a minimum of 75mm;
 - in the case of silt fences,
 - be installed such that stormwater flows are directed through them;
 - have the bottom edge buried at least 150mm into the soil and pegged tightly; and
 - be material specifically designed for sediment control;
 - be erected and maintained around drainage inlets such that sediment is prevented from entering the waterways;
 - be checked at least daily as well as immediately after storm events and shall be repaired or replaced such that barriers at the site are fully functional at all times;
 - be emptied when not more than 40% capacity has been reached; and
 - not be removed until such time as all permanent landscaping has been completed.

Note: Failure to effectively maintain sediment and erosion control devices may result in the responsible individual or corporation receiving an on-the-spot fine, clean-up notice or court action under the *Protection of the Environment Operations Act 1997*.

- h) At large excavation sites, all care shall be taken to ensure that stormwater is directed away from the excavation area at all times. However, in the event that the excavation site fills with water, water shall be removed in a manner that does not increase erosion, sedimentation or pollution of drainage systems, whether natural or not.

Note: Water may **not** be pumped out directly across disturbed soil.

- i) Sediment removed from any trapping device shall be disposed of or relocated so as to prevent further erosion and pollution of waterways.
- j) Any sediment spilled within the property or onto roadways shall be collected and removed with a spade and dry broom (without water) and disposed of so as to prevent further erosion and pollution of waterways. Spilled sediment should never be washed or swept into a watercourse or inlet to a stormwater system.
- k) During dry weather, where there is potential for dust movement, a light spray of water shall be applied to the site at regular intervals to minimise airborne transfer of sediment, however, the water shall not be applied in such a way as to create runoff.
- l) The sub-surface components of the site drainage system shall be installed to working order prior to construction of any building.
- m) Following building works where large areas of soil have been exposed, the land shall be fully protected from erosion through vegetative or other soil stabilisation (eg. geofabrics or matting) within twenty (20) days of completion of building works.
- n) Where works will involve the entry and exit of vehicles to and from the site:
- a single stabilised vehicular access point must be established prior to the commencement of any works. The accessway must connect to either the kerb and gutter or the dish crossing (if neither exists, one or the other, as appropriate, must be constructed);
 - where the building works are greater than a single dwelling development, a shaker pad must be established as part of the vehicular accessway. The shaker pad shall be
 - established on suitably prepared and compacted material;
 - constructed flush with the adjoining surfaces;
 - a minimum of 10 metres in length and breadth;
 - designed with rungs spaced 200-250mm apart and with a maximum width of 75mm each;
 - 300mm clear of the finished sub-grade or base level below; and
 - maintained to the abovelisted standards;
 - fencing shall be used to confine the passage of vehicle to the single stabilised entrance and any internal road; and
 - runoff from access surfaces shall drain to an adjacent sediment-trapping device on the subject site.
- Note:** On larger sites, Council may require the establishment of a stabilised construction road in conjunction with the accessway in order to define movement across or through the site.
- Vehicle loads of waste and construction material must be covered during transportation and must comply with the POEO Act 1997 and the Road Transport Act (NSW) 1999.
 - *Reference to Council's policy on access to public land.*
- o) Stripping and excavation of the site shall not commence until such time as all necessary approvals have been obtained.
- p) Unless specifically required to carry out the plans, stripping of the site shall be staged and the site shall not be wholly stripped at any one time.
- q) Prior to the installation of any roof material on a building, all necessary gutters and downpipes must be fixed and connected to the approved sub-surface drainage system.
- r) The stormwater disposal system shall be installed at the earliest stage possible.
- s) Excavated topsoil shall not be stockpiled at the site for any period greater than two weeks.
- t) Landscaping works or temporary stabilisation with geotextile fabric shall be implemented at the earliest possible stage to ensure stabilisation of the soil.

8.2.2 Management of wastes, chemicals and fuel

Hazardous and/or dangerous liquids must be handled appropriately to prevent the pollution of local waterways and the natural environment as a whole. Proper handling of such materials is also important for the health and safety of people on a work site. The primary principles of proper management of wastes, chemicals and fuel are:

- appropriate storage and handling to prevent discharge of pollutants to waterways,
- on-site containment of wastewater from construction activities, and
- appropriate storage and disposal of waste materials.

Storage of hazardous and dangerous liquids

Under the POEO Act 1997, it is an offence to store hazardous and dangerous liquids (including oils, solvents, fuels, acids and paints) in such a way as to allow any water pollution incident to occur. The following controls apply to the storage of such materials:

- a) Storage areas shall be located well away from drains.
- b) Bunding capable of retaining the full stored capacity shall be constructed around the perimeter of all liquid storage areas.
- c) Where possible, liquids shall be stored indoors.
- d) Outdoor storage areas for liquids shall be roofed to prevent rainwater entering the bunded area unless roofing the area would render it unsafe.
- e) Storage of liquids shall be in accordance with AS1940 – The storage and handling of flammable and combustible liquids or any standard replacing that standard.

Disposal of Wastewater

Particularly when derived from business and industrial properties, wastewater commonly contains pollutants such as grease, oil, paint and chemicals. Stormwater systems are for rainwater only and wastewater must therefore be kept separate from stormwater to ensure that it does not contribute to the pollution of natural waterways. The following controls therefore apply to the disposal of wastewater:

- a) Wastewater shall not enter any stormwater system either on or off the property.
- b) Washing and cleaning activities on commercial or industrial premises shall be undertaken only within the confines of a bunded area.
- c) Wastewater shall be retained on site and treated prior to disposal in accordance with NSW Department of Environment and Conservation and Sydney Water Corporation requirements.

8.2.3 Environmental Site Management Plan

- a) An Environmental Site Management Plan (ESMP) shall be prepared to accompany all development applications in accordance with the environmental controls contained in this chapter.
- b) The ESMP shall demonstrate full consideration by the applicant of the environmental effects of the proposed construction works and the means by which the construction site will be maintained throughout the construction process to ensure the optimum environmental outcome for the project.

The ESMP shall include both written commentary and a plan of the works (minimum scale 1:200) and will be prepared in accordance with Council's DA Guide.

8.2.4 Once consent is granted

- a) Any existing native vegetation or other natural features must be retained except where approved for removal to enable the development to proceed.
- b) All activities must comply with the conditions of consent issued at the time of approval.
- c) The Environmental Site Management Plan shall be provided to all persons responsible for carrying out and maintaining the development.

What if a pollution incident occurs?

- Under the POEO Act 1997, owners and builders have a responsibility to notify Council or the Environment Protection Authority (NSW Department of Environment and Conservation) of any harmful pollution incident as soon as is practicable.
- Failure to notify could result in a maximum fine of \$250,000 for corporations and \$120,000 for individuals.
- Ku-ring-gai Council and the Environment Protection Authority employ officers authorised to issue prevention, clean-up or penalty infringement notices under the POEO Act 1997.

8.3 Permanent post-construction stormwater quality control

New development typically increases the area of impermeable surface on a property and results in an increase in stormwater runoff. During regular rainfall events, runoff flushes pollutants that have been deposited on the impermeable surfaces during the earlier dry period, with the result that a greater pollutant load reaches the waterbodies.

The impact of the various pollutants will depend on the sensitivity of the water body and its adjacent areas, as well as when and how it receives the runoff. Within the Ku-ring-gai local government area the vegetation associated with soils derived from Hawkesbury sandstone are particularly intolerant to phosphorus. For this reason, water quality standards for phosphorus and gross pollutants leaving a site have been set at a high standard. It is important to note that the pollutant load standard to be achieved for phosphorus is based on technology currently available.

Standard are also set for nitrogen and litter because of their visual impacts and cumulative impacts on other receiving water bodies.

8.3.1 General controls

The following controls apply to Development Types 5,6, 8 and 9 (including carparks) at Locations A – D:

- a) All stormwater flows from regular rainfall events (1:2) shall be captured for treatment prior to discharge to the stormwater drainage system.
- b) The captured stormwater shall be treated to the following standards¹:

¹ Standards to be achieved are a percentage of the 'baseline annual pollutant load', which is defined as the expected post-development pollutant load that would be discharged from the site over the course of an average year if no stormwater reuse or treatment measures were applied. The load is determined based on average rainfall of 1200 mm per year from a 50% impervious catchment with concentrations derived from average values reported in Institute of Engineers Australia (2003) Draft Australian Runoff Quality.

| Pollutant | Baseline Annual Pollutant Load (kg/ha/yr) | Standard to be achieved (kg/ha/yr) |
|------------------------|--------------------------------------------------|-------------------------------------------|
| Gross pollutants | 500 ² | 30% (70% reduction) = 150 |
| Total suspended solids | 900 | 20% (80% reduction) = 180 |
| Total Phosphorus | 2 | 55% (45% reduction) = 1.1 |
| Total Nitrogen | 15 | 55% (45% reduction) = 8.25 |

- c) The treatment measure(s) shall include one or more of the following methods or other as appropriate:
- Proprietary device/s including an independent certification that it is able to capture and treat or retain the pollutant load specified
 - Revegetation (this method not to be used where native vegetation / bushland is retained)
Any appropriate method described in Appendix 6 or other technique appropriate to the site including
 - retention (ponds, wetlands, basins),
 - retention and filtration (bioretention, sand filters, porous paving),
 - retention and volume loss (rainwater tanks and infiltration systems), or
 - filtering and conveyance (grassed swales).
 - Gross Pollutant Traps (GPTs)
- d) Treatment shall occur as close as practicable to the source so as to maximise the effectiveness of the device(s).
- e) Where it is proposed to treat stormwater using one or more proprietary devices, technical specifications from the manufacturer shall be provided with the development application as evidence of the performance capabilities of the device.
- f) A suitably qualified and experienced engineer shall certify that the proposed management measure(s) to be used at the site (whether proprietary or otherwise) will achieve the standards for water quality required in this DCP. The certification shall be submitted with the development application.
- g) The submission of the development application shall be accompanied by a maintenance schedule for the proposed water quality management measure(s) that specifies requirements including:
- inspection frequency
 - likely frequency of maintenance during normal rainfall (to be specified)
 - likely frequency of maintenance when rainfall is above average
 - dewatering and waste disposal procedures
 - access (if relevant)
 - training and equipment requirements, including occupational health and safety procedures
 - likely annual maintenance costs
 - performance monitoring methods, and
 - emergency control procedures (in the event of component failure).

8.3.2 Controls for vegetative stabilisation

Where retention of vegetation is not possible, revegetation of cleared areas immediately following construction may be the best means of stabilising disturbed land. Revegetation of a site can be either temporary or permanent, depending on the speed of stabilisation required and the intended future use of the site. It is also possible to make use of both techniques at the

² Gross pollutant load has been set higher than typical Australian values reflecting the significant weight of leaf litter generated within Ku-ring-gai.

same time. Vegetative stabilisation, where utilised, shall be undertaken in accordance with the following controls:

- a) Before undertaking any revegetation works, the initial cause of degradation shall be addressed.
- b) Erosion and sediment control measures must be retained in good working condition until such time as the site is properly stabilised.
- c) All landscaping on disturbed areas shall be carried out in accordance with the approved landscape plans and vegetative stabilisation shall not preclude the carrying out of works in accordance with the landscape plan.
- d) Non-indigenous plant species used for temporary vegetative stabilisation shall be non-invasive and shall be of a form that will not deter the establishment of indigenous species.

Note: Temporary vegetation is generally undertaken using annual species as they tend to grow faster, however annual species are not appropriate for permanent vegetative stabilisation as they commonly cease to provide stabilisation after 6-8 months.

- e) Revegetation undertaken in riparian zones shall be permanent revegetation only utilising locally native vegetation species.

Note: Any development that includes an 'activity' being undertaken within 40 metres of the top of the bank or shore of 'protected waters', with the exception of waters administered by the NSW Waterways Authority and in certain identified circumstances, is Integrated Development. Integrated Development requires consent from at least one public body other than Council. Contact Council prior to finalising the location if the development or any works associated with that development are located within 40 metres of a waterbody.

- f) Plants used for permanent vegetation stabilisation shall consist of not less than 100% locally native tree species and 50% locally native understorey species and any annual plant species used shall be native.
- g) Where permanent vegetative stabilisation is undertaken in bushland, the ground shall be further protected against erosion by the placement of mulch or a biodegradable blanket.
- h) If degradation has altered conditions such that revegetation to pre-development standards is not possible, rehabilitation must be designed to suit the changed conditions.
- i) All disturbed areas shall be rehabilitated (landscaped) within twenty (20) days of completion of building works or provided with interim control treatment.

Chapter 9

Road and Trunk Drainage Design

This chapter is relevant to any development regardless of location, where Council or the proponent of the development determine that works in the road are required or works on Council's drainage system or private property.

9.1 Introduction

The road and trunk drainage system is typically used to convey water collected in gully pits along the roads as well as overflows to the receiving waters. It consists of a network of pipes, overland flow paths and natural and constructed channels. The care, control and management of this system is the responsibility of Council so any work performed on it may only be carried out with Council's knowledge and approval.

This chapter contains the basic requirements for road and trunk drainage systems. Further detail may be found in other Council documents such as Council's *Specification for Road and Drainage Works*.

9.2 Chapter Objectives

1. Proper management of stormwater capture and conveyance.
2. A high standard of safety, health and amenity for persons, vehicles and property.
3. Management and conservation of the Ku-ring-gai environment.

9.3 Design procedures

As required under legislation (including the *Roads Act 1993*), a design plan must be prepared and submitted to Council for approval when any work other than minor maintenance is to be undertaken within the road and trunk drainage system.

9.3.1 General

- a) All designs shall be prepared by a competent qualified civil engineer eligible for membership to the Institution of Engineers Australia.
- b) All calculations and designs shall be in accordance with the procedures set out in *Australian Rainfall and Runoff* (1987).
- c) All submissions of calculations to Council shall, where appropriate, include:
 - (i) a catchment plan showing each sub-catchment and overland flow path,
 - (ii) engineering plans detailing the proposed construction, and
 - (iii) calculations shown on the calculation sheet contained in *Australian Rainfall and Runoff* (1987).

- d) Where the calculations are to be performed by approved computer modelling, full details of the input and output files shall be provided in hard copy and in acceptable electronic form.

9.3.2 Hydrological Calculations

- a) All hydrological calculations submitted to Council for approval shall be carried out in accordance with the procedures set out in *Australian Rainfall and Runoff* (1987) and in accordance with recognised engineering practice.
- b) For catchments greater than 1.5 hectares and/or where there is more than one contributing catchment, peak flowrates shall be determined using a recognised runoff routing computer model such as ILSAX or DRAINS.

Note: In all other cases, use of the rational method for determining flowrates will be considered acceptable. In these instances, the calculation sheet shown in *Australian Rainfall and Runoff* (1987) shall be included together with a plan clearly showing the catchment areas and overland flowpaths.

- c) Runoff coefficients and times of concentration shall give due consideration to likely future development within the catchment.

9.3.3 Recurrence Intervals

- a) Drainage systems shall be designed to provide both minor and major flow conveyance systems as detailed in *Australian Rainfall and Runoff* (1987).
- b) All enclosed stormwater drainage systems shall be designed to have minimum capacity to cater for a storm recurrence interval of once in 20 years, unless otherwise approved by Council.
- c) Overland flowpath shall be established to accommodate the surcharge from rainfall for a storm recurrence interval of either the 100 year ARI with all pipelines 50% operational or the 5 year ARI with all pipes blocked, whichever provides the greatest surcharge.
- d) Constructed trunk stormwater drainage channels shall be designed to have sufficient capacity to convey the 20 year ARI rainfall event with appropriate freeboard at the bankfull level together with provision to convey the 100 year ARI event in overbank flow.

Note 1: Council may require the recurrence intervals specified herein to be increased having regard to the particular circumstances of each case or where danger to persons or risk of significant property damage warrants such an approach.

Note 2: Rainfall intensities for Ku-ring-gai as derived from *Australian Rainfall and Runoff* (1987) are included in Appendix 11. Rainfall intensities for durations not included in this table may be determined using the equation and intensity-frequency-duration co-efficients included at the same Appendix.

Note 3: Topographical maps may be purchased in whole or in part from Council.

Note 4: Council does not retain a complete record of the locations, sizes and levels of all components of its drainage system. Upon written application to Council, relevant information may be researched for the applicant, however, Council cannot guarantee that the correct information is held in its records.

9.3.4 Hydraulic Calculations and System Design

- a) Pipeline design for road and trunk drainage shall be performed using the hydraulic gradeline method set out in chapter 14 of *Australian Rainfall and Runoff* (1987).
- b) Minimum internal pipe diameter shall be 375mm.
- c) Minimum pipe gradient shall be 1.0% to allow for cleaning and self-flushing.

- d) Pipe velocity shall be between 0.5m/s and 7.0m/s and preferably between 1.0m/s and 5.0m/s during the design storm to ensure the flow is self-cleansing but not likely to cause scour.
- e) Minimum pipe cover in areas not subject to vehicular loading shall be 300mm (measured from the crown of the pipe).
- f) Minimum pipe cover in areas subject to vehicle loading must be 450mm. Appropriate design of bedding and backfill is also be required.
- g) Pipe classes, backfill and bedding shall be determined using the AS 3725 or any standard replacing that standard.
- h) Except where approved by Council, pipes shall be rubber ring jointed reinforced concrete pipes to comply with the requirements of Australian Standard AS 1342 – 1973 or any standard replacing that standard.

Note: Council does not permit the use of pipes or traditional concrete lined channels or their equivalent to replace existing open watercourses. Where new drainage channels are proposed, they must be designed and constructed in an environmentally sensitive manner that mimics the environmental benefit of a natural open watercourse. This would typically involve the use of large sandstone rocks that are tightly packed to form a stable channel and also to provide niches for habitat function, sediment collection and plant growth. The size of individual rocks will depend on the design velocity of flood flow along the channel. The channel design will require careful design by the engineer in consultation with a suitably experienced ecologist and/or landscape architect.

- i) Constructed channels shall be designed to cater for a 50% blockage factor (ie, it shall be assumed that the channel is 50% blocked during the critical design storm). This applies to both the minor and major flow conveyance design.
- j) Inlet pits shall be located and provided with kerb inlet of adequate size to relieve the flow in gutters, such that the depth does not exceed 100mm on the high side of residential roads and 75mm on the low side of residential roads and 75mm in commercial areas. Additional pits may be required in certain locations to prevent cross road flows. The location of the gully pits on curves, kerb returns and in line with normal pedestrian traffic flows is to be avoided.
- k) The minimum pit size for any inlet, gully or junction pit on Council drainage systems is 900x900mm clear internal.
- l) The inlet capacity of on-grade and sag inlet pits shall be determined using equations given in *Australian Rainfall and Runoff* (1987) (AR&R) or the charts provided in the Appendix of AR&R. Allowances shall be made for blockage in accordance with the following table:

| Inlet Type | Side Entry | Grated | Combination | Letterbox |
|---------------------|------------|--------|-------------------------------|-----------|
| % Capacity Blockage | 10% | 30% | 100% side inlet capacity only | 50% |

All new pits are to be constructed using galvanised steel grates and sag pits are to have a minimum internal lintel width of 2.4 metres nominal opening.

- m) Water depths and velocities in free surface flows shall be determined using Mannings equation. Where uniform flow is occurring (ie, the channel cross-section, roughness and slope are constant over a reasonable distance), Mannings equation may be applied to the cross-section without consideration of upstream or downstream influences.

Note: For most overland flow analysis, the assumption of uniform flow will not be appropriate and consideration must be given to upstream and downstream controls, losses for afflux and other hydraulic losses.

9.3.5 Preparation of Stormwater Design Drawings for Trunk Systems

- a) Stormwater design drawings submitted to Council for approval shall include a plan view of the proposed stormwater drainage layout and a drainage longitudinal section of each proposed pipeline. These shall be drawn at recognised scales and in accordance with Australian Standard AS 1100, Part 401-1984 or any standard replacing that standard.

- b) The plan view shall clearly show the location, dimensions and types of:
 - i) all existing drainage features including drainage pipelines, channels, structures, utility services and overland flow paths and
 - ii) all proposed drainage features including drainage pipelines, channels, structures and overland flowpaths,together with all necessary information to accurately set out the proposed works including the location, coordinates and levels of survey control marks and coordinates of each drainage node.
- c) Drainage longitudinal sections shall be provided for all proposed stormwater drainage lines. They shall be drawn to Australian Height Datum (AHD) at the same horizontal scale as the plan view and with a vertical exaggeration of five, oriented with chainages running from left to right and shall include the following:
 - (i) existing and design surface profile
 - (ii) existing and design surface levels
 - (iii) existing drainage pipelines
 - (iv) utility services
 - (v) design pit and pipe profiles
 - (vi) chainages along pipe centreline
 - (vii) proposed pipe grade, size and class
 - (viii) design flow and velocity
 - (ix) drainage structure definition
 - (x) junction and node identification

Chapter 10

On-site Wastewater Management

10.1 Chapter Objective

Sustainable use of the water resource without compromise to lifestyle.

10.2 On-site wastewater management controls

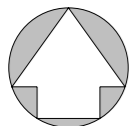
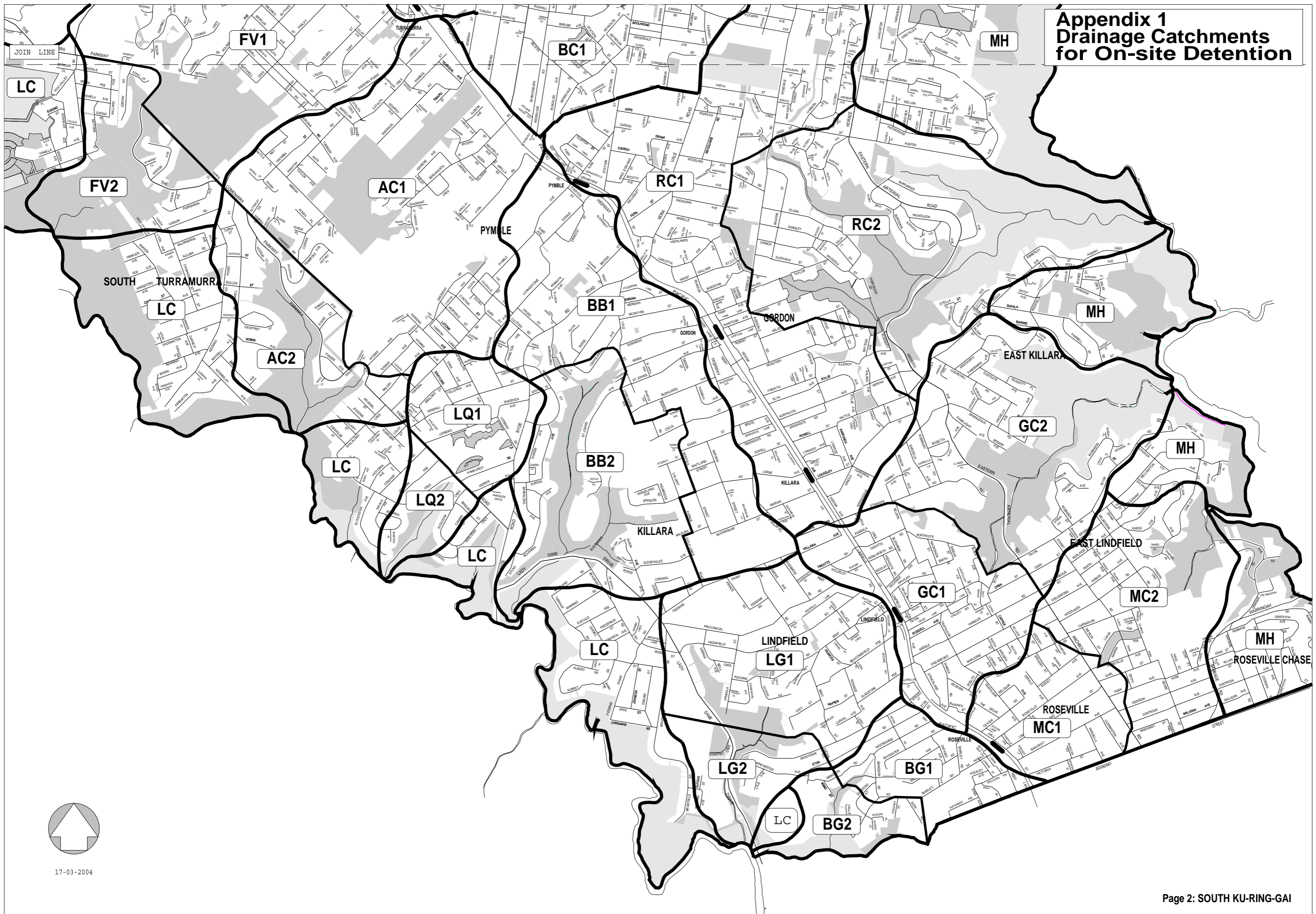
In addition to installation of water savings devices and a rainwater tank (as required in the following chapter), water may also be conserved by treating wastewater on the site and, where appropriate, reusing it. Where on-site wastewater management is to be employed, the proposal must comply with the following controls:

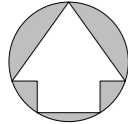
- a) The system shall be designed, located and constructed so as to
 - i) prevent the spread of pathogens to waterways, soil, air, animals or humans,
 - ii) prevent nuisance odour, insect pests, vermin or other amenity impacts,
 - iii) prevent contamination of soil, water or air,
 - iv) ensure that all overflows are to the sewerage system in accordance with Sydney Water requirements.
- b) The proposal to Council must include a design and management plan addressing relevant hydrological, hydrogeological, soil contamination and public health issues in accordance with AS/NZS1547 or any standard replacing that standard.
- c) Any greywater treatment system proposed shall comply with *Greywater Reuse in Sewered Single Domestic Premises* (NSW Health, 2000) or the relevant guideline or any standard replacing that standard.
- d) Direct greywater application to the site must comply with any NSW Health requirements.
- e) Any on-site wastewater system designed for detached single dwellings shall be designed in accordance with the provisions of NSW *Environmental Health and Protection Guidelines – On-site Sewage Management for Single Households*.

Note 1: In addition to any development consent required, approval must be sought from Council under the *Local Government Act 1993* (Chapter 7) for the installation of any on-site wastewater treatment treating no more than 750 kilolitres per day. For systems treating more than this volume, it is necessary for the developer / proponent to consult with the Department of Health and the Department of Environment and Conservation.

Note 2: The provisions of the Local Government (Approvals) Regulation 1999 will apply to any application to which this section relates.

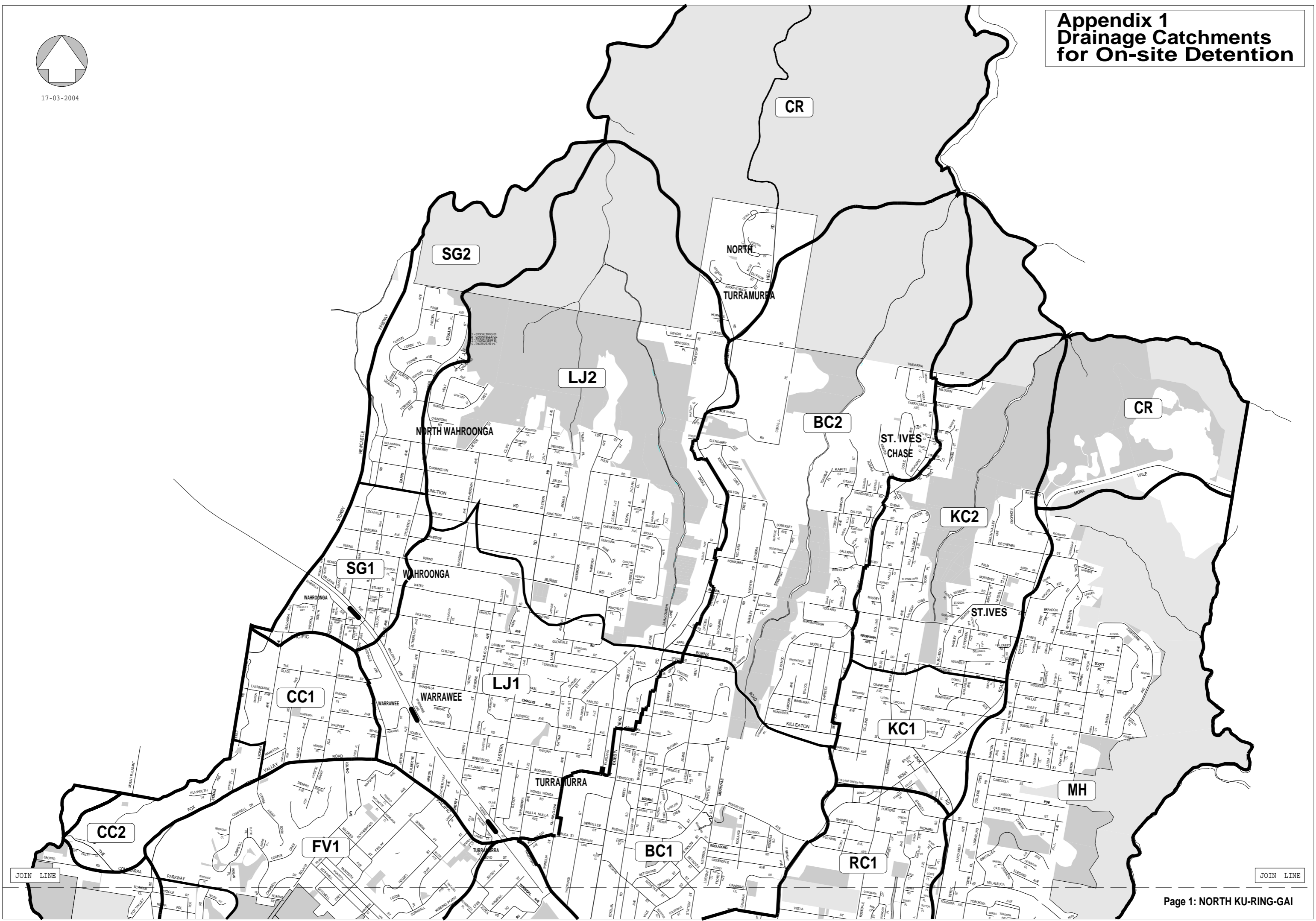
Appendix 1 Drainage Catchments for On-site Detention





17-03-2004

Appendix 1 Drainage Catchments for On-site Detention



Appendix 2

Permitted Site Discharge and Minimum On-site Detention Storage Volumes

The codes in the table below are found on the map in Appendix 1.

| Code | Catchment Area | Permitted Site Discharge (l/s/ha) | Equivalent Minimum OSD Storage Volume (m ³ /ha) |
|------|-----------------------|--------------------------------------|---------------------------------------------------------------|
| AC1 | Avondale Creek | 102 | 398 |
| AC2 | Avondale Creek | 166 | 241 |
| BB1 | Blackbutt Creek | 141 | 302 |
| BB2 | Blackbutt Creek | 166 | 241 |
| BC1 | Cowan Creek | 96 | 414 |
| BC2 | Cowan Creek | 166 | 241 |
| BG1 | Blue Gum Creek | 147 | 287 |
| BG2 | Blue Gum Creek | 166 | 241 |
| CC | Coups Creek | 132 | 325 |
| CR | Cowan River | 166 | 241 |
| FV1 | Fox Valley | 129 | 332 |
| FV2 | Fox Valley | 166 | 241 |
| GC1 | Gordon Creek | 128 | 336 |
| GC2 | Gordon Creek | 166 | 241 |
| KC1 | Ku-ring-gai Creek | 139 | 308 |
| KC2 | Ku-ring-gai Creek | 166 | 241 |
| LG1 | Lady Game Creek | 147 | 287 |
| LG2 | Lady Game Creek | 166 | 241 |
| LC | Lane Cove River | 166 | 241 |
| LQ1 | Loftberg Quarry Creek | 153 | 272 |
| LQ2 | Loftberg Quarry Creek | 166 | 241 |
| LJ1 | Lovers Jump Creek | 94 | 417 |
| LJ2 | Lovers Jump Creek | 166 | 241 |
| MH | Middle Harbour | 166 | 241 |
| MC1 | Moores Creek | 136 | 315 |
| MC2 | Moores Creek | 166 | 241 |
| RC1 | Rocky Creek | 124 | 345 |
| RC2 | Rocky Creek | 166 | 241 |
| SG1 | Spring Gully Creek | 134 | 320 |
| SG2 | Spring Gully Creek | 166 | 241 |

Appendix 3 On-Site Detention Calculation Sheet

Address

Catchment Detail

| | | | | |
|----|--------------------------------|--------------------------------|----------|--|
| 1. | Catchment Name | | | |
| 2. | Catchment Discharge Rate | l/sec/m ² | A | |
| 3. | Catchment Storage Rate | m ³ /m ² | B | |

Site Details

| | | | | | |
|----|-----------------------------------------------------------------|----------------|------------------------|----------------|----------|
| 4. | Site Aream ² | ^ | 60% of site area | m ² | C |
| 5. | Area(s) not draining to the detention system.....m ² | | | | |
| 6. | Total impervious area (roofs, driveways, paving, etc.) | m ² | D | | |
| 7. | Impervious area bypassing detention system | m ² | E | | |

Permitted Site Discharge

| | | | | |
|-----|----------------------------------------------------------------------------------|---------|---------------|--|
| 8. | C [.....m ²] x A [..... l/sec/m ²] = | l/sec | Flow 1 | |
| 9. | Adjustment for any uncontrolled impervious flow E / D = | (<0.25) | F | |
| 10. | Flow 1 [..... l/sec] x F [.....] = | l/sec | Flow 2 | |
| 11. | Flow 1 [.....] – Flow 2 [.....] = | l/sec | PSD | |

Site Storage Requirement

| | | | | |
|-----|-------------------------------------------------------------------------------------------|----------------|-------------|--|
| 12. | C [.....m ²] x B [.....m ³ /m ²] = | m ³ | SSR1 | |
| 13. | If the storage is in a landscaped basin, SSR1 x 1.2 = | m ³ | SSR2 | |

Outlet Control

| | | | | |
|-----|---------------------------------------------------------------------------------------|----|-----------|--|
| 14. | Height difference between top water surface level and the centre of the orifice | m | G | |
| 15. | Orifice Diameter $21.8 \times \sqrt{\frac{PSD}{G}}$ | mm | OD | |

PSD = Permitted Site Discharge

SSR1 = Site Storage Requirement (except for landscaped basins)

SSR2 = Site Storage Requirement (landscaped basins) (**Note: Use only SSR1 or SSR2**)

OD = Orifice Diameter

Signature..... Name.....

Qualifications..... Date

Appendix 4

On-Site Stormwater Detention Certification Sheet

Address: _____

DA Number: _____

Catchment Code: _____

Required Volume: _____m³

Permissible Site Discharge: _____l/sec

Type of System:

☐ Tank (circle description and add dimensions):

circular concrete - precast concrete - brick wall -
block wall - Buffer tank - other: _____

length _____m width _____m

depth _____m

Are step-irons provided? ☐ yes ☐ n/a

Is safety fencing provided? ☐ yes ☐ n/a

Has adequate grade been provided on the base of
the tank to drain the outlet? ☐ yes

Actual volume attained _____m³

Overflow type (please circle): pipe - weir - surface grate

Where overflow is directed: _____

Outlet Control: Stainless steel orifice _____mm
Galvanised orifice _____mm

Depth from centre of orifice to overflow: _____mm

Outlet attained _____l/sec

Where outlet is directed: ☐ kerb ☐ pipe

Is connection in accordance with Council requirements or
the approved plan? ☐ yes ☐ no

Debris Screen: ☐ maximesh ☐ handle provided ☐ readily removable without tools
☐ other _____

Silt Trap: length _____mm ☐ screen fitted exclusively over outlet
width _____mm ☐ subsoil drainage provided to the outlet pipe
depth _____mm ☐ weepholes provided

Will there be any uncontrolled flow from the impervious area of the site? ☐ yes ☐ no

Could access be readily gained to the system for inspection purposes? ☐ yes ☐ no

COMMENTS: _____

I, _____, of _____

hereby certify that the above on-site detention storage facility has been constructed in accordance with the
approved plans.

Signature: _____ / ____ / 20____

Qualification: _____

Note: Council engineers will carry out audit inspections on completed on-site detention systems for compliance purposes.

☐ Surface Basin (circle descriptions & add dimensions):

Surface: grassed - landscape - paved

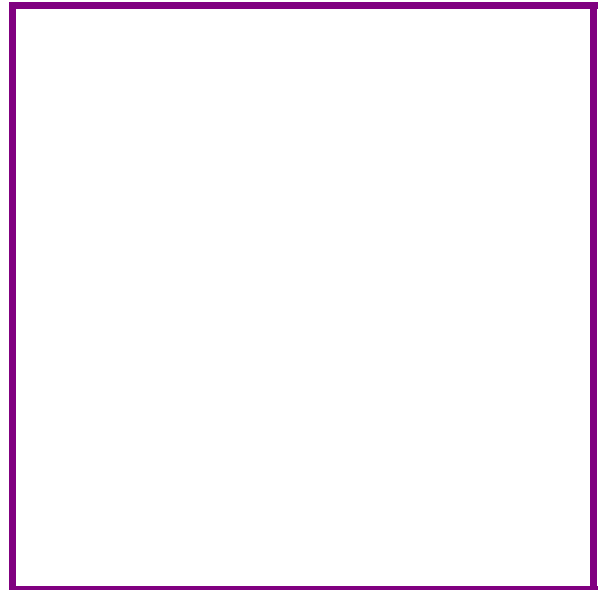
Retaining Walls: brick - block - other: _____

av. length _____m

av. width _____m

max. depth _____m

max. depth _____m



LOCATION SKETCH

Appendix 5

Design of On-site Detention Systems

Depending on the site, stormwater may be detained above and/or below ground. Where it is above ground, it may be held in an open grassed or landscaped area or in a driveway designed for such a purpose. It is possible to use a combination of different locations. The following controls apply to on-site detention tanks:

A5.1 General Controls for on-site detention (OSD) systems

- a) On-site detention (OSD) shall not be established across allotment boundaries.
- b) The design of the facility shall be compatible with the proposed overall site layout and landscaping and shall not be unsightly.
- c) On-site detention storage must generally be located as close as possible to the lowest point of the site.
- d) The site drainage system shall not surcharge before the on-site detention area is full to the design top-water level.
- e) On-site detention storage's must not be located in drainage easements and/or overland flow paths that convey catchment flows through the site.
- f) The on-site detention system is to drain freely to the public drainage system for storm events up to and including the 1:100 yea ARI. If this is not possible, compensation is to be made by increasing the storage volume provided (calculations to be submitted for approval).
- g) The rate of discharge from the OSD system shall be restricted by a single discharge control structure per allotment and shall be calculated based on the following assumptions for minimum impervious site coverage:
 - i) Development Types 1-3 (dwellings) – 60%
 - ii) Development Type 4 (dual occ) – 40%
 - iii) Development Type 5 – 60%
 - iv) Development Type 6 – 100%
 - v) Paved Areas – 100% of the paved area
- h) Where the development is on land that is to be strata titled or community titled, OSD must be located in common areas (and not in private courtyards).
- i) Locations of on-site detention systems must be included on any new final plans of subdivision.
- j) Cut and/or fill within the canopy areas of any trees to be retained is not permitted.
- k) The excavation influence line shall not affect footings of adjacent or neighbouring structures.
- l) The location of the OSD shall not restrict pedestrian access between a public road and any site building and shall not cause hazard or inconvenience in any manner.
- m) A spillway or overflow outlet shall be provided in all OSD systems as part of the operation of the system. The overflow shall be designed to cater for total system failure (blockage) in extreme storm events and designed to safely convey all overflows up to the 100 year ARI uncontrolled flow to an adequate downstream drainage system without adverse impact on neighbouring properties.

Note: Where large overflow structures are required, Council may determine that approval for the structure is required from the Dam Safety Committee.
- n) The overflow from the system shall be collected within a suitably located and sized drainage pipeline with a design capacity equivalent to the 100 year ARI storm runoff from the site.

- o) Overflow shall not be directed to another private property.
- p) The spillway shall be protected by the fixing of suitable armour over the overflow facility.
- q) The overflow level shall be not less than:
 - i) 300mm below the floor level of all habitable areas adjacent to the OSD and
 - ii) 150mm below the floor level of all garage areas adjacent to the OSD.
- r) The top level of kerbs and other retaining structures shall be a minimum of 50mm above the level of flow over the spillway.
- s) The location of all on-site stormwater detention systems shall be marked on site by the fixing of a marker plate of minimum size of 150 x 100mm to the nearest concrete or permanent surface in a prominent position. The plate shall be of non-corrosive metal or 4mm thick laminated plastic and that contains the following wording:

This is an on-site stormwater detention system required by Ku-ring-gai Council. It is an offence to reduce the volume of the tank or basin or to interfere with the orifice plate that controls the outflow. The owner must clean the base of the outlet control pit and the debris screen of debris and sediment on a regular basis. This plate must not be removed
- t) A positive covenant and restriction on use shall be established for the detention system in accordance with Appendix 14 (A14.1).

A5.2 Discharge control pits (DCP)

- a) The discharge control pit shall have dimensions of 600mm x 600mm for pits up to 600mm deep, and 900mm x 600mm for pits exceeding 600mm depth.
- b) To protect against blockage, all outflow controls shall be totally and solely enclosed by a rustproof debris screen or wire cage in accordance with the following:
 - i) the screen material shall be hot dipped galvanised mesh (*lysaght's maximesh 3030* or equivalent product);
 - ii) the minimum surface area of the debris screen shall be 50 times the area of the outlet pipe or orifice;
 - iii) the screen shall be a minimum of 100mm from the face of the orifice and attached (generally on a sliding mechanism) to the wall;
 - iv) the screen shall be capable of removal by hand to permit cleaning and easy inspection of the outlet control; and
 - v) The inlet pipe to a DCP should direct inflows parallel to the screen. To assist in shedding debris, the screen should be positioned as close as possible to the vertical, but not less than 45 degrees to the horizontal.
- c) A sediment collection sump shall be provided below the orifice outlet to the stormwater detention system that:
 - i) has a minimum depth of 200mm below the invert of the orifice;
 - ii) is connected to the outlet pipe by means of 3 x 40mm weepholes plugged with a geofabric filter cloth; and
 - iii) includes an additional filter medium between the weepholes and the connection to the outlet that consists of 15mm river gravel wrapped in geofabric over a minimum length of 600mm, thence to subsoil drainage connected to the main outlet (where possible).
- d) If site discharge is controlled through installation of a choke pipe, the adopted tailwater levels shall be as follows:
 - i) for systems draining directly to the street drainage system –
 - for connections to the kerb, the top of the kerb level, or
 - for connections to street drainage pits, 150mm below the underside of the grate, or

- for connections to footway or easement pipes or pits, the surface level of the point of connection; or
- ii) for systems draining directly to an open channel, the top of the channel.
- iii) for systems draining directly to a watercourse, the top of the watercourse.
- e) If site discharge is controlled by a sharp edged orifice, the following controls apply:
 - i) Orifice plates shall have minimum dimensions of 200 x 200mm with a minimum orifice diameter of 30mm and shall be 3mm thick flat stainless steel.
 - ii) The orifice plate is to be tooled to the exact dimension as calculated and shall be securely fastened in a central position over the outlet pipe using four galvanised (4) dynabolts and epoxy cement.
 - iii) Orifice plates shall be flush with the wall such that flow does not pass between the plate and the wall and shall be located so that the centreline of the orifice is in line with the base of the on-site detention tank.
 - iv) The following formula shall be used to calculate the required diameter of the sharp edged orifice: $D = 21.9 * (PSD / h^{0.5})^{0.5}$
 - where
 - D = orifice diameter (mm)
 - PSD = flowrate (L/s)
 - h = pressure head at the middle of the orifice when the system is at its maximum storage capacity (m)
- Note:** the formula assumes that the water level immediately downstream of the orifice is not above its obvert.
- v) Where the calculated orifice diameter is less than 30mm, the detention system shall be redesigned to either reduce water depths in the storage facility or to increase the catchment draining to the basin.
- vi) The outlet pipe to which the orifice discharge is connected is to have a capacity at least 1.5 times the permissible site discharge for at least the first 2.0 metres downstream from the orifice.

A5.3 Above ground on-site detention systems

- a) The facility must be located where the least possible adjustment to existing ground levels would be required to achieve storage of the necessary volume.
- b) Nuisance flooding shall be avoided by placing an absolute minimum of 20% of the total storage requirement as below ground storage.
- c) The calculated storage volume shall be increased by 20% to allow for the growth of the vegetation and for minor variations to the ground level occasioned by the maintenance regime.
- d) Ponding depth shall not exceed 1.2 metres at any point and shall not exceed 300mm over a minimum width of 1.0 metre at the perimeter.
- e) A childproof fence shall be established around the OSD area where ponding depth exceeds 300mm and where any side of the OSD basin exceeds 15% gradient.
- f) The proposed structure shall be certified by the designing engineer as impermeable and structurally adequate to retain the design volume of water.
- g) Council will not approve post and sleeper walls and/or earth mounding as a retaining structure for on-site detention storage's.
- h) A minimum of 0.15m freeboard to the top of the basin perimeter shall be provided above the level of the overflow spillway invert.
- i) Where ponding on driveways/parking areas is considered the maximum ponding depth shall be 150mm in parking areas and 200mm in all other trafficked areas; and

- j) Where ponding on driveways/parking areas is considered, all driveway gradients and gradient transitions shall meet the standards of Australian Standard 2890.1 – 1993 “Off-street car parking”.

A5.4 Below ground OSD structures

- a) Council will not approve the use of “Drainage Cell” type products for on-site detention storage. Such systems provide no access for maintenance or removal of silt/debris.
- b) A minimum of 300mm soil cover shall be provided where the tank is located under landscaped areas;
- c) The tank shall be structurally designed to withstand all service loads (normal earth, surcharge, traffic and hydrostatic) and to provide a service life of fifty (50) years;
- d) Internal supporting walls must be minimised to ease maintenance. Typically internal supports should only be considered for spans greater than 3m.
- e) Excavation for the tank must be checked for impact on the zone of influence on adjacent footings and structures
- f) An inspection / access grate measuring 600mm x 900mm shall be installed directly over the overflow outlet and shall be readily accessible from a point external to the site building(s);
- g) Where the internal depth of the tank is less than 0.6 metres, surface grates are to be provided in each corner of the on-site detention tank and all inlet pipes shall be connected directly under the grate access to the control outlet of the on-site detention tank. This is to minimise any need to enter the tank for maintenance reasons and to allow for ventilation and remote flushing of the tank floor;
- h) The base of the tank shall have a minimum 1% grade towards the discharge control pit to ensure proper drainage.
- i) Fixed step irons shall be fitted into the tank where the internal tank depth exceeds 1.2 metres;
- j) a child-proof locking system shall be employed for surface grates and lids;
- k) in high water table areas, the tank shall be designed to avoid flotation;
- l) all inlet pipes shall discharge at the tank floor level in order to minimise noise disturbance; and
- m) rainwater tanks designed for aboveground use shall not be utilised for underground OSD purposes.

Appendix 6

Specifications for Water Management Devices

A6.1 – Rainwater Tanks

A6.4 – Bioretention Devices

A6.7 – Other Techniques

A6.2 – Dispersal Trenches

A6.5 – Porous Paving

A6.3 – Infiltration Trenches

A6.6 – Vegetated Swales

A6.1 Rainwater Tanks

In certain circumstances, rainwater tanks with a volume of up to 10,000 litres can be installed without development consent. The circumstances under which this is possible are detailed in State Environmental Planning Policy No. 4. For tanks that are not exempt, the following controls apply:

- a) The tank shall not be located forward of the building line or within the setback to a secondary street frontage, except where
 - i) it is located on a battleaxe allotment and is not visible from the street or
 - ii) where another building is located between the street to which the property is adjoined and the building with which the tank is associated.
- b) The tank shall be located at least 450mm from any property boundary.
- c) The tank shall not be installed over or immediately adjacent to a water main or sewer main unless it is installed in accordance with any requirements of the public authority that has responsibility for the main.
- d) The tank shall not be installed over any structure or fittings used by a public authority to maintain a water or sewer main.
- e) If installed above-ground, the tank shall be located at least 100mm from any parallel potable water supply pipe and if installed below-ground, the tank shall be located at least 300mm from any parallel potable water supply pipe.
- f) No part of the tank or any stand for the tank shall rest on a footing of any building or other structure, including a retaining wall, unless it is demonstrated that the footing or structure is designed to take the load of a full tank of water.
- g) The tank, together with any stand or slab for the tank, shall be structurally sound, shall satisfy any applicable deemed-to-satisfy conditions of the Building Code of Australia and shall be installed in accordance with any requirements of Sydney Water Corporation.
- h) All plumbing work shall be carried out by a licensed plumber.
- i) Excess (overflow) stormwater shall be:
 - i) diverted away from the foundations of any buildings or structures including the rainwater tank itself;
 - ii) directed to an existing stormwater system, to another retention or detention system within the subject property or to a garden area within the subject property;
 - iii) directed in such a way that it does not pool on site or cause nuisance to neighbouring properties or to areas of public access.
- j) The tank shall be enclosed and any inlet to the tank shall be screened or filtered to prevent the entry of foreign matters or creatures.
- k) The tank shall be fitted with a first-flush device that causes the initial run-off from any rain event to bypass the tank in order to reduce the pollutants entering the tank.
- l) A sign shall be affixed to the tank clearly stating that the water in the tank is rainwater and all taps and rainwater tank apertures shall be similarly marked.

- m) Distribution pipes, both below and above ground, from the rainwater tank shall be continuously marked 'RAINWATER' in accordance with AS 1345 or otherwise above-ground distribution pipes shall be clearly labelled 'RAINWATER' with adhesive pipe markers made in accordance with AS 1345 and below-ground distribution pipes shall have identification tape/pipe sleeve continuously marked 'RAINWATER' in accordance with AS 2648.
- n) The tank shall comply with Australian Standard AS/NZS 2179-1994 – Specifications for rainwater goods, accessories and fasteners.
- o) If the tank is metal it shall comply with Australian Standard AS 2180-1986 – Metal rainwater goods – selection and installation.
- p) Noise emissions from any pump used with the rainwater tank shall not exceed 5dB(A) above ambient background noise levels measured at the allotment boundary.
- q) Water retained for indoor household uses shall be augmented by mains water supply and an approval for the activity shall be obtained from Sydney Water Corporation.
- r) As required by Sydney Water Corporation, where retained water is augmented by mains water supply, a backflow prevention device shall be installed to prevent contamination of mains water in accordance with Australian Standard AS 3500.1.2 – National plumbing and drainage: water supply – acceptable solutions.
- s) The indirect connection to mains water shall be by means of a visible 'air gap' external the rainwater tank in accordance with the provisions of AS/NZS 3500 – Minimum air gap requirements.
- t) If the tank water is connected to fixtures other than toilet, laundry and outdoor uses, the water supply shall be monitored and, where necessary, treated, to ensure that it meets the standards for potable water in accordance with the *National Health and Medical Research Council Australian Drinking Water Guidelines 1996*.
- u) Any use of retained water for potable purposes shall be in accordance with NSW Department of Health guidelines.
- v) The rainwater tank shall be maintained in accordance with the NSW Health Department Circular No. 2002/1 "Use of rainwater tanks where a reticulated potable supply is available" or any circular that replaces it.
- w) A positive covenant and restriction on use shall be established for the retention system in accordance with Appendix 14 (A14.2).

A6.2 Dispersal Trenches

Dispersal trenches are designed to disperse stormwater into the groundwater table and can assist with water quality treatment. Where employed in accordance with Chapter 8 requirements, they shall adhere to the following controls:

- a) Dispersal trenches shall be 700mm wide x 700mm deep x 1000mm run per 10m² of area to be drained and located along contours.
- b) Trenches shall be fitted with half round PVC (450mm diameter) dome sections backfilled with crushed or round river gravel to within 150mm of finished surface level, surrounded with suitable geofabric and finished with topsoil and appropriately vegetated.
- c) Unless otherwise specified by a qualified civil engineer, the distance between the infiltration device and the nearest building shall be:
 - 1 metre, where the soil is sand (hydraulic conductivity > 180 mm/hr)
 - 2 metres, where the soil is sandy clay (hydraulic conductivity 180 – 36 mm/hr)
 - 4 metres, where the soil is medium clay (hydraulic conductivity 36 – 3.6 mm/hr)
 - 5 metres, where the soil is reactive clay (hydraulic conductivity 3.6 – 0.036 mm/hr)
- d) Where detached structures, such as sheds or swimming pools, are to be established in the rear yard, these shall be established uphill of the dispersal trenches without compromise to the minimum distances required under the previous control.

Note: Establishment of detached structures uphill of dispersal trenches is necessary so as to ensure that artificial redirection or concentration of overland flow to adjoining neighbouring properties does not occur. A proposal to establish a structure in a manner contrary to this control must be accompanied by certification by a qualified civil/hydraulic engineer that the natural flow pattern will not be affected (which may require the use of extensive infiltration trenches, as described in 8.8.10 to replace the dispersal trenches).

- e) A suitably designed litter and coarse sediment arrestor pit, at least 450mm² and grated is to be provided immediately upstream of the dispersal trench.
- f) Trenches shall be designed so as not to require any excavation under the canopy areas of any trees to be retained unless as approved by a qualified arborist's certification that such excavation will not affect the longevity of the subject tree(s).
- g) Trenches shall be oriented parallel to the ground surface contour and shall be located as far upslope as possible.
- h) A positive covenant and restriction on use shall be established for the retention system in accordance with Appendix 14 (A14.2).

A6.3 Infiltration Trenches

Infiltration trenches are devices that capture and temporarily store stormwater before allowing it to infiltrate into the soil, generally over a period of up to two days. As well as acting as a retention device, they assist in managing water quality. Where an infiltration device is used as a component of stormwater management, the device must comply with the following controls:

- a) Unless the design of the infiltration device has been specified by a qualified civil engineer, on-site infiltration **may not be undertaken** on sites where the soil or terrain conditions include or consist of
 - loose sands
 - heavy clays
 - bedrock exposed at the surface
 - shallow soil over rock or shale
 - steep terrain (slopes greater than 10%)
 - high water table (depth less than 1 metre below the surface) or
 - contaminated sites
- b) Unless otherwise specified by a qualified civil engineer, the distance between the infiltration device and the nearest building shall be:
 - 1 metre, where the soil is sand (hydraulic conductivity > 180 mm/hr)
 - 2 metres, where the soil is sandy clay (hydraulic conductivity 180 – 36 mm/hr)
 - 4 metres, where the soil is medium clay (hydraulic conductivity 36 – 3.6 mm/hr)
 - 5 metres, where the soil is reactive clay (hydraulic conductivity 3.6 – 0.036 mm/hr)
- c) The infiltration device shall not be located within the dripline of any trees to be retained or within vehicle or heavy pedestrian traffic pathways.
- d) The base of the trench shall be at least 1.0m above any underlying watertable or rock stratum.
- e) The infiltration trench drainage system shall be designed by a consulting civil/hydraulic engineer and based upon a site test report provided by a qualified geotechnical engineer.
- f) The system shall enable infiltration of up to the 50 year ARI runoff from all impervious areas (including roofs, paved areas and pools) and areas not at natural ground level for all storm durations without surcharge onto neighbouring properties and shall include consideration of the contribution of any coincident pervious area.
- g) A 50% clogging or siltation factor is to be added to the trench area.
- h) The design infiltration area shall be the area of the base(s) of the trench(es) only and shall not include the sides of the proposed trench(es).

- i) The design method shall be a suitable time-area computer model such as ILSAX or the mass-curve technique in *Australian Rainfall and Runoff 1987* that can accurately assess adequacy of proposed storage volumes.
- j) Trench aggregate fill is to be assumed as being 35% void.
- k) An upstream siltation and litter arresting pit shall be provided.
- l) Overflow stormwater from the infiltration device shall be directed to a swale, landscaping, on-site detention facility or piped stormwater drainage system.
- m) A positive covenant and restriction on use shall be established for the retention system in accordance with Appendix 14 (A14.2).

A6.4 Bioretention Devices

Bioretention devices are designed to capture and temporarily store stormwater before passing it through a filter medium. They are used primarily to control water quality (sediment and gross and chemical pollutants) but can also contribute to stormwater retention on a property. Where used, the following controls apply:

- a) Bioretention trenches shall be installed only where the developer can demonstrate that the existing soil and terrain will be suitable for filtration purposes.
- b) The trench(es) shall be designed to be compatible with the overall layout and landscaping of the development site.
- c) The trench(es) shall be sited so as to capture site stormwater by gravity drainage site and to direct treated stormwater and all overflow to another on-site stormwater management device, landscape area or public drainage system.
- d) The trench(es) shall be sited clear of surface flow paths from adjoining land.
- e) The location and design of the trench(es) must not affect the structural integrity of adjacent buildings.
- f) A sediment trap, grassed buffer or other filter shall be installed upstream from the trench(es) to remove coarse sediment and reduce the risk of clogging.
- g) The design and construction of the trench(es) must be specified by a competent civil engineer eligible for membership to the Institution of Engineers Australia.
- h) A positive covenant and restriction on use shall be established for the retention system in accordance with Appendix 14 (A14.2).

A6.5 Porous Paving

In certain situations, porous paving can be used as a stormwater management device by enabling infiltration and retention of runoff. At the same time, the porous paving system will tend to filter the water to improve water quality. Porous paving may be composed of asphalt, concrete or modular paving units and may incorporate groundcover plantings such as turf within or between the modules.

- a) Paving shall not be laid immediately downstream for areas likely to contribute significant amounts of sediment, debris or windblown material.
- b) The slope of the land where porous paving is utilised shall not exceed 5%.
- c) Sediment traps, vegetated filter strips or specially designed gutter systems shall be installed upstream of the porous paving so as to reduce the volume of sediment input and to minimise the likelihood of clogging.
- d) During the construction phase of the development, in order to ensure the long-term viability of the system, the porous paving shall not be laid until the surrounding areas have been stabilised.

- e) Porous paving shall have the capacity to store the volume of a 1 in 1 year ARI event.
- f) The porous paving must be laid by suitably trained persons.
- g) The porous paving must be cleaned regularly to remove oils and fine sediments in accordance with the designer's maintenance recommendations (gravel in fill will require removal and replacement to ensure ongoing efficiency).
- h) A positive covenant and restriction on use shall be established for the retention system in accordance with Appendix 14 (A14.2).

Note: Owing to the extreme likelihood of soil compaction or compression, porous paving that is laid in areas that receive high traffic volumes or regular use by heavy vehicles will not be considered to be part of the on-site stormwater management system.

A6.6 Vegetated Swales

Vegetated open channels (swales) capture stormwater runoff for temporary storage and treatment, so that they are both a means of OSR and water quality treatment. They work by filtering and conveying during regular rainfall events (with an average recurrence interval of 3-6 months). This device, which can be used at either the street or lot level, helps to prevent streambank erosion and can also assist in maintaining water balance. Where used, vegetated swales shall adhere to the following controls:

- a) The slope of the land on which they are located shall be not more than 5%.
- b) Swales shall be designed to be nearly parallel to the contour with a longitudinal slope of 1% and 4%.
- c) Swales shall be designed so as to minimise the possibility of scour during heavy rain.
- d) Swales shall be designed and located so as to ensure that they are not traversed by vehicles or pedestrians.
- e) Check dams shall be installed along the swales to increase storage capacity and to reduce flow velocity.
- f) The swales shall be designed to minimise the opportunity for waterlogging and to maximise the opportunity for survival of the vegetation (for example, with the installation of low flow pipes and subsoil drainage).
- g) Stormwater overflow shall be directed to the public drainage system (in accordance with the requirements in Chapter 8).
- h) Swales shall be regularly maintained to ensure survival of the vegetation, continued functioning of the swales as stormwater management devices and continued visual attractiveness.
- i) A positive covenant and restriction on use shall be established for the retention system in accordance with Appendix 14 (A14.2).

A6.7 Other Techniques

The developer may wish to propose one or more alternative techniques for on-site stormwater management, stormwater disposal and water quality to those described in this DCP. In such an event, it will be the responsibility of the developer to demonstrate that proposal is appropriate in that it:

- meets the overall Objectives of the DCP;
- meets the specific Chapter Objectives and controls of the relevant section(s) of the DCP;
- is appropriate to the site in terms of soils, appearance and environmental performance; and
- will be viable in the long term.

Appendix 7

Design of Property and Interallotment Drainage Systems

A7.1 Design of Property Drainage Systems

The property drainage system is the system of underground pipes, inlet and junction pits, roof gutters, downpipes and associated plumbing within a property that captures and conveys stormwater to on-site management systems (ie, OSD, OSR and/or EOSD) and to the public drainage system outside the site. The following controls apply to these drainage systems:

- a) A piped drainage system shall be established to capture and convey all stormwater runoff from the following areas of the development site to the approved stormwater disposal system:
- roofs, paved areas, driveways, swimming pool surrounds and other impervious areas,
 - areas subject to changes to natural ground level and including cut or filled areas,
 - areas where the natural or pre-development overland flow regime is disrupted to the potential detriment of an adjoining property,
 - areas where long term ponding of water may occur, and
 - areas where existing runoff from upslope properties is likely to create nuisance to the proposed development.

- b) The piped property drainage shall capture and convey the 50 year ARI storm runoff to the stormwater management/disposal system.

Note 1: At Council's discretion, higher standards may be adopted if the proposed development is sensitive to damage by stormwater or blockage of the drainage system.

- c) All stormwater entering the site, including that which exceeds the capacity of the piped drainage system, is to be captured and conveyed overland within the development site, in a controlled manner not exceeding recognised hazard criteria, to the approved stormwater disposal system.

Note 2: Any proposed concentrated flow onto adjoining properties is only permissible where an easement has been obtained in accordance with the requirements of this DCP (see Chapter 8).

- d) No part of the property drainage system is to consist of aerial drainage systems other than vertical downpipes and guttering.

- e) Underground pipes/plumbing shall:

- have a minimum internal diameter of 100mm,
- not be located beneath buildings except where
 - there is no practicable alternative and pipes cannot be routed around the building,
 - the number of pipes underneath the building is minimised,
 - piping underneath buildings is straight and has no junctions,
 - inspection openings are provided at all points of entry and exit under the building, and
 - the design engineer certifies that the system is in accordance with AS3500.3 – 1998 – National Plumbing and Drainage and the *Building Code of Australia*,
- be subject to a hydraulic grade line analysis by a consulting engineer for any development site exceeding 5000m² in area,
- be sewer class piping or better,
- be designed so that no surcharge occurs onto other properties or pipe flows exceed 100l/s,
- have a minimum longitudinal grade of 1% where pipe diameters are up to and including 150mm or, where larger, a minimum longitudinal grade of 0.5%,
- be compatible with proposed and possible future development in all respects, and

- have the minimum depth of cover from finished ground level to top of pipe as required in accordance with Table 7.1 From AS3500.3 - 1998 National plumbing and drainage Part 3.2: Stormwater drainage - Acceptable solutions

Note 3: Higher standards should be adopted if the proposed development is sensitive to damage by stormwater or blockage of the drainage system.

- f) Discharge from subsoil drainage systems must be to a pit located within the property and not directly to the street gutter. The discharge is to be disposed of in a manner that does not affect adjacent properties nor cause erosion or scour of downstream drainage systems.
- g) In residential developments that consist of more than one (1) dwelling, the private courtyard of each dwelling must contain at least one grated inlet pit.
- h) Surface inlet pits shall:
- be located to catch overland flows experienced during failure of the site drainage system,
 - be provided at all pipe junctions, changes in pipe direction exceeding 45 degrees and at the road boundary (within the property) prior to connection to the public drainage system,
 - be of sufficient size to accept the predicted flow and have dimensions in accordance with the table below:
- | Depth (mm) | Dimension (mm2) |
|------------|-----------------|
| < 600 | 450 x 450 |
| 600 – 900 | 600 x 600 |
| 900 – 1200 | 600 x 900 |
| >1200 | 900 x 900 |
- have step irons inside, where pits are deeper than 1200mm,
 - shall not be of plastic unless not larger than 450 x 450mm with, not deeper than 450mm and of heavy duty plastic to manufacturer's specifications, and
 - have grated pit covers that are removable, designed to appropriate loadings (such as traffic) and constructed of galvanised steel or cast iron.
- i) Heavy duty, grated trench drains of minimum width 200mm and minimum depth 200mm shall be provided across driveways at the following locations:
- outside the entrance to a garage where the driveway falls towards the garage, or
 - at the front (street) boundary of the property, fully within the property, where the driveway falls towards the street.
- j) The minimum diameter outlet pipe from any grated surface inlet pit or trench drainage provided to capture surface runoff shall be 150mm in order to reduce the occurrence of outlet blockage.
- k) All inlet and outlet pipes from a pit are to be finished flush with the internal wall of the pit. The outlet pipe shall be at the same level as the base of the pit to ensure there is no permanent ponding of water in the pit.
- l) Any existing drainage system on a development site to be utilised shall be suitably modified in order to offset any adverse impacts that a proposed development may have on the efficiency of that system.
- m) Stormwater pipes shall be located outside the drip-line or not less than six (6) metres from the trunk (whichever is greater) of any tree to be retained unless the method of pipe installation is certified by a qualified arborist as not affecting the longevity of the tree to be retained.
- Note 4:** For small diameter pipes with minimum cover, careful hand excavation of the installation trench with retention across the trench of all roots greater than 25mm diameter, may be an acceptable method.
- Note 5: For larger diameter pipes, or for small pipes at excessive depth, installation of pipes by remote thrust boring technique may be an acceptable method. In this case a pipe cover of at least one (1) metre should be provided.**
- n) Drainage works, materials and specifications shall be designed and constructed in accordance with:
- Institution of Engineers Australia (1997) *Australian Rainfall and Runoff*,
 - Australian Standard AS 3500 3.2 – 1998 National Plumbing and Drainage, and
 - relevant occupational health and safety requirements.

A7.1.1 Mechanical pump-out systems for basement car parks

Mechanical pump-out drainage is only permissible where gravity drainage cannot be achieved from basement carpark area to the on-site stormwater management system. The following controls apply to mechanical pump-out systems:

- a) The developer shall demonstrate that gravity drainage from the basement carpark is not possible.
Note: Where gravity drainage is possible from some parts of a basement carpark, only those sections where gravity drainage is not possible shall be drained using a mechanical pump-out system.
- b) The catchment area contributing being pumped out shall consist of not more than the basement carpark itself and the driveway ramp to the basement carpark.
- c) The catchment area being drained shall be 100m² or less.
- d) The system shall be designed by a competent qualified civil engineer eligible for membership to the Institution of Engineers Australia.
- e) The system shall be dual alternating with level switches and activation of dual operation at top water level.
- f) Each pump shall cater to a minimum of 110% of the design flow.
- g) A description of the pump(s) shall be provided listing the manufacturer, model number and published duty curves.
- h) An automatic alarm must be installed so that it sounds during pump failure.
- i) The water pumped from the basement carpark shall be directed to the OSD system designed in accordance with the requirements of Chapter 6.
- j) The pump wet well shall have a storage capacity of at least the two hour 100 year ARI storm runoff and shall be checked for adequacy up to the 100 year ARI event by a time-area computer model or the mass-curve technique in ARR 1987.
- k) The noise level from the pump shall not, at any time, exceed the ambient sound pressure levels by 5dB(A) at the boundary of the site and shall not be audible within any habitable room of an adjoining premises.
- l) Proposed maintenance shall be described in the submission to Council.

Note: Council will impose a requirement to create a Positive Covenant on the title of the property requiring regular maintenance and reporting to Council of the pump-out system by a plumber or engineer.

A7.2 Design Controls for Interallotment Drainage Easements

This section describes the requirements for the design and construction of interallotment drainage systems. In the majority of cases, the developer will be required to construct a pipe in the easement once it is created. In limited circumstances, Council may agree that such a pipe is not necessary – it is important to consult with Council on this matter prior to submission of the development application. Agreement of the owner of the downstream property in this respect will also be required. The following controls apply for the design and location of all easements:

- a) The easement shall be designed with sufficient regard to:
 - (i) proposed pipe diameter within the easement and contributing catchments;
 - (ii) significant trees that may be impacted upon by the placement of drainage lines;
 - (iii) the structural requirements of pipes and their laying / upkeep;
 - (iv) any adjoining structures; and
 - (v) the stormwater overland flowpath capacity requirements.
- b) All overflow from rainfall events on a site shall be directed to the interallotment drainage line with the necessary inlet pits and cut-offs.

- c) The interallotment easement shall be designed in accordance with the following table:

| Nominal Pipe Diameter | Minimum Easement Width |
|-----------------------|---------------------------------|
| 150mm | 1.0 metres |
| 225mm | 1.2 metres |
| 300mm | 1.3 metres |
| 375mm | 1.4 metres |
| 450mm | 1.5 metres |
| 525mm | 1.6 metres |
| 600mm | 1.6 metres |
| 750mm | 1.8 metres |
| >750mm | 1 metre + nominal pipe diameter |

Note 1: The presence of an on-site stormwater retention, detention or extended detention system at the development site will not be accepted as a justification for reducing the design flowrate through a downstream interallotment drainage system. The capacity of the system within the easement must be sufficient in the event of a blockage failure or overflow of the detention system.

- d) The in-ground interallotment drainage system (pipe) shall be sufficient to carry:
- (i) the 100 year ARI uncontrolled stormwater runoff from existing and future hard surfaces on the site, and
 - (ii) the additional future design inflows, as determined by the requirements of this section, from all other properties that may benefit from a connection to the system, that adjoin and are uphill from the same associated drainage easement and/or have the benefit of the same associated drainage easement.

Note 2: Upon application, Council may waive this requirement for Development Types 1-3.

Note 3: In rare circumstances, in the event that a long-term overland flow path (such as a paved driveway with kerbing) of sufficient capacity for the major flow is secured over the length of the easement, the 100 year ARI design requirements may be reduced to a 20 year ARI.

- e) The constructed interallotment drainage system (pipe or channel) shall be wholly contained within the drainage easement created on the title(s) of the affected property or properties.
- f) Where the drainage line in the private interallotment drainage easements is to be piped, the minimum pipe diameter shall be not less than 150mm and the minimum depth of cover from finished ground level to the top of the pipe shall be in accordance with Table 7.1 of Australian Standard AS 3500.3.2:1998.
- g) If constructed channels are proposed for interallotment drainage systems, then:
- (i) the channel shall be concrete, stone-pitch or brick lined to form a permanent profile, and
 - (ii) a 50% channel blockage factor is to be adopted in the design.
- h) Stormwater pipes shall be located outside the drip-line or not less than six (6) metres from the trunk (whichever is greater) of any tree to be retained unless the method of pipe installation is certified by a qualified arborist as not affecting the longevity of the tree to be retained.

Note 4: For small diameter pipes with minimum cover, careful hand excavation of the installation trench with retention across the trench of all roots greater than 25mm diameter, may be an acceptable method.

Note 5: For larger diameter pipes, or for small pipes at excessive depth, installation of pipes by remote thrust boring technique may be an acceptable method. In this case a pipe cover of at least one (1) metre should be provided.

- i) An overland flowpath that directs water along the easement shall be established to cater for blockage of the inground interallotment system as far as the discharge point.
- j) Surface inlet pits shall:
- (i) be located to catch overland flows experienced during failure of the site drainage system, into the interallotment drainage line,
 - (ii) be provided at all pipe junctions, changes in pipe direction exceeding 45 degrees and at the road boundary (within the property) prior to connection to the public drainage system,

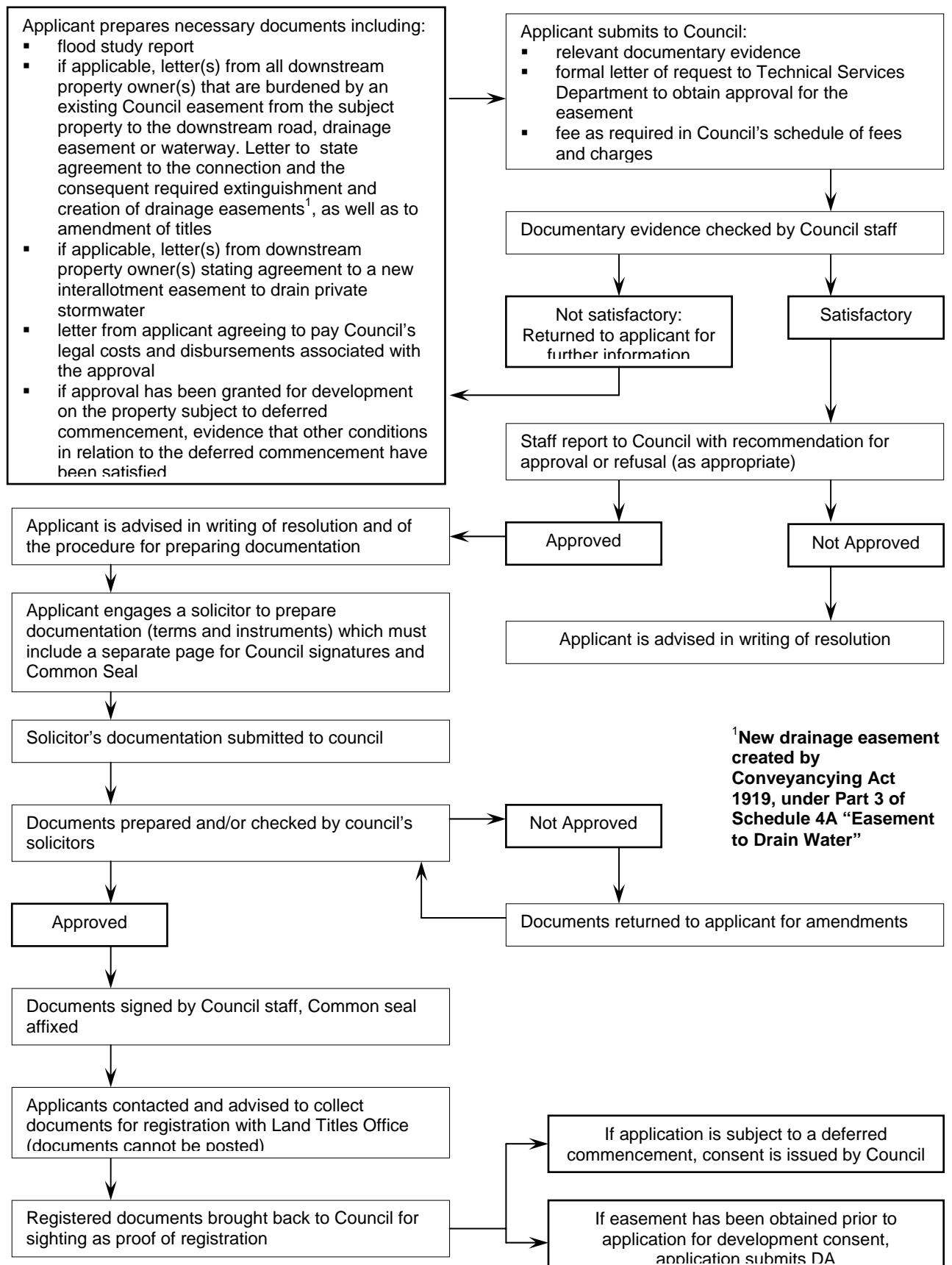
- (iii) be of sufficient size to accept the predicted flow and have minimum dimensions in accordance with the table below:

| Depth (mm) | Dimension (mm) |
|------------|----------------|
| < 600 | 450 x 450 |
| 600 – 900 | 600 x 600 |
| 900 – 1200 | 600 x 900 |
| >1200 | 900 x 900 |

- (iv) have step irons inside, where pits are deeper than 1200mm,
- (v) have pit covers that are removable, designed to appropriate loadings and constructed of galvanised steel or cast iron.
- k) Drainage works, materials and specifications shall be designed and constructed in accordance with:
- (i) Institution of Engineers Australia (1997) *Australian Rainfall and Runoff*,
 - (ii) Australian Standard AS 3500 3.2 – 1998 National Plumbing and Drainage, Part 3 Stormwater Drainage,
 - (iii) the relevant occupational health and safety requirements, and
 - (iv) any other relevant controls in this DCP.
- l) Where it is found that an existing Council owned channel/pipe is present on site that is not within an easement, a suitable easement shall be created over the drain in favour of Council, at no cost to the Council, or else the easement moved accordingly at no cost to Council.
- m) Where an easement benefits one or more private properties, that easement must not also be created to the benefit of Council.

Appendix 8

Process for Obtaining Approval for Connection into an Easement



Appendix 9

Sample Letter to Neighbours Requesting an Interallotment Easement

Dear

We are proposing to redevelop our property at
Council has advised us that, in order to proceed with the proposal, we are required to put forward a proposal for the drainage of stormwater. We have been provided with two options.

The first, preferred, method is to obtain a drainage easement to convey the stormwater runoff from our property to
In order to achieve this, you would be required to grant us a drainage easement through your property. Should you grant us a drainage easement, all costs for the creation of the easement would be borne by us, together with any consideration for the use of your property as may be determined by an independent valuation or later agreement.

The alternative to a drainage easement is that our development be limited to 30% of the property area to allow sufficient area between the house and our back / side fence next to your property for installation of an underground dispersal system that would spread and absorb the stormwater flow into the ground. You may be affected by this option as the runoff and seepage from this system could flow towards your property because of the slope of the land.

It would be appreciated if you would indicate your position regarding drainage from our property by filling out the section at the base of this letter. Once you have done so, we will be able to advise Council of your decision and have assessment of our application progress.

Yours sincerely

.....

Please delete one as relevant:

YES, I / we are willing to grant you a drainage easement.

NO, I / we are not willing to grant you a drainage easement.

Name: Signature:

Name: Signature:

Address:

Appendix 10

Ku-ring-gai Rainfall Intensity Frequency Duration Data

Average recurrence intervals (years)

| Minutes | 1 | 2 | 5 | 10 | 20 | 50 | 100 |
|---------|----|-----|-----|-----|-----|-----|-----|
| 5 | 97 | 124 | 157 | 176 | 201 | 233 | 257 |
| 6 | 91 | 117 | 148 | 165 | 189 | 219 | 242 |
| 7 | 86 | 110 | 140 | 157 | 179 | 208 | 230 |
| 8 | 82 | 105 | 133 | 149 | 171 | 199 | 220 |
| 9 | 78 | 100 | 127 | 143 | 163 | 190 | 211 |
| 10 | 75 | 96 | 122 | 137 | 157 | 183 | 203 |
| 11 | 72 | 92 | 118 | 132 | 151 | 176 | 195 |
| 12 | 69 | 89 | 113 | 127 | 146 | 170 | 189 |
| 13 | 67 | 86 | 110 | 123 | 141 | 165 | 183 |
| 14 | 65 | 83 | 106 | 119 | 137 | 160 | 177 |
| 15 | 63 | 80 | 103 | 116 | 133 | 155 | 173 |
| 16 | 61 | 78 | 100 | 113 | 129 | 151 | 168 |
| 17 | 59 | 76 | 97 | 110 | 126 | 147 | 164 |
| 18 | 57 | 74 | 95 | 107 | 123 | 144 | 160 |
| 19 | 56 | 72 | 92 | 104 | 120 | 140 | 156 |
| 20 | 55 | 70 | 90 | 102 | 117 | 137 | 152 |
| 21 | 53 | 69 | 88 | 100 | 115 | 134 | 149 |
| 22 | 52 | 67 | 86 | 97 | 112 | 131 | 146 |
| 23 | 51 | 66 | 84 | 95 | 110 | 129 | 143 |
| 24 | 50 | 64 | 83 | 94 | 108 | 126 | 140 |
| 25 | 49 | 63 | 81 | 92 | 106 | 124 | 138 |
| 26 | 48 | 62 | 80 | 90 | 104 | 122 | 135 |
| 27 | 47 | 61 | 78 | 88 | 102 | 119 | 133 |
| 28 | 46 | 59 | 77 | 87 | 100 | 117 | 131 |
| 29 | 45 | 58 | 75 | 85 | 98 | 115 | 129 |
| 30 | 44 | 57 | 74 | 84 | 97 | 114 | 126 |
| 31 | 44 | 56 | 73 | 83 | 95 | 112 | 124 |
| 32 | 43 | 55 | 72 | 81 | 94 | 110 | 123 |
| 33 | 42 | 55 | 71 | 80 | 92 | 108 | 121 |
| 34 | 42 | 54 | 70 | 79 | 91 | 107 | 119 |
| 35 | 41 | 53 | 68 | 78 | 90 | 105 | 117 |
| 36 | 40 | 52 | 67 | 77 | 88 | 104 | 116 |
| 37 | 40 | 51 | 67 | 75 | 87 | 102 | 114 |
| 38 | 39 | 51 | 66 | 74 | 86 | 101 | 113 |
| 39 | 39 | 50 | 65 | 73 | 85 | 100 | 111 |
| 40 | 38 | 49 | 64 | 72 | 84 | 99 | 110 |
| 41 | 38 | 49 | 63 | 72 | 83 | 97 | 109 |
| 42 | 37 | 48 | 62 | 71 | 82 | 96 | 107 |
| 43 | 37 | 47 | 61 | 70 | 81 | 95 | 106 |
| 44 | 36 | 47 | 61 | 69 | 80 | 94 | 105 |
| 45 | 36 | 46 | 60 | 68 | 79 | 93 | 104 |
| 46 | 35 | 46 | 59 | 67 | 78 | 92 | 102 |
| 47 | 35 | 45 | 59 | 67 | 77 | 91 | 101 |
| 48 | 34 | 45 | 58 | 66 | 76 | 90 | 100 |
| 49 | 34 | 44 | 57 | 65 | 75 | 89 | 99 |
| 50 | 34 | 44 | 57 | 64 | 75 | 88 | 98 |
| 51 | 33 | 43 | 56 | 64 | 74 | 87 | 97 |
| 52 | 33 | 43 | 56 | 63 | 73 | 86 | 96 |
| 53 | 33 | 42 | 55 | 63 | 72 | 85 | 95 |
| 54 | 32 | 42 | 54 | 62 | 72 | 84 | 94 |
| 55 | 32 | 41 | 54 | 61 | 71 | 84 | 93 |
| 56 | 32 | 41 | 53 | 61 | 70 | 83 | 93 |
| 57 | 31 | 40 | 53 | 60 | 70 | 82 | 92 |
| 58 | 31 | 40 | 52 | 60 | 69 | 81 | 91 |
| 59 | 31 | 40 | 52 | 59 | 68 | 81 | 90 |
| 60 | 30 | 39 | 51 | 58 | 68 | 80 | 89 |
| 61 | 30 | 39 | 51 | 58 | 67 | 79 | 89 |
| 62 | 30 | 39 | 50 | 57 | 67 | 79 | 88 |
| 63 | 30 | 38 | 50 | 57 | 66 | 78 | 87 |
| 64 | 29 | 38 | 50 | 56 | 65 | 77 | 86 |
| 65 | 29 | 38 | 49 | 56 | 65 | 77 | 86 |
| 66 | 29 | 37 | 49 | 56 | 64 | 76 | 85 |
| 67 | 28 | 37 | 48 | 55 | 64 | 75 | 84 |
| 68 | 28 | 37 | 48 | 55 | 63 | 75 | 84 |
| 69 | 28 | 36 | 48 | 54 | 63 | 74 | 83 |
| 70 | 28 | 36 | 47 | 54 | 62 | 74 | 82 |
| 71 | 28 | 36 | 47 | 53 | 62 | 73 | 82 |
| 72 | 27 | 35 | 46 | 53 | 61 | 73 | 81 |
| 73 | 27 | 35 | 46 | 53 | 61 | 72 | 81 |

| Minutes | 1 | 2 | 5 | 10 | 20 | 50 | 100 |
|---------|----|----|----|----|----|----|-----|
| 74 | 27 | 35 | 46 | 52 | 60 | 71 | 80 |
| 75 | 27 | 35 | 45 | 52 | 60 | 71 | 79 |
| 76 | 26 | 34 | 45 | 51 | 60 | 70 | 79 |
| 77 | 26 | 34 | 45 | 51 | 59 | 70 | 78 |
| 78 | 26 | 34 | 44 | 51 | 59 | 70 | 78 |
| 79 | 26 | 34 | 44 | 50 | 58 | 69 | 77 |
| 80 | 26 | 33 | 44 | 50 | 58 | 69 | 77 |
| 81 | 25 | 33 | 43 | 50 | 58 | 68 | 76 |
| 82 | 25 | 33 | 43 | 49 | 57 | 68 | 76 |
| 83 | 25 | 33 | 43 | 49 | 57 | 67 | 75 |
| 84 | 25 | 32 | 43 | 49 | 56 | 67 | 75 |
| 85 | 25 | 32 | 42 | 48 | 56 | 66 | 74 |
| 86 | 25 | 32 | 42 | 48 | 56 | 66 | 74 |
| 87 | 24 | 32 | 42 | 48 | 55 | 66 | 73 |
| 88 | 24 | 32 | 41 | 47 | 55 | 65 | 73 |
| 89 | 24 | 31 | 41 | 47 | 55 | 65 | 72 |
| 90 | 24 | 31 | 41 | 47 | 54 | 64 | 72 |
| 91 | 24 | 31 | 41 | 46 | 54 | 64 | 72 |
| 92 | 24 | 31 | 40 | 46 | 54 | 64 | 71 |
| 93 | 23 | 31 | 40 | 46 | 53 | 63 | 71 |
| 94 | 23 | 30 | 40 | 46 | 53 | 63 | 70 |
| 95 | 23 | 30 | 40 | 45 | 53 | 62 | 70 |
| 96 | 23 | 30 | 39 | 45 | 52 | 62 | 70 |
| 97 | 23 | 30 | 39 | 45 | 52 | 62 | 69 |
| 98 | 23 | 30 | 39 | 45 | 52 | 61 | 69 |
| 99 | 23 | 29 | 39 | 44 | 52 | 61 | 68 |
| 100 | 22 | 29 | 39 | 44 | 51 | 61 | 68 |
| 101 | 22 | 29 | 38 | 44 | 51 | 60 | 68 |
| 102 | 22 | 29 | 38 | 44 | 51 | 60 | 67 |
| 103 | 22 | 29 | 38 | 43 | 50 | 60 | 67 |
| 104 | 22 | 29 | 38 | 43 | 50 | 59 | 67 |
| 105 | 22 | 28 | 37 | 43 | 50 | 59 | 66 |
| 106 | 22 | 28 | 37 | 43 | 50 | 59 | 66 |
| 107 | 22 | 28 | 37 | 42 | 49 | 59 | 66 |
| 108 | 21 | 28 | 37 | 42 | 49 | 58 | 65 |
| 109 | 21 | 28 | 37 | 42 | 49 | 58 | 65 |
| 110 | 21 | 28 | 36 | 42 | 49 | 58 | 65 |
| 111 | 21 | 27 | 36 | 42 | 48 | 57 | 64 |
| 112 | 21 | 27 | 36 | 41 | 48 | 57 | 64 |
| 113 | 21 | 27 | 36 | 41 | 48 | 57 | 64 |
| 114 | 21 | 27 | 36 | 41 | 48 | 57 | 63 |
| 115 | 21 | 27 | 36 | 41 | 47 | 56 | 63 |
| 116 | 21 | 27 | 35 | 41 | 47 | 56 | 63 |
| 117 | 20 | 27 | 35 | 40 | 47 | 56 | 63 |
| 118 | 20 | 26 | 35 | 40 | 47 | 55 | 62 |
| 119 | 20 | 26 | 35 | 40 | 47 | 55 | 62 |
| 120 | 20 | 26 | 35 | 40 | 46 | 55 | 62 |
| 121 | 20 | 26 | 35 | 40 | 46 | 55 | 61 |
| 122 | 20 | 26 | 34 | 39 | 46 | 54 | 61 |
| 123 | 20 | 26 | 34 | 39 | 46 | 54 | 61 |
| 124 | 20 | 26 | 34 | 39 | 45 | 54 | 61 |
| 125 | 20 | 26 | 34 | 39 | 45 | 54 | 60 |
| 126 | 20 | 25 | 34 | 39 | 45 | 54 | 60 |
| 127 | 19 | 25 | 34 | 38 | 45 | 53 | 60 |
| 128 | 19 | 25 | 33 | 38 | 45 | 53 | 60 |
| 129 | 19 | 25 | 33 | 38 | 44 | 53 | 59 |
| 130 | 19 | 25 | 33 | 38 | 44 | 53 | 59 |
| 131 | 19 | 25 | 33 | 38 | 44 | 52 | 59 |
| 132 | 19 | 25 | 33 | 38 | 44 | 52 | 59 |
| 133 | 19 | 25 | 33 | 37 | 44 | 52 | 58 |
| 134 | 19 | 25 | 33 | 37 | 44 | 52 | 58 |
| 135 | 19 | 24 | 32 | 37 | 43 | 52 | 58 |
| 136 | 19 | 24 | 32 | 37 | 43 | 51 | 58 |
| 137 | 19 | 24 | 32 | 37 | 43 | 51 | 57 |
| 138 | 19 | 24 | 32 | 37 | 43 | 51 | 57 |
| 139 | 18 | 24 | 32 | 37 | 43 | 51 | 57 |
| 140 | 18 | 24 | 32 | 36 | 42 | 50 | 57 |
| 141 | 18 | 24 | 32 | 36 | 42 | 50 | 56 |
| 142 | 18 | 24 | 31 | 36 | 42 | 50 | 56 |

Appendix 11

Flood Study Requirements

A flood study is undertaken to identify the reach and depth of overland flows associated with drainage systems on or near a site and to assess the impact of development on such flows and vice versa. Drainage systems include underground pipes, natural watercourses, open channels and depressions and seepage.

The flood study must be undertaken by a suitably qualified and experienced stormwater or hydraulic engineer eligible for Chartered Professional Engineer status with the Institution of Engineers, Australia. It must conform to the principles set out in the Australian Rainfall and Runoff and the NSW Floodplain Management Manual and must include the following information:

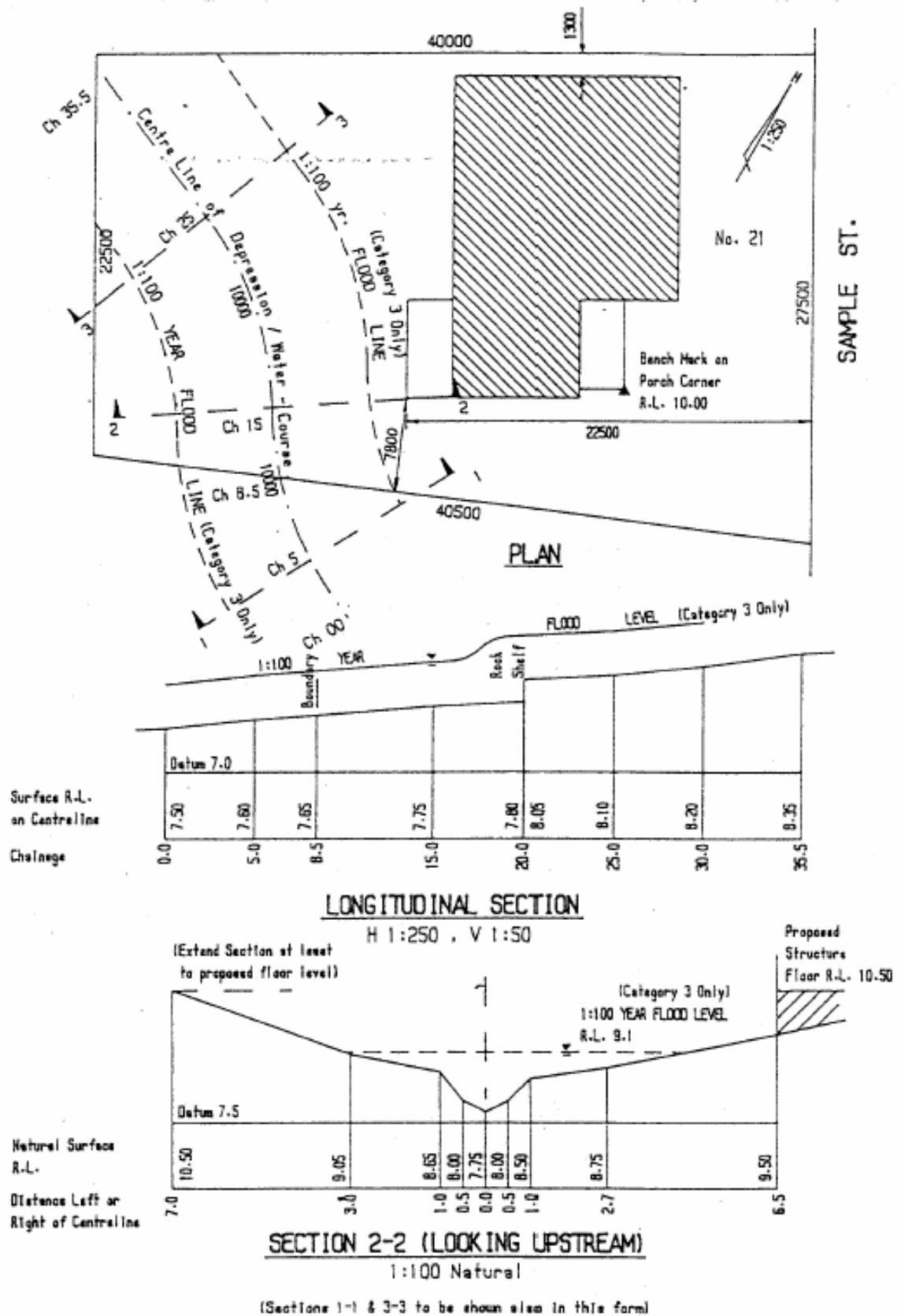
A11.1 Calculations and Supporting Information

- a) A plan of the contributing catchment area and rationale for area determination shall be submitted.
- b) Rationale for time of concentration calculations shall be discussed.
- c) A hydrologic model is required to assess the flow discharge arriving at the site in the 1:100 year ARI event, based on the following:
 - i) For catchment areas less than 3 Ha, a rational method assessment is allowed.
 - ii) For catchment areas greater than 3 Ha, an appropriate runoff routing computer model is to be used (e.g DRAINS, ILSAX etc).
- d) Sufficient survey is to be obtained to accurately define the flow limits and profiles, which may extend onto adjoining properties.
- e) A hydraulic model is required to assess the impact of the flow discharges through the pre-developed and post-developed site.
 - i) For flow rates of $2\text{m}^3/\text{s}$ with no backwater effects, the Mannings Equation may be used.
 - ii) For flow rates greater than $2\text{m}^3/\text{s}$ and/or with backwater effects, HEC-RAS or another suitable model is to be used.
- f) Where an enclosed drainage system exists in the catchment studied (and is to be included in the analysis), the overland flow rate shall be determined as occurring during the greater of:
 - i) The 1:100 year event with the enclosed system operating at a maximum of 50% capacity (due to inlet controlled systems and blockage factors), or
 - ii) The 1:5 year event with the enclosed system fully blocked.

A11.2 Information to be included in submission

- a) All hydrological and hydraulic calculations undertaken to quantify the design flood standard and derive the flood levels together with the catchment map and any other data used in the calculations, as required above.
- b) A **scale plan view** of the determined flood zone shall be provided at the same scale as the site survey for:

- i) The pre-developed site. This may be overlayed on the existing site survey plan and the centreline of the watercourse or drainage depression together with all existing structures and impediments to flow shall be shown on this detail, and
 - ii) The post-developed site. This is to be overlayed on a plan, at the same scale as the submitted architectural plans, showing the footprint of **all proposed structures** in relation to the determined flood zone. The centreline chainages of the watercourse or drainage depression, together with all proposed structures and impediments to flow, shall be shown on this detail.
- c) A minimum of three 1:50 scale **cross-sections** taken at right angles to the drainage system, showing both the pre-developed and post-developed flow sections with all levels to AHD, drawn at the following chainages:
- i) at the upstream property boundary;
 - ii) where the existing and proposed development is closest to the drainage line;
 - iii) at the downstream extent of the development work; and
 - iv) other cross-sections as needed if other parts of the system affect the site.
- Note: Cross-sections must show existing and proposed levels, top water levels, hydraulic data, flood extents and critical proposed development levels such as floor levels.
- d) **A longitudinal section** (at vertical scale 1:50, horizontal scale to that of plan view) of the drainage system through the property showing existing and proposed levels, flood levels, hydraulic data and all changes in grade.
- e) The conclusion of the report shall have a signed declaration by the engineer stating:
- “I have examined the site, existing improvements and proposed development. In accordance with accepted engineering practice, I have undertaken a flood study of the adjacent drainage system and can confirm the accuracy of my calculated results. I declare that the proposed development will be safeguarded from flooding and flood damage associated with the design flood standard as defined in DCP 47 – Water Management and will not adversely affect any other structures or properties.”*
- f) The study shall be submitted in a flood report form which includes an introduction and reference to the plans for the proposed development, methodology adopted and a written explanation/conclusion for findings of the study, together with all supporting information. The study shall nominate floor levels for the proposed development, with regard to Council freeboard requirements.



Typical Survey Information

Appendix 12

Connection of Pipes to Kerb / Gutter or Council Pipes

A3

1) Internal dia. of pipes or internal height of rectangular sections shall be 100mm max, 90mm min.

2) Pipes to be S.H. sewer quality UPVC.

3) Rectangular sections across footway to be cast iron or hot dip galvanised rectangular hollow steel section or a standard Council converter.

4) Convert 150mm dia. pipe within property, to a 200x100x8mm galvanised RHS across footpath, using 300x300 pit with removable lid within property.

5) Connection to kerb across the footpath is to be at a maximum of 30 to the perpendicular from the kerb to the property line.

6) 127x64x4mm RHS hot dipped galvanised (or Aluminium) with adaptor for UPVC pipe to suit.

concrete support

CONNECTION WITH 150 CONCRETE KERB

100 or 150

Sloped or square junction

Disc sealed with cement mortar

2:1 cement mortar sealing for junction

R.C. stormwater pipe

Bend

2:1 cement mortar

R.C. stormwater pipe

Square junction

2:1 cement mortar

100 or 150 dia. pipe

CONNECTIONS OF DRAINAGE LINES TO R.C. PIPE

1. THE R.C. STORMWATER PIPE SHALL BE PIERCED BY A NEAT OPENING AS SHOWN TO ALLOW THE CONNECTION OF A SQUARE, SLOPED JUNCTION OR BEND WHICH SHALL NOT PROTRUDE BEYOND THE INNER SURFACE OF THE R.C. STORMWATER PIPE.

2. THE INTERNAL JUNCTION SHALL BE SMOOTHLY FINISHED WITH 2:1 CEMENT MORTAR SO AS TO PRESENT NO OBSTRUCTION WITHIN THE INTERNAL SURFACE OF THE R.C. STORMWATER PIPE. THE LINE IS NOT TO EXTEND BEYOND JOINT 1 UNTIL APPROVED BY COUNCIL.

3. THE HOLE IN COUNCIL'S PIPE IS TO BE FORMED BY CAREFUL DRILLING TO NEATLY ACCEPT THE OUTSIDE DIAMETER OF THE PIPE.

4. ANY DAMAGE TO THE STRUCTURE OF COUNCIL'S PIPE IS TO BE MADE GOOD TO THE SATISFACTION OF THE CHIEF ENGINEER, IF NECESSARY BY REPLACEMENT OF THE PIPE.

5. PIPE FITTINGS TO BE VITRIFIED CLAY OR S.H. SEWER QUALITY U.P.V.C.

6. COUNCIL LINE TO BE LEFT FREE OF DROPPED CLAY, CONCRETE, MORTAR, ETC.

KU-RING-GAI COUNCIL

CONNECTIONS OF DRAINAGE LINES TO KERB AND R.C. PIPE

PLAN No. 82-024

| NOTES | | SCALE | Not to Scale |
|-------|-----------|-----------------------------------|--------------|
| | | DESIGNED | N.J.T. |
| | | DRAWN | A.G. |
| | | APPROVED | |
| | | CHIEF ENGINEER <i>[Signature]</i> | |
| Date | Amendment | | |



Appendix 13 On-Site Retention and Reuse Certification Checklist

Address

DA No...../.....

Total volume of storage
required under BASIX/DA approval.....L

Volume of storage provided.....L



Location Sketch

| Rainwater Tanks | Checklist (Y) |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1. The tank(s) are installed in accordance with the Construction Certificate issue drawings. | |
| 2. The tank is NOT located forward of the building line or within the setback to a secondary street frontage, except where (i) it is located on a battleaxe allotment and is not visible from the street or (ii) where another building is located between the street to which the property is adjoined and the building with which the tank is associated. | |
| 3. The tank is located at least 450mm from any property boundary. | |
| 4. The tank has NOT been installed over or immediately adjacent to a water main or sewer main unless it is installed in accordance with any requirements of the public authority that has responsibility for the main. | |
| 5. The tank has NOT been installed over any structure or fittings used by a public authority to maintain a water or sewer main. | |
| 6. If installed above-ground, the tank is located at least 100mm from any parallel potable water supply pipe and if installed below-ground, the tank is located at least 300mm from any parallel potable water supply pipe. | |
| 7. No part of the tank or any stand for the tank is resting on a footing of any building or other structure, including a retaining wall, unless demonstrated that the footing or structure has been designed to take the load of a full tank of water. | |
| 8. The tank, together with any stand or slab for the tank, is structurally sound, satisfies the Building Code of Australia and has been installed in accordance with any requirements of Sydney Water Corporation. | |
| 9. All plumbing works were carried out by a licensed plumber. | |
| 10. Excess (overflow) stormwater is: (i) diverted away from the foundations of any buildings or structures including the rainwater tank itself; (ii) directed to the approved drainage disposal point (iii) directed in such a way that it does not pool on site or cause nuisance to neighbouring properties or to areas of public access. | |
| 11. The tank is enclosed and any inlet to the tank is screened or filtered to prevent the entry of foreign matters or creatures. | |
| 12. The tank is fitted with a first-flush device that causes the initial run-off from any rain event to bypass the tank in order to reduce the pollutants entering the tank. | |
| 13. A sign has been affixed to the tank clearly stating that the water in the tank is rainwater and all taps and rainwater tank apertures have been similarly marked. | |
| 14. Distribution pipes, both below and above ground, from the rainwater tank have been continuously marked 'RAINWATER' in accordance with AS 1345 or otherwise above-ground distribution pipes have been clearly labelled 'RAINWATER' with adhesive pipe markers made in accordance with AS 1345 and below-ground distribution pipes have been identification tape/pipe sleeve continuously | |

Water Management Development Control Plan – DCP 47
Appendix 13 – On-Site Retention and Reuse Certification Checklist

| | | |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| | marked 'RAINWATER' in accordance with AS 2648. | |
| 15. | The tank complies with Australian Standard AS/NZS 2179-1994 – Specifications for rainwater goods, accessories and fasteners. | |
| 16. | If the tank is metal, it complies with Australian Standard AS 2180-1986 – Metal rainwater goods – selection and installation. | |
| 17. | Any pumping system required is operational to the required pressure and is readily accessible. | |
| 18. | Noise emissions from any pump used with the rainwater tank does NOT exceed 5dB (A) above ambient background noise levels measured at the allotment boundary. | |
| 19. | Water retained for indoor household uses has been augmented by mains water supply and an approval for the activity shall be obtained from Sydney Water Corporation. | |
| 20. | As required by Sydney Water Corporation, where retained water is augmented by mains water supply, a backflow prevention device has been installed to prevent contamination of mains water in accordance with Australian Standard AS 3500.1.2 – National plumbing and drainage: water supply – acceptable solutions. | |
| 21. | The indirect connection to mains water is by means of a visible 'air gap' external the rainwater tank in accordance with the provisions of AS/NZS 3500 – Minimum air gap requirements. | |

Additional Comments:

.....

Declaration

I, of
 hereby certify that the above certification sheet has been filled out correctly.

Signature: Date:/...../20.....

Qualifications:

Note: Council Engineers will carry out audit inspections on completed on-site stormwater retention and re-use systems for compliance purposes.

Appendix 14

Terms of Positive Covenants and Restrictions on Use

A14.1 Terms for On-site Detention

A14.1.1 Terms of Positive Covenant referred to in the Plan

1. The proprietor of the burdened lot covenants with the Council in respect of any System (as later defined) constructed on the burdened lot to:
 - a) permit stormwater to be temporarily detained by the System;
 - b) regularly keep the System clean and free from grass clippings, silt, rubbish, debris and the like;
 - c) maintain the System to ensure a maximum outflow from the System and a minimum pondage in accordance with plans duly approved by Council;
 - d) ensure that the System at all times includes an overflow to direct any excess flow to the downstream drainage System;
 - e) maintain, repair and replace the System or any part of it due to deterioration or damage without delay so that it functions in a safe and efficient manner;
 - f) comply with the terms of any written notice issued by the Council in respect of the requirements of the Positive Covenant within the time stated in the notice;
 - g) permit the Council to enter upon the burdened lot or any part of it with all necessary materials and equipment at all reasonable times and on reasonable notice (but at any time and without notice in the case of an emergency);
 - to view the state of repair of the System;
 - to ascertain whether or not there has been any breach of the terms of this Positive Covenant;
 - to execute works on the burdened lot for compliance with the requirements of this Positive Covenant;
 - h) indemnify and keep indemnified the Council from and against all claims, demands, actions, suits, causes of action, sums of money, compensation, damages, costs and expenses which the Council or any other person may suffer as a result of any malfunction or non-operation of the System or any failure of the proprietor to comply with the terms of the Positive Covenant.
2. The Council shall have the following additional powers:

In this Positive Covenant unless inconsistent with the context,

“System” means in relation the burdened lot the stormwater drainage detention basin or tank constructed or to be constructed on the burdened lot in accordance with the requirements of the Council including all ancillary, gutters, downpipes, pipes, drains, orifice plates, trench barriers, walls, earth banks, kerbs, pits, grates, tanks, basins and other surfaces designed to temporarily detain and control stormwater located on any part of the burdened lot.

“Proprietor” includes the registered proprietor of the burdened lot from time to time and all of his heirs, executors, assigns and successors in title to the burdened lot and where there are two or more registered proprietors of the burdened lot the terms of this Positive Covenant shall bind all those registered proprietors jointly and severally.

“Council” means the Ku-ring-gai Council or its successor.

- a) In the event that the proprietor fails to comply with the terms of any written notice issued by the Council as set out above or in the event of an emergency, the Council or its authorised agent may enter the burdened lot with all necessary materials and equipment at all reasonable times and on reasonable notice (but at any time and without notice in the case

of an emergency) and carry out any work which the Council in its discretion considers reasonable to comply with the said notice referred to in Part 1.1(f) above or to alleviate the emergency.

- b) The Council may recover from the proprietor as a liquidated debt in a court of competent jurisdiction;
 - any expense reasonably incurred by it in exercising its powers under sub-paragraph (a) hereof,
 - 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(4) of the Conveyancing Act, 1919 or providing any certificate required pursuant to Section 88G of the Act or obtaining any injunction pursuant to Section 88H of the Act.

A14.1.2 Terms of Restriction on the Use of Land referred to in the Plan

Unless inconsistent with the context words used herein have the same meaning as those ascribed to them in the Positive Covenant referred to in the Plan.

The proprietor of the burdened lot covenants with the Council not to:

- a) allow any obstruction or interference of any kind to be erected, placed, created or performed so as to inhibit the flow of water to and from the System;
- b) except in accordance with the written approval of the Council allow any building, erection or structure to be constructed or allowed to remain constructed or placed on the System;
- c) carry out or allow to be carried out any change of land profile or earthworks on the System;
- d) carry out or allow to be carried out any alterations to the System including surface levels, controlled outflows, grates, pipes, orifice plate, mesh screen or any other materials or elements thereof outside those normally required for the formation, maintenance and proper function of the System

A14.1.3 Name of Authority empowered to release, vary or modify any Positive Covenant or Restrictions on the Use of Land referred to in the Plan:

Ku-ring-gai Council

General Manager
Ku-ring-gai Council

A14.2 Terms for On-site Retention

A14.2.1 Terms of Positive Covenant Referred to in the Plan

1. The proprietor of the burdened lot covenants with the Council in respect of any System (as later defined) constructed on the burdened lot to:
 - a) permit stormwater to be retained and re-used by the System;
 - b) regularly keep the System clean and free from grass clippings, silt, rubbish, debris and the like;
 - c) maintain the System to ensure a maximum outflow from the System and a minimum pondage in accordance with plans duly approved by the Principal Certifying Authority;
 - d) ensure that the System at all times includes an overflow to direct any excess flow to the downstream drainage System;
 - e) maintain, repair and replace the System or any part of it due to deterioration or damage without delay so that it functions in a safe and efficient manner;
 - f) comply with the terms of any written notice issued by the Council in respect of the requirements of the Positive Covenant within the time stated in the notice;
 - g) permit the Council to enter upon the burdened lot or any part of it with all necessary materials and equipment at all reasonable times and on reasonable notice (but at any time and without notice in the case of an emergency);
 - to view the state of repair of the System;
 - to ascertain whether or not there has been any breach of the terms of this Positive Covenant;
 - to execute works on the burdened lot for compliance with the requirements of this Positive Covenant;
 - h) indemnify and keep indemnified the Council from and against all claims, demands, actions, suits, causes of action, sums of money, compensation, damages, costs and expenses which the Council or any other person may suffer as a result of any malfunction or non-operation of the System or any failure of the proprietor to comply with the terms of the Positive Covenant.
2. The Council shall have the following powers:
 - a) In the event that the proprietor fails to comply with the terms of any written notice issued by the Council as set out above or in the event of an emergency, the Council or its authorised agent may enter the burdened lot with all necessary materials and equipment at all reasonable times and on reasonable notice (but at any time and without notice in the case of an emergency) and carry out any work which the Council in its discretion considers reasonable to comply with the said notice referred to in Part 1.1(f) above or to alleviate the emergency.
 - b) The Council may recover from the proprietor as a liquidated debt in a court of competent jurisdiction;
 - i) any expense reasonably incurred by it in exercising its powers under sub-paragraph (a) hereof,
 - ii) 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(4) of the Conveyancing Act, 1919 or providing any certificate required pursuant to Section 88G of the Act or obtaining any injunction pursuant to Section 88H of the Act.
3. In this Positive Covenant unless inconsistent with the context,

"System" means in relation the burdened lot the stormwater retention and re-use tank or other device constructed or to be constructed on the burdened lot in accordance with the requirements of

the Council including all ancillary, gutters, leaf gutter guards, downpipes, pipes, drains, filter, pump, delivery plumbing, trench barriers, walls, earth banks, kerbs, pits, grates, tanks, basins and other surfaces designed to retain and re-used and control stormwater located on any part of the burdened lot.

“Proprietor” includes the registered proprietor of the burdened lot from time to time and all of his heirs, executors, assigns and successors in title to the burdened lot and where there are two or more registered proprietors of the burdened lot the terms of this Positive Covenant shall bind all those registered proprietors jointly and severally.

“Council” means the Ku-ring-gai Council or its successor.

A14.2.2 Terms of Restriction on the Use of Land referred to in the Plan

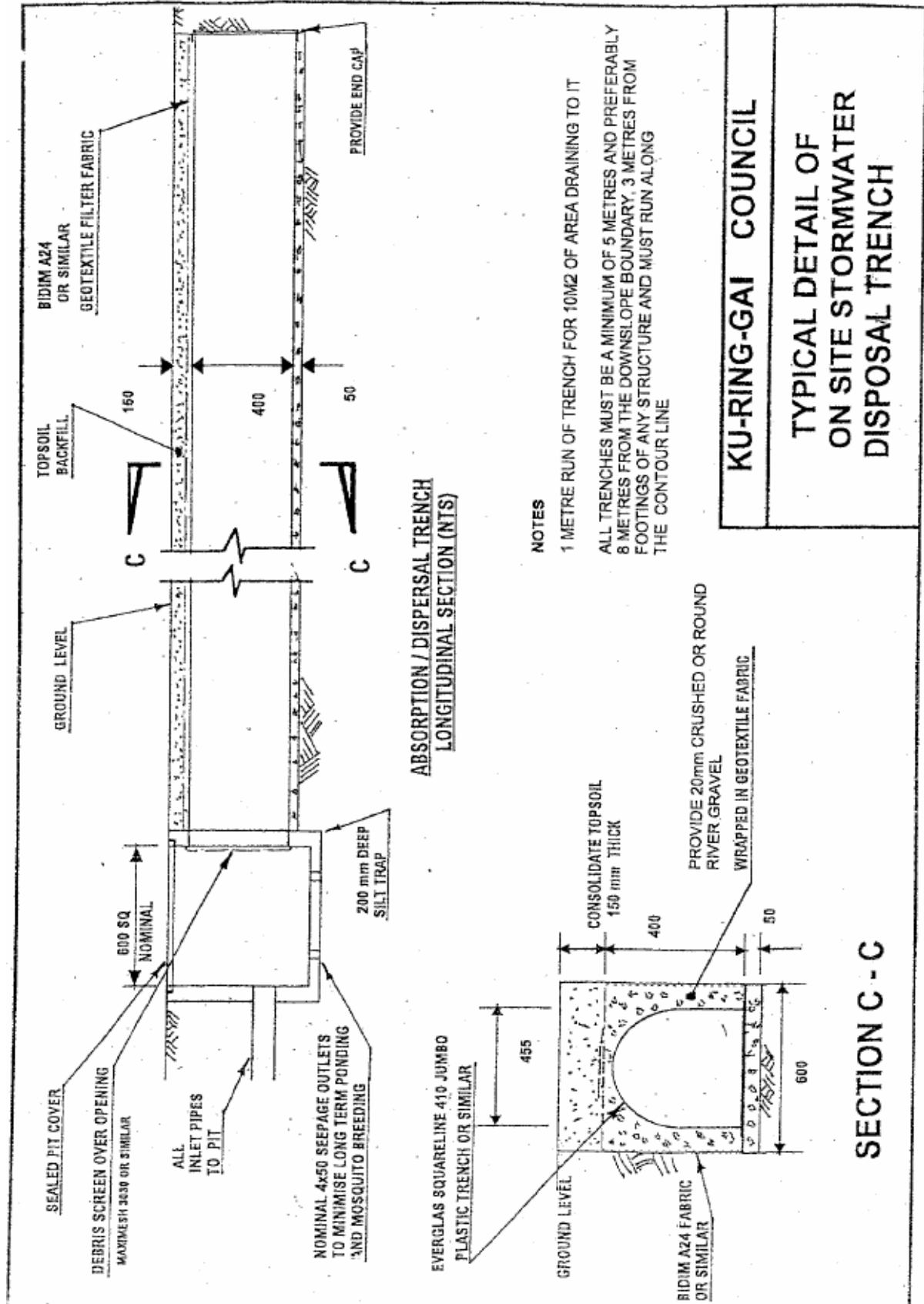
1. The proprietor of the burdened lot covenants with the Council not to:
 - a) allow any obstruction or interference of any kind to be erected, placed, created or performed so as to inhibit the flow of water to and from the System;
 - b) except in accordance with the written approval of the Council allow any building, erection or structure to be constructed or allowed to remain constructed or placed on the System;
 - c) carry out or allow to be carried out any change of land profile or earthworks on the System;
 - d) carry out or allow to be carried out any alterations to the System including surface levels, controlled outflows, grates, pipes, filter, pump, delivery plumbing or any other materials or elements thereof outside those normally required for the formation, maintenance and proper function of the System
2. Unless inconsistent with the context words used herein have the same meaning as those ascribed to them in the Positive Covenant referred to in the Plan.

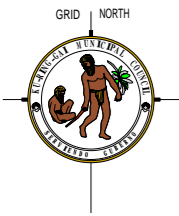
A14.2.3 Name of Authority empowered to release, vary or modify any Positive Covenant or Restrictions on the Use of Land referred to in the Plan

Ku-ring-gai Council

General Manager
Ku-ring-gai Council

Appendix 15 Stormwater Disposal Trench

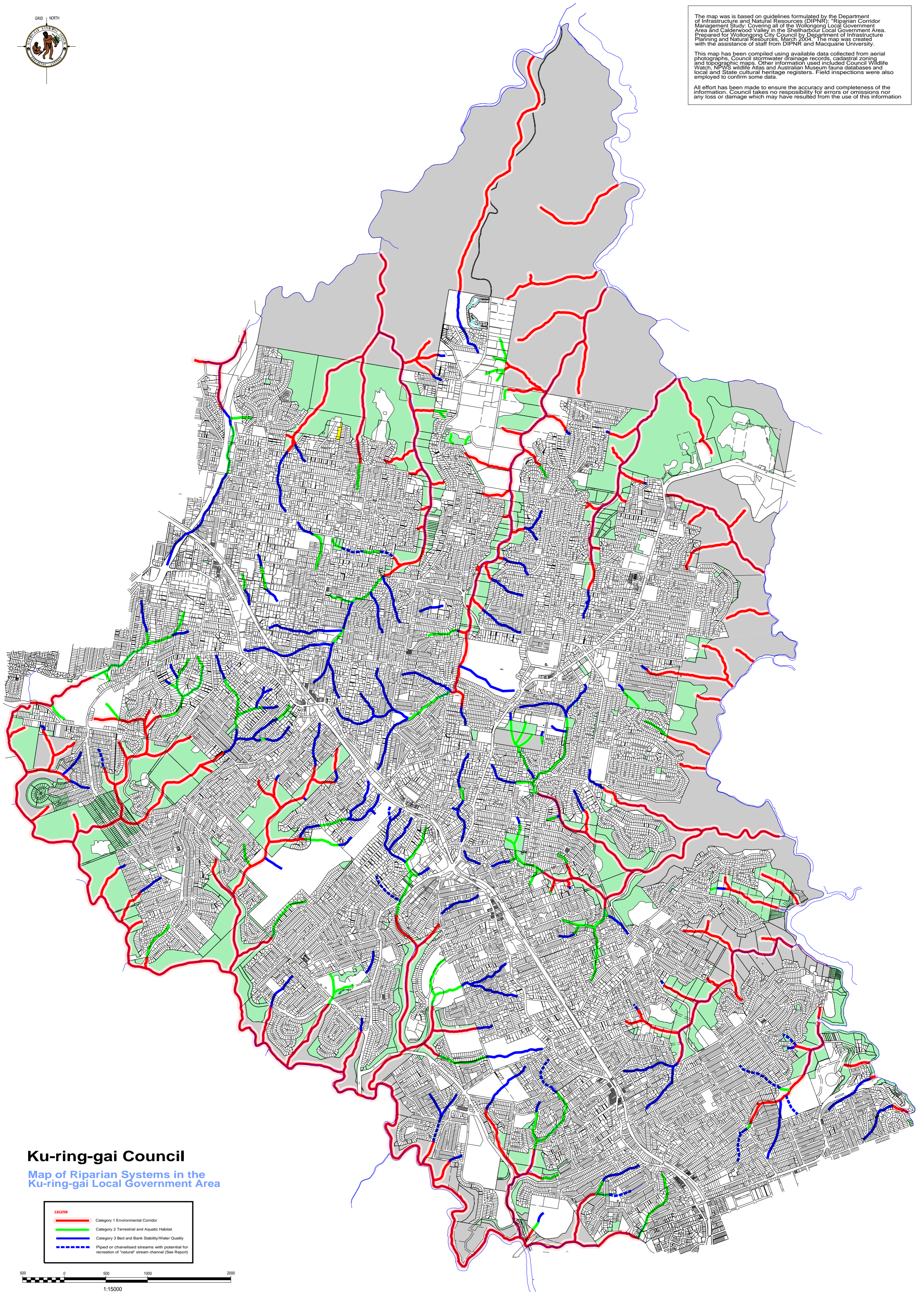




The map was is based on guidelines formulated by the Department of Infrastructure and Natural Resources (DIPNR), "Riparian Corridor Management Study: Covering all of the Wollongong Local Government Area and Calderwood Valley in the Shellharbour Local Government Area. Prepared for Wollongong City Council by Department of Infrastructure Planning and Natural Resources, March 2004". The map was created with the assistance of staff from DIPNR and Macquarie University.

This map has been compiled using available data collected from aerial photographs, Council stormwater drainage records, cadastral zoning and topographic maps. Other information used included Council Wildlife Watch, NPWS wildlife Atlas and Australian Museum fauna databases and local and State cultural heritage registers. Field inspections were also employed to confirm some data.

All effort has been made to ensure the accuracy and completeness of the information. Council takes no responsibility for errors or omissions nor any loss or damage which may have resulted from the use of this information



Ku-ring-gai Council
Map of Riparian Systems in the
Ku-ring-gai Local Government Area

LEGEND

- Category 1 Environmental Corridor
- Category 2 Terrestrial and Aquatic Habitat
- Category 3 Bed and Bank Stability/Water Quality
- Piped or channelised streams with potential for recreation of "natural" stream channel (See Report)

