



Ashfield
Council

Ashfield Interim Development Assessment Policy 2013

Stormwater Management Policy

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The following Policy for Stormwater Management was adopted by resolution of Ashfield Council.

Policy Statement

All development/building works within the Ashfield Council area shall incorporate stormwater drainage facilities to collect and convey stormwater runoff to Council's system, ensuring adverse impact on the surrounding environment is avoided.

Objectives

- ◆ *to preserve and protect the amenity and property of existing residents, property owners and the community;*
- ◆ *to ensure the safety of residents and the community;*
- ◆ *to meet reasonable expectations and statutory requirements for the development of properties;*
- ◆ *to protect the physical environment and receiving waters of catchments.*

Administration

All development/building activities within the area of Ashfield Council affecting stormwater runoff will be regulated to achieve the objectives.

Development/building submissions and activities will need to be in accordance with the procedures and requirements contained in Council's "Stormwater Management Code" to comply with this policy.

This Policy and the Code will be administered by Council's Engineering Section, and will be reviewed regularly and revised as appropriate.

The "Stormwater Management Code" is published to enable anyone undertaking development activities within the Ashfield Council area to prepare and design developments to comply with the policy.

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1. PURPOSE

As a consent authority, Council requires all developers to demonstrate that any development/building work proposed will comply with all relevant codes, standards and policies.

This code is intended to provide a clear statement of policy, requirements and methods relating to stormwater drainage for residential, commercial, industrial and all other types of development. The Code will assist in the submission of the necessary information required to expedite Council approvals.

Technical information is provided only in the supplements. As designs are to be prepared by suitably qualified and experienced designers.

The Code should be read by all developers prior to lodging applications for Council approval.

2. COMMENTARY

2.1 *Document Structure*

The document is separated into the following sections:-

- | | |
|------------|---|
| Section 3 | Scope and Application - Details when and where the Code is to apply. |
| Section 4 | Planning Issues - Discusses the issues that should be considered and dealt with at the time the development is being planned and feasibility determined. |
| Section 5 | Design Requirements - Outlines details required and to be considered in the design of the development. |
| Section 6 | Construction - Describes the way construction activities, relating to the development, are undertaken. |
| Section 7 | Documentation Required - Lists the documentation and details necessary for Council to approve applications and for there to be a demonstration of compliance with the policy. |
| Section 8 | Other Parties - Provides information on the requirements of other parties affected by developments that need to be satisfied. |
| Section 9 | Information Available from Council - An indication of where Council can assist applicants in the process. |
| Section 10 | Glossary - Explanation of terms used. |

Section 11 Details of sources referred to within the document or of assistance in complying with the guideline requirements.

Section 12 Supplements - Specific information for design purposes.

Items in Section 4 to 8 have reference to standard engineering conditions that may be applied to approvals. These are a guide only, and other conditions may apply in addition to these.

Where the term Council's Engineer or Planner are used in the Code, the persons referred to is Council's Traffic & Design Engineer or equivalent.

The term development in the document is to be taken to include building works.

2.2 General

The costs of all works and restoration involved in the development, including that within public road and other properties, utility adjustments, easement acquisition and legal costs are to be borne by the developer.

The responsibility for the submission of satisfactory details as required by this Code and any consent conditions, rests with the applicant.

3. SCOPE AND APPLICATION

The Code applies to all development works requiring Council consent within the Ashfield Council area, and will be administered by Council's Engineer.

Development activities that are covered by the Code are those requiring written consent from Council. This covers:-

Residential

Single dwelling	-	New (including replacement)
Single dwelling	-	Extensions, garages, carports etc
Dual Occupancy		
Medium Density	-	Villa, Townhouses etc
High Density	-	Units, Apartments etc
Tennis Courts		

Commercial

Industrial		
Institutional Buildings	-	Schools, Hospitals etc
Paving, Driveways & Roadworks		
Subdivisions		
Drainage Works		
	-	in public lands
	-	pipng or lining of open watercourses
	-	modification to existing systems excluding roofwater lines

All other developments.

4. PLANNING ISSUES

4.1 *Adverse Impact & Controlling Site Runoff*

Development activities must not cause an adverse impact on adjoining or any other properties. This includes preserving surface flow paths and not increasing water levels. Site discharges will need to be restricted to pre development discharges using On-site Stormwater Detention. Protection is to be provided for all rainfall events through to 100 years ARI.

Refer Conditions 1.1, 1.6, 1.7, 1.18, 1.17, 1.21.

4.2 *On-site Stormwater Detention (OSD) Storage*

OSD of stormwater is required to limit discharges from developments to pre development conditions. Council's OSD requirements have been formulated to ensure there is no increase in discharges adjacent to the site or elsewhere in the catchment for virtually all rainfall events though to 100 years ARI.

OSD will be required for all developments except for:-

- * extensions to existing single residential dwellings where the proposed extended roof or paved area is less than 40m².
- * for sites that discharge directly to Parramatta River or one of its bays as shown on Council's plans.

All OSD systems will require full hydraulic design in accordance with the details in Supplement 4, except for single residential dwellings where:-

- the building works are an extension of an existing house/garage, and
- the total proposed extended roof and paved area is less than 100m².

In these exceptions the OSD required can be constructed in accordance with the standard detail in Supplement 8.1 without requiring a full design.

The Development Application is to include a Stormwater Drainage Concept Plan (SDCP - see 4.7) which will outline the OSD proposed. A detailed design will be required at the Building Application stage.

Where separate titles can or will be created (by subdivision) with the development, separate OSD storages are generally to be provided. Storages can be amalgamated or omitted for some lots providing the storage proposed for the overall development can meet the permitted site discharge and storage requirements in accordance with Supplement 4, and the pipework draining to the storage is wholly within the lot with

the storage.

Storage outflows are to be controlled to ensure the full range of ARI protection occurs. This will require the OSD to incorporate a range of storage-discharge values for various ARI's.

OSD storages should be located as close as possible to the lowest point of the site, with paved areas and pipes to drain to it. Storages are encouraged to be above ground and incorporated into driveway/parking areas. Storages in landscaping areas will require additional measures to discourage later modifications, as well as extra volume to compensate for vegetation growth.

Storages should not be located in overland flow paths which convey catchment flows through the site. Storages are to be in common areas (rather than privately controlled areas such as courtyards) for developments with multiple dwellings or units.

Refer Conditions 1.3, 1.4, 1.5, 1.7

4.3 Surface Flow Paths

Surface flow paths are an integral part of the drainage system. They are to be preserved, or alternatives provided, wherever they pass through or affect the development site. Site discharges are not to be concentrated to a degree greater than that which naturally occurs. Redirection of flows including to other sub catchments is not permitted unless appropriate counter measures are undertaken. Flows to the receiving system or sub-catchment are not to be increased. Flow paths are to be retained within easements wherever possible.

Refer Conditions 1.1, 1.3, 1.6, 1.7, 1.21

4.4 Floor and Ground Levels

Building floor levels need to be set above surrounding ground levels with an adequate freeboard to surface runoff flows or ponding levels. Where re-contouring of the site is proposed, the existing ground levels at the boundaries are to be retained with maximum 1 in 4 finished ground level slopes. Retaining walls are not to be constructed closer than 0.9m to the boundary unless approved by Council. Existing ground surface levels are to be retained within 0.9m of any property boundary.

Refer Conditions 1.1, 1.7, 1.14, 1.15, 1.20

4.5 Gravity Drainage

All stormwater drainage connecting to Council's drainage systems is to be by gravity means. Mechanical means (ie pumps) for disposal of stormwater runoff will not be permitted. Subsoil and basement seepage systems where separate from the stormwater drainage may be exempted from this requirement.

The acquisition of an easement over any intervening downstream properties (at the developers cost) will normally be required for sites that do not drain to:-

- * the street;
- * Council land containing a drainage line; or
- * an existing Council pipeline within the development site.

Without a gravity stormwater drainage system being provided, development consent will not be granted. Written consent for the piping and acquisition of an easement is to be obtained from adjoining owners and provided to Council with the development application.

Exception to gravity disposal may be given at the discretion of Council's Engineer for sites that do not drain to the street, only where extensions to an existing single residential building or replacement of an existing house is proposed, and genuine attempts at acquiring a downstream easement have failed. Written documentation of these attempts, including reasonable financial consideration, must be included in any application for exception.

For minor extensions (ie less than 40m²) to existing single residential buildings, connections may be made direct to the existing site drainage system where one exists.

A bond may be required to ensure the registration of any easements required, the value of which will be determined by Council's Engineer.

Refer Conditions 1.2, 1.3, 1.4, 1.9, 1.10, 2.10

4.6 Relationship to Other Properties

Where surface runoff from adjoining properties flows onto the development site, such flows are to be catered for within the development. Obstructions that cause damming and backwater effects on upstream properties will not be permitted. Similarly, surface runoff from the site that is conveyed through the site is not to be concentrated onto downstream properties, or diverted from existing discharge points unless into Council's drainage system. Diverting flows from one catchment to another will not normally be permitted.

Refer Conditions 1.6, 1.7, 1.17, 1.18

4.7 Stormwater Drainage Concept Plans (SDCP)

For developments that require a development application (DA), a SDCP is to be submitted with the application demonstrating the feasibility of the proposed drainage systems within the site and connection to Council's system. This plan is also to show surface flow path treatment, any easements required, On Site Detention Storages as well as internal piped systems. The application will not be accepted without such a plan. Detailed design plans and calculations will later be required to be submitted with the Building Application for Council approval.

Where only a Building Application is required, full details and plans of the stormwater system including relevant calculations are required with the application. Building consent will not be issued until these details are submitted to and approved by Council.

Where easements are necessary over any adjoining or downstream property to achieve gravity drainage, a written agreement from the adjoining owners is to be submitted with the SDCP.

Refer Conditions 1.3, 1.4, 1.5, 1.6, 1.7, 1.9

4.8 Easements

For sites that have existing Council pipelines through them that are not covered by an easement, or where an existing pipeline is not within the easement, Council will require the creation of an easement in favour of itself over the pipeline. The easement width is to be the pipe, box, or channel section width plus 1.5m, with an overall minimum width of 2.5m.

Site drainage systems will require inter-allotment easements over downstream properties where the drainage traverses any other private property to connect to Council's drainage system.

Dual occupancies, where separate title is created over each unit, will require an inter-allotment drainage easement over the downstream lot in favour of the other lot for any drainage lines or structures affecting the

former.

The process for obtaining easements is:-

- Registered Surveyor to prepare plan of survey;
- plan to be submitted to Council for approval;
- plan and application to be lodged with owners approval at Land Titles Office and fees paid;
- Council to be advised of lodgement details;
- Land Titles Office advises applicant/owner and Council of registration.

Refer Conditions 1.9, 1.10, 1.11, 2.10

4.9 Site Discharge & Connection to Council System

Site drainage is to connect to Council's system at the nearest suitable location.

Single residential developments will be permitted to connect pipe systems to the street gutter provided the discharge doesn't exceed 10 l/s per outlet for the 100yr ARI design, with a maximum of two per nominal 20m street frontage.

Dual occupancy developments may be permitted kerb connection where the total site discharge is less than 15 l/s for the 100yr ARI design.

All other developments are required to connect directly to a Council pipe or channel system. The point of connection will be the closest suitable point as determined by Council's Engineer. An access pit will be required at the point of connection, with one to be constructed if none exists.

Where the piped drainage system extends beyond the site to connect to Council's system, an access pit is to be provided at the boundary within the development site.

Where the connection point is not in front of the site, the site drainage line is to be run to the kerb line and then to the nearest Council pit. A standard Council pit is to be constructed at the kerb in accordance with the Council drawing as shown in Supplement 8.2. The pipeline from the kerb pit to Council's pit is to be constructed under the kerb and gutter. Any pavement or kerb and gutter disturbed is to be replaced. The pipes within the road or public lands are to be reinforced concrete with a minimum 375mm diameter. All costs for the connection are to be borne by the developer.

Refer Conditions 1.2, 1.3, 1.4, 1.23

4.10 Studies/Analysis

In situations where flooding problems have occurred, or there is a risk of such occurrence, a flood study or drainage system analysis of the catchment containing the development site will be required. Where such a study is to be carried out, the calculation methods required to demonstrate satisfactory treatment of the development will generally be in accordance with current practice as outlined in Australian Rainfall & Runoff (1987), and subject to the satisfaction of Council's Engineer.

Refer Condition 1.1

4.11 Standards

Pipe systems draining the development site are to be designed to an ARI standard shown in the table below, with suitable treatment of all surface flows to a 100yr ARI standard. All pipe and surface flows to the 100yr ARI standard are to be routed through any OSD required.

Developments with higher potential damage risks from surface flows will require higher design standards. Where surface flow paths are not available, the pipe standard will rise to 100yr ARI.

Where the site or buildings are at or below the level of a downstream road or embankment, Probable Maximum Precipitation events are to be considered. OSD will require all ARI's to be examined to ensure no adverse effect for any size storm.

Piped Systems - ARI Standards

Residential	20 yrs
Commercial Industrial	50 yrs
OSD Range	2 to 1 00 yrs

Refer Conditions 1.2, 1.3, 1.7

4.12 Safety & Consideration of Failure

Open drainage system components are to be designed to meet relevant safety criteria. Storage basins are to have battered slopes for egress, maximum ponding depths, and appropriate signage and fencing. Specific reference is made to Figure 6 Appendix B of the Floodplain Development Manual for velocity and depth limits, and to Supplement 4 for the design of OSD storages.

The possibility of failure of components of the system must be considered, and provision made for the safe conveyance of flows should failure occur. For OSD basins emergency spillways must be provided. The potential for obstructions to overland flow paths is to be minimised.

Refer Conditions 1. 3, 1.5, 1. 7

4.13 Visual Impact

All drainage structures and measures are to be designed to be visually unobtrusive and sympathetic with the development. This requirement is necessary to ensure future occupants do not adjust or remove facilities for aesthetic reasons without understanding the functional impact of such actions.

4.14 Runoff Quality (and Sediment) Control

Any stormwater runoff from the development that has the potential for contamination by specific pollutants will require treatment and be discharged in accordance with the requirements of the Environment Protection Authority (EPA). Referral for all other developments will be at the discretion of Council.

Sediment control measures will be required during the construction of all developments, including all residential construction. Where the development has an on going risk of erosion, permanent measures will also be required. The measures are to be in accordance with the 'Urban Erosion And Sediment Control' Handbook, available from the NSW Department of Conservation and Land Management (CALM).

A plan of the proposed measures will be required with the application. Where off site disposal of excavated material will occur, a truck cleaning area will be required. The plan is to comply with the details given in section 5 of the CALM handbook. A summary of these is given in supplement 1 0.

Building plans/consent will not be released until the sediment control plan and details have been approved.

Refer Conditions 1.2, 1.3, 1.19

4.15 Restrictions As To User - Positive Covenants

The potential for modification or adjustment to OSD storages and/or surface flow paths through the property is significant enough to warrant extra protection. Future owners of properties also need to be aware of their presence and purpose. Consequently, a Restriction As To User/Positive Covenant may be required on the property title as part of the development.

The restriction is created as a Positive Covenant using Form 55A for an Instrument Pursuant To Section 88E(3) of the Conveyancing Act, 1919. The Instrument is to ensure the continued functioning and maintenance of the items detailed in the consent condition.

A bond will be required against the creation of the restriction, the value of which will be determined by Council's Engineer.

Positive Covenants for OSD will be required where the development includes :-

- dual occupancy dwellings.
- medium and high density residential housing.
- commercial or industrial structures.
- tennis courts.

Refer Conditions 1.12, 1.20, 2.10

4.16 Structures Over or Near Drainage Lines and Easements

New buildings, structures and tennis courts will not be permitted over drainage lines or within easements. Paving over any drainage line or easement is acceptable, but will require appropriate jointing at the easement boundary, and to be in a material approved by Council's Engineer.

Clearances to easement boundaries are required to prevent structural loads on drainage structures or encroachment within the angle of repose of the soil. Peering is an acceptable technique to achieve this.

If there is an existing structure over the drainage line or easement within the site that is part of the application, then an access pit is required to be provided upstream and downstream of the structure.

4.17 Natural Watercourses and Open Channels

The straightening, widening, lining, or piping of open channels will require the creation of inlet structures and surface flow paths to convey all flows to the 100 year ARI standard, Additionally, emergency flow paths are required in case of obstruction. Depending upon channel conditions on properties adjacent to the site, inlet training and outlet scour controls will be required.

Approval for enclosing or lining natural channels may be refused in areas where such work is not consistent with the character of the watercourse in the vicinity.

5 DESIGN REQUIREMENTS

5.1 *Calculation Requirements*

Calculations are to be prepared by an acceptable practitioner (see 7.2), and in accordance with current practices and principles outlined in "Australian Rainfall & Runoff" and other relevant sources.

Hydrologic calculations for internal systems can be prepared using a rational method basis. Hydraulic grade line calculations are required for any pipe systems where flows are in excess of 100 l/s.

Where external catchment analysis is required, hydrologic calculations using time-area methods or a suitable equivalent are to be undertaken, with water surface profiles determined using grade line or backwater calculations as appropriate.

On Site Detention storage systems are to be sized and designed in accordance with Supplement 4. Where sites that require OSD can't drain the whole site through the single or multiple storages to be installed, additional attenuation of flows through the storage and extra volume are required to compensate.

Areas likely to be paved after completion of the development at any point in the future based on the function of the development (eg driveways), will be determined as part of the impervious area and included as such in any calculations.

Refer Conditions 1.3, 1.4, 1.5, 1.6

5.2 *Tailwater Conditions and Downstream Controls*

Water surface level calculations are to recognise the effect of any downstream controls, whether on the development site or external to the site. Where downstream water levels vary depending upon tide or channel flows, 100 year ARI levels of the external system being connected to are to be used unless joint probability calculations are performed

Refer Condition 1.4

5.3 *Freeboard*

Freeboard for floor levels above top water level (TWL) of OSD storages is required for buildings near OSD storages, of at least 0.15m above the maximum spillway operating level.

A building floor level freeboard ranging from 0.3m to 0.5m will be required against channel or mainstream flows, or in areas where significant overland flow occurs. In all other circumstances a minimum freeboard of 0.15m is required above surrounding finished ground levels.

Refer Conditions 1.1, 1.6, 1.7, 1.14, 1.15

5.4 Structural Requirements

The design of any structures to be constructed as part of the drainage system excepting manufacturers pre-cast units such as pits, pipelines, and box culverts, are to be certified by a suitable experienced professional structural or civil engineer.

Refer Condition 1.4

5.5 Practicalities, Physical Limits, Maintenance

OSD design is to provide for minimum maintenance and be as tamper proof as possible. If located in landscaping areas, nominally twice the volume will be required to allow for vegetation growth and siltation, the actual value to be determined by Council's Engineer (design of the hydraulic controls is to be based on the normal volume).

Pits are to be a minimum of 0.6m by 0.9m, with the longer side parallel to the pipes. Step irons are required for pits over 1.2m deep. Pipe junctions are to be configured for minimum hydraulic losses. Pits are to be located wherever drainage lines bend greater than 5 degrees, enter public lands from private property, or connection to Council's system.

Standard details for kerb inlet pits are shown in Supplement 8. Access grates in road gutters are to be bicycle safe, with hinged grates. Where the pit is located in a roadway (other than the gutter), pit lids are to withstand T44 traffic loadings and be of a lock down type.

Pipes within public lands are to be reinforced concrete, spigot and socket, rubber ring type. Alternatives pipe materials and joints may be approved at the discretion of Council's Engineer.

Refer Conditions 1.3, 1.4, 1.5, 1.23

6 CONSTRUCTION & DEVELOPMENT ACTIVITIES

6.1 *Bonds*

Where works are carried out on Council or public lands (ie roads, parks etc) by or on behalf of the developer, a bond will be required to cover the cost of potential rectification works. The value of the bond will depend on the works proposed, and be determined by Council's Engineer.

Bonds may also be required to cover the provision of OSD systems and the creation of casements and Positive Covenants. Any bonds required will need to be paid prior to the release of building approval.

Refer Conditions 1.12, 2.10

6.2 *Contractors Insurance and Road Opening Permits*

Where works are carried out by parties other than Council on Council or public lands, the person or company carrying out the works will be required to carry public liability insurance, the minimum value of such coverage to be specified in the consent. Proof of the coverage will be required before works commence. Where such works are within a public roadway, a road opening permit is to be obtained before commencing works.

Refer Conditions 2.6, 2.7

6.3 *Inspections*

Where works are to be carried out on a public roadway, or involve Council owned operated structures, then advance notice and inspections will be required at specified stages during the works to ensure compliance with any requirements or conditions. The developer will be required to pay for inspections in accordance with Council's Fees & Charges.

The specified stages for inspections normally are :-

- i After the excavation of pipeline trenches.
- ii after the laying of all pipes, prior to backing
- iii after the completion of all pits and connection points.

A minimum of 24 hours notice shall be given to Council to obtain an inspection. Work is not to proceed until the works or activity covered by the inspection is approved.

Refer Conditions 1.16, 2.9

6.4 Certification and Works-As-Executed (WAE) Plans

Certification and/or WAE plans may be required demonstrating that certain structures have been provided according to the submitted calculations or approved plans. This will normally be when the correct construction of these is critical to the functioning of the drainage system.

Such certification will be either from an acceptable practitioner or a registered surveyor, as appropriate.

Refer Conditions 1.12, 1.13

6.5 Traffic Control & Safety

Where works are undertaken on public roads, the applicant or contractor is to provide adequate traffic control and directions to motorists. Where such measures are not satisfactorily provided, Council may provide such and recover the costs from any bonds held. Traffic control is to be in accordance with Australian Standard 1742.3 - Traffic Control Devices For Works On Roads, or any directions issued by Council's Engineer during the works.

If driveway access to properties is to be disrupted, residents are to be advised in writing a minimum of 24 hours prior to the works. Access is to be restored outside normal working hours

Refer Condition 2.8

6.6 Connection to Council System

Where drainage works to connect to Council's system are to be carried out within public roads or lands, the applicant or any contractors performing the work are to ensure public safety at all times. The works are to be secured, sign posted and lit whenever the site is unattended.

If Council deems public safety to be at risk, it will provide all necessary measures to secure the site. The costs of such measures will be recovered from any security deposits or bonds held.

Refer Conditions 2.6, 2.7, 2.8, 2.9, 2.10

6.7 Restoration

Any disturbed areas within public roads or lands are to be restored to original or better condition. including landscaping. All restoration costs are to be borne by the developer.

Where other utilities or services require restoration as a result of works for the development, the restoration is to be to the relevant authorities requirements.

Where sections of kerb are to be replaced, including driveways, an integral kerb and gutter profile is to be used. Existing concrete structures are to be saw cut and contraction/expansion joints provided.

Road pavement restorations will be carried out by Council using the road restoration fees paid with the road opening permit, or using any bonds held. Where restoration works are permitted to be carried out by approved contractors, inspections and compaction testing will be conducted to the requirements of Council's Engineer.

Refer Conditions 1.4, 1.8, 2.1, 2.2, 2.6, 2.10

6.8 Pipe Laying & Materials

All pipe laying and construction works are to comply with the requirements of any relevant Australian Standards and codes, as well as the manufacturer's specifications. Occupational Health & Safety legislation requirements are to be adhered to at all times.

For reinforced concrete (RC) and fibre reinforced concrete (FRC) pipes, spigot and socket rubber ring joints are required. All other materials are to be to the manufacturers specifications for jointing. Where bolts or similar are required, stainless steel is to be used. PVC and HDPE pipes will not be permitted in load bearing situations.

All pits in public roads are to be constructed in reinforced concrete, and kerb inlet pits in accordance with the detail in Supplement 8.

Refer Conditions 1.3, 1.4, 1.23

7 DOCUMENTATION REQUIRED

7.1 *All Submissions*

All applications are to include plans and calculations prepared by an acceptable practitioner which adequately demonstrate compliance with the policy and this Code.

7.2 *Acceptable Practitioners*

Any hydrologic, hydraulic or structural calculations submitted to Council are to be performed by a suitably qualified professional civil engineer. Similarly, any certification of works carried out that rely on these calculations are to be certified by an equally qualified person.

Registered surveyors may be recognised as suitable practitioners for drainage calculations at the discretion of Council's Engineer, and subject to satisfactory demonstration of capability and experience.

Refer Conditions 1.3, 1.5, 1.12, 1.13

7.3 *Works-As-Executed Details (WAE)*

Certification from a registered surveyor that all drainage works and structures have been constructed in accordance with the approved plans is to be provided to Council before permission to occupy is granted. Such certification is to include WAE plans. Any bonds held will not be released until all required certification has been received.

Refer Conditions 1. 12

7.4 *Details To Be Submitted With Applications*

A Stormwater Drainage Concept Plan (SDCP) is to be submitted with any Development Application, outlining the treatment and disposal of all stormwater from the site (See 4.7). This plan is to demonstrate that the methods proposed are feasible and comply with the Code.

Design plans and calculations are to be submitted with building applications to demonstrate all measures and structures will function as claimed, and comply with relevant codes and/or practice. This should also include survey information about structures, surface flow paths, and ground levels extending at least 5m beyond the property boundaries. The latter is particularly important where recontouring of the site is proposed or the development has the potential to affect other properties.

Plans of the layout and dimensions of all drainage structures and treatments is required. Any Benchmark used to determine levels is to be shown, with levels to AHD wherever a PM or SSM is available within 250m.

Refer Condition 1.4

8 OTHER AUTHORITIES

8.1 Water Board

Applications may be referred to the Board where it is responsible for any channel being connected to downstream of the development. Any requirements of the Board will need to be met before approval can be granted.

Refer Condition 1.8

8.2 Services

Wherever any public utility service is affected by the developer, it is the responsibility of the developer to ensure the development complies with the requirements of the relevant authority. All costs associated with any works required are to be borne by the developer.

Refer Conditions 1.8, 2.2, 2.7, 2.8

8.3 Environment Protection Authority (EPA)

All stormwater runoff must ultimately comply with the Clean Waters Act 1970 and Clean Waters Regulations 1972, which are administered by the Environment Protection Authority (EPA) of NSW. It is the responsibility of the developer to ensure any EPA requirements are met.

Certain developments, such as petrol stations, will require written confirmation that appropriate approvals and licences have been obtained prior to the release of building plans.

Refer Condition 1.19

9 INFORMATION AVAILABLE FROM COUNCIL

9.1 *Drainage System Information*

Council will make available information on its drainage system where it is available, on the express understanding that Council is not liable for the accuracy of the information or the consequences of it being used. Results from drainage studies carried out for Council, which have been reported to the Council, may also be made available.

Information provided to Council by other parties may be released at the discretion of Council's Engineer subject to copyright and privacy restrictions, and on the understanding Council makes no guarantees as to its validity.

9.2 *Location and Details of Pipelines*

The developer will need to confirm, by inspection and/or survey, any information affecting designs.

Refer Condition 1.8

9.3 *Codes and Policies*

Any Council document or policy referred to in this Code will be available to the public. A fee will be charged for the document to cover production costs, and will be set in Council's annual fees and charges.

10 GLOSSARY

Australian Rainfall & Runoff (AR&R)

A technical publication from the Institution of Engineers Australia providing guidance on current drainage design practice.

Average Recurrence Interval (ARI)

A statistical likelihood of a storm event of at least a designated average rainfall intensity occurring. The probability is a long term average, and not a period between events (eg 10 years ARI indicates 10 events over 100 years).

Hydrology & Hydraulic

Hydrology is the estimation of the runoff and flow rates of rainfall once on the ground. The term hydraulic refers to calculating the capacity or characteristics of flow control devices and conduits (pipes).

On-site Stormwater Detention (OSD) Storage

Restricting the outflow of stormwater runoff from a site by draining collected surface flows from paved and roof areas through a storage with an outflow control device.

Probable Maximum Precipitation (PMP)

An estimate of the maximum amount of rainfall that could possibly occur.

Stormwater Drainage Concept Plan (SDCP)

A site plan of a development showing buildings and proposed drainage measures and structures. This should include existing and proposed ground and floor levels, as well approximate sizes of drainage structures and surface flow path treatments. Preliminary hydrologic calculations should accompany the plan.

11 REFERENCES

- "Australian Rainfall & Runoff", (AR&R) 1987, Institution Of Engineers, Australia.
- "Surface Water Management On The Covered Forecourt Areas Of Service Stations", Environmental Protection Authority, 1992.
- "Urban Erosion & Sediment Control", NSW Department Of Conservation And Land Management, Draft 1992.
- "Floodplain Development Manual", December 1986, Department of Planning, NSW Government.
- "The Estimation of Probable Maximum Precipitation in Australia for Short Durations and Small Areas", Bulletin 51, August 1984, Bureau of Meteorology, Department of Science & Technology.
- "Storm drainage design in small urban catchments", 1986, ARRB Special Report No.34, John Argue.
- "Model Analysis To Determine Hydraulic Capacities Of Kerb Inlet and Gully Pit Gratings.", 1979, Department Of Main Roads NSW
- "Pressure Changes at Storm Drain Junctions", Engineering Services Bulletin 41. 1 958, University of Missouri, Sangster et al.
- "Magnitude of Head Losses at Junctions in Piped Drainage Systems.", 1983, Civil Engineering Transactions, C.Hare.
- "Stormwater Pollution Control Code For Local Government", Sydney Coastal Councils, May 1992

12 SUPPLEMENTS

- 1 Standard Engineering Conditions
- 2 Checklists
- 3 Intensity Frequency Duration (IFD) Rainfall Data
- 4 On Site Stormwater Detention (OSD) requirements
- 5 Requirements For Hydrologic Calculations & Modelling
- 6 Not Used
- 7 Hydraulic Design & Details
- 8 Standard Structures and Details
 - 8.1 Detention Storage & Infiltration Tank - Residential Dwellings
 - 8.2 Grated Road Stormwater Pit With Extended Kerb Inlet
- 9 Wordings For Restrictions As To User & Easements
- 10 Sediment Control Plans

SUPPLEMENT I

Standard Engineering Conditions

The following conditions are standard conditions used by Council that may be applied to any development or building consent issued. Additional conditions may also be applied depending upon the details of the development. Specific wording may also vary between Councils.

S1 DRAINAGE CONDITIONS

- 1.1 A detailed drainage study shall be prepared by a suitably qualified engineer and submitted with the building application, demonstrating the development has no adverse effects on adjoining properties as a result of flooding and stormwater runoff and that there is adequate protection for buildings against the ingress of surface runoff.
- 1.2 Stormwater runoff from all roof and paved surfaces shall be collected and discharged by means of a gravity pipe system to
 - a *the nearest appropriate council drainage line*
 - b *the street gutter*
 - c *council's drainage system located...*
 - d *council's street drainage system*
 - e *via an infiltration storage on site*
- 1.3 Details of the proposed method of stormwater disposal shall to be prepared by a suitably qualified professional civil engineer in accordance with Council's Stormwater Management Code, and submitted to and approved by Council prior to the release of the building approval.
 - a *Separate drainage systems shall be provided for each lot.*
- 1.4. Details and calculations to be submitted prior to the release of the building approval shall include:
 - i a catchment plan.
 - ii plans showing proposed and existing floor, ground and pavement levels.
 - iii details of pipelines/channels showing calculated flows, velocity, size, materials, grade, invert and surface levels.
 - iv details and dimensions of pits and drainage structures.
 - v hydrologic and hydraulic calculations.
 - vi details of any services near to or affected by any proposed drainage line.
 - vii any calculations necessary to demonstrate the functioning of any proposed drainage facility is in accordance with Council's requirements.
 - viii The depth and location of any existing stormwater pipeline and/or channel being connected to shall be confirmed by the applicant on site. Certification of such is to be provided to Council prior to the release of the building approval.

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- 1.5 On-site Stormwater Detention storage shall be provided in conjunction with the stormwater disposal. This storage shall be designed in accordance with Council's Stormwater Management Code. Details of the storage shall be submitted to and approved by Council prior to the release of the building approval.
- 1.6 Allowance shall be made for surface runoff from adjacent properties, and to retain existing surface flow path systems through the site. Any redirection or treatment of these flows shall not adversely affect any other properties.
- 1.7 Overflow paths shall be provided to allow for flows in excess of the capacity of the pipe/drainage system draining the site, as well as from any on-site stormwater detention storage.
- 1.8 (1) The depth and location of all services within the area of effect of the development (ie. gas, water, sewer, electricity, telephone, traffic lights, etc.) shall be confirmed by the applicant on site
- a prior to the release of the building approval.*
- (2) Any adjustments required will be at the applicant's expense. The relevant authority's written consent for any adjustments or works affecting their services shall be obtained prior to works commencing.
- 1.9 (1) An easement in favour of the development site lot shall be obtained over any downstream properties traversed by the gravity drainage line connecting to council's drainage system. The cost of creating the easement will be at the applicant's expense.
- (2) For pipes less than 350mm diameter, the easement width shall be a minimum of 1.0m. Easements for larger diameter pipes shall be the pipe diameter plus 1.0m wide, with a minimum width of 2.4m.
- (3) Written consent of the relevant owners shall be provided to Council prior to the release of the building approval.
- (4) The application to create the easement shall be lodged at the Land Titles Office prior to release of the building approval and proof of lodgement provided to Council. Registration of the easement shall be effected before completion of the development.
- 1.10 Easements in favour of upstream lots shall be provided over the lots traversed by the common drainage lines. The minimum width shall be 1.0m. Registration of the easement shall be effected before completion of the development.

- 1.11 An easement in favour of Council shall be created over the existing drainage line located...for the purpose of constructing and maintaining stormwater drainage structures. The wording of the dedication shall be approved by council prior to lodgement at the Land Titles Office, and proof of lodgement is to be provided to Council prior to the release of the building approval. Proof of the dedication of the easement shall be furnished to Council prior to the completion of the development.
- 1.12 Prior to the occupation of the development,
a or release of any security bonds referred to in Condition 2.10,
written verification from a suitably qualified professional civil engineer shall be obtained, stating that all stormwater drainage and related work has been constructed in accordance with the approved plans. In addition, full works-as-executed plans, prepared and signed by a registered surveyor, shall be submitted. These plans shall include levels and location for all drainage structures and works, buildings (including floor levels) and finished ground and pavement surface levels.
- 1.13 Certification shall be obtained from a registered surveyor at the following stage(s) of construction to ensure approved levels are achieved:
a. footings excavation prior to placement of concrete.
b. Ground floor level prior to placement of concrete.
c. Car park / garage level prior to placement of concrete or pavement.
- 1.14 *a Habitable floor levels shall be at a minimum of RL m AHD.*
b Habitable floor levels shall be a minimum of 150mm above the surrounding finished ground levels.
- 1.15 *a Garage floor levels shall be at a minimum of RL m AHD.*
b Garage floor levels shall be a minimum of 100mm above the surrounding finished ground levels,
- 1.16 (1) For drainage works
a within council controlled lands,
b connecting to council's stormwater drainage system
inspections will be required :
i After the excavation of pipeline trenches.
ii after the laying of all pipes, prior to backfilling.
iii after the completion of all pits and connection points.
- (2) A minimum of 24 hours notice shall be given to Council to obtain an inspection. Work is not to further proceed until the works or activity covered by the inspection is approved.
- 1.17 A physical barrier (nominally 150mm high and wide) shall be constructed along the... frontage, excepting at vehicular and pedestrian access points, to prevent surface runoff onto the road reserve.
- 1.18 Grated drains shall be provided along the property boundary at the vehicular crossings and are to connect to the internal drainage system.

- 1.19 Temporary measures shall be provided during construction to prevent sediment and polluted waters discharging from the site. Plans showing such measures shall be submitted and approved prior to the release of the building approval.
- 1.20 A Positive Covenant under section 88E of the Conveyancing Act shall be created on the title of the property(s) detailing the
- a surface flow path...*
 - b finished pavement and ground levels*
 - c prevent the erection of any structures or fencing...*
 - d On-site Storm water Detention system*
- incorporated in the development. The wording of the instrument shall be submitted to, and approved by Council prior to lodgement at the Land Titles Office. The instrument shall be registered prior to the completion of the development.
- 1.21 The... boundary fences shall be constructed in materials that allow unobstructed passage of surface stormwater flows. Fencing details shall be submitted and approved prior to the release of the building approval.
- 1.22 All stormwater drainage works shall be constructed in accordance with the Plans... submitted as part of the *development / building* application.
- 1.23 (1) The connection to Council's street drainage system shall consist of a pipeline across to the street kerb
- a with the pipeline then continuing under the kerb and gutter to Council's pipe.*
- The pipes shall be... mm diameter reinforced concrete spigot and socket with rubber ring joints. A pit shall be constructed at the property boundary, and
- b at the kerb line,*
 - c and at the connection to Council's pipe.*
- (2)
- d The pipeline and pits shall be constructed at the applicant's expense.*
 - e The applicant shall pay a contribution of \$... prior to the release of the building approval, for Council to construct a pipeline along the kerb line as far as the site including a pit at the kerb for connection.*

S2 GENERAL CONDITIONS

- 2.1 The public footpath along... shall be reconstructed using... to the requirements of Council's Engineer.
- 2.2 All redundant vehicular crossings shall be removed and replaced with kerb and gutter and footpath at no cost to Council.
- 2.3 Finished ground surface levels shall match existing levels at the property boundary.
- 2.4 A vehicular access driveway shall be constructed...
a for each dwelling
b with a limit of one driveway per dwelling.
and in accordance with Council's standard drawing. Driveways shall be located a minimum of 1.0m clear of any existing stormwater pits, lintels or poles and 2m clear of any trees within the road reserve. The maximum width of driveways within the road reserve shall be... m.
- 2.5 Existing damaged... is to be reconstructed to the requirements of Council's Director Engineering Services at the completion of all building works.
- 2.6 A road opening permit shall be obtained for all works carried out in public or Council controlled lands. Restoration of landscaping, roads and paths shall be to Council's requirements. All other restoration shall be to the satisfaction of the affected parties.
- 2.7 The applicant or any contractors carrying out works in public or Council controlled lands shall have public liability insurance cover to the value of \$10 million, and shall provide proof of such cover prior to carrying out the works.
- 2.8 Where works are undertaken on public roads, adequate traffic control and directions to motorists shall be provided. Where such measures are not satisfactorily provided, Council may provide such and recover the costs from any bonds held.
- 2.9 (1) An inspection by Council's staff will be required for... at the following times :
a After excavation
b After the erection of formwork and placement of reinforcement and prior to Pouring of concrete.
c After placement of road base course
d After completion of any pits
e After pipes have been layed and prior to backfilling
f On completion of the works
- (2) A minimum of 24 hours notice is required to be given to Council to obtain an inspection. Work is not to further proceed until the works or activity covered by the inspection is approved.

- 2.10 A bond of \$... in the form of cash or bank guarantee shall be lodged prior to the release of the building approval. This bond covers
- a creation of drainage easements on the title of downstream properties required under condition 4.1.9,*
 - b creation of inter-allotment drainage easements on the title required under condition 4.1.1.0,*
 - c creation of drainage easements on the title in favour of Council required under condition 4.1.11,*
 - d road and stormwater drainage works in roadways and public areas,*
 - e creation of the Positive Covenant on the title required under condition 4.1.20,*
 - f connection to council's stormwater drainage,*
 - g installation and maintenance of sediment control measures for the duration of construction activities,*
 - h construction of the On-site Stormwater Detention facility,*
- and will be released upon satisfactory completion of these items.
- 2.11 The... vehicular crossing(s) shall be relocated to be
- a further than 25m from the signalled intersection*
 - b further than 6m from the intersection*
 - c further than 3m from the front property line.*
 - d at least 1m clear of any poles, pit inlet or... and 2m clear of any trees within the road reserve.*
- 2.12 Rights of carriageway shall be created over the common vehicular access to the lots.
- 2.13 Spoil and building materials shall not be placed or stored within any public roadway or footpath.

S3 CUSTOM CONDITIONS

Note 1 Could you please ensure Section 94 contributions are applied to the consent for

- a traffic management*
- b parking*

Note The Positive Covenant required under Condition 4.1.20 is to prevent future modification or alteration of

- a the surface flow path...*
- b finished pavement and ground levels*
- c prevent the erection of any structures or fencing...*
- d the On-site Stormwater Detention system*

without written consent of Council, and to ensure suitable maintenance of such facilities.

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SUPPLEMENT 2

Applicant Checklist

	Single Residential	Dual Occupancy	Villa, Flats, Town Houses etc	Commercial Industrial Institutional	Tennis Courts	Drainage Works Only	Paving
On Site Detention	Yes (3,6)	Yes	Yes	Yes	Yes	No	*** (1)
Gravity Pipe System Required	Yes (4)	Yes	Yes	Yes	Yes	Yes	Yes
Pumps System Permitted	No. (4)	No	No	No	No	No	No
Drainage Easement over downstream property (2)	If site doesn't drain to street	If site doesn't drain to street	If site doesn't drain to street	If site doesn't drain to street	If site doesn't drain to street	*** (1)	*** (1)
Connection to kerb permitted when no Council pipeline nearby	*** (1)	Maximum flow must be less than 15 l/s	No	No	*** (1)	No	*** (1)
Security Bonds required	*** (1)	Yes	Yes	Yes	Yes	Yes	*** (1)
Qualified Engineer required to prepare drainage design	Yes (3)	Yes	Yes	Yes	Yes	Yes	*** (1)
Sediment Control Plan required	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Positive Covenant required (ie 88E Instrument)	No (5)	Yes	Yes	Yes	Yes	No	No

1. Depends on details of development.
2. Alternatively, the applicant may construct a pipeline within the road reserve until a connection point with Council's system is reached that allows gravity drainage.
3. Except for cases where increased roof and paved areas is less than 40m².
4. Except where genuine attempts to acquire an easement at reasonable costs have failed. Documentary evidence of these attempts will be required.
5. Unless in a landscaped area.
6. Where OSD is required and the increased roof and paved areas is less than 100m² Council's standard OSD design from Supplement 8.1 can be adopted.

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SUPPLEMENT 3

Intensity Frequency Duration (IFD) Rainfall Data

TIME	Strathfield - Concord						Ashfield - Burwood - Drummoyne - Leichhardt					
	2 year		50 year				2 year		50 year			
	1 ₁ hr : 36.0		1 ₁ hr : 71.0				1 ₁ hr : 40.0		1 ₁ hr : 85.0			
	1 ₁₂ hr : 7.4		1 ₁₂ hr : 15.5				1 ₁₂ hr : 8.0		1 ₁₂ hr : 16.0			
	1 ₇₂ hr : 2.4		1 ₇₂ hr : 5.0				1 ₇₂ hr : 2.5		1 ₇₂ hr : 5.0			
	AVERAGE RECURRENCE INTERVAL (ARI) Years						AVERAGE RECURRENCE INTERVAL (ARI) Years					
	2	5	10	20	50	100	2	5	10	20	50	100
5 mins	115.2	145.9	163.3	186.7	217.0	239.9	126.5	160.8	180.4	206.6	240.6	266.3
6 mins	108.0	136.9	153.4	175.4	204.0	225.6	118.7	151.3	170	194.8	227.1	251.6
7 mins	102.0	129.5	145.1	166.0	193.1	213.6	112.1	143.3	161.2	184.9	215.8	239.3
8 mins	96.9	123.1	138.0	157.9	183.8	203.4	106.6	136.4	153.6	176.4	206.1	228.7
9 mins	92.5	117.5	131.8	150.9	175.7	194.5	101.7	130.5	147.1	169	197.6	219.4
10 mins	88.6	112.6	126.4	144.7	168.6	186.6	97.5	125.2	141.3	162.5	190.1	211.2
12 mins	82.0	104.4	117.2	134.2	156.4	173.2	90.3	116.3	131.4	151.3	177.4	197.2
14 mins	76.5	97.6	109.6	125.6	146.5	162.3	84.3	109	123.3	142.1	166.8	185.6
15 mins	74.2	94.6	106.3	121.9	142.1	157.5	81.8	105.8	119.7	138.1	162.2	180.5
16 mins	72.0	91.8	103.2	118.4	138.1	153.1	79.4	102.8	116.5	134.4	157.9	175.8
18 mins	68.1	87.0	97.8	112.2	130.9	145.1	75.1	97.5	110.6	127.7	150.3	167.4
20 mins	64.7	82.7	93.1	106.8	124.7	138.3	71.4	92.9	105.5	121.9	143.6	160.1
25 mins	57.9	74.2	83.5	95.9	112.1	124.3	64	83.6	95.1	110.2	130	145.1
30 mins	52.7	67.6	76.2	87.6	102.4	113.6	58.3	76.4	87.1	101.1	119.5	135.5
40 mins	45.2	58.1	65.6	75.4	88.3	98.1	50.1	66	75.5	87.8	104.1	116.6
50 mins	39.9	51.5	58.1	66.9	78.4	87.2	44.3	58.7	67.3	78.4	93.2	104.6
1 hour	36.0	46.5	52.6	60.6	71.1	79.0	40	53.2	61.1	71.4	85	95.5
1.5 hours	28.0	36.3	41.1	47.5	55.8	62.1	31	41	47.1	54.9	65.2	73.1
2 hours	23.4	30.4	34.4	39.8	46.8	52.2	25.7	34	38.9	45.3	53.8	60.3
3 hours	18.0	23.5	26.7	30.9	36.5	40.7	19.8	26	29.7	34.5	40.9	45.8
4.5 hours	13.9	18.2	20.7	24.0	28.4	31.7	15.2	19.9	22.7	26.3	31.1	34.7
6 hours	11.6	15.2	17.3	20.1	23.8	26.6	12.6	16.4	18.7	21.7	25.6	28.5
9 hours	8.9	11.8	13.4	15.6	18.5	20.7	9.6	12.6	14.3	16.5	19.4	21.7
12 hours	7.4	9.8	11.2	13.1	15.5	17.4	8	10.4	11.8	13.6	16	17.8
15 hours	6.5	8.6	9.8	11.4	13.6	15.2	7	9.1	10.3	11.9	14	15.6
18 hours	5.8	7.7	8.8	10.3	12.2	13.6	6.2	8.1	9.2	10.6	12.5	13.9
24 hours	4.9	6.5	7.4	8.6	10.2	11.5	5.2	6.8	7.7	8.9	10.5	11.7
30 hours	4.3	5.7	6.5	7.5	8.9	10.0	4.5	5.9	6.7	7.7	9.1	10.1
36 hours	3.8	5.1	5.8	6.7	7.9	8.9	4	5.2	5.9	6.9	8.1	9
48 hours	3.2	4.2	4.8	5.6	6.6	7.4	3.3	4.3	4.9	5.7	6.7	7.4
72 hours	2.4	3.2	3.6	4.2	5.0	5.5	2.5	3.2	3.7	4.3	5	5.6

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Common: Co-efficient G : 0.00 F₂ : 4.29 F₅₀ : 15.80

SUPPLEMENT 4

On Site Stormwater Detention (OSD) Storage Requirements

S4.1 Design Values - Strathfield

The OSD storage is to be designed to the storage/discharge relationship appropriate to the development type.

The values are given per 1000m² of the **total development site**. All paved and drained impervious surfaces are to drain to the OSD storage.

	Group	Storage (m ³) *	Permitted Discharge (l/s) *
Residential (Except Single Dwellings **) based on 70% impervious	1	6	13
		9	17
		15	23
Commercial/Industrial small based on 95% impervious	2	7	20
		11	25
		18	33
Commercial/Industrial large based on 95% impervious	3	12	12
		21	16
		32	23

NOTES

* The three pairs of values respectively represent 2, 10 and 100 year ARI values.

** Refer Section 4.2. for limits to applicability.

S4.1 Design Values - Ashfield

Hydrologic calculations are required to demonstrate the post development site runoff does not exceed that prior to development for all recurrence intervals over the range 5 to 100 years ARI. Calculation methods considered acceptable for this demonstration are:-

- a Triangular Hydrographs
- b Swinburne
- c Time Area models such as ILSAX.

Other methods may be accepted at the discretion of Council's Engineer.

Times of concentration are to be calculated using the kinematic wave equation from p300 of AR&R.

S4.2 Other Design Requirements

- * The outflow control structure is to be designed to control variable outflow rate in accordance with the storage-discharge relationship from S4.1
- * All roof and paved areas are to drain through the storage.
- * Storages are to be located separate from any external surface flow paths.
- * Finished ground levels are to be constructed so that impervious area runoff, in excess of the pipe system capacity, drains to the storages.
- * The maximum storage level is to be such that habitable floor levels are at least 0.3m above the maximum water level, and garages 0.15m above.
- * An emergency overflow with flowpath is to be provided, and is to be free of obstructions such as fences.
- * Maximum ponding depths for above ground storages are to be 0.15m in parking areas, 0.3m in landscaping, and 1m in a fenced off area.
- * Storage volumes in landscaping areas are to be doubled to allow for vegetation growth.
- * Surface storage areas in strata or community title developments are not to be in privately controlled areas such as courtyards.
- * Kerb outlets shall have a minimum diameter of 100mm.
- * Hydraulic control devices are to be constructed to be non removable.
- * Minimum orifice diameter shall be 65mm.
- * Existing stormwater storages can be incorporated into the new design
- * Maximum impervious areas to be used for the purpose of pre-development impervious area calculations shall not exceed 60% of the total site area.

S4.3 Worked Example - Hydraulic Controls

Development Type	Dual Occupancy
Site area determined from title	1200m ²

Separate storage required for each lot if separate (ie community) titles apply.
Say Lot 1 = 700m² and Lot 2 = 500m².

Storage/ Discharge - Group 1

Storage(m ³)	Permitted Discharge (l/s)
7.2	15.6
10.8	20.4
18 (ie Max)	27.6

Therefore, proportion areas and discharges between lots

Basin 1		Basin 2		Discharge (l/s)
Storage (m ³)	Permitted Discharge (l/s)	Storage (m ³)	Permitted Discharge (l/s)	
4.2	9.1	3	6.5	6.5
6.3	11.9	4.5	8.5	8.5
10.5	16.1	7.5	11.5	11.5

Above ground storages with maximum depth of storage 150mm
 max head in pit = 150mm + 300mm pit depth adopt linear increase of
 volume with depth

Basin 1

low outlet : ~ head = $4.2/10.5 * 150 + 300 = 360$ mm
 using $Q = 1.62 * \text{dia}^{1.87} * \text{head}^{0.63}$ where $Q = 9.1$ l/s

pipe outlet ~ diameter = 88mm
 (HEC5 based formula for pipe outlets)
 or using $Q = 0.6 \text{ Orifice Area } (2g \text{ head})^{0.5}$ where $Q = 9.1$ l/s
 & head = $360 - 44$ mm = 315mm
 orifice ~ diameter = 88mm
 (orifice formula)

high outlet : ~ pipe + weir

weir = 16.1 l/s - 88mm dia. pipe at 450mm head = 16.1 - 10.4 l/s
 = 5.7 l/s

weir level set at 2yr ARI volume ie 40% volume

head = 450 - 360 mm (ie 60mm +300) using $Q = 1.67 \text{ width} * \text{head}^{1.5}$
 then width = 127mm

check mid range limits comply

head = $6.3/10.5 * 150 + 300 = 390$ mm
 pipe = 9.5 l/s (88mm dia.)
 weir = 0.8 l/s for 0.03m head
 total $Q = 10.3$ l/s < 11.9 l/s OK.

S4.4 Basis For Determining Catchment Based Design Values - Strathfield

The design values for the above table were determined from studies of two catchments undertaken by Bewsher Consulting on behalf of Council. The catchments were C4 Rochester St and C9 Augusta St, draining to the Parramatta and Cooks River basins respectively. The shape, size and characteristics are typically representative of all of the catchments within the Strathfield area.

The study used generic developments located at various points within the catchments. The storage requirements were set to ensure no increase in runoff after development anywhere within the catchment.,

The results indicated the values were not greatly sensitive to initial pervious area or site location within the catchment. The adopted design requirements are intended to provide the simplest design criteria that meets the no increase in runoff requirement.

Assumed values of potential impervious area for development types have been used to cover future impervious site coverage not controlled by application to Council eg paving. The values are the maximum permitted by Council policy or code for the development type.

S4.5 Example of Hydrologic Calculations

Triangular Hydrographs - Refer Supplement 6

Time Area Hydrographs - Refer Supplement 6

SUPPLEMENT 5

Requirements for Hydrologic Calculations & Modelling

S5.1 Rational Method Calculations

Rational method calculations are generally acceptable to determine stormwater runoff quantities to design piped drainage systems. However, where multiple storages are proposed then a time based model is required to account for variable timing of storage outflow peaks. Also, if a pipe system requires a capacity greater than 250 l/s or the development site area exceeds 0.5 Ha, a model is required to design the system.

The Rational Method formula is $Q=C.I.A.K$, where

Q	=	discharge
I	=	Intensity for T_c
T_c	=	Time of overland flow concentration
A	=	Area
K	=	constant dependant upon units used

Intensity is determined using Supplement 3

T_c can be calculated using the kinematic wave formula from AR&R pp300.

Note L = is pre existing flow path that is modified by the development by piping, paving or redirecting.
n is per AR&R pp300 with minimum of 0.25 for non paved areas
A = area of catchment affected, not just the development site.

S5.2 Modelling Drainage Systems & Flooding

The preferred model for urban pipe systems is ILSAX. Other acceptable models are RORB,RAFTS,EXTRAN,MIKE11-UD,MOUSE.

Council may not have the models referred to or expertise in their use, excepting ILSAX. Calculations based on these models may cause delays in checking. Also full model details, data and calculation results will be required.

Parameters for the preferred model :

*	Soil = 3			
*	AMC=3			
*	Infiltration	Initial Paved =	1	
		Grassed	=	5mm

- * Storms. As per AR&R 1987.
25min & 2hr are the expected worst case due to temporal patterns.
Other storm durations should be checked to confirm the worst case adopted.
- * Time of Entry (T_e) uses the Kinematic Wave formula - see rational method calculations for details.
- * No stored bypass or surcharge. Either redirect or determine storage behaviour.

SUPPLEMENT 6

Examples of Hydrologic Calculations for OSD

S6.1 Triangular Hydrographs

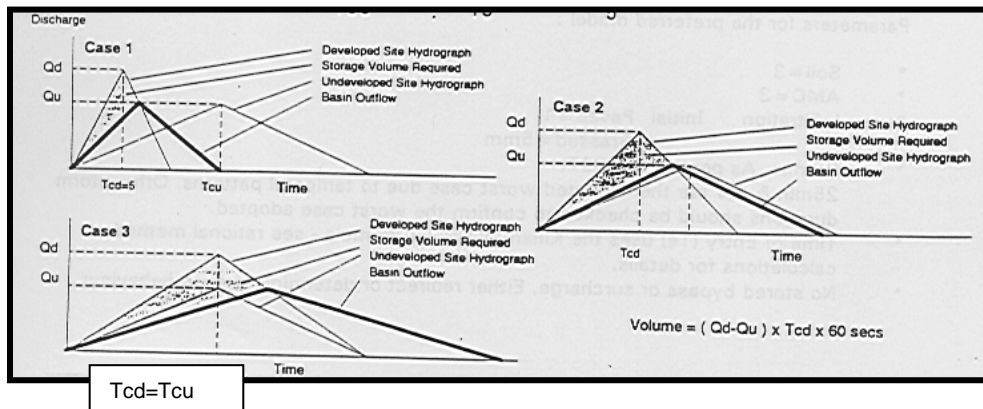
This method is that presented by Wollongong City Council. Runoff calculations are based on the Rational Method, with runoff coefficients calculated using the chart or formula from AR&R 1987. Times of concentration for the site prior to development are to be based on the kinematic wave equation from AR&R 1987 p300-301. A minimum time of 5 minutes is to be used for the post development state.

The maximum storage volume required for a given ARI is that calculated from the area under the developed site hydrograph above a line drawn from the origin to the point on the falling limb corresponding to the maximum pre development discharge. The time of concentration for the developed site hydrograph is to be taken from 5 minutes through to the pre development time of concentration to determine the time giving maximum volume. The diagrams show the formation of the hydrographs and areas.

Example: Site Area = 1 Ha.
 Existing 100% grassed - 120m at 3% with n=0.15
 Developed 100% paved

Rainfall Data to		I_2 mm/hr	I_{50} mm/hr
construct IFD table	1 hour 35	70	
	12 hour	7.5	15
	72 hour	2.45	5.1
		G=0	F2=4.29
			F50=15.8

Overland flow times	ARI (Yrs)	Pre-dev. Tc	Post-dev. Tc (min)
	5	19	5
	10	18	5
	20	17	5
	50	16	5
	100	15	5



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Example Calculations

60 Intensity mm/hr 10yr 1hr - for determining C

Location		Site A																							
% Imperv. (pre-dev)		0																							
% Imperv. (dev)		100																							
Area (Ha)		0.12																							
ARI (yrs)	5					10					20					50					100				
C pre-dev	0.54					0.57					0.59					0.65					0.68				
C post-dev	0.86					0.90					0.95					1.04					1.08				
Pre-dev	I	Qu	Vol	I	Qu	Vol	I	Qu	Vol	I	Qu	Vol	I	Qu	Vol	I	Qu	Vol							
	mm/hr	l/s	m ³	mm/hr	l/s	m ³	mm/hr	l/s	m ³	mm/hr	l/s	m ³	mm/hr	l/s	m ³	mm/hr	l/s	m ³							
	110	20		124	23		143	28		157	36		185	42											
Post-dev	Tc	Qd			Qd			Qd			Qd			Qd											
	min	l/s			l/s			l/s			l/s			l/s											
Case 1	5	143	41	6	161	48	7	184	58	9	215	74	11	238	86	13									
Case 3	7	127	36	7	143	43	8	164	52	10	191	66	12	212	76	14									
	8	121	34	7	136	41	8	156	49	10	182	63	13	202	73	15									
	9	115	33	7	130	39	8	149	47	10	174	60	13	193	69	15									
	10	110	31	7	124	37	8	143	45	10	167	58	13	185	67	15									
	11	106	30	7	120	36	8	138	43	10	161	56	13	179	64	15									
	12	102	29	7	115	35	8	132	42	10	155	53	12	172	62	14									
	13	99	28	7	112	34	8	128	40	9	150	52	12	167	60	14									
	14	96	27	6	108	32	8	124	39	9	145	50	12	161	58	14									
	15	93	27	6	105	32	7	121	38	9	141	49	11												
	16	90	26	6	102	31	7	117	37	8	137	47	11												
	17	88	25	5	99	30	6																		
Case 2	18	85	24	5	96	29	6																		

Volume = (Qd-Qu)*Tc*60 Note: Volumes are rounded to nearest m³

Basin	Qu=Qout l/s	Volume m ³	if less than 100% of site drains through storage say 60% through - 10 yr ARI example
ARI (years)	5 20	7	Qout = 0.4 * 32 l/s + Basin flow
	10 23	8	23 l/s = 12.8 l/s + Basin
	20 28	10	Basin Outflow = 10.2 l/s
	50 36	13	Volume = [(0.6 * 32 l/s) - 10.2 l/s] * 14 min
			*60 sec/min/
	100 42	15	= 8m ³

S6.2 Time Area Hydrographs

Runoff is to be calculated using a computer model using appropriate time area calculations, such as ILSAX or compatible programs.

The storage required is that which will restrict total flows from the development site to match the site runoff prior to development, for a given ARI. The volume/discharge relationship determined is to be for all ARI's for the range of 5 to 100 yrs ARI.

The effects of both the 2 hour and 25 minute temporal pattern are to be examined.

When accounting for existing storages, the peak discharge prior to development is to be determined including the characteristics of that storage.

Example :

same site details as appendix A.

AMC= 3 ; Soil= 3 ; Initial Loss/Storage -Paved 1 mm Grassed 5mm

	Q l/s	Q l/s
	Pre	Post
5 yr	129	393
10 yr	171	444
20 yr	229	511
50 yr	295	538
100 yr 350	598	(note: say set storage to commence at 75 % 5yr Q)

Basin relationship

Vol M ³	Q l/s
1	100
150	130
195	230
235	350
240	350 + overflow gives

	Q l/s	
	Pre-Dev	Basin outflow
5 yr	129	128
10 yr	171	167
20 yr	229	227
50 yr	295	288
100 yr 350	343	

SUPPLEMENT 7

Hydraulic Designs & Details

S7.1 Pit Inlet Capacities Design Values

For standard grated inlet pits with an extended kerb inlet as detailed in Supplement 8, the inlet capacities are (using the form $y = mx + b$) :

Inlet Length	1m	2m	3m
Constant - b (l/s)	25	35	4
Rate - m	0.42	0.55	0.75

Sag pits formulae for grates and kerb inlet openings are available on page 303 of AR&R. Note these values make no provision for blockage or surcharged pits. On grade pit capacities are based on work by Bowditch (1973), Department Of Main Roads NSW (1979) and Armstrong (1 979).

S7.2 Hydraulic Grade Line (HGL)

HGL calculations are required where pipe flows exceed 100 l/s, the drainage system crosses properties external to the development, or where Council's Engineer determines that the connection to Council's system warrants such calculations.

Pit Losses.

- * Use Missouri charts (Sangster et al), Hare charts or relevant derivations of these.
- * Ensure the pit loss factor (K) used matches the pit design. The pit configuration should ensure the projection of the incoming pipe is within the outgoing conduit on the downstream pit face. *(NB this generally requires rectangular pits to be built parallel/square to the upstream line, with the downstream pipe cut at an angle where it joins the pit. This is the opposite of typical construction patterns. Therefore the worst case assumption will be used by council in checking K factors unless construction plans have pit layout diagrams.)*
- * Drop pits are discouraged as there is no acceptable determination of loss factors, as well as empirical results indicating drop pits behave as surcharge points generally having a capacity less than the nominal system capacity. Invert matching is recommended in preference to obverts.
- * Use Colebrook White roughness values.

- * Use the surface level as the downstream HGL for connections to existing pit.
- * Backwater calculations to the downstream control are required for open channels. Subcritical regime is to be adopted in open channels. HGL is to be adjusted to obverts to maintain the pipe full assumption.
- * Outflow control devices. Use orifice formula if the assumption/requirements can be met for expansion/contraction, edge type etc. Otherwise, HEC-5 and HEC-10 empirical results or equivalent formulae of Boyd replicating the curves are to be used.

SUPPLEMENT 8.1

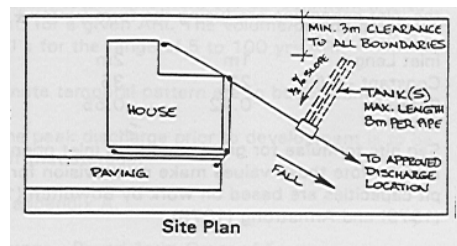
Standard Drawings & Details

No. 8.1

Detention Storage & Infiltration Tank - Single Residential Dwellings

Check if use of this detail is permitted.

1. Determine new roof and paving area.
2. If Area < 40m² then OSD. is not required.
3. If Area > 100m² then use Supplement 4.



Otherwise

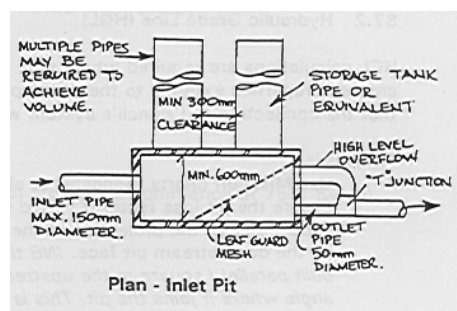
Tank Volume =

0.012m³ per m² of TOTAL roof
(new and existing) and new
paving areas.

Known tank materials/suppliers :

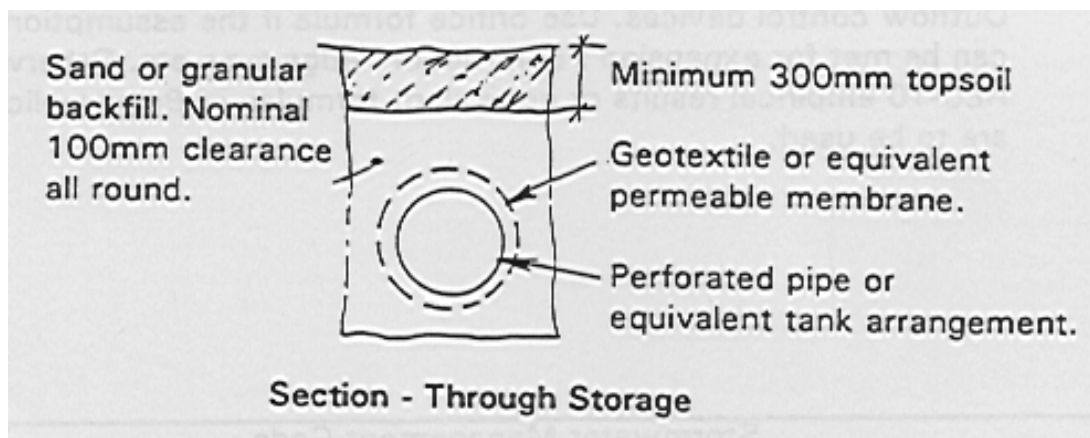
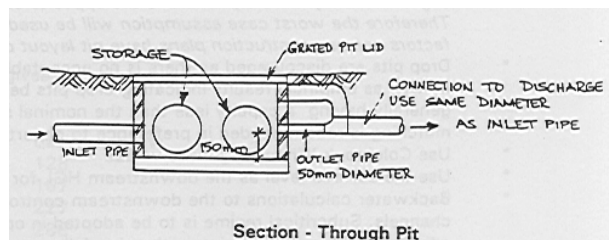
- * Atlantis Drainage Cells
- * Everhard Industries Trench
- * RibLoc perforated pipe

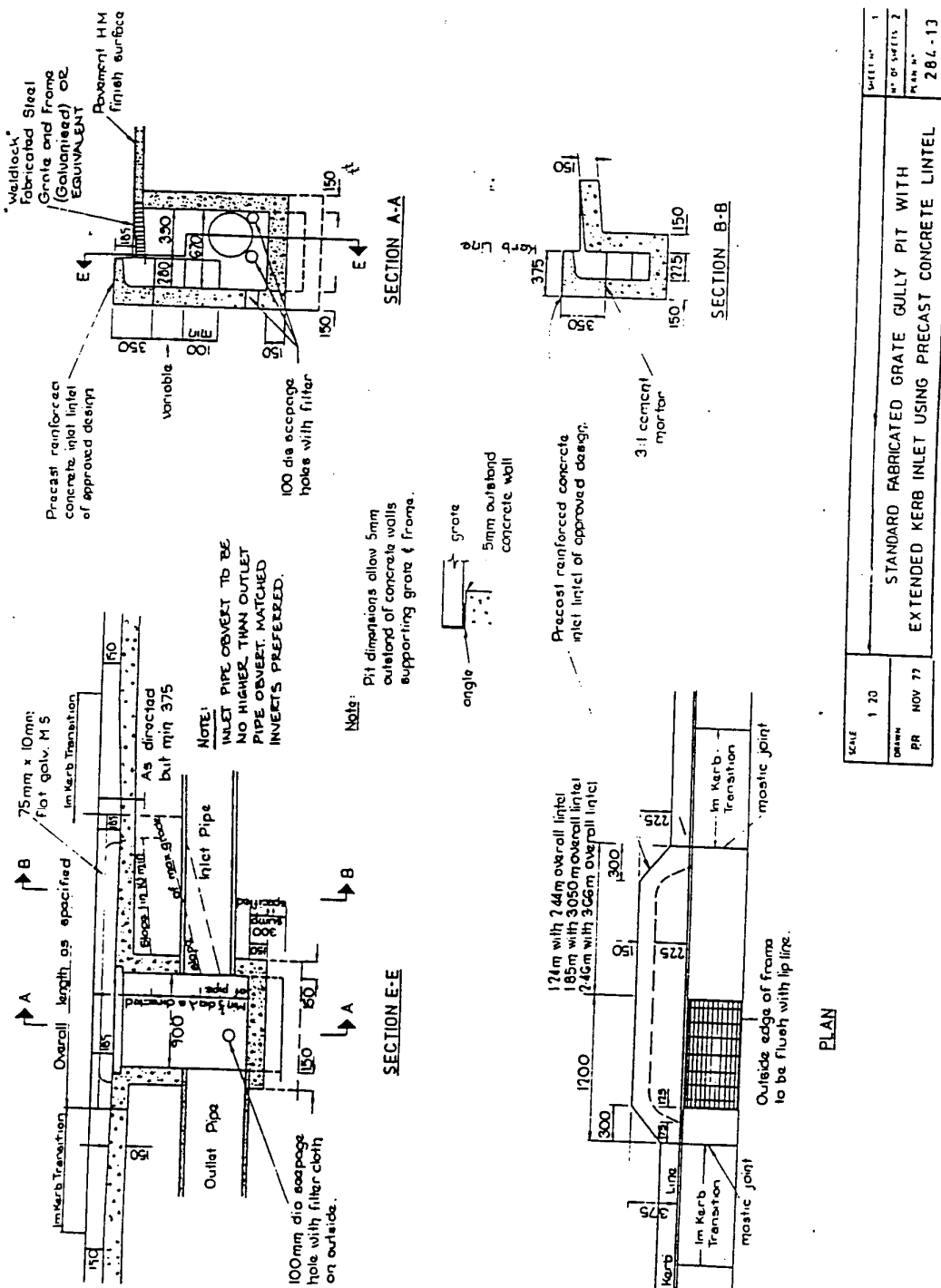
This list is not exhaustive and does not
imply endorsement of any particular product



PIPES

Diameter (mm)	Length (metres) per m ³ volume
300	13.3
375	9.1
450	5.9





SCALE	1:20
DATE	PR NOV 77
STANDARD FABRICATED GRATE GULLY PIT WITH EXTENDED KERB INLET USING PRECAST CONCRETE LINTEL	
SHEET NO.	1
NO. OF SHEETS	2
PLAN NO.	284-13

SUPPLEMENT 9

Wordings for Restrictions as to User Easements

Restriction As To User - Positive Covenant Form 55A
Instrument Pursuant To Section 88E(3), Conveyancing Act, 1919

On Site Detention

"The stormwater detention facility as described by the plan... of Ashfield Council Building Consent... and the conditions of such consent, shall not be altered or removed in whole or in part without written approval of Ashfield Council.

The registered proprietor is to maintain the stormwater detention facility in working condition.

Authorised Ashfield Council employees are to be allowed access for inspection upon reasonable notice. The registered proprietor is to comply with any notices issued by Council regarding rectification or maintenance works to be carried out for compliance.

In the event of the registered proprietor not complying with the notice, Council or its authorised agents may enter and carry out the specified work, and recover the costs due."

Stormwater Surface Flow Path

"The stormwater surface flow path defined... shall not be obstructed or have the (*finished ground (and/or) pavement levels*) within the defined area modified in whole or in part without written approval of Ashfield Council. It shall be the responsibility of the registered proprietor to ensure the stormwater surface flow path is kept unobstructed by fences or any physical structures or barriers (whether temporary or not) at all times.

Authorised Ashfield Council employees are to be allowed access for inspection upon reasonable notice. The registered proprietor is to comply with any notices issued by Council regarding rectification or maintenance works to be carried out for compliance.

In the event of the registered proprietor not complying with the notice, Council or its authorised agents may enter and carry out the specified work, and recover the costs due."

SUPPLEMENT 10

Sediment Control Plans

Preparation of the Plan

The following is a brief summary of the details involved in preparing a control plan taken from chapter 5 of the "Urban Erosion and Sediment Control" handbook by the Department of Conservation and Land Management. The handbook should be referred to in the preparation of the plan.

The points under each item give the details required to be submitted as part of the control plan. Some details listed will already be provided to meet other requirements.

- 1 Investigate site characteristics ie Topography, soils, vegetation. The plan should include :
 - Locality plan
 - Plan of site and surrounding area with contours and catchment boundaries.
 - Soil and vegetation types and coverage
 - Any other relevant features
- 2 Integrate clearing and grading with site layout plan, including consideration of staging of works. The plan should include areas to be exposed and the type and extent of the earthworks.
- 3 Determine existing and proposed drainage patterns, including diversion of flows entering the property from upstream, and impact of development on flow paths. Much of this information should be detailed as part of the stormwater design.
- 4 Select erosion control practices. Details of the proposed measures should include:-
 - Location and design criteria of structural and vegetative erosion control measures needed to control the volume, direction and velocity of runoff.,
 - Scheduling of construction/implementation of the measures.
 - Maintenance of the measures.
- 5 Outline the rehabilitation program, including :
 - areas where temporary and permanent revegetation is to be employed.
 - details of stabilising of exposed soils.
 - types of planting materials or ground coverings.

ASHFIELD COUNCIL

ENGINEERING CHECKLIST - lodgement of Applications

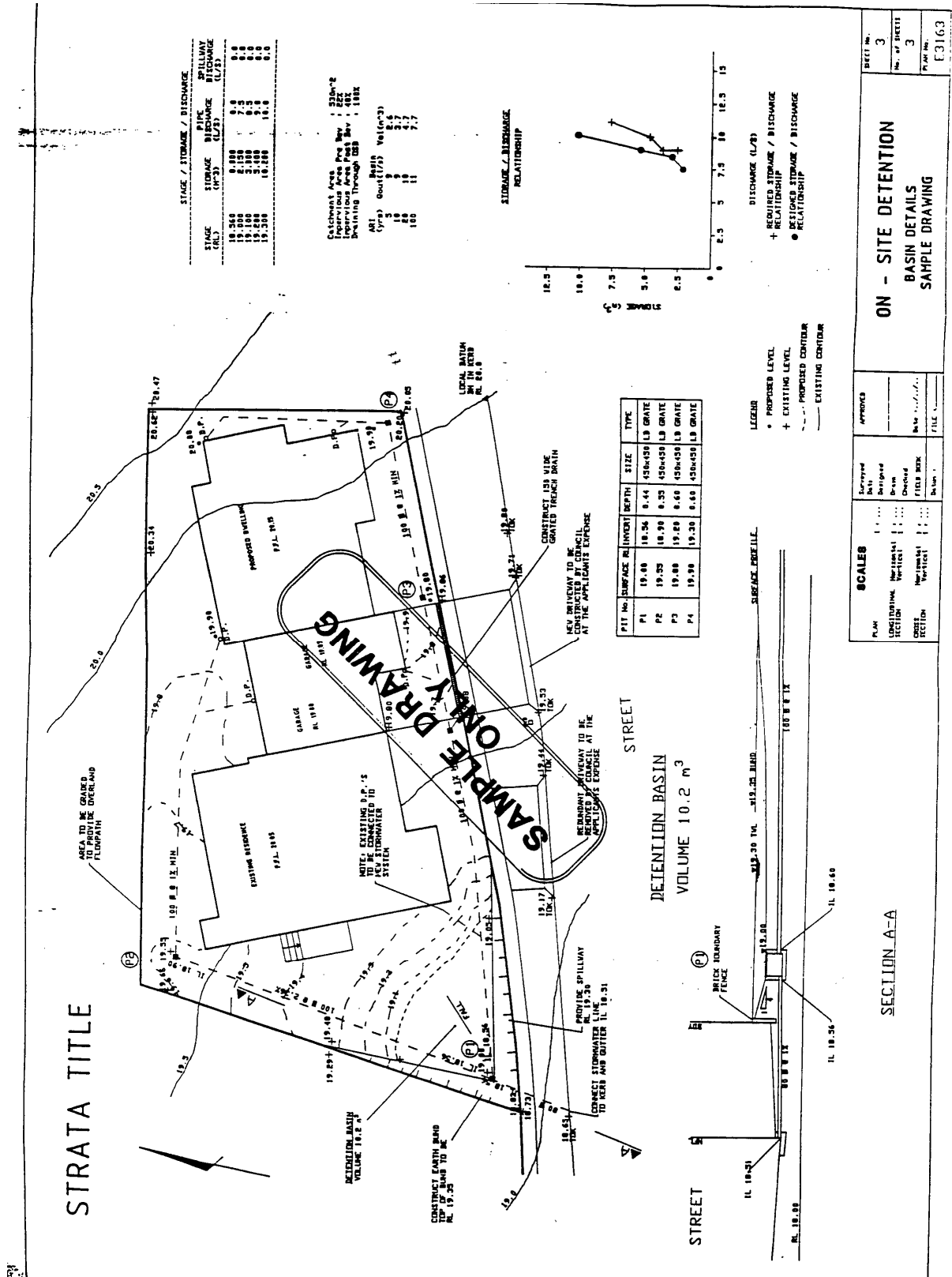
Address :

Application No. :

	YES/ NO	Amendment Required	Action Required if Yes
Pre DCU Meeting			
Are there any previous applications.			Find Application No. and check history.
Is the lot affected by an easement, pipeline or watercourse.			Drainage study required.
Is the property near or in a low point.			Drainage study may be required.
Are there any flooding or complaint records.			Investigate.
Is the property on the low side of the street.			Easement may be required.
At the DCU Meeting			
Is an OSD design required.			Referral required.
Details submitted are not adequate, including SDCP.			Advise applicant.
Is there a new driveway crossing or adjustments.			Check location and for conflicts.
Are there any redundant crossings.			Replace with K&G.
Is it a "Traffic generating development" or has access to a State of Regional road.			Refer to Council Development Committee or Regional Development Committee.
Site Inspection			
Are any adjoining properties affected.			
Any damaged path or driveway.			
Are traffic volumes, movements, parking or access points an issue.			Traffic study required (Refer to CDC, RDC ?)
Will any works be on a footpath, roadway or reserve (other than driveway or roofwater to kerb).			Road Opening Permit and Security Bond required.
Do any services require adjustment.			Refer to relevant body.
Are Contributions required for any works.			Determine works and cost estimate.

Refer to Engineering : Yes/No

Assessed By :



STAGE (m)	STORAGE (m³)	PIPE DISCHARGE (L/S)	SPILLWAY DISCHARGE (L/S)
19.00	8.00	7.5	8.8
19.10	8.10	7.5	8.8
19.20	8.20	7.5	8.8
19.30	8.30	7.5	8.8
19.40	8.40	7.5	8.8
19.50	8.50	7.5	8.8
19.60	8.60	7.5	8.8
19.70	8.70	7.5	8.8
19.80	8.80	7.5	8.8
19.90	8.90	7.5	8.8
20.00	9.00	7.5	8.8

Catchment Area: 226-2
 Impervious Area: 226-2
 Infiltration Area: 226-2
 Infiltration Through: 226-2

PIT No.	SURFACE RL	INVERT DEPTH	SIZE	TYPE
P1	19.48	18.36	450x450	LB GRATE
P2	19.35	18.30	450x450	LB GRATE
P3	19.00	18.20	450x450	LB GRATE
P4	19.00	18.30	450x450	LB GRATE

ON - SITE DETENTION BASIN DETAILS
SAMPLE DRAWING

BEET No. 3
 No. of SHEETS 3
 PLAN No. E3163

APPROVED

SCALES

PLAN: 1:100
 LONGITUDINAL SECTION: 1:100
 CROSS SECTION: 1:100

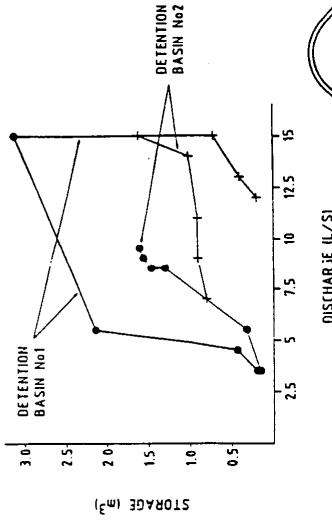
SECTION A-A

DETENTION BASIN No2

Catchment Area	1 281m ²
Infiltration Area Pre Dev	1 375
Infiltration Area Post Dev	1 715
Draining Through DIB	1 735
AEI (l/s)	0.00
AEI (l/s) (incl. DIB)	0.00
AEI (l/s) (incl. DIB) (incl. DIB)	0.00
AEI (l/s) (incl. DIB) (incl. DIB) (incl. DIB)	0.00
AEI (l/s) (incl. DIB) (incl. DIB) (incl. DIB) (incl. DIB)	0.00

STAGE / STORAGE / DISCHARGE			
STAGE (RL)	STORAGE (CUH)	LOW LEVEL DISCHARGE (L/S)	SPILLWAY DISCHARGE (L/S)
20.350	0.000	0.00	0.00
20.450	0.140	3.5	0.00
20.550	0.335	5.5	0.00
21.050	1.795	9.5	0.00
21.150	1.840	9.5	0.00
21.310	1.555	9.5	0.00
21.610	1.600	9.5	0.00

STORAGE / DISCHARGE RELATIONSHIP

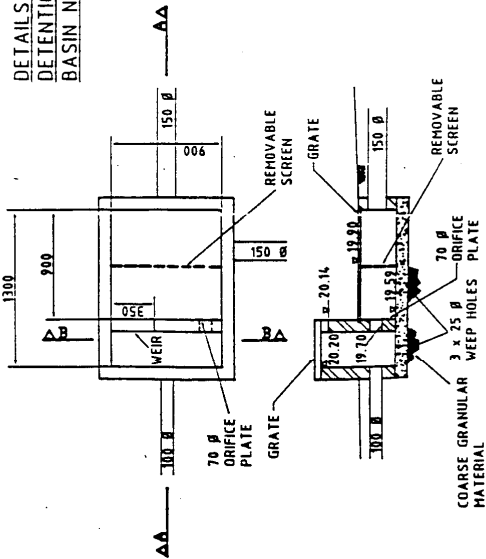


DETENTION BASIN No1

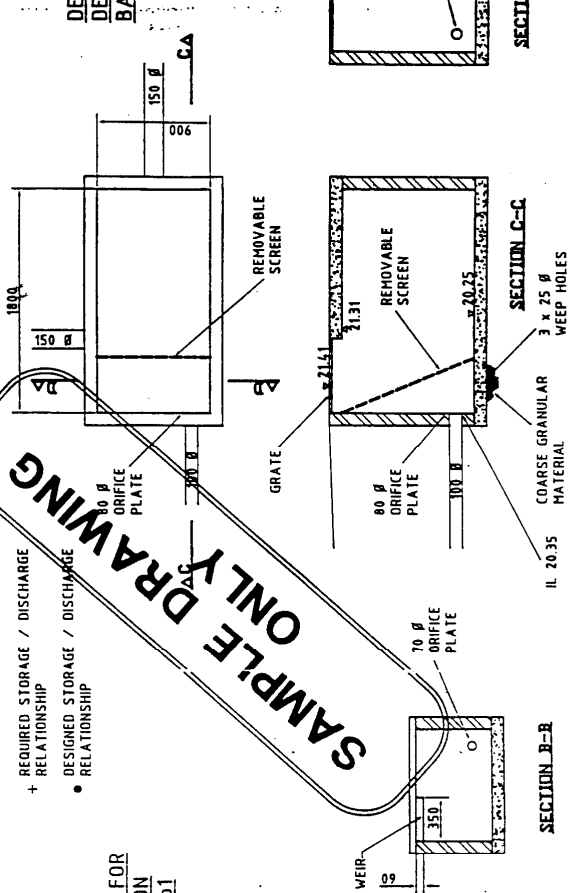
Catchment Area	1 330m ²
Infiltration Area Pre Dev	1 482
Infiltration Area Post Dev	1 372
Draining Through DIB	1 302
AEI (l/s)	0.00
AEI (l/s) (incl. DIB)	0.00
AEI (l/s) (incl. DIB) (incl. DIB)	0.00
AEI (l/s) (incl. DIB) (incl. DIB) (incl. DIB)	0.00

STAGE / STORAGE / DISCHARGE			
STAGE (RL)	STORAGE (CUH)	LOW LEVEL DISCHARGE (L/S)	SPILLWAY DISCHARGE (L/S)
19.000	0.000	0.00	0.00
19.100	0.200	3.5	0.00
19.275	0.440	5.5	0.00
19.850	1.830	9.5	0.00
19.950	1.880	9.5	0.00
20.110	1.160	9.5	0.00
20.410	1.210	9.5	0.00

DETAILS FOR DETENTION BASIN No1



DETAILS FOR DETENTION BASIN No2



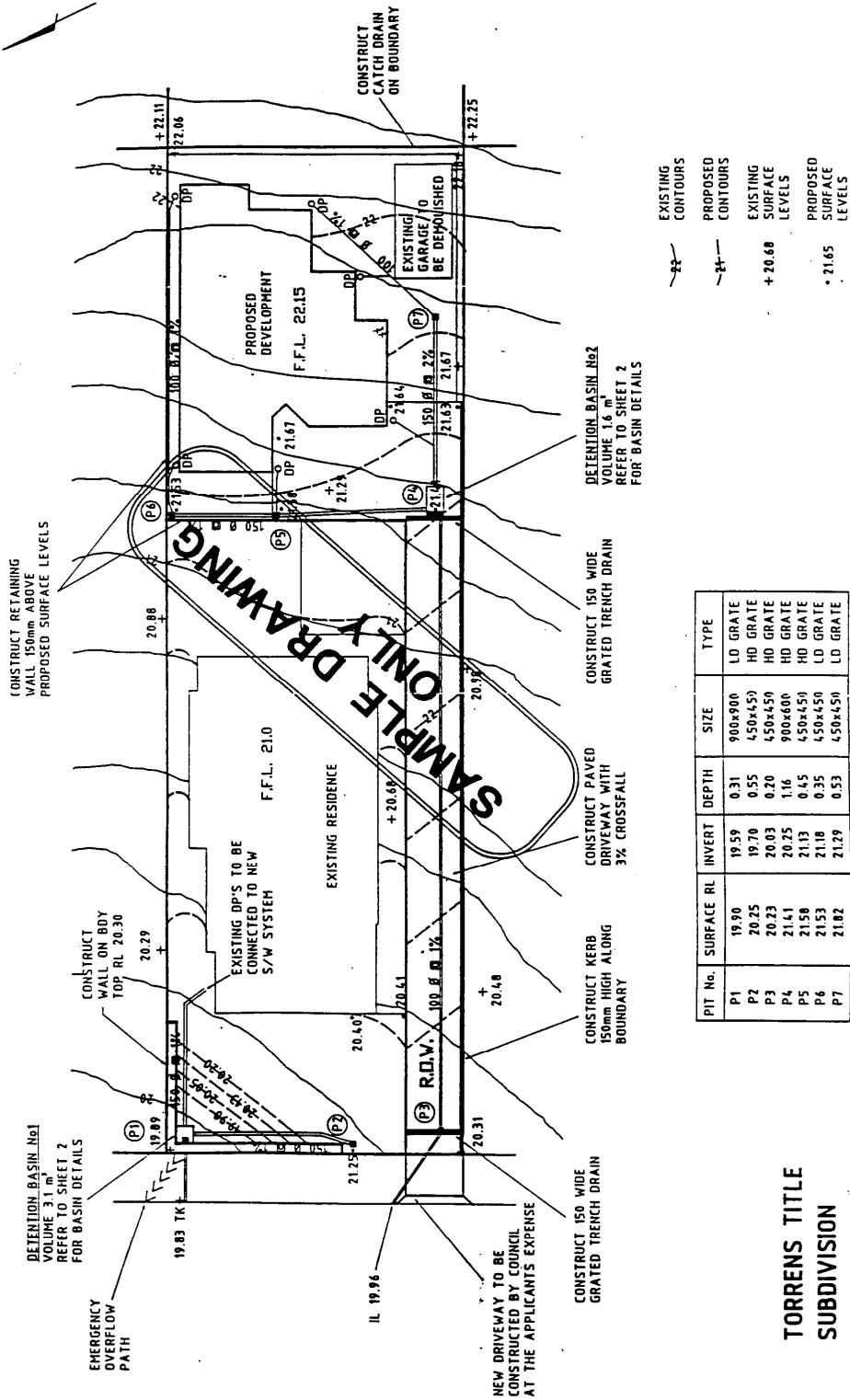
ON - SITE DETENTION BASIN DETAILS SAMPLE DRAWING

SCALE: 1:10 (Horizontal), 1:20 (Vertical)

DATE: 10/10/14

PROJECT: E3163

SHEET No. 2 OF 3



TORRENS TITLE
SUBDIVISION

PIT No.	SURFACE RL	INVERT	DEPTH	SIZE	TYPE
P1	19.90	19.59	0.31	900x900	LD GRATE
P2	20.25	19.70	0.55	450x450	HD GRATE
P3	20.23	20.03	0.20	450x450	HD GRATE
P4	21.41	20.25	1.16	900x600	HD GRATE
P5	21.58	21.13	0.45	450x450	LD GRATE
P6	21.53	21.18	0.35	450x450	LD GRATE
P7	21.82	21.29	0.53	450x450	LD GRATE

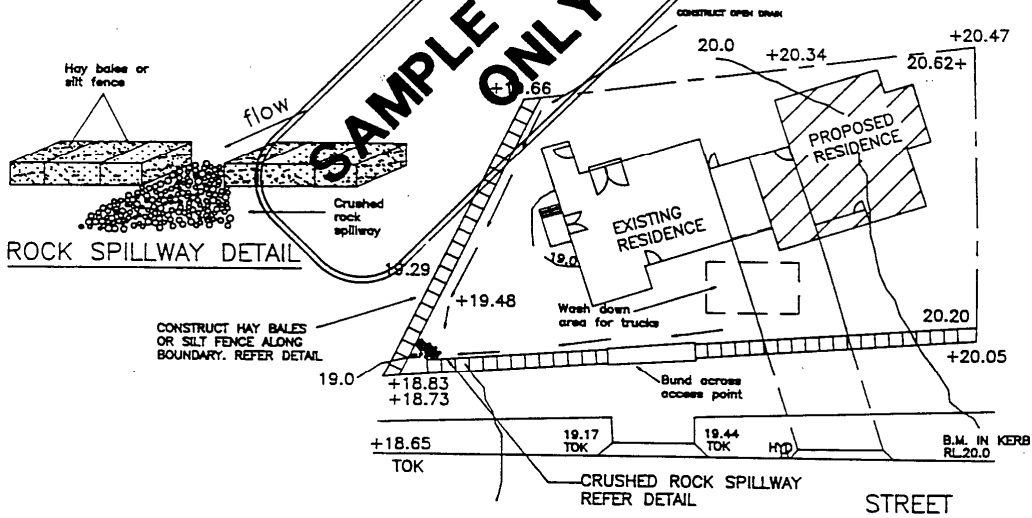
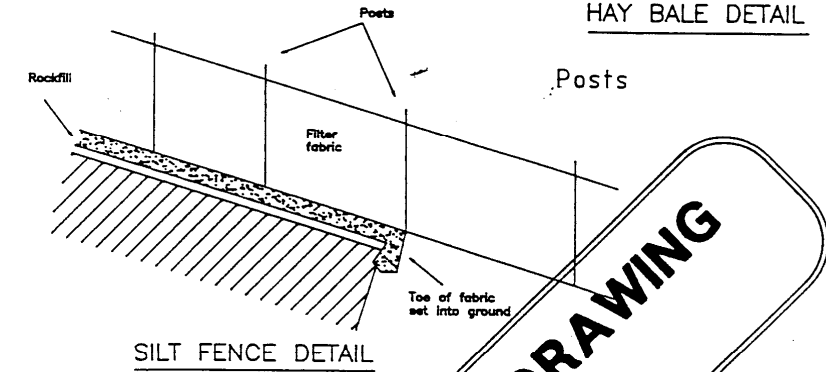
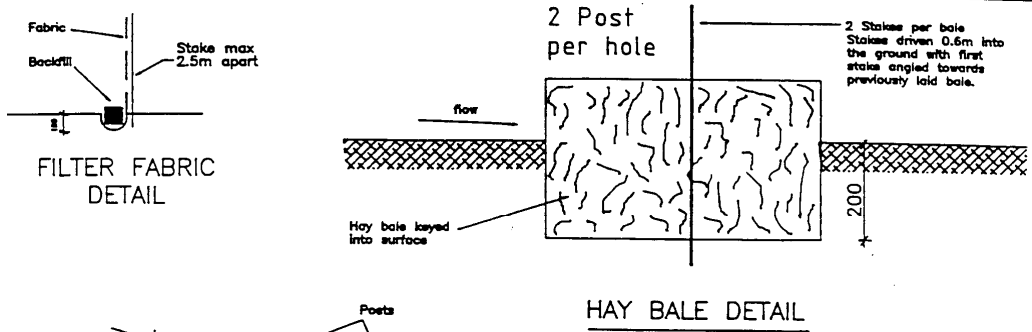
EXISTING CONTOURS
PROPOSED CONTOURS
EXISTING SURFACE LEVELS
PROPOSED SURFACE LEVELS

**ON - SITE DETENTION
SAMPLE DRAWING**

SCALES

PLAN: 1:100 (Horizontal), 1:100 (Vertical)
SECTION: 1:10 (Horizontal), 1:10 (Vertical)
ELEVATION: 1:10 (Horizontal), 1:10 (Vertical)
SECTION: 1:10 (Horizontal), 1:10 (Vertical)

DATE: 1/1/2014
DRAWN BY: [Name]
CHECKED BY: [Name]
SCALE: 1:100
SHEET NO. 3
PROJECT NO. E3163



SEDIMENT CONTROL DETAILS

SAMPLE DRAWING SHOWING TYPICAL SEDIMENT CONTROL SITES DETAILS FOR DEVELOPMENT SITES