BURWOOD COUNCIL

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STORMWATER MANAGEMENT CODE

Revised Edition, November 2004

PO Box 240, BURWOOD NSW 1805
2 Conder Street, BURWOOD NSW 2134
Phone: 9911-9911 Fax: 9911-9900
Email: council@burwood.nsw.gov.au

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1.0 FOREWORD

This code sets out Burwood Council's requirements for stormwater and related facilities associated with property developments in Burwood Local Government Area.

It updates the code released in 1995, defining simpler procedures for on-site stormwater detention (OSD) and covering water-sensitive urban design and property drainage system requirements. OSD regulations are based on computer modelling of Council's street drainage systems.

This 2004 Revised Edition of the *Stormwater Management Code* has been prepared in accordance with objectives and strategies published in Council's Management and Business Plans, as set out on Council's website, www.burwood.nsw.gov.au. 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, and to comply with Council's Stormwater Management Policy.

2.0 Stormwater Controls on Developments

Stormwater management is an important part of Council's requirements for new developments and re-developments. These have the potential to cause damage affecting present and future occupiers of developments and neighbouring properties, and for generating harmful stormwater pollution loads. Property drainage systems must therefore be constructed properly and stormwater discharges from these must meet Council's requirements based on assessments of catchment-wide impacts. They must also meet water- and energy-saving requirements for the NSW Government's BASIX process, which can relate to stormwater systems.

Burwood Council applies a number of development control codes and guidelines, which are available from its website, www.burwood.nsw.gov.au. Forms for Development Applications (DAs) and Construction Certificates are also available from the site, or directly from Council's Enquiry Counter.

A DA must be lodged for the following types of development:

(a) Residential

- A new single dwelling (including replacement)
- Extensions, garages, carports, etc for a single dwelling
- A dual occupancy (medium density) development
- Villa, townhouses etc (high density)
- Multi units, apartments etc
- Tennis Courts

(b) Commercial developments

(c) Industrial developments

(d) Institutional buildings (schools, hospitals etc)

(e) Paving, driveways and roadworks

(f) Subdivisions

(g) Drainage works

- in public lands
- piping or lining of open watercourses
- modification to existing systems excluding roofwater lines

(h) All other developments

The DA documentation required includes an application form for the particular type of development (single dwelling, dual occupancy, subdivision, etc.) and associated plans and reports describing aspects of the development. The stormwater requirements are for:

(a) a stormwater drainage concept plan, showing the designed locations of stormwater drainage pipes and pits on the developed property, and if applicable, the locations of rainwater tanks and on-site detention systems,

(b) a flood report, required if a site may be affected by stormwater flows running through or past it, defining flood flows and depths and indicating safe levels for habitable rooms and other features.

In the subsequent application for a Construction Certificate, detailed design information is required, supported by reports, sets of calculations or other material. 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.

Designs are to be prepared by suitably qualified and experienced designers.

The following sections of the Code explain Council's requirements. Reference should be made to the Applicant Checklist in Supplement G.

3.0 Planning Requirements

3.1General

This section sets out the general rules applying to stormwater management for developments. It is intended to guide developers and designer to understand of the types of drainage facilities required, and suitable locations for these.

3.2The Site Drainage System

The property drainage system installed shall be adequate to convey stormwater from, and where appropriate, through the site without causing damage to buildings or facilities on the site, or risks of injury to occupants.

It should prevent waterlogging and flooding up to the technical standards required, and should be constructed so that it does not cause harm to buildings, and is itself robust.

3.3Rainwater and Stormwater Tanks

The New South Wales Government BASIX system (www.iplan.nsw.gov.au/basix) requires developers to provide water-saving devices on new and re-developed properties. These include rainwater tanks, collecting roof water, and stormwater tanks, collecting water from surface areas and balconies . Any overflows from such tanks should be directed into on-site detention (OSD) storages where these are required on a site. The volume of OSD storage required will be reduced where tanks are provided. (See Section 4.7.)

3.4On-Site Stormwater Detention (OSD) Facilities

Development activities must not cause any adverse impact on adjoining or any other properties. This includes preserving existing surface flow paths and not increasing flood levels in major storms. Where applicable, site discharges are to be restricted to pre development discharges using OSD storages.

OSD will be required for all developments that have post-development impervious area percentages of 60% or more for the entire site, including buildings, garages, driveways, paved and landscaped areas. (This corresponds to an overall floor space ratio of 0.60 : 1). With Council's approval, landscaped areas having at least 600 mm of soil over an impervious surface may be considered to be pervious, as may porous paving areas, at Council's discretion.

OSD will not be required in developments within 150 m of the Cooks River, in the south-western corner of the Burwood local government area.

The requirement for OSD for free standing residential developments may be reduced or waived at the discretion of Council's Director of Environmental Services provided that it is adequately demonstrated that such changes will not adversely affect any existing buildings or property.

Where separate titles are created (by subdivision) within a development, usually separate OSD storages are to be provided. However, 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 Section 4.7, and the pipework draining to the storage is wholly within the lot containing the storage.

OSD storages should be located as close as possible to the lowest point of the site, with paved areas and pipes draining to it. Storages should preferably be above-ground and be incorporated into yards or 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.

Due to the lack of suitable porous soils in the Burwood local government area, which is largely on clay and shale strata, on-site stormwater retention (OSR) systems that rely on infiltration of stormwater into the ground shall not be permitted, unless the soil involved is an artificial fill, or the designer can provide evidence of suitable infiltration rates from field tests.

Storages shall not be located in overland flow paths that convey catchment flows through the site. Storages are to be in common areas (rather than privately controlled areas such as courtyards) for multi unit developments.

3.5Internal Surface Flow Paths

Surface flow paths that carry overflows from parts of a site drainage system in major storms, or in the event of blockages, are an integral part of the drainage system. They are to be preserved, or alternative paths or pipes are to be provided.

3.6External Surface Flow Paths

Where surface runoff from adjoining properties flows onto the development site, such flows are to be allowed to pass through the development. Obstructions that cause damming and backwater effects on upstream properties are not permitted. Flow paths are to be retained within easements wherever possible.

Surface discharges from a site, whether originating on a site, or flowing from upstream properties, shall not be concentrated to a degree greater than that which occurred prior to development. Redirection of flows, including transfers to other sub-catchments, is not permitted unless appropriate countermeasures against downstream flooding are undertaken, or discharges are diverted into Council's drainage system. Diverting flows from one sub-catchment to another will not normally be permitted.

3.7Floor and Ground Levels

Where stormwater flows past buildings, or forms ponds near buildings, building floor levels need to be set above the calculated levels with an adequate freeboard (as described in Section 4.9).

Levels on the site boundaries cannot be altered, but land can be sloped away from them and retaining walls built..

3.8Gravity Drainage

All stormwater drainage connecting to Council's drainage systems is to be by gravity. Mechanical means (i.e. pumps) for disposal of stormwater runoff will only be permitted for commercial, industrial and multi-unit residential developments, where the developer can demonstrate that a suitable emergency response procedure can be implemented to remedy problems in the event of a power failure, or that sufficient storage exists to accommodate stored runoff in the event of a power failure.

Pumps may be permitted to empty subsoil and basement seepage systems where these are separate from the piped stormwater system.

3.9Acquisition of a Downstream Easement

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

- a street,
- council land containing a drainage line, or
- an existing council pipeline within the development site.

Development consent will not be granted unless a gravity stormwater drainage system is provided. 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.

An exception to acquiring an easement may be given at the discretion of Council's Director of Environmental Services for sites that do not drain to the street, ***only*** where extensions to an existing freestanding 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 an exception. In these instances Council will consider the use of a pipe without the easement over the downstream properties as a preferred alternative, followed by the use of the OSD as a retention and infiltration tank.

For minor extensions (those less than 25m^2) to existing single residential buildings, connections may be made directly 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 Director of Engineering Services.

3.10 Registration of an Easement for a Pipeline through a Site

For sites that have existing Council pipelines passing 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 over the pipeline in favour of itself. The easement width is to be the pipe, box, or channel section width plus 1.5 m, with an overall minimum width of 2.5 m.

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. These easements are to be a minimum of 0.9 m wide.

Dual occupancies, where a 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:

- A Registered Surveyor must prepare a plan of survey.
- This plan is to be submitted to Council for approval.
- The plan and application are to be lodged with the owner's approval at the Land Titles Office and fees paid.
- The Council is to be advised of lodgement details.
- The Land Titles Office advises the applicant / owner and Council of the registration.

3.11 Site Discharge and Connection to a Council System

Site drainage is to connect to Council's system at the nearest suitable location. There are restrictions on the rates at which discharges can occur to street gutters (see Section 4.12).

3.12 Safety and Consideration of Failure

Open drainage system components are to be designed to meet relevant safety criteria for persons and vehicles. Storage basins are to have battered slopes for egress, maximum ponding depths, and appropriate signage and fencing. Specific reference is made to Appendix G of the NSW *Floodplain Management Manual* (NSW Government, 2001) for velocity and depth limits.

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 obstruction of overland flow paths is to be minimised.

3.13 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.

In the assessment of designs, Council will consider the effects on landscaping and heritage aspects of any site.

3.14 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 Department of Environment and Conservation (DEC). 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 *Soils and Construction - Volume 1,* 4th Edition, Landcom (2004) and *Planning for Erosion and Sediment Control on Single Residential Allotments,* 1st Edition, Landcom (2004).

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 the above manuals.

A Construction Certificate will not be released until the sediment control plan and details have been approved.

The infiltration component of the standard OSD design for freestanding residential developments is intended to detain pollutants washed off roofs and driveways in low intensity storms. Provision of a similar feature in all OSD designs should be considered.

3.15 Restrictions As To User - Positive Covenants

The potential for modification or adjustment to OSD storages and / or surface flow paths through a property is significant enough to warrant extra protection. Future owners of properties also need to be aware of the presence and purpose of these facilities. 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 Director of Engineering Services.

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.

3.16 Structures Over or Near Drainage Lines and Easements

New buildings, structures and tennis courts will not 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 Director of Engineering Services.

Clearances to easement boundaries are required to prevent structural loads on drainage structures or encroachment within the angle of repose of the soil. Piering 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 access pits must be provided upstream and downstream of the structure.

3.17 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 up 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 inconsistent with the character of the watercourse in the vicinity.

The costs of all works and restoration involved in the development, including that within public roads 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.

4.0 Design Requirements

4.1General

This section provides technical, engineering information for the use of designers. It specifies suitable technical methods and numerical criteria.

4.2Stormwater 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 and OSD storages, as well as internal piped systems. The application will not be accepted without such a plan. Detailed design plans and calculations must be submitted later with the application for a Construction Certificate for Council approval.

Where only a Construction Certificate is required, full details and plans of the stormwater system including relevant calculations are required with the application.

Plans should show the layout and dimensions of all drainage structures and treatments, including survey information about structures, surface flow paths, and ground levels extending at least 5 m beyond the property boundaries. The latter is particularly important where re-contouring of the site is proposed or the development has the potential to affect other properties. Levels are to be to Australian Height Datum (AHD).

4.3Studies / Analyses

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 and Runoff* (1987), and subject to the satisfaction of Council's Director of Engineering Services.

Flood studies are to be conducted in accordance with the principles set out in the NSW *Floodplain Management Manual* (NSW Government, 2001). Where flooding may result in serious damage or threaten lives, probable maximum precipitation (PMP) flooding must be analysed, using design rainfalls from *Bulletin 53* of the Bureau of Meteorology.

4.4Qualifications of Designers

Any hydrologic, hydraulic or structural calculations submitted to Council are to be prepared by a suitably qualified professional civil engineer. Any certifications 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 Director of Engineering Services, and subject to satisfactory demonstration of capability and experience.

4.5Calculation Requirements

Calculations are to be carried out in accordance with current practices and principles outlined in *Australian Rainfall and Runoff* (Institution of Engineers, Australia, 1987) and other relevant sources.

Roof and site drainage calculations are to be certified by the designer as having been carried out in accordance with *AS/NZS 3500.3.2*, the Australian standard dealing with property drainage systems.

Where external catchment analysis is required, hydrologic calculations using methods from *Australian Rainfall and Runoff,* or a suitable equivalent computer model or calculation method, are to be undertaken. Where water depths and other flow characteristics of surface flows must be determined, normal depth calculations can be used for unrestricted flows, with grade line or backwater calculations being required in flow paths subject to backwater influence.

OSD storage systems are to be sized and designed in accordance with Section 5.4.

Where sites that require OSD cannot drain the whole site through the storage(s) to be installed, additional attenuation of flows through the storage and extra volume are required to compensate.

4.6Rainwater and Stormwater Tanks

These are to be sized according to the requirements of the BASIX system administered by the NSW Department of Infrastructure, Planning and Natural Resources, through the on-line design process on the website, www.iplan.nsw.gov.au/basix.

4.7On-Site Stormwater Detention Requirements

OSD storages are required in all new and redeveloped building developments in the Burwood local government area, except for:

- properties within 150 m of the Cooks River, or
- properties with an impervious area, including all parts of the site, of less that 60%.

OSD is required on all types of property, including single dwellings with impervious area percentages exceeding 60%. OSD regulations apply regardless of the area impervious of the of the site in its pre-development state.

OSD storages must restrict outflows from a site during 100 year ARI storms to a permissible site discharge (PSD) determined from:

PSD (L/s) = Site Area (ha) x 150.

This restriction can be applied using a hydraulic control such as a circular orifice plate. The diameter of the orifice required to limit the flowrate from a storage to a value Q (m^3/s) can be obtained from the orifice equation:

$Q = C_D . A . (2gh)^{0.5}$

Where C_D id the orifice discharge coefficient, equal to 0.6,
A is the area of the orifice, equal to P/4.D2, where D is the orifice diameter (m),
g is the acceleration due to gravity (9.80 m/s^2), and
h is the height from the centre of the orifice plate to the maximum water depth in the storage (m).

The volume of storage required is to be determined from:

Storage (m^2) = Site Area (ha) x 300, where no rainwater tank is provided and.
Storage (m^2) = Site Area (ha) x 225, where a rainwater tank is provided as part of the NSW Government's BASIX requirements.

The site area will be taken as the full area of the site, less any areas occupied by flow paths that carry upstream flows through the site. For dual occupancies, the full site area is to be considered. Where only part of an allotment is being developed, the site area may be considered to be less than the full allotment, at the discretion of Council's Director of Engineering Services

These requirements should allow the design of OSD storages without the need for reservoir routing calculations. Additional requirements are set out in the following sections.

4.8Tailwater 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 channel flows, 100 year ARI levels of the external system being connected to are to be used unless joint probability calculations are performed.

OSD systems are to be designed to ensure that the conditions at the inlet side of the control device (i.e. inlet control) govern under all conditions.

4.9Freeboards

A freeboard for floor levels above the top water level (TWL) of OSD storages must be applied for buildings near OSD storages. This should be at least 0.3 m above the maximum spillway operating level for habitable areas, and 0.15 m above this for other areas within buildings.

A building floor level freeboard ranging from 0.3 m to 0.5 m will be required where a development is adjacent to a channel or stream, or in areas where significant overland flow occurs. The lower value will apply where channel flow velocities are low and the higher value when velocities are greater than 1.2 m/s. In all other circumstances a minimum freeboard of 0.15 m is required above surrounding finished ground levels.

4.10 Driveway Entrance Levels

Where driveways to properties lead to lower areas than the street, especially to underground car parks, the possibility of runoff entering properties must be considered. If this is possible in 100 year ARI storm events, driveways must be set at a suitable level above the expected flood level, plus an additonal freeboard to allow for waves and flows redirected by obstructions.

The freeboard shall be set equal to the depth of flow plus 0.1 m, with a maximum freeboard of 0.5 m.

4.11 Levels at Site Boundaries

Where re-contouring of the site is proposed, the existing ground levels at the boundaries are to be retained with maximum 1 : 4 (vertical : horizontal) finished ground level slopes. Retaining walls are not to be constructed closer than 0.9 m to the boundary unless approved by Council. Similarly, existing ground surface levels are to be retained within 0.9 m of any property boundary unless otherwise approved by Council.

4.12 Inter-Allotment Drainage Systems

Where a development extends over several allotments, or requires an additional pipe system running through other properties, the inter-allotment (or common drainage line) pipe system to be provided shall have a minimum diameter of 300 mm and shall be designed according to street drainage design standards (as in *Australian Rainfall and Runoff*, 1987).

4.13 Connections to Council's Stormwater Drainage System

Single residential developments are permitted to connect pipe systems to the street gutter provided the discharge does not exceed 10 L/s per outlet for peak 100 year ARI design flows, with a maximum of two discharge points per nominal 20 m street frontage.

Dual occupancy developments are permitted kerb connection where the total site discharge is less than 15 L/s for the peak 100 year ARI design flows.

All other developments draining directly to streets 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 Director of Engineering Services. An access pit is 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 at the 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 E. The pipeline from the kerb pit to Council's pit is to be constructed under the kerb and gutter. Alternatively, the pipeline may be located behind the kerb or under the road pavement if approved by Council's Director of Engineering Services. 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.

4.14 Structural Requirements

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

4.15 Practicalities, Physical Limits, Maintenance

OSD system designs are to provide for minimum maintenance and be as tamper proof as possible. If located in landscaping areas, nominally 1.2 times the calculated volume will be required to allow for vegetation growth and siltation, the actual value to be determined by Council's Director of Engineering Services (design of the hydraulic controls is to be based on the calculated volume).

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

Litter screens are to be fitted to OSD outlets. These screens are to be easily removable and designed to retain leaf litter and the like without blocking the outlet. They are to be positioned such that incoming flows wash across the face of the screen to assist in preventing blockage, and as close as practical to vertical. The screen area should be a minimum of 50 times the area of the outlet.

Standard details for kerb inlet pits are shown in Supplement E. 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 Director of Engineering Services.

5.0 Construction and Development Requirements

5.1Bonds

Where works are carried out on Council or public lands (i.e. 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 Director of Engineering Services.

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

5.2Contractors 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 will 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.

5.3Inspections

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 and Charges.

The specified stages for inspections normally are:-

- after the excavation of pipeline trenches,
- after the laying of all pipes, prior to backfilling,
- after the completion of all pits and connection points.

A minimum of one (1) working day's 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.

5.4Certification and Works-As-Executed (WAE) Plans

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.

5.5Traffic Control and 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 Director of Engineering Services 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

5.6Connection 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.

5.7Restoration

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 Director of Engineering Services.

5.8Pipe Laying and 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 and 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 manufacturer's specifications for jointing. Where bolts or similar are

required, stainless steel is to be used. PVC and HDPE pipes may be used for inter-allotment drains, but 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 E.

6.0 Requirements of Other Authorities

6.1Sydney Water Corporation

Applications may be referred to Sydney Water where it is responsible for any pipe or channel into which the development connects. Any requirements of Sydney Water will need to be met before approval can be granted.

6.2Services

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.

6.3Department of Environment and Conservation (DEC)

All stormwater runoff must ultimately comply with the Clean Waters Act 1970 and Clean Waters Regulations 1972, which are administered by the NSW Department of Environment and Conservation. It is the responsibility of the developer to ensure any DEC 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.

7.0 Information Available from Council

7.1Drainage System Information

Council will make available information on its drainage system where this 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. Council has undertaken computer modelling of all of its drainage systems, from which flows can be estimated for flood study purposes. Flow estimates can be obtained from Council's Director of Engineering Services for an appropriate fee.

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

7.2 Location and Details of Pipelines

The developer and / or designer will need to confirm, by inspection and survey, any information affecting designs. This includes confirmation of pit and pipe locations and sizes, and any utility authority services location and dimensions.

7.3 Codes and Policies

Any Council document or policy referred to in this Code will be available to the public on Council's website, www.burwood.nsw.gov.au, and in paper format. A fee may be charged for the document to cover production costs, as set in Council's annual fees and charges.

8.0 References

Australia, Bureau of Meteorology (1994) *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method, Bulletin 53*, Department of the Environment, Sport and Territories, AGPS, Canberra

Landcom (2004) *Soils and Construction - Volume 1*, 4th Edition, Sydney

Landcom (2004) *Planning for Erosion and Sediment Control on Single Residential Allotments,* 1st Edition, Sydney

Institution of Engineers, Australia (1987) Australian Rainfall and Runoff, A Guide to flood Estimation, 2 volumes (edited by D.H. Pilgrim and R.P. Canterford), Canberra (revised into eight loose-leaf books, 1998)

New South Wales Government (2001) *Floodplain Management Manual, the management of flood liable land*, Sydney

Standards Australia (2003) AS/NZS 3500.3.2 *Stormwater drainage - acceptable solutions*, Sydney

SUPPLEMENT A DEFINITIONS

Australian Rainfall and Runoff (AR&R)

A technical publication from the Institution of Engineers Australia providing guidance on current drainage design practice. The 1987 sections dealing with design rainfalls, flood estimation procedures and urban stormwater drainage have not yet been updated. Revision of the urban drainage section is being undertaken, and will probably be available in 2007. Where more recent information or methods are available than those in AR&R, they should be applied.

Average Recurrence Interval (ARI)

A statistical likelihood of a storm event of a designated average rainfall intensity occurring, or being exceeded. The probability is a long term average, and not a fixed period between events (e.g. 10 years ARI indicates that 10 events will occur over 100 years, in random patterns).

BASIX

A system introduced by the New South Wales State Government in 2004, requiring developers to provide water- and energy-saving facilities in new buildings. It is administered through the NSW Department of Infrastructure, Planning and Natural Resources (DIPNR) through the website www.iplan.nsw.gov.au/basix. A BASIX certificate must be obtained before a DA can be submitted to Council.

Hydrology and Hydraulics

Hydrology is the branch of science that includes techniques for estimating rainfalls and stormwater runoff flowrates. Hydraulics includes calculations of capacities or characteristics of flow control devices and conduits (pipes and open channels).

On-Site Stormwater Detention (OSD)

A practice of providing a storage and outflow control device that will detain stormwater runoff on the site from which it is generated, thus reducing the peak outflow of stormwater runoff from the site. OSD is applied to reduce the impacts of increased development, which usually increased percentages of impervious area on sites, and increases the volumes and peak flowrates of stormwater runoff from storms. OSD can be applied as surface storages, in landscaped yards and driveways, or as more expensive underground tanks, where space is limited.

On-Site Stormwater Retention (OSR)

A stormwater detention system that disposes of some of the stored runoff without releasing it to the downstream drainage system. This can be done by collecting water in rainwater or stormwater tanks and using it on-site, or by

allowing it to infiltrate into the ground. (Infiltration systems will be ineffective over most of the Burwood local government are due to the low infiltration capacity of the underlying clay soils.)

Probable Maximum Precipitation (PMP)

An estimate of the maximum amount of rainfall that could possibly occur, producing a probable maximum flood (PMF).

Stormwater Drainage Concept Plan (SDCP)

A site plan of a development showing buildings and proposed drainage measures and structures. This must be submitted with a Development Application to Council. The plan should include existing and proposed ground and floor levels, as well as approximate sizes of drainage structures and surface flow path treatments. Preliminary hydrologic calculations should accompany the plan.

SUPPLEMENT B STANDARD ENGINEERING CONDITIONS

The following conditions are standard conditions used by Council that may be applied to consents for any development or building. Additional conditions may also be applied depending upon the details of the development.

1. 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 The details and calculations to be submitted prior to the release of the Construction Certificate shall include:

- i a catchment plan.
- ii plans showing proposed and existing floor, ground and pavement levels
  - *a to AHD.*
- 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.

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 to be submitted to and approved by Council prior to the release of the Construction Certificate.

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 350 mm diameter, the easement width shall be a minimum of 0.9 m.
Easements for larger diameter pipes shall be the pipe diameter plus 1.0 m wide, with a minimum width of 2.5 m.

(3) Written consent of the relevant owners shall be provided to Council prior to the release of the Construction Certificate.

(4) An 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 inter-allotment drainage lines. The minimum width shall be 0.9 m. 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.at…….. 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 Construction Certificate. 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, 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 150 mm above the surrounding finished ground levels.

1.15 *a Garage floor levels shall be at a minimum of……. RLm 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 Ccouncil'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 one (1) working day's 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 150 mm 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 Construction Certificate.

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 Stormwater 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 Application/* Construction Certificate.

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 Construction Certificate, for Council to construct a pipeline along the kerb line as far as the site including a pit at the kerb for connection.*

2. GENERAL CONDITIONS

2.1 All activities and works external to the site, or that affect public roads, are to be carried out in accordance with Council's Code for Activities Affecting Roads.

2.2 The public footpath along…...shall be reconstructed using…....to the requirements of Council's Director of Engineering Services.

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 1.0 m clear of any existing stormwater pits, lintels or poles and 2 m clear of any trees within the road reserve. The maximum width of driveways within the road reserve shall be …... m.

2.5 The 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 basecourse,

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 one (1) working day's 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 Construction Certificate. This bond covers:-

a creation of drainage easements on the title of downstream properties required under condition 1.9,

b creation of inter-allotment drainage easements on the title required under condition 1.10,

c creation of drainage easements on the title in favour of Council required under condition 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 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,

i erection and maintenance of hoardings and barricades around the site required for public safety and traffic control.

and will be released upon satisfactory completion of these items.

2.11 The ..... vehicular crossing(s) shall be relocated to be

a further than 25 m from the signalised intersection,

b further than 6 m from the intersection,

c further than 3 m from the front property line,

d at least 1m clear of any poles, pit inlet or ... and 2 m 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.

2.14 All construction vehicles are to access and egress the site using the route(s) of ……. being the shortest practical route from the nearest state or regional road. All requirements of the Traffic Act still apply to such vehicles.

2.15 (1) A contribution of $..... shall be paid prior to the release of the building plans to cover the costs of

a constructing the concrete vehicular footpath crossing(s) ……..,

b reconstructing the footpath fronting the development in ……..,

c reconstructing the kerb and hutter fronting the development in ……..,

d construction of stormwater drainage within the roadway,

e replacing the redundant driveway crossing with kerb and gutter and footpath.

(2) The cost of any necessary adjustments to public utility services is not included, and shall be paid by the applicant to the relevant authority prior to Council commencing the work.

(3) Should the monies not be paid within six (6) months from the date of this letter, Council may vary the amount required to be paid.

2.16 A damage deposit of $ …....against damage to Council's footpath, kerb and gutter and roadway shall be paid prior to

a the release of the building plans.

b demolition commencing.

This deposit is refundable if no damage occurs.

2.17 Footings shall extend below the invert of Council's pipeline located .....

2.18 Waste containers shall be placed in accordance with Council's Code for Activities Affecting Roads and the payment of the appropriate fees.

2.19 All demolition and excavation materials are to be removed from the site or disposed of on site using methods that comply with relevant environmental protection legislation.

2.20 An assessment shall be made by a suitably qualified professional of the impact of:

a construction,

b excavation,

c demolition.

traffic on the roads on the route nominated in condition ...A contribution shall be paid by the applicant to Council of an amount comensurate with the consumption of usable pavement life. The contribution shall be paid prior to the release of demolition approval, and is in addition to any other fees, or repair costs of specific actual damage. The value of the contribution will be determined using the provided assessment and based on Council's reconstruction rates for the appropriate

3. CUSTOM CONDITIONS

3.1 Section 94 contributions are to be applied to the consent for

a traffic management

b *parking*

3.2 The Positive Covenant required under Condition 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.

3.3 A bank guarantee can be used in lieu of cash for bonds and damage deposits amounts over $10,000.

SUPPLEMENT C – DESIGN RAINFALL INTENSITIES

Intensity Frequency Duration (IFD) Rainfall Data

2 year	50 year	*2 year*	*50 year*
I_1 hr : 36.0	I_1 hr : 71.0	*I_1 hr : 40.0*	*I_1 hr : 85.0*
I_{12} hr : 7.4	I_{12} hr : 15.5	*I_{12} hr : 8.0*	*I_{12} hr : 16.0*
I_{72} hr : 2.4	I_{72} hr : 5.0	*I_{72} hr : 2.5*	*I_{72} hr : 5.0*

rs	*AVERAGE RECURRENCE INTERVAL (ARI) years*											
TIME	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	133.5
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 hours	36.0	46.5	52.6	60.6	71.1	79.0	40	53.2	61.1	71.4	85	95.5
1.5 hrs	28.0	36.3	41.1	47.5	55.8	62.1	31	41	47.1	54.9	65.2	73.1
2 hrs	23.4	30.4	34.4	39.8	46.8	52.2	25.7	34	38.9	45.3	53.8	60.3
3 hrs	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 hrs	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 hrs	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 hrs	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 hrs	7.4	9.8	11.2	13.1	15.5	17.4	8	10.4	11.8	13.6	16	17.8
15 hrs	6.5	8.6	9.8	11.4	13.6	15.2	7	9.1	10.3	11.9	14	15.6
18 hrs	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 hrs	4.9	6.5	7.4	8.6	10.2	11.5	5.2	6.8	7.7	8.9	10.5	11.7

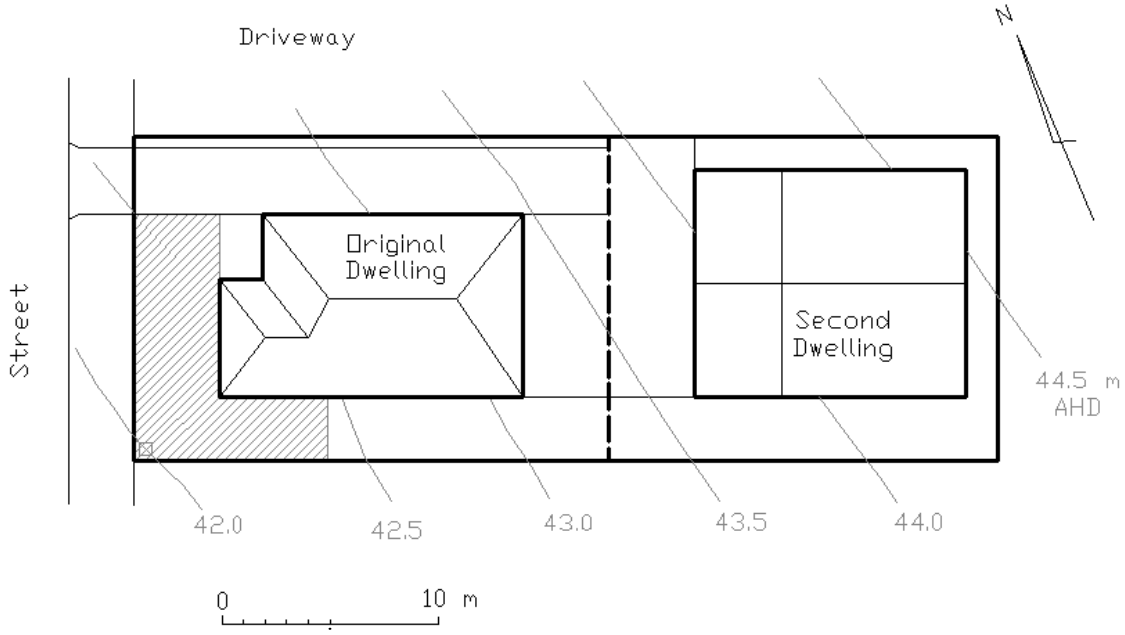
30 hrs	4.3	5.7	6.5	7.5	8.9	10.0	4.5	5.9	6.7	7.7	9.1	10.1
36 hrs	3.8	5.1	5.8	6.7	7.9	8.9	4	5.2	5.9	6.9	8.1	9
48 hrs	3.2	4.2	4.8	5.6	6.6	7.4	3.3	4.3	4.9	5.7	6.7	7.4
72 hrs	2.4	3.2	3.6	4.2	5.0	5.5	2.5	3.2	3.7	4.3	5	5.6

Common: Co-efficient G : 0.00 F_2 : 4.29 F_{50} : 15.80

AVERAGE RECURRENCE INTERVAL (ARI) year

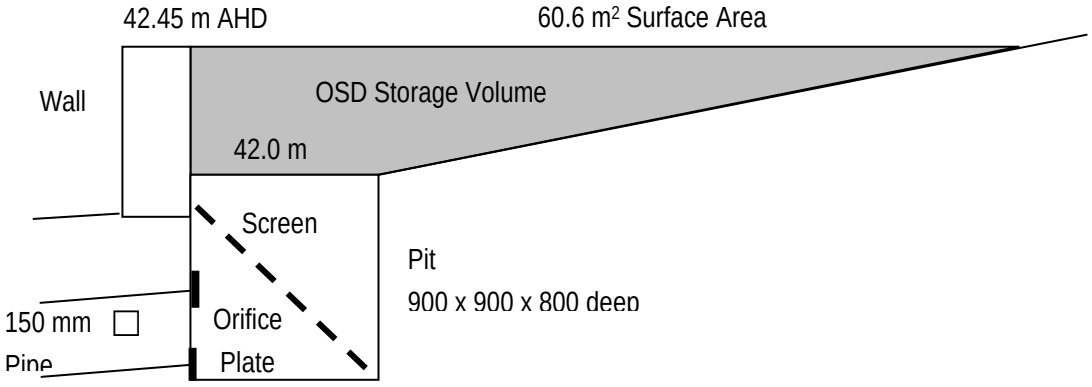
SUPPLEMENT D OSD DESIGN EXAMPLE

The plan below shows a dual occupancy re-development on a 600 m^2 block at Burwood, with an impervious area percentage of 70%. The property drains directly to a street and there is no obvious flow through the property from upstream.



An L-shaped area at the front, partly surrounded by a brick wall, is to be used as an OSD storage collecting water from all of the site. This will have a top water level of 42.45 m AHD, which must be at least 300 mm below any habitable rooms on the site or on adjoining properties.

It is possible to set up a pit connecting to the street gutter using the arrangement shown below:



The diameter of orifice required can be determined from the equation:

$$Q = C.\ A\ .\ \sqrt{2g.h}$$

where Q is the flowrate through the orifice (m^3/s),
C is the orifice coefficient, which is 0.6
A is the orifice area, $\frac{\pi}{4}.d^2$, where is the orifice diameter (m),
g is acceleration due to gravity, 9.80 m/s^2, and
h is the height of water above the centre of the orifice (m).

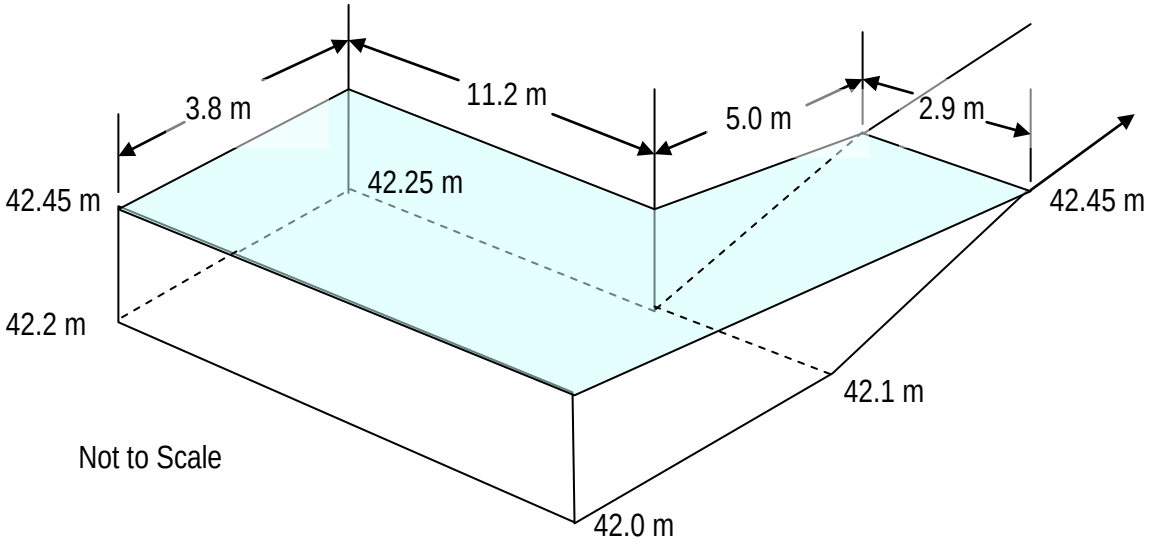
Council requires that discharges from a site be limited to a permissible site discharge (PSD) of 150 L/s/ha in 100 year ARI storms. Thus the allowable outflow rate for this site will be 150 x 600 / 10,000 = 9.0 L/s.

If the maximum height above the centre of the orifice is 42.45 - 41.35 = 1.1 m, the orifice equation becomes:

$$0.009 = 0.6 \times \frac{\pi}{4} \times d^2 \times \sqrt{2 \times 9.80 \times 1.1}$$

giving d = 0.063 m or 63 mm.

The levels of the landscaped area are shown below:



The available storage is 15.7 m^3 above-ground and 0.6 m^3 in the pit, a total of 16.3 m^3.

Council's requirement is 600 x 225 = 13.5 m^3, assuming that rainwater tanks are to provided on both dwellings. This must be increased by 20% to allow for future changes to landscaping, increasing the volume required to 16.2 m^3, which the design meets.

SUPPLEMENT E STANDARD DRAWINGS

Grated Road Stormwater Pit With Extended Kerb Inlet

Detention Storage & Infiltration Tank - Residential Dwellings

SUPPLEMENT F WORDING OF POSITIVE COVENANT

Wordings For Restrictions As To User & Easements. Restriction As To User - Positive Covenant Form 55A Instrument Pursuant To Section 88E(3), Conveyancing Act, 1919

F.1 On-Site Detention

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

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

Authorised {Name} 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."

F.2 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 {Name} 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 {Name} 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 G APPLICANT CHECKLIST

	Single Residential	Dual Occupancy	Villa, Flats, Town Houses etc	Commercial Industrial Institutional	Tennis Courts	Drainage Works Only	Paving
On Site Detention	See Detail Suppl. E	Yes	Yes	Yes	Yes	No	*** (1)
Gravity Pipe System Required	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pump System Permitted	No	No	No	No	No	No	No
Drainage Easement over downstream property (2)	If site does not drain to street (3)	If site does not drain to street	If site does not drain to street	If site does not drain to street	If site does not 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	***(1)	Yes	Yes	Yes	Yes	Yes	***(1)
Sediment Control Plan Required.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Positive Covenant Required. (ie 88E Instrument)	No	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. Exceptions may be granted - refer to Section 3.9 of this Code.