MANLY

Specification for

Stormwater Drainage 2003

Prepared by

Manly Council
June 2003

MANLY

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Date of Adoption—19 May 2003

Date of Enforcement—16 June 2003.

IMPORTANT NOTES

Before you turn to the specific requirements of this specification please read these notes, the guidelines, aims and objectives.

1. Applicants should bear in mind that the requirements in this specification have been formulated following Council's wish to ensure that development in the Manly local government area retains the essential qualities of the natural and urban environment of Manly and to give guidance that creates compatible infill development and redevelopment.

   The intention of this specification is to address issues of stormwater runoff from public and private infrastructures to:

   - protect the environmental qualities of Manly
   - provide protection and assure improvement of public and private amenities for residents and visitors.

2. All Development Applications (DA) are assessed under S79C of the Environmental Planning and Assessment Act 1979. This specification are one of the 'Matters for Consideration' specified under S79C that is taken into account by Council prior to determining the DA.

3. The requirements of this specification will be considered prior to the issuing of a Development Approval and a Construction Certificate prescribed under S109C of the Environmental Planning and Assessment Act 1979.

4. Applicants should have regard to the:

   - Manly Local Environmental Plan 1988 (as amended) (LEP)
   - Development Control Plan (DCP) for the Business Zone 1989 (as amended)
   - DCP for the Residential Zone 2001 (as amended)
   - Building Code of Australia 1993
   - Local Government Act 1993
   - All relevant Australian Standards

   where relevant when preparing a DA.

If you have any enquiries regarding this specification please contact:

Environmental Services Division
on 9976 1500
Monday—Friday 8.30am-5pm.

CERTIFICATION

The Manly Specification for Stormwater Drainage 2003

were adopted by Council Resolution on 19 May 2003

and came into force on 16 June 2003.

Henry T Wong
General Manager

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A. EXECUTIVE SUMMARY

This Manly Specification for Stormwater Drainage 2003 provides guidelines for the design of drainage systems to cater for public and private infrastructure during the design stage of development and subdivisions.

This specification reflects Council's concern for the need to protect the environment from the impact of developments to ensure that stormwater pollution and degradation does not occur. In this regard, design guidelines have been provided to safely manage, convey and control stormwater runoff.

The requirements described in this specification apply to the assessment of development in the Manly local government area.

B. GENERAL INFORMATION

B1 Adoption date

The Specification for Stormwater Drainage 2003, was adopted by Manly Council on 19 May 2003 and came into operation by public notification on 16 June 2003.

B2 Citation

This document may be cited as Manly Specification for Stormwater Drainage 2003.

B3 Land to which these guidelines apply

This specification applies to all land within the Manly local government area as described in Manly Council's DCP for the Business Zone 1989 (as amended) and DCP for the Residential Zone 2001.

B4 Relationship to Manly LEP, other Manly DCP's and other policies

The Specification for Stormwater Drainage 2003 supplement Manly Council's DCP for the Business Zone 1989 (as amended) and DCP for the Residential Zone 2001.

This specification should be read in conjunction with the following DCP's and/or policies:

- Manly Local Environmental Plan 1988 (as amended) (LEP)
- DCP for the Residential Zone 2001 (as amended)
- DCP for the Business Zone 1989 (as amended)
- Specification for On-site Stormwater Management 2003
- Specification for Civil Infrastructure Works, Developments & Subdivisions 2003.

B5 Aim and objectives of this specification

The aim of this specification is to provide:

- more specific, detailed design guidelines for property drainage, street drainage (both piped and surface flowpaths), trunk drainage (large conduits and open channels) and receiving waters (rivers, creeks, groundwater storage, sea or ocean) within the Manly local government area.

The objectives are to:

- provide uniform guidelines for the control and conveyance of stormwater through public and private properties
- ensure that stormwater drainage pollution and degradation does not occur as a result.

C. HOW THE MANLY SPECIFICATION FOR STORMWATER DRAINAGE WORKS

C1 Structure of the document

This specification is for the design of stormwater drainage systems. It is structured to provide a general guideline for the design of drainage systems acceptable for the disposal of stormwater within the Manly local government area.

It also provides parameters for the design of stormwater drainage systems.

Design parameters for minor and major systems (trunk drainage) catchment hydrology, hydraulics, drainage pits, open channels and inter-allotment drainage are all covered, including guidelines for stormwater pollution and erosion control.

C2 Understanding the specification

This document is divided into the following sections:

- **1 to 5:** provides a general overview and description of what this specification covers and how it can be achieved—methods of stormwater disposal acceptable to Council are briefly outlined
- **6:** describes the minor and major drainage system design methodology
- **7:** provides design guidelines for catchment hydrology
- **8:** provides guidelines for hydraulic design
- **9 to 13:** provides design guides for pits and open channels—locations of buildings adjacent to stormwater drainage systems, connections and services are also covered
- **14:** reference to stormwater easements are provided
- **15:** provides design guidelines for inter-allotment drainage design
- **16:** provides guidelines for pollution and erosion control devices
- **17:** provides details of the information required for submission to Council.

C3 Obtaining approvals

C3.1 Pre-lodgement consultation

Applicants are strongly advised to make an appointment with a Council Assessment Officer before detailed plans for the proposal are commenced. This will help identify important issues at an early stage.

A number of **Fact Sheets** are available from Council free of charge. They define the various categories of development and help an applicant through the various Council policies that may need to be addressed during the design and construction phases of any development.

C3.2 The Development Application (DA)

Council's **DA package** is available from:

- Customer Service Centre
  1 Belgrave St., Manly OR
- www.manly.nsw.gov.au

It contains information and checklists required for an application to be accepted, processed and resolved by Council.

C4 Steps in using this specification:

Step 1

Read section **1 to 5**.

Step 2

Read section **6.**

Determine minor/major system and go to appropriate subsections.

Step 3

Read section **7 & 8.**

Determine catchment hydrology, hydraulics and controls.

Step 4

Read appropriate section **9 to 16 as applicable.**

1. GENERAL

Stormwater drainage systems covered in this specification shall include property drainage, street drainage (both piped and surface flow paths), and trunk drainage (larger conduits, open channels) and receiving waters (rivers, creeks, groundwater storage, sea or ocean).

2. WHY IS STORMWATER DRAINAGE REQUIRED

Stormwater drainage is required to collect, control and convey stormwater runoff to the receiving waters with minimal nuisance, danger to life or damage to properties and that pollutants which are carried by the stormwater are minimised from entering the receiving waters. In this regard, drainage systems shall be designed to:

- have adequate sub-surface drainage to provide protection to structures, and prevent long term water ponding
- collect and convey surface stormwater runoff to prevent water from entering buildings or damage structures, minimise nuisance and danger to persons and vehicular traffic, prevent long term surface water ponding, prevent erosion, and protect adjoining and downstream properties from any adverse impacts as a result of stormwater runoff from proposed developments
- include a system of overland flowpaths, where possible, to provide fail-safe protection to buildings, structures, adjoining and downstream properties in the event of pipe blockage or storm events that exceed the capacity of the piped drainage system.

This can be achieved by:

- the construction of surface flow routes to convey floodwaters away from private and public properties and that in flood prone land, the velocity and depth of flows are controlled and minimised
- the provision of surface flow routes and piped drainage systems to direct/control frequent runoff, so that convenience and safety to pedestrians and vehicle traffic, is provided
- the provision of both piped drainage and surface flowpaths for new developments, re-developments and new subdivisions
- the installation of water quality control devices such as gross pollutant traps, basins, baskets and the like to collect pollutants present in the stormwater.

3. REFERENCES AND STANDARDS

This Specification shall cover Council's minimum design requirements for hydrological and hydraulic design and operation of these stormwater drainage systems. Reference shall be made to the following standards, guidelines and technical data for other aspects not covered in this Specification.

- Manly Council's Specification for On-site Stormwater Management
- AS1254—Unplasticised PVC (uPVC) pipes and fittings for stormwater or surface water applications
- AS1657—Fixed platforms, walkways, stairways and ladders –design, construction and installation
- AS2032—Code of practice for the installation of uPVC pipe systems
- AS3725—Loads on buried concrete pipes
- AS3500.3—Stormwater drainage
- AS4058—Precast concrete pipes
- AS4139 - Fibre reinforced concrete pipes and fittings
- New South Wales Government—Floodplain Management Manual: The management of flood liable land, January 2001
- The Institution of Engineers, Australia —Australian rainfall and Runoff (AR&R)–A guide to flood estimation, volumes 1 and 2, 1987 or later editions
- NSW Department of Housing—Managing Urban Stormwater, Soils and Construction, August 1998
- Hare C M—Magnitude of Hydraulic Losses at Junctions in Piped Drainage Systems, transactions, I E Aust. February 1983
- Sangster W M, Wood H W, Smerdon E T, and Bossy H G—Pressure changes at storm drain junction, engineering series, Bulletin No 41, Engineering Experiment Station, University of Missouri, 1958
- Concrete Pipe Association of Australia—Concrete Pipe Guide, Charts for the selection of concrete pipes to suit varying conditions
- Chow V T—Open Channel Hydraulics, 1959
- Henderson F M—Open Channel Flow, 1966.

4. STANDARD DRAWINGS

The following standard drawings are relevant to this document:

- drawing no. 1 : connection to kerb detail, location of foundations near easements detail.

See appendix 2 for drawing.

5. STORMWATER DISPOSAL

Stormwater drainage shall follow the natural fall of the land and must be disposed of by gravity means, whenever possible. Re-directing stormwater runoff from one catchment (or sub-catchment) to another catchment (or sub-catchment) is **not permitted**.

Council will not approve drainage against the natural grade of the land for any land subdivision or road drainage. Re-directing stormwater using pump-out or charged systems or on-site disposal by absorption may only be granted for residential or commercial developments and re-developments (sub-divisions excluded) but **only** in the following circumstances:

- the site lies within a zone, as identified on Council's Map D: Stormwater Control Zones* of which the method of disposal is acceptable, or
- downstream property owners have indicated** that they will not be prepared to grant easements to permit the drainage of the property to follow the natural fall of the land, and
- Council has assessed that the proposed receiving drainage system can adequately cope with the additional runoff.

* **Note 1**: Reference should be made to Council's ***Stormwater Drainage Policy***, ***Residential DCP*** and ***Specification for On-site Stormwater Management*** for further details.

** **Note 2**: Applicants are required to submit to Council, evidence that genuine attempt at easement acquisition, through downstream properties, have failed.

Where it is acceptable to Council, guidelines for alternative methods of stormwater disposal are given in Council's ***Specification for On-site Stormwater Management***.

6. MINOR AND MAJOR SYSTEM DESIGN

The method of stormwater drainage system design used to size pipe networks and trunk drainage systems to the receiving water is known as a 'dual drainage' system approach or minor/major design concept, as described in ***AR&R***. The design criteria are set out below.

6.1 Minor system

The gutter and pipe network capable of conveying runoff during minor storm events is known as the 'minor system'.

The minor system design rainfall recurrence intervals are given in ***Section 7.2 Average recurrence interval***.

The maximum gutter flow widths shall be the lessor of the following:

- 2.5 metres, or
- one-quarter of the road carriageway width.

Wider flow widths may be acceptable on roads with cross-sectional grades of less than 1.0%.

The minimum conduit sizes for the minor system design shall be as follows:

- public system—pipes, 375mm-dia
- public system—box culverts, 600mm wide x 450mm high
- private system—90mm dia for roof runoff only
- private system—100mm dia for surface runoff within the property only
- road reserve—375mm dia or equivalent box section

The minimum pipe grade shall be as follows:

- for pipes less than 225mm dia–3%
- for pipes greater than or equal to 225mm dia–1.0%
- for concrete box culverts poured in-situ –0.5%.

Pipes which are to be laid at a slope greater than 20% will require anchor blocks at the top and bottom of the section and at intervals of not more than 3.0 metres. Bulkheads shall be provided on steep gradients where soil instability is likely. To retain backfill material, bulkheads shall be installed at intervals of no less than 5.0 metres

Type of pipe material and jointing for the minor system design shall be as follows:

- public system—reinforced or fibre reinforced concrete*, rubber ring jointed
- private system—up to 300mm-dia uPVC, solvent welded joints; 300mm-dia and larger reinforced or fibre reinforced concrete*, rubber ring jointed

* **Note**: Council prefers the use of reinforced concrete pipes in preference to plastic pipes for the following reasons:

- concrete pipes generally retain their structural integrity better than plastic materials
- concrete pipes are generally rubber ring jointed whereas plastic pipes are solvent welded and offers more deflection tolerance and it is easier to replace sections when required
- Council's ***Energy Efficient DCP 1998***, encourages the use of environmentally friendly building materials. Plastic pipe production generally produces toxic by-products during manufacture, which is unacceptable
- plastic pipes may be less resistant to chemical attack in harsh and exposed environments.

However other types of piping material may be acceptable where it can be demonstrated that the substitute material has the same, if not better, structural, environmental and durable qualities than reinforced concrete.

Depth of cover to the conduit obvert shall be as follows:

- public system not subject to vehicle loads—450mm
- public system subject to vehicle loads—600mm
- private system not subject to vehicle loads—300mm
- private system subject to vehicle loads—600mm.

Where it is not practical to provide for the minimum cover requirements, at least 50mm thick granular overlay shall be provided over the obvert of the conduit with a 150mm thick reinforced concrete slab construction over, or pipe to be 150mm mass concrete encased.

The appropriate class of pipe to be used shall depend on the minimum cover provided and the loading onto the pipe in accordance with ***AS3725—1989***, ***loads on buried concrete pipes***.

Design velocity of flows shall be:

- Conduits—0.6 m/s minimum, 6.0m/s maximum
- Surface flow—2.0* m/s maximum

* **Note**: Where this cannot be achieved, appropriate erosion control measures are to be provided.

Maximum permitted depth of surface flow (not for on-site stormwater detention systems) shall be:

- road carriageway, driveways, footpaths and carparks—150mm
- landscaped areas—300mm.

6.2 Major system

The 'major system' comprises the drainage route, which conveys the runoff for the major storm events. This may be a series of trunk drainage systems and overland surface routes including open channels, creeks, and rivers.

The major system design rainfall recurrence intervals are given in ***Section 7.2 Average recurrence interval***

Overland flow routes are permitted:

- within the road carriageway excluding footpaths and the footway reserve—flows across footpaths will only be permitted where this will not cause flooding of property or danger to pedestrians and is subject to Council approval
- within drainage easements—however, where it is not practical to provide an overland flow route over the easement (eg physical constraint), the piped drainage system shall be sized to accept the runoff for the major storm event i.e. the 100-year ARI
- within a known and designated floodway
- within creeks and river systems.

The minimum freeboard shall be provided as follows:

- 150mm for roadways—between the 100-year ARI overland flow route and warehouse, factory, and carport floor levels and entrances to open carparks
- 300mm for roadways—between the 100-year ARI overland flow route and office, living rooms, retail space, storeroom, and show room floor levels
- 300mm for surcharge paths e.g. easements—between the 100-year ARI overland flow route and all internal building floor levels, garages and basement carparks
- 500mm for channels, creeks and rivers—between the 100-year flood water level and all internal building floor levels, garages, and basement carparks.

Design velocities and depths of surface flows shall be in accordance with Figures G1 and G2 of the ***New South Wales Government Floodplain Management Manual: The management of flood liable land***, with acceptable hazard category 'low hazard'.

7. HYDROLOGY

7.1 Rainfall data

Intensity-Frequency-Duration (IFD) rainfall data, obtained from the Bureau of Meteorology, is given in appendix 1.

7.2 Average recurrence interval

The Average Recurrence Interval (ARI) to be used to design major and minor drainage systems is as follows:

- **Classification—public system**

Minor system—piped and channel drainage

LOCATION	ARI (YEARS)
Local roads	10
Collector roads	10
Sub-arterial roads	10
Arterial roads	20
State roads	50
Access to emergency facilities	100
At a depression (low point) in the road	100
Through private property with or without a safe overflow route	100

- **Classification—private system**

Minor system—piped and channel drainage

LOCATION	ARI (YEARS)
Residential - low density	10*
Residential - medium to high	20*
Commercial	50*
Industrial	50*
Hospitals and emergency facilities	100

* **Note:** The underground drainage system (this includes pipes, conduits and pits) shall be designed for an ARI of 1 in 100 years where major system flows are likely to surcharge across private property e.g. along a drainage easement. A surcharge path must be provided to safely convey surface stormwater across private property within the easement. The minimum design ARI for surcharge paths shall be the 1 in 100 years.

- **Classification—public system**

Major system

The design ARI shall be the 1 in 100-years.

- **Classification—private system**

Major system

The design ARI shall be the 1 in 100 years.

7.3 Catchment area

The catchment area is defined by the limits from where surface runoff will make its way, either by man-made or natural paths, to the point of exit.

Catchment boundaries can be determined from ortho-maps or obtained from Council upon written request. A fee may be charged in accordance with Council's fees and charges schedule.

7.4 Determination of catchment runoff

Catchment runoff shall be determined using a suitable hydrological method depending on the level of accuracy required and the extent and shape of the catchment. The Rational Method or more complex hydrological models may be used.

For more detailed description of each type of model, their limitations and applications are given in ***AR&R***.

7.4.1 Rational method

The use of Rational Method for the estimation of peak flows will be acceptable for very small catchments of sizes less than 600 sqm.

This method is best suited to catchments with uniform slope and roughness characteristics and where accuracy is not essential.

The method described in ***AR&R*** for the calculation of overland flow times shall be used. The minimum values of surface roughness or retardance factors given in ***AR&R*** are to be used.

7.4.2 Hydrological computer models

The use of hydrological computer models are best suited for medium to large catchments and where a reasonable level of accuracy is required.

Acceptable computer models include ILSAX, DRAINS, RAFTS, and RORB. However the preferred model is ILSAX or DRAINS, for medium level of complexity.

Where a computer model is to be used, the input and output data in electronic format and a hard copy shall be provided upon submission of the design drawings for approval.

7.4.3 Impervious areas

The percentage impervious areas to be used in the design of inter-allotment drainage systems for subdivisions, developments and re-developments shall be designed in accordance with ***section 15. inter-allotment drainage*.**

Public, road and trunk drainage systems are to be designed for the following percentage impervious areas:

- minimum 50% for all residential areas,
- 100% in commercial areas, and
- 70% for road reserves

7.4.4 Roughness coefficients for the calculation of free surface flow

For the purpose of determining the runoff in open channels and free surface hydraulics, Manning's roughness coefficients shall be used. Typical values are given in ***Section 10. open channels***.

For sections with composite roughness values, Horton's Equation may be used to convert to an equivalent roughness value for simplicity in calculations.

Horton's Equation is given as:

$$n = \left[\frac{\Sigma (P_i . n_i^{3/2})}{\Sigma P_i} \right]^{2/3}$$

where

n_i = is the Manning's roughness coefficient for section i and

P_i = is the wetted perimeter or length of the section with a roughness value n_i

8. HYDRAULICS

8.1 Hydraulic grade line analysis

Hydraulic grade line calculations shall be carried out in accordance with ***AR&R***, and shall be undertaken by a qualified person with experience in hydrology and hydraulic design.

Full hydraulic calculations must be submitted for all public and major piped systems (375mm-dia and larger), drainage lines through easements or where Council deems it necessary to determine the feasibility of the proposal.

Drainage lines shall be designed with minimal bend losses. Where this is unavoidable, junction pits shall be provided at the location of bends or changes in direction.

Pipes will not be permitted to be laid such that a larger pipe joins into a smaller pipe downstream, to avoid potential chokes in the system. However, this may be unavoidable and will be acceptable when the new line is connected into an existing system.

For surface drainage systems e.g. channels, open drains and the like, hydraulic calculations must include the determination of the water surface profiles and backwater effects using suitable computer models such as DRAINS and HEC-RAS.

Frictional losses in closed conduits of circular cross-section e.g. pipes, shall be determined using the Darcy-Weisbach Formula. This Formula may be applied to rectangular sections e.g. box culverts, by converting the product of the area and hydraulic radius to the power of two-thirds ($A.R^{2/3}$) to an equivalent circular section.

The following Colebrook-White roughness parameters shall be used:

- uPVC , k=0.03mm
- reinforced concrete, k=0.60mm
- fibre reinforced concrete, k=0.60mm

Pit energy losses and pressure changes at junctions, bends, transition structures, slope junctions, inlet pits, junction pits, drops and outlets must be considered. Pressure head coefficients for determining these 'head losses' are to be obtained from the following sources:

- Missouri Charts
- Hare Equations
- U S Corp of Engineers mitre bend charts
- AR&R 1987 or later editions

8.2 Downstream hydraulic controls

The downstream water surface level is to be adopted as one of the following:

- where the hydraulic grade line level downstream of the proposed works, including the upstream pit losses at the starting pit is known, this level is to be adopted
- where the downstream starting point is at a pit and its hydraulic grade line is unknown, a level of 150mm below the surface level of this pit is to be adopted
- where the outlet is to an open channel, the water surface level is to be determined using Manning's Equation or an appropriate model which can determine water surface profiles—the water level, shall be adopted as the normal depth, calculated using an appropriate method, or the top of the outlet pipe, whichever is the greater
- where the outlet is to an open channel, and the downstream flood levels are known, the water surface level to be adopted shall be the 1% AEP flood level

- where the outlet is affected by tidal or wave action, the resulting water level shall be adopted
- where the outlet is at a connection to an existing pipe or conduit, the hydraulic grade line of the conduit shall be determined downstream to a pit where its water level is known e.g. at a grate in the gutter where the maximum free surface ponding is at the top of kerb
- where the outlet is to the invert of the kerb, the water surface level shall be adopted at the top of the kerb.

9. PITS

9.1 Location of pits

Stormwater pits shall be:

- spaced such that the gutter flow width is limited to 2.5 metres maximum width for the minor system design
- located at the upstream side of allotments to minimise runoff flowing across the road
- located at sag points and at road depressions
- located where access for inspections and maintenance is readily available
- provided at changes in direction, grade, conduit level, size, or class of conduit
- provided at junctions
- spaced at a distance no greater than 100 metres apart.

9.2 Pit types

Standard Council kerb inlet pits shall have minimum internal dimensions of 600 x 900 and shall have grated covers. Council inlet pits in landscaped areas, and pavements other than at kerb locations, shall have minimum 600 x 600 internal dimensions. Non-Council inlet pits may have smaller dimensions of 300 x 300 and 450 x 450 where minor runoff is to be collected. However, where the depth of the pit exceeds 1.2 metres, the minimum internal dimension shall be increased to 600 x 900 regardless of its design collection rate or location. Internal pit dimensions shall be increased to suit the size and orientation of the inlet and outlet pipes.

Private pits i.e. pits which collect/ convey property runoff only, shall be located wholly within property boundaries. Pits, which are to be located in public land, shall be constructed to Council standard and shall become part of the public drainage system. This shall include drainage conduits and any other part of the drainage system considered relevant by Council.

Grates over Council pits are to be galvanised and hinged to frame with minimum dimensions of 450 x 900 for kerb inlet pits and 450 x 450 for standard inlet pits not located at a kerb. Non-Council pits may have grates of minimum 300 x 300 to suit the internal dimensions of the pit. However they must not be less than 450 x 450 where the pit depth exceeds 1.2 metres. In the road carriageway, vehicle accessways, carparks and driveways, they are to be of heavy-duty construction. In landscaped areas where vehicle traffic is unlikely, these can be of medium duty. Light duty grates are not to be used.

Where pits are not designed to collect stormwater, solid concrete covers are to be used. These must be liftable for inspections and maintenance. Sealed pits are not acceptable. Junction pits are not to be designed as pressurised systems.

Where pits exceed 1.2 metres in depth, step irons in accordance with ***AS1657*** are to be provided one side of the pit wall to allow access for routine inspections and cleaning.

Letterbox type pits are not permitted at or near kerb locations where there is likely pedestrian and/or vehicular traffic. In these locations, pits with butterfly type grates flush with the surrounding ground level is preferred.

Lintels shall be provided at kerbs with the length dependent on its design capture rate but no less than 1.2 metres and not greater than 4.0 metres.

Pits are to be constructed of reinforced concrete or reinforced concrete blockwork fully rendered, concrete infilled and waterproofed. Pre-cast pits may be used. However these must be watertight and structurally adequate for the intended traffic loads. Where proprietary products are to be used, the manufacturer's specification will need to be submitted to support the use of the item.

The base of pits shall be concrete benched to minimise hydraulic losses.

Pits constructed of brick or unreinforced concrete blockwork will **not** be acceptable.

9.3 Inlet capacity

The inlet capacity of pits shall be determined in accordance with ***AR&R***.

Allowance must be made for blockages as follows:

LOCATION	INLET TYPE	PERCENTAGE OF THEORETICAL CAPACITY ALLOWED
sag	side entry only	80%
sag	grated only	80%
sag	combination	100% side entry only grate assumed completely blocked
sag	letterbox	50%
on-grade	side entry only	80%
on-grade	grated only	50%
on-grade	combination	80%

10. OPEN CHANNELS

Open channels will only be permitted where they form part of the major drainage system. Where permitted, they shall be designed to have smooth transitions, with adequate access provisions available for inspections and maintenance and adequate safety measures to protect persons and vehicles e.g. perimeter fences, bollards or grills over outlet pipes.

Open channels shall be designed in accordance with ***AR&R*** and the ***NSW Government Floodplain Management Manual*** and shall fully contain the major system runoff.

Mannings roughness coefficients for open channel sections applicable to specific channel types shall be obtained from ***AR&R***. Typical values are given below:

MANNINGS ROUGHNESS COEFFICIENTS

SURFACE	n
Concrete pipes or box sections	0.012
Concrete trowel finish	0.015
Concrete formed without finishing	0.016
Sprayed concrete, gunite	0.018
Bitumen, smooth finish	0.016
Bricks or pavers	0.016
Pitchers or dressed stone in mortar	0.016
Rubble masonry or random stone in mortar	0.028
Rock lining or rip-rap	0.028
Corrugated metal	0.027
Earth, clean	0.022
Earth, weed and gravel	0.028
Rock cut	0.033
Short grass	0.033
Long grass	0.043
Medium to dense brush	0.150

Open channels shall be designed to avoid hydraulic jumps or generate supercritical flow conditions.

Side slopes shall not exceed 1 in 4, unless fully fenced off.

Where possible, low flows shall be contained within a piped system or contained within a concrete lined channel at the invert of the channel.

11. BUILDING ADJACENT TO STORMWATER DRAINAGE SYSTEMS

Structural supports such as foundations, piers, and footings located adjacent to the drainage system will only be permitted if they do not load bear onto the underlying drainage structure.

Typically, where a drainage structure is to be laid parallel to foundations, piers or footings, the trench or easement of the drainage structure shall be located beyond a 45 degree angle from the base of the footing.

Clearance zones are given in Council standard drawing no. 1 labelled ***location of foundations near easements detail***. Refer also to the ***Specification for On-site Stormwater Management***, appendix 1 drainage easements.

12. STORMWATER CONNECTIONS

12.1 Under buildings

Shall be carried out in accordance with ***AS3500.3, Section 3***.

12.2 Above-ground pipe work

Shall be carried out in accordance with ***AS3500.3, Section 6***.

13. SERVICES

Care shall be taken to ensure that the proposed stormwater drainage system will not conflict with utility services. In this regard, all services shall be located prior to final drainage system design. Stormwater drainage conduits crossing over or under sewer lines must be laid in accordance with Sydney Water's requirements. This may require support trenching and concrete encasement of sections that traverse the utility.

Where drainage lines are to be laid in the road reserve, they shall be located under or in front of the kerb line within the road carriageway, to avoid conflict with the services in the footway. Where drainage lines must cross the footway reserve, they shall be laid across the footway perpendicular to or at a maximum angle of 45 degrees to the kerb face to minimise conflict with the services.

14. EASEMENTS

Easements for stormwater drainage shall be required for constructed drainage systems within private properties, to ensure that Council has rights of access to such drainage systems for the purpose of inspection, maintenance or upgrade.

Stormwater drainage easements shall be required for all inter-allotment drainage lines.
For further details, refer to ***Specification for On-site Stormwater Management***, appendix 1 drainage easements.

15. INTER-ALLOTMENT DRAINAGE

Inter-allotment drainage shall be provided for every allotment, which does not drain directly to its street frontage, an existing stormwater drainage system or natural watercourse.

Easements shall be created over all inter-allotment drainage in favour of upstream allotments. The minimum width shall be 1.0m for pipes less than 150mm in diameter and 1.0m plus the width of the outside pipe diameter when greater than 150mm in diameter.

For further details of drainage easements, refer to ***Specification for On-site Stormwater Management***, appendix 1 drainage easements.

The impervious area to be used to determine the contributing runoff shall be the proposed impervious area of the allotment. However, in the absence of more detailed information, the following impervious areas shall be adopted:

TYPE OF DEVELOPMENT	PERCENTAGE IMPERVIOUS AREA OF ALLOTMENT
Road (including footway)	70
Residential	75
Medium Density	75
Industrial	100
Commercial	100

Inter-allotment drainage pits* and pipes* shall be constructed of reinforced concrete, fibre reinforced concrete or uPVC. Pipes are to be rubber ring jointed or solvent welded as specified by the manufacturer and in accordance with ***AS4058***, ***AS4139***, and ***AS1254*** respectively. Refer also ***Section 6.1 minor system***.

* **Note**: Council encourages the use of environmentally friendly products and materials (refer Council's ***Energy Efficient DCP 1998***) and such materials may be used in substitution of the above provided it satisfies all the relevant standards.

16. STORMWATER POLLUTION AND EROSION CONTROL

16.1 Soil and water management plan

A soil and water management plan shall be submitted and approved by Council prior to the commencement of any works. Sediment control measures must be taken into consideration during any development. Specification shall be in accordance with the ***Managing Urban Stormwater, Soils and Construction Manual, NSW Department of Housing***.

All sediment control devices are to be installed prior to any commencement of clearing and earthworks on the site. Ongoing maintenance of these devices during construction will be required.

16.2 Soil erosion control

Soil erosion control is required to protect adjoining properties, bush land, roadways and receiving waters from degradation due to silt laden stormwater runoff as a result of development and/or concentration of runoff. Erosion control shall be provided as follows:

- Appropriate scour protection installed at the outlet to stormwater conduits, and
- Installation of pollution control devices at the source, on-line*, off-line or at the end of the line to control sediment laden overland stormwater flows.

Scour protection devices shall include embankment stabilisation e.g. rock walls, concrete aprons, gabions, turfing, jute mesh, energy dissipating units, or other more appropriate erosion control devices approved by Council. However, preference is for 'soft engineering' solutions.

Please note that stormwater devices are not appropriate within or adjacent to creek locations. In this regard, the Department of Sustainable Natural Resources (DSNR) and NSW Fisheries shall be contacted for advice about suitable erosion control measures here.

* **Note**: stormwater management measures shall not be located on-line in water courses or within riparian zones or areas of remnant native vegetation.

Control devices may be required as part of a development to remove pollutants during the "first flush". These devices shall be installed within the site and may include proprietary items such as Humeceptors or CDS units, silt and grease arrestors approved by Council. Installation of these devices shall be in accordance with the manufacturers specification.

Other sediment control devices such as stilling basins, constructed wetlands shall be required for large-scale developments. These shall include land and community title subdivisions. Design of these devices shall be in accordance with the ***Managing Urban Stormwater, Soils and Construction Manual, NSW Department of Housing, August 1998***.

16.3 Intergrated developments

Any development within 40m of a water body such as a stream, creek, lagoon, or river may require a Part 3a Permit under DLWC Guidelines and The Rivers and Foreshores Improvement Act 1948. A development of this nature is classified as an Integrated Development. Advice should be sought from Council in this regard.

17. SUBMISSION OF DESIGN DETAILS

17.1 Submission details

A drainage concept plan must be submitted with the Development Application. Detailed design drawings and calculations of the proposed stormwater drainage system must be submitted and approved prior to the issue of the Construction Certificate by a suitably qualified person with experience in stormwater design.

17.2 Information to be submitted

Engineering drawings shall be submitted as follows:

- A1 size drawing sheets at an appropriate scale of 1: 100, 1:200 or 1:500
- Showing the layout of the proposed drainage system including the location of all downpipes, kerbs, channels, open drains, pits and pipes
- Showing the size and class of all stormwater conduits, grades, and pit dimensions
- Showing the invert and surface levels of all pipes and pits
- Showing the finished surface levels of any open channels, drains, or swales
- Showing the location of all buildings, driveways, impervious and pervious surfaces
- Showing the finished surface levels of paved areas, unpaved areas, building floors and garages
- Showing the flow widths and depth of ponding across road carriageways and floodways for the minor storm event, if any
- Showing the overland flowpath for the major storm event
- Showing the extent of flow and depth of ponding for the major storm event
- Showing cross section details of any open channels, drains, or swales
- Where drainage easements are required, the location of the proposed easement for stormwater drainage and legal agreements
- Showing a longitudinal section of the piped system to the point of connection including pipe sizes, class, gradients, flowrates and a hydraulic grade line
- Showing details of the On-site Stormwater Detention System (OSD) or On-site Absorption (OSA) facilities, if any, in accordance with Council's ***Specification for On-site Stormwater Management***
- Include supporting computation information on 3½" computer disc (where applicable) and hard copy with relevant hydrologic and hydraulic information and calculations
- Showing the location of any utility services, structures, trees, etc., which may affect the proposed drainage system. **Note**: It is the responsibility of the applicant to submit full details of all relevant services, which may conflict with the proposed design. The exact locations of any crossings or connections are to be shown.

Before Council can issue the Final Certificate, upon completion of the works, the following must be submitted:

- Works-as-executed drawings. An engineering survey of the final works is to be submitted on one (1) set of the approved plans. This plan is to include all finished surface levels of pits, the location of all drainage pipes, sizes and levels, etc., and signed by a Registered Surveyor.
- Copies of Titles showing the creation of *easements, Positive Covenants,* and *restrictions on the land*, where applicable

- Certification of the constructed drainage system by a suitably qualified and experienced Chartered Professional Engineer, on the National Professional Engineers Register with the Australian Institute of Engineers.

APPENDIX

Appendix 1

Design Rainfall Intensity

Appendix 2

Drawing No. 1: Connection to kerb detail, location of foundations near easements detail

A1: DESIGN RAINFALL INTENSITY DIAGRAM

LOCATION 33.800 S 151.250 E : NEAR.. Balgowlah ISSUED 24TH OCTOBER 2000 REF.-FN5431

PREPARED BY -- HYDROMETEOROLOGICAL ADVISORY SERVICE -- MELBOURNE

(C) COMMONWEALTH OF AUSTRALIA, BUREAU OF METEOROLOGY 1987

* ENSURE THE COORDINATES ARE THOSE REQUIRED, SINCE DATA IS BASED ON THESE AND NOT THE LOCATION NAME.

LIST OF COEFFICIENTS TO EQUATIONS OF THE FORM

$$LN(I) = A + B*(LN(T)) + C*(LN(T))**2 + D*(LN(T))**3 + E*(LN(T))**4 + F*(LN(T))**5 + G*(LN(T))**6$$

T = TIME IN HOURS I = INTENSITY IN MILLIMETRES PER HOUR

RETURN PERIOD (YEARS)	A	B	C	D	E	F	G
1	3.4046	-.5766	-.0263	.00657	-.000270	-.0003592	.0000277
2	3.6698	-.5747	-.0281	.00641	.000005	-.0003454	.0000199
5	3.9567	-.5696	-.0401	.00607	.001213	-.0003253	-.0000165
10	4.0966	-.5676	-.0453	.00630	.001665	-.0003614	-.0000221
20	4.2515	-.5655	-.0499	.00627	.002154	-.0003713	-.0000331
50	4.4280	-.5625	-.0552	.00791	.002772	-.0003418	-.0000546
100	4.5425	-.5609	-.0586	.00765	.003106	-.0003419	-.0000634

RAINFALL INTENSITY IN MM/HR FOR VARIOUS DURATIONS AND RETURN PERIODS

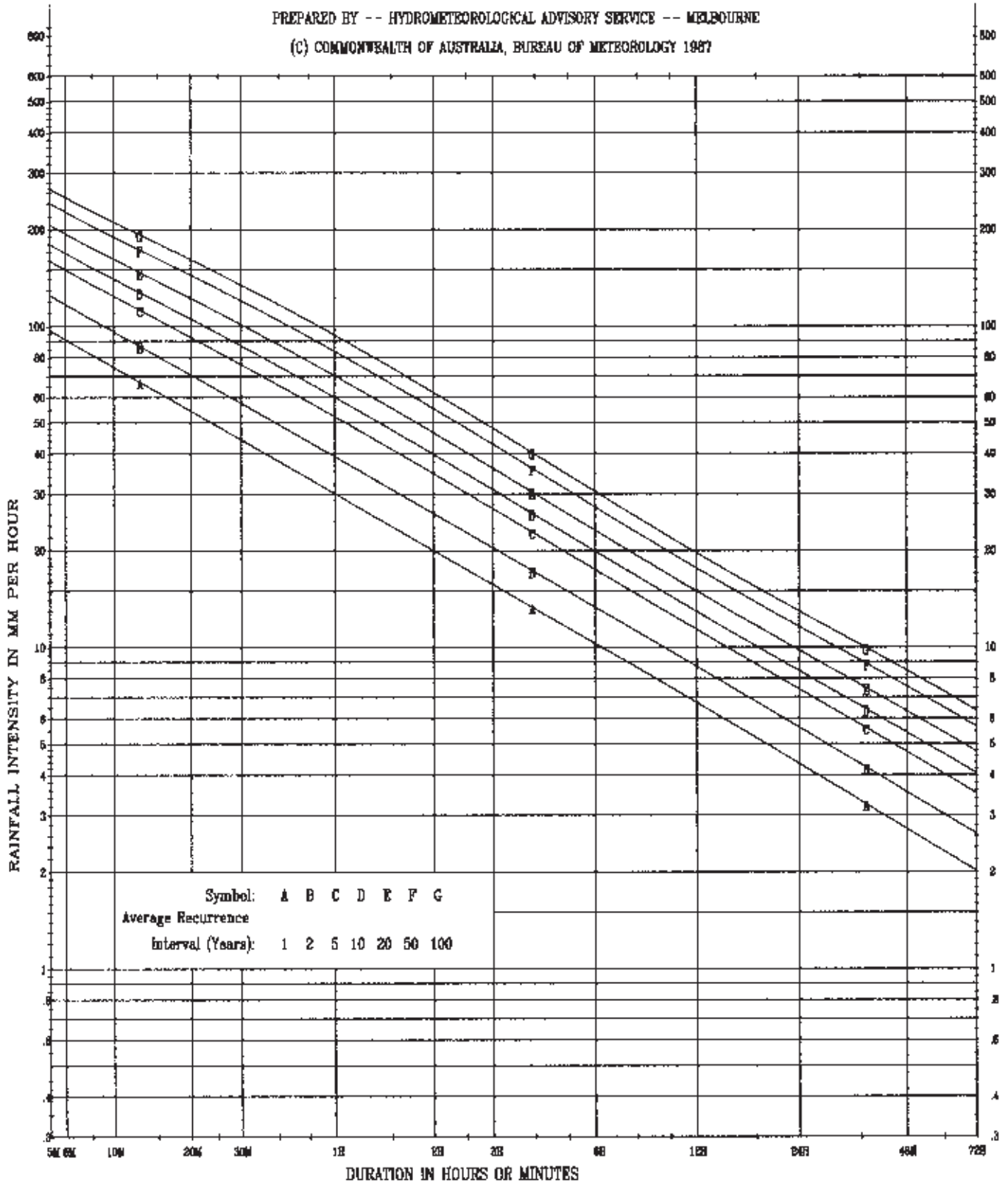
DURATION (HOURS)	RETURN PERIOD 1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
.083	97.1	125.	160.	180.	207.	241.	268.
.100	90.9	117.	150.	169.	194.	227.	252.
.167	74.4	96.1	124.	140.	162.	189.	211.
.333	54.4	70.5	92.4	105.	122.	144.	161.
.500	44.2	57.5	75.9	86.9	101.	120.	134.
1.000	30.1	39.2	52.3	60.1	70.2	83.6	93.9
2.000	20.0	26.1	34.7	39.9	46.6	55.3	62.1
3.000	15.6	20.4	27.0	30.9	36.0	42.7	47.9
6.000	10.3	13.3	17.6	19.9	23.1	27.3	30.5
12.000	6.72	8.70	11.3	12.9	14.8	17.6	19.7
24.000	4.35	5.63	7.40	8.43	9.79	11.5	12.9
48.000	2.72	3.54	4.72	5.42	6.32	7.54	8.48
72.000	2.01	2.63	3.51	4.06	4.73	5.65	6.36

DESIGN RAINFALL INTENSITY DIAGRAM

LOCATION 33.800 S 151.250 E ' NEAR.. Balgowlah

ISSUED 24TH OCTOBER 2000 REF. -FN5431

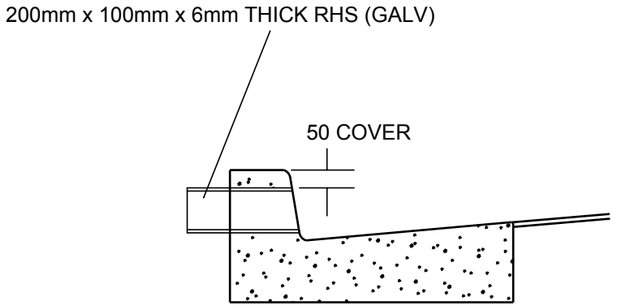
PREPARED BY -- HYDROMETEOROLOGICAL ADVISORY SERVICE -- MELBOURNE



A2: DRAWING NO. 1: CONNECTION TO KERB DETAIL, LOCATION OF FOUNDATIONS NEAR EASEMENTS DETAIL

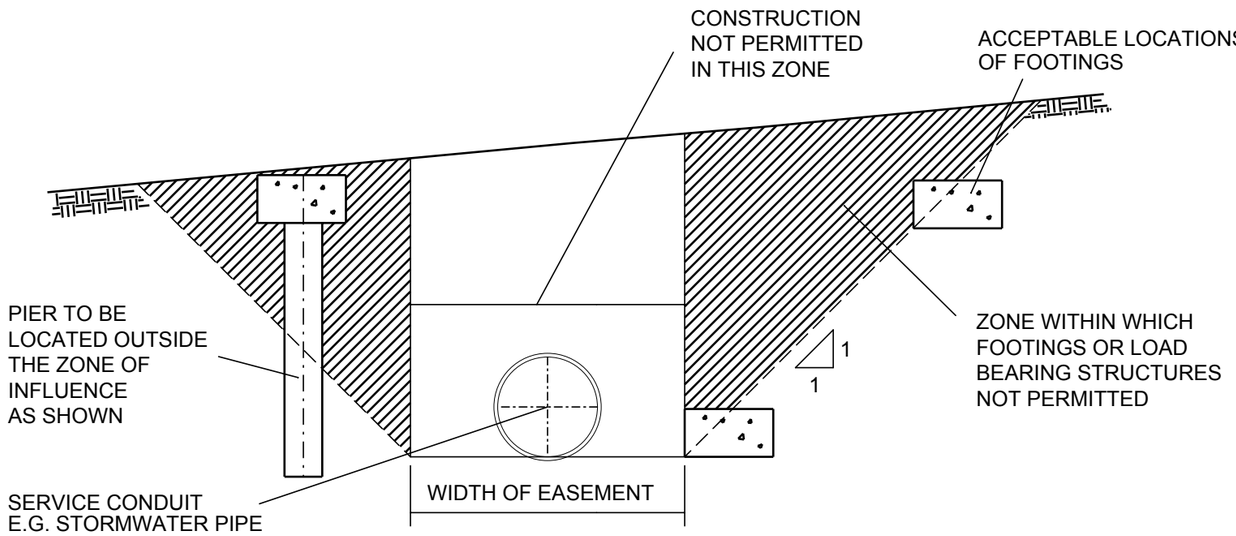
CONNECTION TO KERB NOTES

CONVERT 150mm-DIA PIPE WITHIN PROPERTY, TO A 200 x 100 x 6 RHS (GALVANISED) ACROSS THE FOOTPATH. A JUNCTION PIT 300 x 300 OR 450 x 450 SHALL BE CONSTRUCTED WITHIN THE PROPERTY. CONNECTION TO THE KERB ACROSS THE FOOTPATH IS TO BE MAXIMUM OF 45 DEGREES FROM THE KERB TO THE PROPERTY LINE



CONNECTION TO KERB DETAIL

N.T.S.



LOCATION OF PIER AND FOOTINGS NEAR EASEMENTS

N.T.S.

FOUNDATIONS NEAR EASEMENT NOTES

1. FOOTINGS REFERS TO ALL LOAD BEARING STRUCTURES FOR BUILDINGS, WALLS, THE UNDERSIDE OF POOLS, FLOOR SLABS AND OTHER STRUCTURES, SUBJECT TO COUNCIL'S APPROVAL.

2. FILLING OR EXCAVATING THE NATURAL SURFACE WITHIN THE EASEMENT BOUNDARIES, IS NOT PERMITTED.

3. PRIOR TO ANY WORK, EXCAVATION, OR FILLING NEAR THE EASEMENT, THE EDGE OF THE EASEMENT SHALL BE PEGGED AND THE PIPE WITHIN THE EASEMENT EXPOSED AT EACH END TO DETERMINE THE EXACT LOCATION OF THE PIPE.

4. WHERE THE FOOTINGS ARE TO BE FOUNDED ON ROCK, THE SOUNDNESS AND DEPTH OF THE ROCK SHALL BE DETERMINED BY EXCAVATION ADJACENT TO THE PIPE.

5. WHERE A PERMANENT EXCAVATION IS TO BE MADE WITHIN 2.0 METRES OF THE EASEMENT, TO A LEVEL BELOW THE OBVERT OF THE PIPE, PROVISION SHALL BE MADE FOR FUTURE SUPPORT OF THE PIPE, COLLECTION OF SEEPAGE WATER ALONG THE LINE OF THE PIPE TRENCH AND ACCESS FOR MAINTENANCE OR UPGRADE. COUNCIL WILL NOT ACCEPT LIABILITY FOR DAMAGE OR NUISANCE CAUSED BY SEEPAGE.

CIVILCAD ******AUTOCAD	MC1.DWG			
REVISION DETAILS		DRAWN	APPROV.	DATE
A	TO COMPLY WITH DA CONSENT	TL		03/02

DATUM AHD

FIELD BOOKS | LEVEL BOOKS

SURVEYED	N.A.	***
DRAWN	TL	05/02
DESIGNED	N.A.	05/02
CHECKED		

PLANNING + STRATEGY GROUP

RECOMMENDED GROUP MANAGER P+S

APPROVED DIRECTOR P+S

STANDARD DETAILS

MANLY COUNCIL

CONNECTION TO KERB DETAIL
LOCATION OF FOUNDATIONS NEAR EASEMENTS DETAIL

FILE No | REV. | SHT 1 of 10 | PLAN No *****