COFFS HARBOUR CITY COUNCIL

DEVELOPMENT SPECIFICATION
DESIGN

0074 Stormwater drainage (Design)

Version 1 01 January 2009

0074 STORMWATER DRAINAGE (DESIGN)

1 SCOPE AND GENERAL

1.1 SCOPE

The worksection sets out the design of stormwater drainage systems for urban and rural areas.

Note: Where a Council is not the asset owner or contract Principal carrying out the works, the term 'Council' may need to be replaced throughout this document by another term such as 'Superintendent'.

1.2 OBJECTIVES

The objectives of stormwater drainage design are as follows:

- To ensure that inundation of private and public buildings located in flood-prone areas occurs only on rare occasions and that, in such events, surface flow routes convey floodwaters below the prescribed velocity/depth limits.
- To provide convenience and safety for pedestrians and traffic in frequent stormwater flows by controlling those flows within prescribed limits.
- Retain within each catchment as much incident rainfall and runoff as is possible and appropriate for the planned use and the characteristics of the catchment.

1.3 DESIGN PRINCIPLES

General

Works are to provide a stormwater drainage system in accordance with the 'major/minor' system concept set out in Australian Rainfall & Runoff, (AR&R); that is, the 'major' system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events while the 'minor' system shall be capable of carrying and controlling flows from frequent runoff events.

Reconstruction

Where the proposed works replaces an existing facility, the on-site drainage system is to be designed in such a way that the estimated peak flow rate from the site for the design average recurrence interval (ARI) of the receiving minor system is no greater than that which would be expected from the existing facility.

1.4 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements:

Worksection

0160 Quality (Design)

Standards

AS/NZS 1254	PVC pipes and fittings for storm and surface water applications
AS/NZS 2032	Installation of PVC pipe systems
AS 2200	Design charts for water supply and sewerage
AS/NZS 3725	Loads on buried concrete pipes
AS/NZS 4058	Precast concrete pipes (pressure and non-pressure)
AS 4139	Fibre reinforced concrete pipes and fittings
AS/NZS 2566	Buried flexible pipelines
AS/NZS 2566.1	Structural design
AS/NZS 2566.2	Installation
AS/NZS 5065	Polyethylene and polypropylene pipes for drainage and sewerage applications

Other publications

Engineers Australia

Australian Rainfall and Runoff (AR&R)—A guide to flood estimation

Concrete Pipe Association of Australasia

Refer to www.concpipe.asn.au for the design of steel reinforced concrete pipelines.

Hydraulic Design Manual for precast concrete pipes.

Australian National Conference On Large Dams, Leederville WA.

ANCOLD, Guidelines on Acceptable Flood Capacity for Dams (2007).

1.5 BIBLIOGRAPHY

Worksections

1121 Open drains including kerb & channel gutter

1352 Pipe drainage

1353 Precast box culverts

1354 Drainage structures

Standards

AS 5100 Bridge design

Other publications

NSW RTA

Model Analysis to determine Hydraulic Capacities of Kerb Inlets and Gully Pit Gratings, 1979

Queensland Urban Drainage Manual, Volumes 1 & 2, 1993

Sangster, WM., Wood, H.W., Smerdon, E.T. and Bossy, H.G. Pressure changes at storm drain junction, engineering series, Bulletin No. 41, Eng. Experiment Station, Univ. of Missouri 1958

Hare C.M. Magnitude of Hydraulic Losses at Junctions in Piped Drainage Systems. Transactions, Inst. of Eng. Aust., Feb. 1983

Henderson, F.M. Open Channel Flow, 1966

Chow, Ven Te Open Channel Hydraulics, 1959

John Argue—Australian Road Research Board Special Report 34 Stormwater drainage design in small urban catchments: A handbook for Australian practice

2 HYDROLOGY

2.1 DESIGN RAINFALL DATA

Intensity-Frequency-Duration (IFD) relationships

Design Intensity-Frequency-Duration (IFD)—Rainfall relationships shall be derived in accordance with Volume 1 of Australian Rainfall and Runoff (AR&R), for the particular catchment under consideration.

The nine basic parameters read from Volume 2 of AR&R shall be shown in the calculations as approved by the Designer, except where the Bureau of Meteorology provides a polynomial relationship for the catchment.

Where design IFD rainfalls are provided for specific locations these are provided in Council's current Handbook of Drainage Design Criteria (refer to Appendix A).

Average recurrence intervals

Design Average Recurrence Intervals (ARI) for minor systems are given below:

- 10 years for commercial
- 5 years for residential areas / industrial areas
- 5 years for rural residential areas
- 1 year for parks and recreation areas

Recurrence intervals for minor events depends on the zoning of the land being serviced by the drainage system.

Easements in private property

Where works are designed in such a way that the major system flows involve surcharge across private property, then the underground system (both pipes and inlets) shall be designed to permit flows into

and contain flows having an ARI of 100 years from the upstream catchment which would otherwise flow across the property.

A surcharge path shall be defined for systems even where 100 year ARI flows can be maintained within the system. Easements are to be provided in private property over pipe systems and surcharge paths.

2.2 CATCHMENT AREA

The catchment area of any point is defined by the limits from where surface runoff will make its way, either by natural or man made paths, to this point. Consideration shall be given to likely changes to individual catchment areas due to the full development of the catchment.

Where no detailed survey of the catchment is available, 1:4000 orthophoto maps are to be used to determine the catchments and to measure areas.

Catchment area land use shall be based on current available zoning information or proposed future zonings, where applicable.

2.3 RATIONAL METHOD

General

Rational Method calculations to determine peak flows shall be carried out in accordance with Volume 1 of AR&R and the requirements of this worksection.

Qualified person

All calculations shall be carried out by a qualified person experienced in hydrologic and hydraulic design.

Run-off co-efficients

Co-efficients of run-off shall be calculated as per Volume 1 of AR&R and full details of co-efficients utilised shall be provided.

Details of percentage impervious and co-efficients of run-off for specific locations and for individual zonings may be given in Council's current Handbook of Drainage Design Criteria (refer Appendix A). These can be used in lieu of more detailed calculations.

Time of concentration

The time of concentration of a catchment is defined as the time required for storm runoff to flow from the most remote point on the catchment to the outlet of the catchment.

Flow time

Where the flow path is through areas having different flow characteristics or includes property and roadway, then the flow time of each portion of the flow path shall be calculated separately.

The maximum time of concentration in an urban area shall be 20 minutes unless sufficient evidence is provided to justify a greater time.

Flow paths to pits

Flow paths to pits shall be representative of the fully developed catchment considering such things as fencing and the likely locations of buildings and shall be shown for each collection pit on the catchment area plan. Consideration shall be given to likely changes to individual flow paths due to the full development of the catchment.

Surface roughness co-efficient ('n')

Surface roughness co-efficients 'n' shall generally be derived from information in Volume 1 of AR&R. Values applicable to specific zoning types and overland flow path types are given in Table 2.1.

Table 2.1 Specific zoning 'n' values

Type of flow	'n'
Across parks	0.35
Across rural residential land	0.30
Across residential (2a)	0.21
Across residential (2b)	0.11
Across industrial	0.06
Across commercial	0.04
Across paved areas	0.01

Type of flow	'n'
Across asphalt roads	0.02
Across gravel areas	0.02

2.4 ALTERNATIVE MODELS AND COMPUTER ANALYSIS

Other hydrological models may be used as long as the requirements of AR&R are satisfied, summaries of calculations are provided and details are given of all program input and output.

A sample of a summary sheet for hydrological calculations is given in Council's current *Handbook of Drainage Design Criteria (refer Appendix A).*

Where computer analysis programs are used, copies of the final data files shall be provided on submission of the design to the Superintendent and with the final Drawings.

Details on the use of specific programs and additional requirements when using these are given in Council's current *Handbook of Drainage Design Criteria* (refer Appendix A).

3 HYDRAULICS

3.1 HYDRAULIC GRADE LINE

Calculations

The calculations shall generally be carried out in accordance with AR&R and shall substantiate the hydraulic grade line adopted for design of the system and shown on the Drawings.

Summaries of calculations are added to the plan and details of all calculations are given including listings of all programme input and output.

A sample of a summary sheet for hydraulic calculations is given in the Council's current Handbook of Drainage Design Criteria (refer Appendix A).

Qualified person

All hydraulic calculations shall be undertaken by a qualified person experienced in hydrologic and hydraulic design.

Major/minor systems

The 'major' system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events while the 'minor' system shall be capable of carrying and controlling flows from frequent runoff events.

Downstream control

The downstream water surface level requirements are given below:

- Known hydraulic grade line level from downstream calculations including pit losses at the starting pit in the design event.
- Where the downstream starting point is a pit and the hydraulic grade line is unknown, a level of 0.15 m below the invert of the pit inlet in the downstream pit is to be adopted.
- Where the outlet is an open channel and the design storm is the minor event the top of the outlet pipe shall be the downstream control.
- Where the outlet is an open channel, the design storm is the major event and downstream flood levels are not known, the top of the outlet pipe shall be the downstream control.
- Where the outlet is an open channel, the design storm is the major event and downstream flood levels are known, the downstream control shall be the 1% probability flood level.

Water surface limits

The water surface in drainage pits shall be limited to 0.150 m, below the gutter invert for inlet pits and 0.150 m below the underside of the lid for junction pits.

3.2 MINOR SYSTEM CRITERIA

Gutter flow widths

The acceptable gutter flow widths in the 20% probability event is 2.5 metres maximum. Wider flow widths may be approved on roads with flat grades.

Conduit sizes
Minimum conduit sizes shall be as follows:

Pipes—375 mm diameter.

Box culverts—600 mm wide × 300 mm high.

Velocity limits
Minimum and maximum velocity of flow in stormwater pipelines shall be 0.6 m/sec and 6 m/sec respectively.

3.3 PITS

Spacing
Inlet Pits shall be spaced so that the gutter flow width is limited in accordance with this worksection and so that the inlet efficiency is not affected by adjacent inlet openings. Preference shall be given to the location of drainage pits at the upstream side of allotments.

Other pits shall be provided:

- To enable access for maintenance.
- At changes in direction, grade, level or class of pipe.
- At junctions.

The maximum recommended spacing of pits where flow widths are not critical are given in Table 3.1:

TABLE 3.1 PIT SPACING

	Pipe size (mm)	**Spacing (m)**
Generally	less than 1200	100
	1200 or larger	150
In tidal influence	all	100

Inlet capacity
Kerb inlet lengths to side entry pits are to be a preferred maximum of 3.0 m, with an absolute maximum of 5.0 m where the grade is 10% or more, and an absolute maximum of 4.0 m where the grade is less than 10%

Information on pit capacities is available in the following sources:

- *Council's current Handbook of Drainage Design Criteria*.
- Pit relationships—Volume 1 of AR&R.
- Roads and Traffic Authority's "Model analysis to determine Hydraulic Capacities of Kerb Inlets and Gully Pit Gratings", with due allowance to inlet bypass due to grade, for grade inlet pits, and recognised orifice or weir formulae for sag inlet pits.

Allowable pit capacities
None of the AR&R pit charts include any blockage factors. The percentage of theoretical capacity allowed in relation to type of pit is given in Table 3.2:

Table 3.2 Allowable pit capacities

Condition	**Inlet type**	**Percentage of theoretical capacity allowed**
Sag	Side entry	80%
Sag	Grated	50%
Sag	Combination	Side inlet capacity only Grate assumed completely blocked
Sag	'Letterbox'	50%
Continuous Grade	Side entry	80%
Continuous Grade	Grated	50%
Continuous Grade	Combination	90%

3.4 HYDRAULIC LOSSES

Pits

The pressure change co-efficient 'K_e' shall be determined from the appropriate charts given in council's current *Handbook of Drainage Design Criteria*.

Allowable reduction in 'K_e' due to benching is given in Council's current *Handbook of Drainage Design Criteria*.

Computer program default pressure change co-efficient 'K_e' shall not be acceptable unless they are consistent with those from the charts in Council's current *Handbook of Drainage Design Criteria*.

The chart used and relevant co-efficients for determining 'K_e' value from that chart shall be noted on the hydraulic summary sheet provided for plan checking and included on the final design drawings.

Bends

Bends may be permissible in certain circumstances and discussions with the Superintendent regarding their use is required prior to detailed design.

Appropriate values of pit pressure change co-efficient at bends are given in Council's current *Handbook of Drainage Design Criteria*.

Service entries

Where possible design should try to avoid clashes between services. However, where unavoidable clashes occur with existing sewer mains then the pressure change co-efficient Kp shall be determined from the chart given in Council's current *Handbook of Drainage Design Criteria*.

Requirements for private pipes entering Council's system are given below:

- All pipe inlets, including roof and subsoil pipes, shall where possible, enter the main pipe system at junction pits. These shall be finished off flush with and be grouted into the pit wall.
- If a junction has to be added which is larger than 225 mm then a junction pit shall be built at this location in accordance with this worksection.

Pipe junctions

Construction of a junction without an inlet structure should be avoided where possible. Permission to do this is required by Council prior to detailed design.

Where this is unavoidable the pressure change co-efficients K_u, for the upstream pipe and K_l, for the lateral pipe, shall be determined from the chart given in Council's current *Handbook of Drainage Design Criteria.*

Contraction/expansion

Going from larger upstream to smaller downstream conduits is not permitted without approval of Council prior to detailed design.

In going from smaller to larger pipes benching shall be provided in pits to enable a smooth flow transition. Losses in sudden expansions and contractions are given in Council's current *Handbook of Drainage Design Criteria.*

Pipe friction

Drainage pipe systems shall be designed as an overall system, with due regard to the upstream and downstream system and not as individual pipe lengths.

Drainage pipeline systems shall generally be designed as gravity systems flowing full at design discharge, but may be pressurised with the use of appropriate pits and joints.

Pipe friction losses and pipe sizes in relation to discharge shall be determined using the Colebrook-White formula with the acceptable roughness co-efficients nominated in AS 2200.

3.5 MAJOR SYSTEM CRITERIA

Surcharging

Surcharging of drainage systems which would provide for water depth above the top of kerb is not permitted except:

- Surcharging of drainage system for storm frequencies greater than 5% probability may be permitted across the road centreline where the road pavement is below the natural surface of the adjoining private property.
- Flow across footpaths will only be permitted in situations specifically approved by Council, where this will not cause flooding of private property.

Velocity/depth criteria

The velocity × depth product of flow across the footpath and within the road reserve shall be such that safety of children and vehicles is considered.

The maximum allowable depth of water is 0.2 metres and the maximum velocity × depth product of 0.4 m^2/s is permitted.

Where the safety of only vehicles can be affected, a maximum velocity × depth product of 0.6 m^2/s is permitted.

In open channels the above velocity × depth product criteria will be followed where possible or the design shall address the requirements for safety in relation to children by providing safe egress points from the channel or other appropriate methods.

Freeboard

Freeboard requirements for floor levels and levee bank levels from flood levels in roadways, stormwater surcharge paths and open channels are given below:

- In roadways:
  - . A minimum freeboard of 0.3 m shall be provided between the 100 year flood level and floor levels on structures and entrances to underground car parks. A higher freeboard may be required in certain circumstances.
  - . Where the road is in fill or overtopping of kerbs and flow through properties may occur a 100 mm freeboard shall be provided between the ponding level of water in the road and the high point in the footpath. Driveway construction in these instances needs to consider this requirement.
- In stormwater surcharge paths—A minimum freeboard of 0.3 m shall be provided between the 100 year flood level and floor levels on structures and entrances to underground car parks.
- In open channels—A minimum freeboard of 0.5 m shall be provided between the 100 year flood level and floor levels on structures and entrances to underground car parks.

Roadway capacities

Road capacity charts are provided in the Council's current Handbook of Drainage Design Criteria for some standard road designs.

For other road designs, flow capacities of roads should be calculated using Volume 1 of AR&R with a flow adjustment factor as given in Council's current Handbook of Drainage Design Criteria.

3.6 OPEN CHANNELS

Criteria

Design of open channels shall be in accordance with Volume 1 of AR&R. Open channels shall be designed to contain the major system flow less any flow that is contained in the minor system, with an appropriate allowance for blockage of the minor system.

Location

Generally, open channels will only be permitted where they form part of the trunk drainage system and shall be designed to have smooth transitions with adequate access provisions for maintenance and cleaning.

Where Council permits the use of an open channel to convey flows from a works site to the receiving water body, such a channel shall comply with the requirements of this worksection.

Channel roughness

Friction losses in open channels shall be determined using Mannings 'n' values given in Table 3.3. Mannings 'n' Roughness Co-efficients for open channels shall generally be derived from information in AR&R. Mannings 'n' values applicable to specific channel types are given in Table 3.3.

Safety of persons

Where the product of average Velocity and average flow Depth for the design flow rate is greater than 0.4 m^2/s, the design will be required to specifically provide for the safety of persons who may enter the channel in accordance with Volume 1 of AR&R.

Side slopes

Maximum side slopes on grassed lined open channels shall be 1 in 4, with a preference given to 1 in 6 side slopes, channel inverts shall generally have minimum cross slopes of 1 in 20.

Low flows

Low flow provisions in open channels (man-made or altered channels) will require low flows to be contained within a pipe system or concrete lined channel section at the invert of the main channel.

Subsurface drainage shall be provided in grass lined channels to prevent waterlogging of the channel bed. The width of the concrete lined channel section shall be the width of the drain invert or at least sufficiently wide enough to accommodate the full width of a tractor.

Hydraulic jumps

Transition in channel slopes to be designed to avoid or accommodate any hydraulic jumps due to the nature of the transition.

Table 3.3 Specific channel type 'n' values

Channel type	**'n'**
Concrete pipes or box sections	0.011
Concrete (trowel finish)	0.014
Concrete (formed without finishing)	0.016
Sprayed concrete (gunite)	0.018
Bitumen seal	0.018
Bricks or pavers	0.015
Pitchers or dressed stone on mortar	0.016
Rubble masonry or random stone in mortar	0.028
Rock lining or rip-rap	0.028
Corrugated metal	0.027
Earth (clear)	0.022
Earth (with weeds and gravel)	0.028
Rock cut	0.038
Short grass	0.033
Long grass	0.043

3.7 MAJOR STRUCTURES

Criteria

All major structures in urban areas, including bridges and culverts, shall be designed for the 100 year ARI storm event without afflux.

Some afflux and upstream inundation may be permitted in certain rural and urban areas provided the increased upstream flooding is minimal and does not inundate private property.

A minimum clearance of 0.3 m between the 100 year ARI flood level and the underside of any major structure superstructure is required to allow for passage of debris without blockage.

Design by certified persons

Certified structural design in accordance with *0160 Quality (Design)* shall be required on bridges and other major culvert structures and may be required on some specialised structures where the Superintendent deems necessary.

Culverts

Culverts (either pipe or box section) shall be designed in accordance with charts provided in Council's current Handbook of Drainage Design Criteria, with due regard being given to inlet and exit losses, inlet and outlet control and scour protection.

Retarding basins

Critical storm duration

For each ARI a range of storm events shall be run to determine the peak flood level and discharge from the retarding basin.

Storm patterns shall be those given in Volume 1 of AR&R. Sensitivity to storm pattern should be checked by reversing these storm patterns.

The critical storm duration with the retarding basin is likely to be longer than without the basin.

A graph showing the range of peak flood levels in the basin and peak discharges from the basin shall be provided for the storms examined.

Routing

Flood routing should be modelled by methods outlined in AR&R.

High level outlet

The high level outlet to any retarding basin shall have capacity to contain a minimum of the 100 year ARI flood event. Additional spillway capacity may be required due to the hazard category of the structure.

The hazard category should be determined by reference to ANCOLD.

The spillway design shall generally be in accordance with the requirements for Open Channel Design in this worksection.

Salinity prevention

Wherever practical and certainly in areas known to be affected by high water tables and/or salinity of groundwater, retarding basins shall be designed to be water retentive so that surface drainage water does not leak to the subsurface, recharging groundwater.

Pipe systems shall contain the minor flow through the Retarding Basin wall.

Outlet pipes shall be rubber ring jointed with lifting holes securely sealed.

Pipe and culvert bedding shall be specified to minimise its permeability, and cut off walls and anti-seepage collars installed where appropriate.

Low flow provision

The low flow pipe intake shall be protected to prevent blockages.

Freeboard at dwellings

Minimum floor levels of dwelling shall have a freeboard of 0.5 m above the 100 year ARI flood level in the basin.

Public safety issues

Basin design is to consider the following aspects relating to public safety:

- Side slopes are to be a maximum of 1 in 6 to allow easy egress. Side slopes of greater than 1 in 4 may require handrails to assist in egress.
- Water depths shall be, where possible, less than 1.2 m in the 20 year ARI storm event. Where neither practical or economic greater depths may be acceptable. In that case the provision of safety refuge mounds should be considered.
- The depth indicators should be provided indicating maximum depth in the basin.
- Protection of the low flow intake pipe shall be undertaken to reduce hazards for people trapped in the basin.
- Signage of the spillway is necessary to indicate the additional hazard.
- Basins shall be designed so that no ponding of water occurs on to private property or roads.
- No planting of trees in basin walls is allowed.
- No basin spillway is to be located directly upstream of urban areas.
- Submission of design Drawings to the Dam Safety Committee is required where any of these guidelines are not met or Council specifically requires such submission.

4 STORMWATER DETENTION

4.1 CRITERIA

Installation of stormwater detention is required on work sites within the Council area where under capacity drainage systems exist.

Installation of Stormwater Detention is required on redevelopment sites within the Council area where under capacity drainage systems exist.

A redevelopment site is defined as a site which used to have or was originally zoned to have a lower density development than is proposed.

4.2 SALINITY PREVENTION

Location of basins for stormwater detention, stormwater treatment or sedimentation purposes shall avoid areas that are known to be permanent or seasonal groundwater discharge areas. This action reduces the likelihood of recharge into the groundwater.

The requirements for stormwater detention design are outlined in the Council's current Handbook for Drainage Criteria.

5 INTERALLOTMENT DRAINAGE

5.1 CRITERIA

Interallotment drainage shall be provided for every allotment which does not drain directly to its frontage street or a natural watercourse.

Interallotment drainage shall be contained within an easement not less than 1.0 m wide, and the easement shall be in favour of the upstream allotments.

The interallotment drain shall be designed to accept concentrated drainage from buildings and paved areas on each allotment for flow rates having a design ARI the same as the 'minor' street drainage system.

In lieu of more detailed analysis, the areas of impervious surface given in Table 5.1 are assumed to be contributing runoff to the interallotment drain.

Table 5.1 Runoff contribution to interallotment drains

Development type	% of lot area
Residential (2a)	40
Residential (2b)	70
Industrial	80
Commercial	90

5.2 PIPES

Pipes shall be designed to flow full at the design discharge without surcharging of inspection pits.

Pipes shall be constructed with rubber ring joins and be of either fibre reinforced concrete, reinforced concrete, PVC, Polypropylene or flexible which shall conform respectively to the requirements of AS 4139, AS/NZS4058, AS/NZS1254 and AS/NZS 5065.

The interallotment drainage pipes shall have a minimum longitudinal gradient of 0.5%.

5.3 PITS

Interallotment drainage pits shall be located at all changes of direction. Pits shall be constructed of concrete, with 100 mm thick walls and floor and have a minimum 600 × 600 internal dimensions.

Pits shall be with a 100 mm concrete lid finished flush with the surface of works. Depressed grated inlets are acceptable.

5.4 SEWER MAINS RELATIONSHIP

Where interallotment drainage and sewer mains are laid adjacent to each other they are to be spaced 1.5 metres between pipe centrelines (where the pipe inverts are approximately equal).

Where there is a disparity in level between inverts the spacing is to be submitted for approval.

Where sewer mains are in close proximity to interallotment drainage lines they are to be shown on the interallotment drainage plan.

6 DETAILED DESIGN

6.1 CONDUITS

Materials

Conduits and materials shall be in accordance with the standards detailed in Council's current *Handbook for Drainage Design Criteria*.

Bedding and cover

Pipe bedding and cover requirements for reinforced and fibre reinforced concrete pipes shall be determined from the *Concrete Pipe Association* refer to www.concpipe.asn.au or AS/NZS 3725. For PVC and PP pipes, the requirements shall be to AS/NZS 2032.

Particular situations may be identified during the design of works for the use of buried flexible pipes in accordance with AS/NZS 2566.1 and submitted for approval by the Superintendent. Council.

Jointing
Conduit jointing shall be in accordance with Council's current Handbook for *Drainage Design Criteria.*

Location
Drainage lines in road reserves shall generally be located behind the kerb line and parallel to the kerb. Drainage lines in easements over private property shall generally be centrally located within easements.

Bulkheads
Bulkheads shall be designed on drainage lines where the pipe gradient exceeds 5%. The design details shall address the size, and position in the trench as well as spacing along the line.

6.2 PITS

Pits shall be designed with benching to improve hydraulic efficiency and reduce water ponding. Typical pit designs and other pit design requirements are included in Council's current Handbook for Drainage Design.

Safety and safe access are important considerations in pit design. Step irons (where required) shall be detailed and grates shall be of 'bicycle safe' design.

A list of the Standards or Codes relevant to pit designs are included in Council's current *Handbook for Drainage Design.*

6.3 STORMWATER DISCHARGE

Salinity prevention
Stormwater discharge shall be located so as to avoid recharging groundwater and creating or worsening salinity degradation of adjacent land.

Stormwater discharge shall be located to avoid areas with high groundwater tables, groundwater discharge areas or salt affected land.

The Designer shall meet requirements of the appropriate land and water resources authority with regard to the salinity levels of discharge to natural watercourses.

Scour protection
Scour protection at culvert or pipe system outlets shall be constructed in accordance with guidelines set down in Council's current Handbook of Drainage Design Criteria unless outlet conditions dictate the use of more substantial energy dissipation arrangements.

Kerb and channel (gutter) termination
Kerb and channel (gutter) shall be extended to drainage pit or natural point of outlet. Where outlet velocity is greater than 2.5 m per second or where the kerb and gutter discharge causes scour, then protection shall be provided to prevent scour and dissipate the flow.

Easements, adjoining owners
Where required by the consent authority, at points of discharge of gutters or stormwater drainage lines or at any concentration of stormwater on to adjoining properties, either upstream or downstream, the Superintendent shall arrange for a Deed of Agreement with the adjoining owner(s) granting permission to the discharge of stormwater drainage and the creation of any necessary easements.

Other authorities' requirements
Where the drainage is to discharge to an area under the control of another statutory authority, e.g. Public Works, the design requirements of that Statutory Authority shall be met.

Minimum easement width
The minimum drainage easement width shall be 3.0 m for Council drainage systems. The overall width of the easement in Council's favour will be such as to contain the full width of overland flow or open channel flow in the major system design event.

Discharge to recreation reserves
Piped stormwater drainage discharging to recreation reserves is to be taken to a natural water course and discharged in an approved outlet structure or alternatively taken to the nearest trunk stormwater line.

6.4 TRENCH SUBSOIL DRAINAGE

Subsoil drainage shall be provided in pipe trenches in cases where pipe trenches are backfilled with sand or other pervious material.

A 3 m length of subsoil drain shall be constructed in the bottom of the trench immediately upstream from each pit or headwall.

The subsoil drain shall consist of 100 mm diameter agricultural pipes, butt jointed with joints wrapped with hessian, or slotted PVC pipe.

The upstream end of the subsoil drain shall be sealed with cement mortar, and the downstream end shall discharge through the wall of the pit or headwall.

7 DOCUMENTATION

7.1 DRAWINGS AND SCALES

Catchment areas

Catchment Area Plans shall be drawn to scales of 1:500, 1:4000 or 1:25000, unless alternative scales are specifically approved by Council and shall show contours, direction of grading of kerb and gutter, general layout of the drainage system with pit locations, catchment limits and any other information necessary for the design of the drainage system.

Drainage system layout

The drainage system layout plan shall be drawn to a scale of 1:500 and shall show drainage pipeline location, drainage pit location and number and road centreline chainage, size of opening and any other information necessary for the design and construction of the drainage system.

The plan shall also show all drainage easements, reserves and natural water courses. The plan may, for some projects, be combined with the road layout plan.

Longitudinal section

The drainage system longitudinal section shall be drawn to a scale of 1:500 horizontally and 1:50 vertically and shall show pipe size, class and type, pipe support type in accordance with AS/NZS 3725 or AS/NZS 2032 as appropriate, pipeline and road chainages, pipeline grade, hydraulic grade line and any other information necessary for the design and construction of the drainage system.

Open channels

Open channel cross sections shall be drawn to a scale of 1:100 natural and shall show the direction in which the cross sections should be viewed. Reduced levels are to be to Australian Height Datum (AHD), unless otherwise approved by the Superintendent where AHD is not available.

Details

Details including standard and non-standard pits and structures, pit benching, open channel designs and transitions shall be provided on the Drawings to scales appropriate to the type and complexity of the detail being shown.

Work-as-executed drawings

Work-as-executed drawings shall be submitted to the Superintendent upon completion of the drainage construction.

The detailed drawings may form the basis of this information, however, any changes must be noted on these drawings.

Where the works are for a subdivision, the work-as-executed drawings must be submitted before a subdivision certificate can be issued.

7.2 EASEMENTS AND OTHER DEEDS OF AGREEMENT

Any deed of agreement or easement necessary to be entered into as part of the drainage system, in accordance with this worksection, will need to be completed prior to commencement or work.

Where the works are for a subdivision, evidence will need to be submitted prior to any approval of the engineering Drawings.

Where an agreement is reached with adjacent landowners to increase flood levels on their property or otherwise adversely affect their property, a letter signed by all the landowners outlining what they have agreed to and witnessed by an independent person shall be submitted prior to commencement of work.

Where the works are for a subdivision, the letter will need to be submitted prior to any approval of the engineering Drawings.

Easements will need to be created prior to the issue of the subdivision certificate.

7.3 SUMMARY SHEETS

Hydrology

A copy of a hydrological summary sheet providing the minimum information set out in Council's current Handbook of Drainage Design Criteria is required.

Hydraulics

A copy of a hydraulic summary sheet providing the minimum information set out in Council's current Handbook of Drainage Design Criteria is required.

Computer data files and output

Computer program output may be provided as long as summary sheets for hydrological and hydraulic calculations in accordance with this worksection are provided with plans submitted for checking and with final drawings.

Copies of final computer data files, for both hydrological and hydraulic models shall be provided for Council's database of flooding and drainage information in formats previously agreed with Council.

Council's handbook for drainage design criteria

This worksection has been designed to be used with Council's own 'Handbook of Drainage Design Criteria'. Where required, the handbook should include co-efficients, design requirements, design charts, material standards, and summary sheets for calculations that the Consultant shall use in design.

For ease of reviewing or preparing a handbook, the following list contains the requirements that are to be presented and the clauses in this worksection where references are required.

Design IFD rainfalls for specific locations and individual zonings	**Design rainfall data**
Percentages impervious for specific locations and individual zonings	**Rational Method**
Run-off co-efficients for specific locations and individual zonings	
Sample summary sheet for hydrological calculations	**Alternative models and computer analysis**
Additional requirements for use of specified computer analysis programs	
Sample summary sheet for hydraulic calculations	**Hydraulic grade line**
Pit capacities	**Pit**
Pressure change co-efficient 'K_e' charts	**Hydraulic losses**
Allowable reductions in 'K_e' due to benching	
Pit pressure change co-efficients at bends	
Chart for pressure change co-efficient K_p	
Junction pressure change co-efficients K_l and K_u chart	
Sudden expansion and contraction losses	
Road capacity charts and flow adjustment factors to Tech Note 4 Chapter 14 of AR&R 1987	**Major system criteria**
Culvert Design Charts—inlet and exit losses, inlet and outlet control and scour protection	**Major structures criteria**
Requirements for stormwater detention design	**Criteria**
Conduit and material standards	
Conduit jointing details	**Conduits**
Typical pit designs, and other pit design requirements	**Pitts**
Lists of Standards or Codes relevant to pit design	

Guidelines for scour protection at outlets

Stormwater discharge