QUEANBEYAN CITY COUNCIL

HANDBOOK OF DRAINAGE DESIGN CRITERIA – SOUTH JERRABOMBERRA

VERSION 1 – MARCH 2015

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Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments for development at South Jerrabomberra.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
VERSION 1	**SOUTH JERRABOMBERRA**				
1	South Jerrabomberra Design Specification referenced	Preface	A	KD	20/03/15
2	Large Lot Residential referenced	1.03	A	KD	

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HANDBOOK OF DRAINAGE DESIGN CRITERIA – SOUTH JERRABOMBERRA – VERSION 1

PREFACE

GENERAL

1. This handbook has been produced to be read in conjunction with Queanbeyan City Council's *Engineering Design Specification - South Jerrabomberra*.

2. All relevant design principles referenced below must be integrated in the design of vehicular access. The design of vehicular access must be considered in conjunction with the geometric road design and subdivision layout.

Technical Data

OBJECTIVES

1. This specification aims to set standards related to the provision of vehicular access to proposed allotments, which are to be safe and convenient, and shall maintain a satisfactory level of service for the user.

Safety

Level of Service

2. This specification also aims to set the minimum design standards required for the provision of vehicular footpath crossings and driveways, located within allotments and Council's Road Reserve.

Vehicular Footpath Crossings

3. Where further technical design data are required that are not provided in this handbook, then the criteria shall be obtained from:

ACT Urban Services: *Design Standards for Urban Infrastructure, Part 1 Stormwater*, or

ACT Stormwater Standards

The Institution of Engineers, Australia*: Australian Rainfall and Runoff* 1987.

AR&R 1987

Technical data that is not included in this handbook or the references listed above shall be confirmed with Queanbeyan City Council prior to the commencement of detailed stormwater design.

4. Where further construction standards or specifications are required that are not provided in Queanbeyan City Council's *Engineering Design Specification - South Jerrabomberra*. or this handbook, then the standards shall be obtained from the ACT Urban Services *Design Standards for Urban Infrastructure*, *part 1 Stormwater*, and confirmed with Queanbeyan City Council prior to the commencement of detailed stormwater design.

Urban Stormwater Standards

SECTION 1 - HYDROLOGY

1.01 SCOPE

1. This section sets out technical data to be used in the estimation of rainfall intensities and runoff.

Vehicle Kerb Crossings

1.02 DESIGN INTENSITY-FREQUENCY-DURATION

1. The rainfall intensities given in Figure 1.1 shall be used for the estimation of design flows within the City of Queanbeyan.

Design Flows

1.03 PERCENTAGE OF IMPERVIOUS AREA

1. The percentage of impervious area used in hydrological calculations for each specific zoning type given in Table 1.1 shall be adopted.

Area/Zoning Type	% Impervious
Large Lot Residential	20 %
Residential	
450 - 600 m^2	60 %
600 - 800 m^2	45 %
800 - 1000 m^2	35 %
> 1000 m^2	30 %
Multi-dwelling	70 %
Commercial	85 %
Playing fields/Parks	10 %
Rural/Open country < 10 % slope	40 %
Steep rocky country > 10 % slope	70 %

Table 1.1
Percentage of Impervious Area

1.04 RUNOFF COEFFICIENTS

1. 1. The following runoff coefficient shall be used for all impervious areas;

Runoff Coefficient

$$C_i = 0.90$$

The following relation shall be used for pervious areas in residential developments with densities in the range of 10 - 15 blocks per hectare:

$$C_p = 0.91 - 3.14i^{-0.594}$$

where,
C_p = runoff coefficient for pervious grassed surfaces
i = rainfall intensity (mm/hr)

2. Time of Concentration - The procedures employed to calculate the overland flow travel time component (t_o) of the total surface flow time of concentration (t_c)for sub-catchment pervious runoff shall be as follows;

Time of Concentration

$$t_o = \frac{107 n L^{0.333}}{S^{0.2}} \qquad \text{for L} \leq 200 \text{ m}$$

$$t_o = \frac{0.058 L}{A^{0.1} S^{0.2}} \qquad \text{for L} > 200 \text{ m}$$

where,

A = catchment area (hectares)
t_o = overland flow travel time (minutes)
L = flow path length (m)
S = slope of surface (%)
n = Horton's roughness value for the surface (table 1.2)

The maximum travel time of concentration shall be set at 20 minutes and the minimum travel time set at 5 minutes.

3.

Surface Type	'n' Value
Paved surface	0.015
Bare soil surface	0.028
Poorly grassed surface	0.035
Average grassed surface	0.045
Densely grassed surface	0.060

Table 1.2
Horton's Roughness Values

1.05 HYDROLOGICAL CALCULATIONS

Summary Sheet

1. Hydrological calculations shall be submitted in the format shown on the sample calculation summary sheet. A copy of the summary sheet is shown in Figure 1.2. Calculations which are not submitted in this format will not be accepted by Queanbeyan City Council.

1.06 RAINFALL/RUNOFF MODELLING REQUIREMENTS

Parameters and Procedures

1. The following clauses specify parameters and procedures that shall be used in lieu of values and procedures recommended in the program documentation and related reports. The parameters have been determined from calibration tests performed in the ACT.

1.07 RAFTS

1. Rainfall Loss Rates - the Rafts program offers a choice between two approaches to rainfall loss estimation. They are the initial/continuing loss model and the infiltration/water balance procedure which utilises the Australian Representative Basins Model (ARBM). The use of the ARBM shall be used in preference to the initial/continuing loss model due to the ability of ARBM to model a range of ARI events with a single set of parameters. The values for the ARBM loss model are given in Table

1.3.

Parameter	Adopted Values	Initial Values
Storage Capacities		
Impervious (IMP)	0.50	0.0
Interception (ISC)	1.00	0.00
Depression (DSC)	1.00	0.00
Upper Soil (USC)	25.00	20.00
Lower Soil (LSC)	50.00	40.00
Infiltration		
Dry soil sorptivity (SO)	3.00	
Hydraulic Conductivity (K_o)	0.33	
Lower soil drainage factor (LDF)	0.05	
Groundwater recession;		
constant rate (KG)	0.94	
variable rate (GN)	1.00	
Evapo-Transpiration		
Proportion of rainfall intercepted by vegetation (IAR)	0.70	
Max. Potential evapo-transpiration;		
upper soil (UH)	10.00	
lower soil (LH)	10.00	
Proportion of evapo-transpiration from upper soil zone (ER)	0.70	
Ratio of potential evaporation to A class pan (ECOR)	0.90	

Table 1.3
RAFTS ARBM Loss Rates

2. Surface Runoff Routing - The recommended surface runoff routing parameters given in Table 1.4 shall be adopted	

Parameter	Value
Impervious surface roughness	0.015
Pervious surface roughness	0.040
Non-linearity coefficient (default)	0.285

Table 1.4
RAFTS Surface Runoff Routing Parameters

1.08 ILSAX	
1. Rainfall Loss Rates - the ILSAX program incorporates the Horton's infiltration equation to determine losses occurring on pervious surfaces. ILSAX also requires that a catchment soil type and antecedent moisture condition be specified. The parameter values given in Table 1.5 shall be adopted.	

Parameter	Value
Impervious (paved) depression storage	1 mm
Pervious (grassed) depression storage	5 mm
Soil type	3.0
AMC	3.2

Table 1.5
ILSAX Rainfall Loss Parameters

2. Time of Concentration - The procedures employed to calculate the travel times of concentration for sub-catchment pervious runoff shall be as specified for overland flow in Section 1.04 above. The travel time of concentration for all impervious areas should be adopted globally and set at 6 minutes.	
1.09 RORB	
1. It is recommended that the following RORB parameters be used with caution for ungauged catchments. Gauged catchments should be calibrated against recorded storm events using the runoff coefficient as the calibration parameter.	***Ungauged Catchment Caution***
2. Rainfall Loss Rates - The RORB model utilises a constant loss rate for impervious areas and an initial loss followed by a runoff coefficient or constant (continuing) proportional loss rate for pervious areas. The rainfall loss parameters given in Table 1.6 shall be adopted.	***Loss Rate***

Parameter	Value
Initial loss	10 mm
Runoff coefficient	45%

Table 1.6
RORB Pervious Area Rainfall Loss Parameters

3. Surface Runoff Routing - The RORB runoff routing method is based on the storage-discharge relationship $S = 3600kQ^m$. The dimensionless coefficient m is a measure of catchment non-linearity with a value of 1.0 implying a linear catchment. The dimensionless empirical coefficient k is the product of two factors, k_c and k_r. The factor k_r is a dimensionless ratio called the relative delay time applicable to an individual reach storage and k_c is an empirical coefficient applicable to the entire catchment and stream network. The runoff routing parameters given in Table 1.7 shall be adopted.	

Parameter	Value
m (adopt default)	0.8
k_c (adopt default equation)	$2.2A^{0.5}$ (1)

(1) A = catchment area (km^2)

Table 1.7
RORB Runoff Routing Parameters

1.10 OTHER METHODS AND MODELS

1. The use of other hydrological methods or models will not be permitted without the prior approval of Queanbeyan City Council. To obtain approval, the designer must demonstrate that a particular method or model is appropriate for Queanbeyan conditions, by calibration of the method or model.

2. The designer shall submit a report to Queanbeyan City Council, prior to the assessment of the design, giving full details of the method or model to be used including all assumptions made, recommended parameters values, and tabulated flow comparisons for major and minor system ARI's.

Rainfall Intensity (mm/hr) For Queanbeyan							
Duration	**Average Recurrence Interval (Years)**						
	1	**2**	**5**	**10**	**20**	**50**	**100**
5 m	55.75	73.37	99.02	114.68	136.06	165.79	189.71
6	52.19	68.62	92.37	106.83	126.59	154.03	176.09
7	49.23	64.67	86.85	100.31	118.74	144.30	164.82
8	46.71	61.30	82.15	94.78	112.09	136.06	155.29
9	44.51	58.38	78.09	90.00	106.33	128.94	147.06
10	42.58	55.81	74.52	85.80	101.29	122.71	139.87
11	40.87	53.53	71.36	82.08	96.83	117.20	133.51
12	39.33	51.48	68.52	78.76	92.84	112.28	127.82
13	37.93	49.63	65.96	75.75	89.24	107.84	122.71
14	36.66	47.94	63.63	73.03	85.97	103.82	118.08
15	35.50	46.40	61.51	70.54	82.99	100.15	113.05
16	34.43	44.98	59.55	68.25	80.26	96.79	109.98
17	33.45	43.67	57.75	66.15	77.74	93.69	106.41
18	32.53	42.45	56.08	64.19	75.41	90.83	103.12
20	30.88	40.27	53.08	60.69	71.22	85.69	97.21
25	27.55	35.87	47.07	53.69	62.87	75.46	85.46
30	25.02	32.53	42.52	48.39	56.57	67.75	76.63
35	23.01	29.88	38.93	44.22	51.61	61.71	69.71
40	21.37	27.72	36.00	40.84	47.60	56.82	64.11
45	20.00	25.91	33.57	38.02	44.26	52.76	59.48
50	18.84	24.38	31.51	35.64	41.44	49.34	55.57
55	17.83	23.06	29.74	33.59	39.02	46.40	52.22
60	16.95	21.90	28.19	31.81	36.92	43.85	49.31
75	14.74	19.03	24.44	27.54	31.93	37.87	42.55
90	13.13	16.94	21.71	24.44	28.30	33.54	37.66
2.0 hr	10.91	14.06	17.96	20.19	23.35	27.62	30.97
3.0	8.39	10.78	13.71	15.38	17.74	20.94	23.45
4.0	6.95	8.93	11.32	12.66	14.59	17.19	19.23
5.0	6.01	7.71	9.75	10.89	12.54	14.75	16.48
6.0	5.33	6.84	8.63	9.63	11.08	13.02	14.54
8.0	4.42	5.66	7.13	7.94	9.12	10.70	11.93
10.0	3.83	4.90	6.14	6.84	7.84	9.19	10.24
12.0	3.40	4.35	5.44	6.05	6.93	8.11	9.03
14.0	3.09	3.94	4.92	5.46	6.24	7.30	8.11
16.0	2.84	3.62	4.50	4.99	5.60	6.65	7.39
18.0	2.63	3.35	4.17	4.61	5.26	6.13	6.81
20.0	2.46	3.13	3.88	4.29	4.90	5.70	6.32
22.0	2.32	2.95	3.65	4.02	4.59	5.33	5.91
24.0	2.19	2.79	3.44	3.79	4.32	5.01	5.55
36.0	1.68	2.13	2.60	2.86	3.24	3.74	4.13
48.0	1.38	1.74	2.12	2.32	2.62	3.01	3.32
60.0	1.17	1.48	1.79	1.95	2.20	2.53	2.78
72.0	1.02	1.29	1.55	1.69	1.90	2.17	2.38

Figure 1.1
Intensity-Frequency-Duration Chart for Queanbeyan

HYDROLOGY DATA AND RESULTS

NODE NAME	RETURN PERIOD	TIME OF CONCENRATION						AREA		FLOWS							CRITICAL AREA DATA		
		IMPERVIOUS			PERVIOUS							SURFACE FLOWS			PRIMARY PATH				
		LENGTH	SLOPE	Tc	LENGTH	SLOPE	Tc	TOTAL	IMPERVIOUS	TOTAL FLOW	PIPE FLOW	CATCHMENT CONTRIBUTION	TOTAL GUTTER FLOW	CAPTURED FLOW	DESTINATION	FLOW	CRITICAL AREA Tc	INTENSITY	EQ. IMPERVIOUS AREA
		m	%	min	m	%	min	ha	ha	cms	cms	cms	cms	cms		cms	min	mm/hr	ha

Figure 1.2
Sample Summary Sheet for Hydrological Calculations

SECTION 2 - HYDRAULICS

2.01 PIT INLET CAPACITIES

1. Pit inlet capacities for on-grade and lowpoint sumps on kerb and gutter (KG), modified layback kerb (MLBK), and modified kerb and gutter (MKG) shall be estimated as set out in part 1.5 Sumps of the ACT Urban Services, Design Standards for Urban Infrastructure, 1. Stormwater.

3. 2.02 ROAD CAPACITIES

Flow Widths on Roads

1. Flow widths for surface flows on roads shall be estimated as set out in part 1.5 Sumps of the ACT Urban Services, *Design Standards for Urban Infrastructure, 1 Stormwater*. Other road designs flow capacities shall be calculated using Technical Note 4 in Chapter 14 of AR & R 1987. The flow adjustment factor given in Technical Note 4 in Chapter 14 of AR & R 1987 shall be used.

2.03 CULVERT DESIGN

Urban Culverts

1. Culvert crossings in Urban areas shall be designed for a 100 year ARI flow with an upstream freeboard of at least 0.6m.

2. Culverts shall be sized in accordance with Section 3 Culverts, of the Concrete Pipe Association of Australia, *Hydraulics of Precast Concrete Conduits.*

3. Entrance loss coefficients shall be in accordance with Table 2.**1**

Design of Entrance	k_e
Pipe Culverts	
Pipe projecting from fill,	
square cut end	0.5
socket end	0.2
Headwall with or without wingwalls,	
square end	0.5
socket end	0.2
Pipe mitred to conform to fill slope,	
precast end	0.5
field cut end	0.7
Box Culverts	
No wing walls, headwall parallel to embankment,	
square edge on three edges	0.5
three edges rounded to 1/12	
barrel dimensions	0.2
Wing walls at 30 to 75 to barrel,	
square edge at crown	0.4
crown rounded to 1/12	
culvert height	0.2
Wing walls at 10 to 30 to barrel,	
square edge at crown	0.5
Wing walls parallel (extension of sides),	
square edge at crown	0.7

Table 2.1
Culvert Entrance Loss Coefficients

2.04 PRESSURE CHANGE COEFFICIENTS	
1. Pressure head change coefficient data and water surface elevation coefficient data for sumps and manholes shall be obtained from the charts and figures given in Appendix A Sump and Manhole Head Loss Charts, of ACT Urban Services, *Design Standards for Urban Infrastructure 1. Stormwater*.	
2.05 HYDRAULIC CALCULATIONS	
1. Hydraulic calculations shall be submitted in the format shown on the sample calculation summary sheet. A copy of the summary sheet is shown in Figure 2.1. Calculations which are not submitted in this format will not be accepted by Queanbeyan City Council.	***Summary Sheet***
2.06 PIT DESIGN	
1. Typical pit designs for sump inlets on kerb and gutter, plantation sumps, special structures, etc are shown on the standard drawings adopted by Queanbeyan City Council.	***Standard Drawings***

HYDRAULIC DATA AND RESULTS

UPSTREAM PIT NAME	DOWNSTREAM PIT NAME	NUMBER OF CONDUITS	RETURN PERIOD	CONDUIT DATA											DATA AT UPSTREAM MANHOLE							
															MANHOLE LOSSES							
				TOTAL LENGTH	DIAMETER OR HEIGHT	PIPE CLASS	UPSTREAM INVERT	DOWNSTREAM INVERT	CONDUIT GRADE	UPSTREAM HGL	DOWNSTREAM HGL	FRICTION GRADE	FLOW	VELOCITY	Ku	Kw	INLET CAPACITY	INLET INFLOW	PONDING LEVEL LIMIT	MANHOLE COVER LEVEL	WATER SURFACE LEVEL	FREEBOARD
				m	m		m	m	%	m	m		cms	m/s			cumec	cms	m	m	m	

Figure 2.1
Sample Summary Sheet for Hydraulic Calculations

SECTION 3 - STORMWATER DETENTION DESIGN

3.01 TECHNICAL DATA

1. Technical data required for the design of stormwater detention facilities shall be obtained from Queanbeyan City Council prior to the commencement of design.