Greater Taree
CITY COUNCIL

ON-SITE DETENTION GUIDELINES

DESIGN SPECIFICATION D5 - ANNEXURE
ONSITE DETENTION GUIDELINES

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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.

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

ON-SITE DETENTION GUIDELINES

GENERAL

.01 SCOPE

Detention storage is required in areas where there is an existing or potential flood problem, or the local drainage system cannot cope with additional flows. Provision of the storage is intended to prevent increased flood hazard and damage to existing developments by limiting surface runoff to pre-development levels. In cases where adequate on-site Detention is provided no contribution will be necessary under Council's "Stormwater Drainage Contribution Policy".

Storage is necessary in most older parts of the City, although there are some areas where there are not any problems and it is not required. Each development is considered on its merits, and applicants are advised to contact the Director Engineering to determine specific requirements.

These guidelines should be read in conjunction with the following documents:

- Aus-Spec Development Design Specifications, GTCC
- "Technical Guide to Subdivisions" – GTCC November 1991
- "Stormwater Drainage Contribution Policy" – GTCC September 1991
- Australian Rainfall and Runoff 1987 – i.e. Aust.
- Floodplain Development Manual – NSW Government
- Managing Urban Stormwater : Soils and Construction – Landcom
- Greater Taree City Council Flood Management Policy 1987

The requirements apply to developments within the City of Greater Taree for which there is an increase in impervious area over the existing usage or the impervious area exceeds 25% of the site (except developments involving only a single residential dwelling). This document is not to be interpreted to prevent the use of acceptable alternative design procedures not specifically referred to herein.

As a guideline, the calculation procedures presented herein are limited in their application to sites smaller than 5 hectares, and where storage is separate from any stream or channel flows within or through the site. Notwithstanding this, the requirements of the guidelines still applies to the larger site.

Sites with On-site Detention Storage will have the provision of such storage registered as an 88B restriction as to user on the title of the land to ensure owners/purchasers are aware of its presence.

Notwithstanding the abovementioned new developments within the Greater Taree City Council Local Government Area require Onsite Detention to be provided in accordance with AUS-SPEC D5. These guidelines generally applies to existing developments or re-development of existing areas.

.02 SPECIFIC OBJECTIVES

To control stormwater runoff from development sites such that peak discharge from the site does not exceed that prior to development for storm events up to and including a 1:100 year ARI event.

.03 DESIGN REQUIREMENTS

Detention storage is to be located separate from any natural watercourses and there overflow paths, and is not to be inundated by any events up to and including Council's adopted flood standard (currently 1 in 100 year ARI event). Sufficient storage volume is to be provided such that the combination of pipe outflow and weir overflow does not exceed the maximum permissible outflow determined using the triangular hydrograph method.

Designs and construction supervision shall be carried out by a suitably qualified and experienced Civil Engineer, being a member of the institution of Engineers, Australia in accordance with these requirements and to the satisfaction of the Director Engineering. Developers and designers are encouraged to use principles of good aesthetics and landscaping. Long term viability and maintenance of the storage area also need to be considered.

(Note: Persons such as Registered Surveyors with suitable Post Graduate qualifications and demonstrated experience may also prepare these designs with the prior approval of the Director Engineering Services).

A minimum of 100% of the total site is to drain through the detention storage. Roof drainage is to be designed in conjunction with ground form to ensure the roof water is in fact directed through the detention facility in severe storm events. Where by-pass is anticipated this is to be accounted for in the calculations.

An emergency overflow spillway or alternative is to be provided. A distinct overflow path is to be created, and it is to be free of obstructions such as fences, buildings, etc.

Floor levels and/or the maximum water surface level of the storage are to be fixed so that habitable floor levels are a minimum of 0.5m above the water storage/flow levels for the 1 in 100 year ARI event, for both new and existing buildings or as specified in the development consent conditions. Garage floor levels are to be above the maximum water surface level based on the 1 in 100 year ARI event, where possible.

In the interests of safety and amenity, ponded water depths are not to exceed:

	Desirable Max	**Absolute Max**
Parking/Paved Areas	0.15m	0.2m
Landscaping	0.6m	*1.2m
Covered/Fenced Storage	NO LIMIT	
Roof Area	As required by structural integrity	

* *Storages with depths exceeding 0.6m must be given special consideration for safety and integrity and certified by a qualified civil engineer.*

Rainfall intensities used in design are to be based on rainfall intensity isopleths provided by Council in conjunction with the procedures in Chapter 2 of the current edition of "Australian Rainfall and runoff", or by data obtained directly from the Bureau of Meteorology for a specific location.

Design calculations based on the rational method are to use co-efficient of runoff obtained from Figure 1.

Runoff times of concentration for the undeveloped site are to be calculated using the kinematic wave equation recommended in "Australian Rainfall and Runoff" (p300-301). A time of 5 minutes is to be used for the after development state.

Storage volumes required are to be calculated using triangular hydrographs, these being a reasonable approximation of inflow and outflow hydrographs (refer "Australian Rainfall and Runoff", Section 7.5.6, p140).

Discharge from the site routed through detention storage (i.e. a restricted pipe and weir outlet) is to be connected to a piped drainage system, channel or drainage path approved by the Director Engineering.

To ensure the continued function and amenity of developments, open storage areas are not to be located in privately controlled areas (such as courtyards) for multiple occupancy sites, for example, villa housing.

FIGURE 1 – Determination of Runoff Co-Efficient

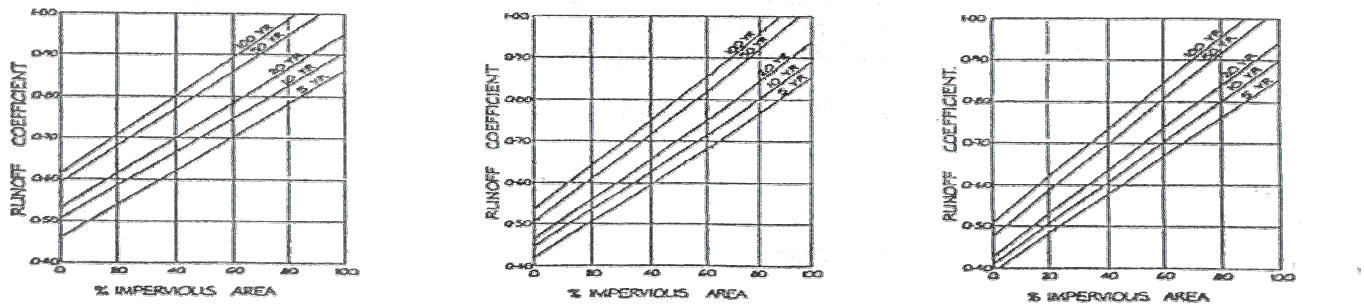


FIG 1A - COASTAL VILLAGES. FIG 1B - TAREE FIG 1C - WINGHAM

Note: Other locations may be interpolated or new graphs developed by following the procedures in Australian Rainfall and Runoff.

.04 TRIANGULAR HYDROGRAPHS – CALCULATION PROCEDURE

The following simplified method is recommended however alternate designs based on accepted hydraulic principles and the general guidelines listed below will be considered by the Director Engineering.

The maximum storage volume required is the greatest required from the following three (3) cases:

(a) Area under the developed site hydrograph above a line drawn from the origin to the point on the falling limb corresponding to the maximum discharge from the site prior to development (Qu) for the same ARI. The time of concentration for the hydrograph peak from the developed site is to be taken as 5 minutes. Refer Figure 2.1.

(b) The equivalent area under the hydrograph, but using peak flow (Qd) for the developed site hydrograph determined at the site's pre-development time of concentration $T_c u$. Refer Figure 2.2.

(c) The equivalent area under the hydrograph, with the time of concentration for the developed site hydrograph peak being between 5 minutes and $T_c u$, the time being that which results in the greatest volume of required storage. Refer Figure 2.3.

Qu represents discharge from the undeveloped site and Qd after development. Any trailing number is the relevant ARI. $T_c d$ represents a varying time of concentration adopted greater that 5 minutes but less that $T_c u$.

The storage requirement is to be calculated for the full range of ARI's to determine the maximum (ie 1, 2, 5, 10, 20, 50 and 100 year).

The maximum discharge should correspond to the event requiring the maximum volume of storage. Should this not be the case, the events with a greater discharge should have the discharge restricted and the volume required checked. The design should then be modified accordingly.

If only part of the site is drained through the detention storage, the maximum discharge marked on the falling limb of the hydrograph is to be reduced so that the discharge from the storage plus the discharge from the remainder of the site does not exceed that from the site prior to development.

The maximum piped discharge from the site is to be less than or equal to the 1 in 5 year ARI pre-development discharge. Excess discharge shall be conveyed by overland flow and/or stored on-site if it is not practical to safely convey the excess discharge overland. Notwithstanding this, there should be consideration given to the PMP event to ensure safety at all times.

See Appendix A for worked examples.

The maximum outflow rates can be determined from the formula:

Submerged Pipe Outlet:

Qmax = 1.62 x (Orifice Diameter) 1.87 x (Head) 0.63

- provided the pipe outlet conditions are not submerged, otherwise pressure line calculations are required.

Weir Outlet:

Qmax = 1.7 x Weir Length x (Weir Flow Depth) 1.5

.05 PAYMENT IN LIEU

Payments in lieu will only be accepted in accordance with Council's Stormwater Drainage Contribution Policy where it is unsafe or impractical to provide storage on site and no serious deficiencies exist in the downstream drainage system. Payments will only be accepted with the approval of the Director Engineering.

.06 INFORMATION TO BE SUPPLIED AND FEES PAYABLE

6.1 To enable checking of the adequacy of the storage basin design, the following information is to be supplied, together with the Engineering Checking Fee (2005, $450, reviewed annually).

- Catchment Plan.
- Plan showing proposed and existing floor, ground and pavement levels to AHD.
- Longitudinal section of pipelines showing calculated flows, velocity, size and class of pipe, grade, invert levels, ground levels and pressure line levels.
- Details and dimensions of pits, grates, weirs and orifice plates.
- Hydrologic and hydraulic calculations.
- Other details as required by GTCC Aus-Spec D5 and D7 or as applicable in

other State Government regulations

6.2 Immediately upon completion of the works, work-as-executed details obtained by the person responsible for the design and supervision are to be submitted to verify the storage has been constructed in accordance with the design requirements, and that floor levels are above the minimum required. Any significant variations must be supported by amended calculations.

6.3 Verification that an appropriate 88B restriction as to user has been placed on the title of the land describing the facility clearly and that it is not to be varied in any way without the consent of Council.

All of the above requirements must be satisfied prior to occupation of the premises.

Figure 2·1

Case 1

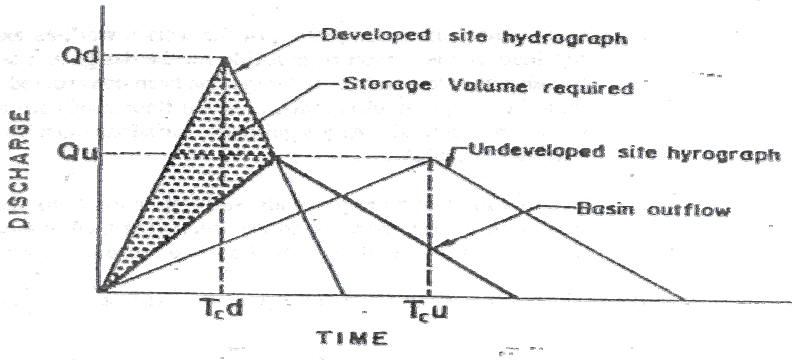


Figure 2·2

Case 2

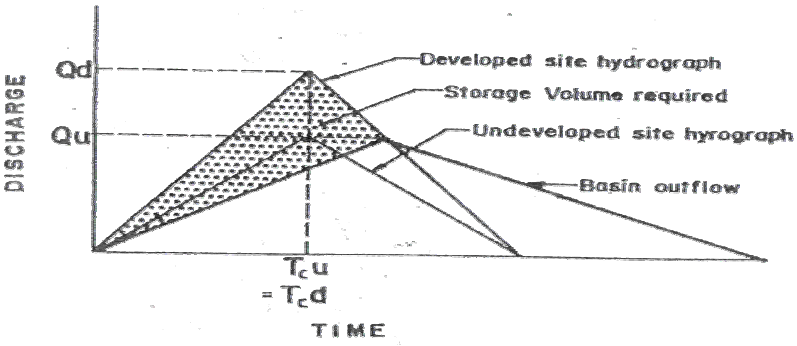
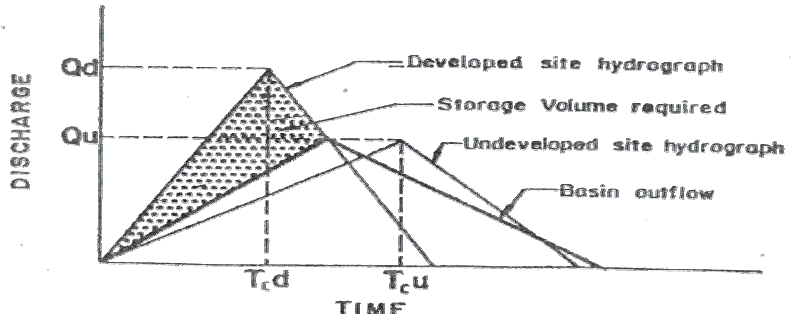


Figure 2·3

Case 3



Volume = (Qd – Qu) T_cd x 60 sec.

APPENDIX A

EXAMPLE CALCULATIONS

Rainfall Data

1_2 year	1 hour	=	46.5 mm / hr
	12 hour	=	11.1 mm / hr
	72 hour	=	4.0 mm / hr
1_{50} year	1 hour	=	111.1 mm / hr
	12 hour	=	26.5 mm / hr
	72 hour	=	8.6 mm / hr

Skew Co-efficient "G" = 0 : F_2 = 4.28 : F_{50} = 15.8

Intensity-Frequency-Duration Rainfall Data calculated using procedure in Chapter 2 of "Australian Rainfall and Runoff, 1987".

Site

Area = 1 ha

Existing Condition
- 100% grassed
- Overland flow path, say, 120m @ 3% grassed
  n = 0.15

Developed Condition
- 100% paved

Overland Flow Times

ARI	Pre-Development	Post-Development
5 years	17 mins	5 mins
10 years	16 mins	5 mins
20 years	15 mins	5 mins
50 years	14 mins	5 mins
100 years	13 mins	5 mins

Rainfall Intensities

Time	ARI Years				
	5	10	20	50	100
5 mins	182	203	231	267	295
7 mins	162	182	261	242	267
8 mins	155	174	196	232	250
10 mins	142	161	182	215	238
12 mins	133	150	170	202	218
13 mins					217
14 mins				191	
15 mins			159		
16 mins		134			
17 mins	115				

Required Storage/Discharge – 5 Year ARI

Pre-Development

Maximum Outflow = Qu5 = C.I.A.K.
= 0.7 x 115 mm/hr x 1 ha/360
= 224 l/s

Case 1 Qd5 – 5 mins = 0.86 x 182 mm/hr x 1 ha/360
= 435 l/s
Storage Volume = (0.435 – 0.224) m^3/s x 5 mins x 60 secs
= 63 m^3

Case 2 Qd5 – 17 mins = 0.86 x 115 mm/hr x 1 ha/360
= 275 l/s
Storage Volume = (0.275 – 0.224) m^3/s x 17 mins x 60 secs
= 52 m^3

Case 3 Qd5 – Various Mins
7 mins = 0.86 x 162 mm/hr x 1 ha/360
= 387 l/s
Storage Volume = (0.387 – 0.224) m^3/s x 7 mins x 60 secs
= 69 m^3
8 min = 0.86 x 155 mm/hr x 1 ha/360
= 370 l/s
Volume = (0.370 – 0.224) m^3/s x 8 mins x 60 secs
= 70 m^3

10 mins = 0.86 x 142 mm/hr x 1 ha/360
= 354 l/s
Volume = (0.352 – 0.224) m^3/s x 10 mins x 60 secs
= 69 m^3

Therefore, 70 m^3 of storage required for an ARI event of 5 years.

Required Storage – Other ARI's

Repeating calculation procedure as above with 10 year to 100 year ARI intensities. See table 1.

Pipe Outflow

5 year ARI – pipe outflow only – the maximum allowable piped outflow

Max Discharge = Discharge from site prior to development
= 224 l/s
= $1.62 \times \text{diameter}^{1.87} \times HW^{0.63}$

Adopting approximately 150 mm water depth plus, say, 650 mm deep pit:

Diameter = $O\ (.224/[1.62 \times 0.8^{0.63}])^{1/1.87} = 0.374$
= (Adopt 375mm diameter)

For larger events the increased storage will increase the available head and thus pipe discharge. This is acceptable as the maximum outflow permitted for larger events is correspondingly higher. Weir flow calculations will need to account for this effect to ensure that the total outflow from the site is not in excess of the requirements.

Maximum Storage Volume

From Table 1 – 50 year ARI T_cD = 8 mins
Vol = 106 m^3
For Qout = 424 l/s

Check 100 year ARI with Qout = 424 l/s
T_cD = 12 mins
Vol = 143 m^3 which is > 106 m^3

As the 1 in 100 year ARI events gives a greater discharge for lesser volume of storage, the basin cannot limit the 1 in 50 year ARI discharge unless its characteristics are changed.

To achieve a consistent increase of both Qout and Storage for increasing ARI, an arbitrary Qout can be adopted for the 100 year events. (Say 470 l/s for this example, which gives Vol = 117 m^3).

Storage – Discharge – Stage* Relationship

ARI	Storage m^3	Qout Total l/s	Qpipe l/s	Qweir l/s	Storage Depth mm**
5 years	70	224	224	0	150
10 years	85	261	230	31	190
20 years	96	327	237	90	235
50 years	106	424	244	180	280
100 years	117	470	251	219	300

* See weir calculations below
** Depth not to exceed this value for corresponding storage volume

Weir Design

1 in 100 year ARI - adopt maximum storage depth = 300 mm
ie H = .03 – 0.15 depth for pipe only

- $Q = C \times L \times H^{1.5}$

- L = 2.215 say 2.2 m

1 in 50 year ARI - Q = 180 L/s
C = 1.7

L = 2.2 m
H = $(0.18/17 \times 2.2)^{0.667}$
= 131 mm
Storage Depth = 150 mm + 130 mm
= 280 mm for 106 m^3

Repeat for remaining ARI's

Results

Therefore the requirements of the Onsite Detention Guidelines have been met with the following configuration:

Storage volume	=	117 m^3
Orifice diameter	=	375 mm
Weir	=	300 mm high x 2200 mm long.

The combined volumetric flowrate of the weir and the pipe is less than or equal to the pre-development rates for all events up to and including the 1:100 year event.

TABLE A1

LOCATION	**Site A**			**EXAMPLE CALCULATIONS SPREADSHEET FORMULA**														
% Imperv	**100**																	
Area (ha)	**1**																	
ARI (years)	**5**			**10**			**20**			**50**			**100**			**100 Adopted**		
C Pre-Dev	0.7			0.7			0.74			0.8			0.84			0.84		
Dev	0.86			0.9			0.95			1			1			1		
Pre-Dev	**I** mm/hr 115	**Qu** m^3/s 0.224	**Vol** m^3	**I** mm/hr 134	**Qu** m^3/s 0.261	**Vol** m^3	**I** mm/hr 159	**Qu** m^3/s 0.327	**Vol** m^3	**I** mm/hr 191	**Qu** m^3/s 0.424	**Vol** m^3	**1** mm/hr 217	**Qu** m^3/s 0.506	**Vol** m^3	**1** mm/hr 217	**Qu** m^3/s 0.470	**Vol** m^3
Post-Dev Mins	**Qd** m^3/s			**Qd** m^3/s			**Qd** m^3/s			**Qd** m^3/s			**Qd** m^3/s			**Qd** m^3/s		
Case 1 5	182	0.435	63	203	0.508	74	231	0.610	85	267	0.742	95	295	0.819	94	295	0.819	105
Case 2																		
7	162	0.387	69	182	0.455	82	208	0.549	93	242	0.672	104	267	0.742	99	267	0.742	114
8	155	0.370	70	174	0.435	84	199	0.525	95	232	0.644	106	256	0.711	98	256	0.711	116
9	148	0.354	70	167	0.418	85	191	0.504	96	223	0.619	105	247	0.686	97	247	0.686	117
10	142	0.339	69	161	0.403	85	184	0.486	95	215	0.597	104	238	0.661	93	238	0.661	115
12	133	0.318	68	150	0.375	82	172	0.454	91	202	0.561	98	224	0.622	83	224	0.622	110
14	125	0.299	63	141	0.353	77	162	0.428	85	190	0.528	87	212	0.589	69	212	0.589	100
16	118	0.282	56	134	0.335	71	154	0.406	76	181	0.503	75	201	0.558	50	201	0.588	85
18	112	0.268	47	127	0.318	62	147	0.388	66	173	0.481	61	193	0.536	32	193	0.536	71
20	107	0.256	38	122	0.305	53	141	0.372	54	166	0.461	44	185	0.514	9	185	0.514	53
Case 3 13													217	0.603	75	217	0.603	104
14											191	0.531	83					
15							159	0.420	83									

APPENDIX A Intensity Frequency Duration Tables

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF (1987)

Site name: Taree

Site latitude = 31.57 degrees S
longitude = 152.24 degrees E
skewness = .05

2-year ARI, 1 hour intensity = 36.00 mm/hr
12 hour intensity = 8.50 mm/hr
72 hour intensity = 2.50 mm/hr

50-year ARI, 1 hour intensity = 67.00 mm/hr
12 hour intensity = 16.30 mm/hr
72 hour intensity = 6.00 mm/hr

IFD Table for Various ARIs and Durations

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	91.36	116.20	146.15	163.34	186.57	216.89	239.94	263.27	294.77
6 min	85.60	108.88	136.98	153.11	174.91	203.36	224.98	246.88	276.43
10 min	70.01	89.08	112.14	125.39	143.28	166.64	184.40	202.39	226.68
12 min	64.72	82.35	103.70	115.97	132.53	154.16	170.60	187.26	209.75
15 min	58.50	74.44	93.77	104.89	119.88	139.47	154.36	169.46	189.83
18 min	53.66	68.29	86.04	96.25	110.03	128.03	141.71	155.58	174.31
20 min	50.96	64.86	81.75	91.46	104.55	121.66	134.68	147.86	165.67
24 min	46.50	59.20	74.62	83.50	95.47	111.11	123.01	135.07	151.35
30 min	41.40	52.71	66.48	74.40	85.08	99.04	109.65	120.42	134.96
45 min	33.19	42.26	53.34	59.72	68.31	79.55	88.10	96.77	108.48
1.0 hr	28.18	35.89	45.32	50.76	58.08	67.65	74.93	82.32	92.31
1.5 hr	22.39	28.53	36.10	40.47	46.35	54.04	59.90	65.85	73.89
2.0 hr	18.95	24.17	30.62	34.35	39.37	45.93	50.93	56.01	62.89
3.0 hr	14.94	19.07	24.21	27.19	31.19	36.43	40.42	44.48	49.98
4.5 hr	11.77	15.03	19.12	21.50	24.68	28.86	32.05	35.29	39.67
6.0 hr	9.94	12.70	16.18	18.21	20.91	24.47	27.18	29.94	33.69
9.0 hr	7.84	10.02	12.79	14.41	16.57	19.40	21.57	23.78	26.77
12.0 hr	6.62	8.47	10.83	12.21	14.05	16.46	18.31	20.19	22.75
18.0 hr	5.07	6.53	8.52	9.70	11.26	13.32	14.91	16.55	18.78
24.0 hr	4.18	5.42	7.16	8.22	9.60	11.44	12.87	14.34	16.36
30.0 hr	3.59	4.67	6.25	7.21	8.46	10.14	11.45	12.80	14.67
36.0 hr	3.17	4.13	5.57	6.47	7.62	9.17	10.39	11.65	13.39
48.0 hr	2.57	3.38	4.63	5.41	6.42	7.79	8.86	9.99	11.54
72.0 hr	1.88	2.49	3.49	4.13	4.95	6.08	6.97	7.91	9.22

IFD Polynomial: ln I = a + b*ln(D) + c*ln(D)**2 + d*ln(D)**3 + e*ln(D)**4 + f*ln(D)**5 + g*ln(D)**6
where duration D is in hrs and average intensity I is in mm/hr

ARI	a	b	c	d	e	f	g	Max % error
1	3.3392716	-.5690387	-.0156277	.0094575	-.0016828	-.0004936	.0000887	.67
2	3.5818343	-.5673231	-.0162522	.0089708	-.0014243	-.0004186	.0000700	.50
5	3.8169089	-.5626104	-.0180176	.0076127	-.0007006	-.0002090	.0000176	.31
10	3.9311286	-.5601202	-.0189504	.0068951	-.0003182	-.0000983	-.0000101	.40
20	4.0666174	-.5580505	-.0197257	.0062987	-.0000004	-.0000063	-.0000331	.48
50	4.2200459	-.5557067	-.0206037	.0056233	.0003595	.0000979	-.0000592	.61
100	4.3229294	-.5541351	-.0211924	.0051704	.0006008	.0001678	-.0000767	.76
200	4.4174974	-.5526904	-.0217336	.0047541	.0008226	.0002320	-.0000927	.89
500	4.5326334	-.5509316	-.0223924	.0042473	.0010927	.0003102	-.0001123	1.06

Overland Flow Travel Time Aid
Table of t*I**0.4 where t = time in min and I = intensity in mm/h

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	30.43	33.50	36.71	38.38	40.47	42.97	44.74	46.43	48.57
6 min	35.57	39.16	42.94	44.91	47.37	50.32	52.40	54.39	56.92
7 min	40.55	44.65	48.97	51.22	54.03	57.40	59.78	62.05	64.94
8 min	45.39	49.98	54.82	57.34	60.49	64.26	66.92	69.47	72.70
9 min	50.11	55.18	60.52	63.29	66.77	70.93	73.87	76.68	80.24
10 min	54.72	60.25	66.08	69.10	72.89	77.44	80.64	83.71	87.59
12 min	63.64	70.07	76.83	80.34	84.75	90.02	93.75	97.30	101.82
14 min	72.22	79.52	87.18	91.16	96.16	102.14	106.36	110.39	115.51
16 min	80.51	88.65	97.19	101.63	107.19	113.86	118.56	123.06	128.76
18 min	88.56	97.51	106.91	111.79	117.91	125.24	130.42	135.36	141.64
20 min	96.38	106.13	116.37	121.68	128.35	136.34	141.97	147.36	154.19
22 min	104.02	114.54	125.60	131.34	138.54	147.17	153.26	159.08	166.46
24 min	111.48	122.76	134.62	140.79	148.51	157.77	164.31	170.55	178.47
26 min	118.79	130.81	143.47	150.05	158.29	168.17	175.14	181.80	190.25
28 min	125.95	138.71	152.15	159.14	167.88	178.37	185.77	192.84	201.82
30 min	132.99	146.47	160.68	168.07	177.32	188.41	196.23	203.71	213.20
40 min	166.60	183.52	201.44	210.76	222.42	236.40	246.26	255.69	267.66

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF (1987)

Site name: OLD BAR VILLAGE AREA

Site latitude = 31.59 degrees S
longitude = 152.35 degrees E
skewness = .03

2-year ARI, 1 hour intensity = 38.00 mm/hr
12 hour intensity = 8.40 mm/hr
72 hour intensity = 2.60 mm/hr

50-year ARI, 1 hour intensity = 70.00 mm/hr
12 hour intensity = 17.00 mm/hr
72 hour intensity = 5.60 mm/hr

IFD Table for Various ARIs and Durations

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	96.23	122.12	152.07	168.96	191.97	221.77	244.24	266.86	297.19
6 min	90.18	114.47	142.62	158.49	180.13	208.13	229.26	250.53	279.05
10 min	73.81	93.74	116.96	130.09	147.94	171.07	188.53	206.11	229.71
12 min	68.25	86.69	108.24	120.42	136.98	158.44	174.64	190.97	212.88
15 min	61.70	78.40	97.96	109.03	124.07	143.56	158.28	173.12	193.03
18 min	56.61	71.95	89.96	100.16	114.00	131.95	145.52	159.19	177.54
20 min	53.78	68.36	85.50	95.22	108.40	125.49	138.41	151.43	168.91
24 min	49.09	62.41	78.12	87.02	99.10	114.77	126.61	138.55	154.58
30 min	43.72	55.61	69.66	77.64	88.44	102.47	113.08	123.77	138.14
45 min	35.07	44.63	56.00	62.47	71.22	82.58	91.18	99.85	111.51
1.0 hr	29.79	37.93	47.66	53.20	60.68	70.40	77.76	85.19	95.18
1.5 hr	23.38	29.84	37.72	42.24	48.31	56.23	62.23	68.30	76.49
2.0 hr	19.62	25.08	31.85	35.75	40.97	47.78	52.96	58.21	65.29
3.0 hr	15.28	19.58	25.02	28.18	32.38	37.88	42.08	46.34	52.10
4.5 hr	11.89	15.27	19.63	22.19	25.57	30.01	33.40	36.85	41.53
6.0 hr	9.95	12.80	16.54	18.73	21.62	25.44	28.35	31.33	35.36
9.0 hr	7.75	9.99	12.99	14.76	17.09	20.17	22.53	24.94	28.21
12.0 hr	6.49	8.38	10.95	12.47	14.47	17.11	19.14	21.22	24.05
18.0 hr	5.05	6.53	8.58	9.80	11.40	13.51	15.15	16.82	19.10
24.0 hr	4.21	5.46	7.20	8.24	9.60	11.41	12.80	14.23	16.18
30.0 hr	3.65	4.74	6.27	7.19	8.38	9.98	11.21	12.47	14.19
36.0 hr	3.24	4.21	5.58	6.41	7.49	8.92	10.03	11.17	12.72
48.0 hr	2.67	3.47	4.62	5.32	6.22	7.43	8.37	9.33	10.64
72.0 hr	1.99	2.59	3.48	4.01	4.71	5.64	6.36	7.11	8.13

IFD Polynomial: ln I = a + b*ln(D) + c*ln(D)**2 + d*ln(D)**3 + e*ln(D)**4 + f*ln(D)**5 + g*ln(D)**6
where duration D is in hrs and average intensity I is in mm/hr

ARI	a	b	c	d	e	f	g	Max % error
1	3.3920918	-.5819509	-.0296802	.0080257	.0002441	-.0002721	.0000012	.22
2	3.6342479	-.5782523	-.0283326	.0079484	.0001452	-.0002628	.0000026	.16
5	3.8641196	-.5682599	-.0246868	.0077344	-.0001203	-.0002368	.0000062	.05
10	3.9749138	-.5630022	-.0227685	.0076217	-.0002599	-.0002231	.0000080	.09
20	4.1072067	-.5586438	-.0211783	.0075284	-.0003757	-.0002117	.0000096	.16
50	4.2566392	-.5537206	-.0193820	.0074229	-.0005065	-.0001989	.0000113	.24
100	4.3566218	-.5504265	-.0181801	.0073524	-.0005940	-.0001903	.0000125	.30
200	4.4483684	-.5474039	-.0170773	.0072876	-.0006743	-.0001824	.0000136	.35
500	4.5598710	-.5437303	-.0157370	.0072089	-.0007719	-.0001729	.0000149	.41

Overland Flow Travel Time Aid
Table of t*I**0.4 where t = time in min and I = intensity in mm/h

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	31.07	34.18	37.31	38.91	40.95	43.38	45.08	46.71	48.76
6 min	36.32	39.95	43.63	45.52	47.91	50.76	52.77	54.68	57.09
7 min	41.40	45.55	49.76	51.92	54.65	57.91	60.21	62.39	65.15
8 min	46.34	50.99	55.71	58.13	61.20	64.86	67.43	69.88	72.97
9 min	51.16	56.30	61.51	64.19	67.58	71.62	74.47	77.17	80.59
10 min	55.87	61.47	67.18	70.10	73.81	78.23	81.34	84.29	88.03
12 min	64.98	71.51	78.15	81.56	85.88	91.03	94.64	98.09	102.45
14 min	73.76	81.17	88.72	92.59	97.50	103.35	107.46	111.38	116.33
16 min	82.24	90.51	98.94	103.27	108.74	115.28	119.86	124.24	129.76
18 min	90.48	99.58	108.87	113.63	119.66	126.86	131.91	136.73	142.82
20 min	98.50	108.41	118.53	123.73	130.30	138.14	143.65	148.90	155.53
22 min	106.32	117.02	127.96	133.58	140.68	149.16	155.11	160.78	167.96
24 min	113.96	125.44	137.19	143.22	150.84	159.94	166.33	172.42	180.12
26 min	121.45	133.69	146.22	152.66	160.79	170.50	177.32	183.82	192.04
28 min	128.79	141.78	155.09	161.93	170.56	180.87	188.12	195.02	203.75
30 min	136.00	149.72	163.80	171.03	180.17	191.07	198.73	206.03	215.26
40 min	170.36	187.60	205.38	214.53	226.05	239.81	249.49	258.70	270.37

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF (1987)

Site name: NABIAC

Site latitude = 32.10 degrees S
longitude = 152.38 degrees E
skewness = .04

2-year ARI, 1 hour intensity = 37.00 mm/hr
12 hour intensity = 8.12 mm/hr
72 hour intensity = 2.54 mm/hr

50-year ARI, 1 hour intensity = 67.00 mm/hr
12 hour intensity = 15.90 mm/hr
72 hour intensity = 5.30 mm/hr

IFD Table for Various ARIs and Durations

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	93.76	118.87	147.95	164.38	186.82	215.89	237.86	260.00	289.73
6 min	87.88	111.43	138.71	154.12	175.17	202.45	223.06	243.83	271.72
10 min	71.95	91.24	113.63	126.29	143.56	165.96	182.89	199.95	222.86
12 min	66.53	84.38	105.11	116.83	132.82	153.55	169.22	185.02	206.24
15 min	60.17	76.31	95.08	105.70	120.18	138.95	153.15	167.45	186.67
18 min	55.21	70.03	87.27	97.02	110.32	127.57	140.61	153.76	171.42
20 min	52.45	66.53	82.92	92.20	104.84	121.25	133.64	146.14	162.94
24 min	47.88	60.74	75.72	84.20	95.76	110.75	122.09	133.51	148.87
30 min	42.66	54.12	67.48	75.05	85.36	98.74	108.85	119.05	132.76
45 min	34.23	43.43	54.19	60.28	68.58	79.35	87.49	95.70	106.74
1.0 hr	29.09	36.91	46.07	51.26	58.33	67.50	74.44	81.43	90.84
1.5 hr	22.81	29.01	36.39	40.60	46.30	53.71	59.33	65.01	72.66
2.0 hr	19.13	24.36	30.67	34.29	39.17	45.52	50.35	55.23	61.81
3.0 hr	14.89	18.99	24.04	26.95	30.86	35.96	39.84	43.77	49.08
4.5 hr	11.57	14.79	18.82	21.16	24.28	28.37	31.49	34.66	38.94
6.0 hr	9.68	12.39	15.83	17.83	20.49	23.99	26.66	29.37	33.04
9.0 hr	7.53	9.66	12.41	14.01	16.14	18.95	21.09	23.28	26.24
12.0 hr	6.31	8.10	10.44	11.81	13.63	16.03	17.87	19.74	22.29
18.0 hr	4.92	6.33	8.20	9.31	10.77	12.69	14.18	15.69	17.75
24.0 hr	4.11	5.30	6.89	7.84	9.09	10.73	12.00	13.30	15.07
30.0 hr	3.57	4.60	6.01	6.85	7.95	9.40	10.52	11.67	13.24
36.0 hr	3.17	4.09	5.36	6.11	7.10	8.42	9.43	10.47	11.88
48.0 hr	2.61	3.38	4.44	5.08	5.92	7.02	7.88	8.76	9.96
72.0 hr	1.95	2.53	3.35	3.85	4.49	5.35	6.01	6.70	7.63

IFD Polynomial: ln I = a + b*ln(D) + c*ln(D)**2 + d*ln(D)**3 + e*ln(D)**4 + f*ln(D)**5 + g*ln(D)**6
where duration D is in hrs and average intensity I is in mm/hr

ARI	a	b	c	d	e	f	g	Max % error
1	3.3678643	-.5822992	-.0309841	.0078567	.0004367	-.0002473	-.0000079	.24
2	3.6068720	-.5795886	-.0296988	.0077590	.0003536	-.0002328	-.0000078	.17
5	3.8302612	-.5722351	-.0262192	.0074893	.0001305	-.0001930	-.0000078	.06
10	3.9379757	-.5683578	-.0243845	.0073470	.0000129	-.0001720	-.0000077	.10
20	4.0678867	-.5651393	-.0228615	.0072290	-.0000848	-.0001545	-.0000077	.18
50	4.2148142	-.5614993	-.0211391	.0070955	-.0001952	-.0001348	-.0000077	.27
100	4.3132297	-.5590610	-.0199854	.0070061	-.0002692	-.0001215	-.0000077	.33
200	4.4036151	-.5568218	-.0189258	.0069239	-.0003371	-.0001094	-.0000076	.38
500	4.5135612	-.5540979	-.0176369	.0068240	-.0004197	-.0000946	-.0000076	.45

Overland Flow Travel Time Aid
Table of t*I**0.4 where t = time in min and I = intensity in mm/h

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	30.75	33.81	36.90	38.48	40.50	42.91	44.60	46.22	48.26
6 min	35.94	39.53	43.15	45.01	47.38	50.21	52.20	54.09	56.49
7 min	40.98	45.06	49.21	51.33	54.04	57.27	59.54	61.70	64.44
8 min	45.87	50.45	55.09	57.47	60.50	64.11	66.66	69.08	72.15
9 min	50.64	55.69	60.81	63.44	66.79	70.78	73.59	76.27	79.66
10 min	55.30	60.81	66.40	69.28	72.93	77.29	80.36	83.28	86.98
12 min	64.32	70.74	77.24	80.58	84.82	89.89	93.45	96.85	101.15
14 min	73.01	80.29	87.67	91.45	96.27	102.02	106.06	109.92	114.79
16 min	81.42	89.54	97.75	101.97	107.34	113.75	118.26	122.55	127.99
18 min	89.58	98.51	107.55	112.19	118.09	125.14	130.10	134.83	140.81
20 min	97.52	107.24	117.08	122.14	128.56	136.24	141.63	146.78	153.29
22 min	105.27	115.76	126.39	131.84	138.78	147.07	152.90	158.45	165.48
24 min	112.84	124.09	135.49	141.34	148.78	157.67	163.91	169.87	177.41
26 min	120.26	132.25	144.40	150.64	158.57	168.05	174.71	181.06	189.10
28 min	127.53	140.25	153.14	159.77	168.18	178.24	185.31	192.05	200.58
30 min	134.67	148.11	161.73	168.73	177.63	188.25	195.72	202.85	211.86
40 min	168.72	185.58	202.73	211.55	222.74	236.11	245.51	254.47	265.82

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF (1987)

Site name: Wingham

Site latitude = 31.42 degrees S
longitude = 152.22 degrees E
skewness = .06

2-year ARI, 1 hour intensity = 34.00 mm/hr
12 hour intensity = 8.00 mm/hr
72 hour intensity = 2.40 mm/hr

50-year ARI, 1 hour intensity = 65.00 mm/hr
12 hour intensity = 16.00 mm/hr
72 hour intensity = 5.80 mm/hr

IFD Table for Various ARIs and Durations

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	86.40	110.39	140.87	158.71	182.52	213.88	237.89	262.36	295.61
6 min	80.93	103.40	131.97	148.68	170.99	200.37	222.88	245.81	276.96
10 min	66.13	84.50	107.86	121.53	139.78	163.81	182.21	200.97	226.45
12 min	61.11	78.08	99.67	112.31	129.18	151.39	168.41	185.75	209.30
15 min	55.21	70.55	90.06	101.48	116.73	136.80	152.19	167.86	189.15
18 min	50.62	64.68	82.58	93.05	107.04	125.45	139.56	153.93	173.46
20 min	48.07	61.42	78.42	88.37	101.65	119.14	132.54	146.20	164.75
24 min	43.84	56.02	71.53	80.61	92.73	108.69	120.92	133.38	150.31
30 min	39.01	49.85	63.66	71.75	82.54	96.75	107.63	118.73	133.80
45 min	31.24	39.92	50.99	57.47	66.12	77.50	86.23	95.12	107.21
1.0 hr	26.50	33.87	43.27	48.77	56.11	65.78	73.19	80.75	91.01
1.5 hr	21.04	26.91	34.48	38.93	44.85	52.65	58.64	64.75	73.06
2.0 hr	17.79	22.78	29.25	33.06	38.13	44.81	49.94	55.18	62.32
3.0 hr	14.02	17.97	23.14	26.20	30.25	35.61	39.73	43.94	49.68
4.5 hr	11.03	14.16	18.29	20.74	23.98	28.27	31.57	34.95	39.56
6.0 hr	9.31	11.95	15.48	17.57	20.33	24.00	26.82	29.71	33.66
9.0 hr	7.33	9.43	12.24	13.92	16.13	19.07	21.34	23.66	26.83
12.0 hr	6.19	7.97	10.37	11.80	13.69	16.20	18.14	20.13	22.85
18.0 hr	4.77	6.17	8.16	9.37	10.95	13.07	14.71	16.41	18.74
24.0 hr	3.95	5.13	6.87	7.94	9.33	11.20	12.66	14.17	16.25
30.0 hr	3.40	4.44	6.00	6.97	8.22	9.91	11.24	12.61	14.52
36.0 hr	3.00	3.93	5.35	6.24	7.39	8.95	10.17	11.45	13.22
48.0 hr	2.45	3.22	4.45	5.22	6.22	7.58	8.65	9.77	11.34
72.0 hr	1.81	2.39	3.36	3.99	4.79	5.89	6.77	7.70	9.00

IFD Polynomial: $\ln I = a + b\ln(D) + c\ln(D)^2 + d\ln(D)^3 + e\ln(D)^4 + f\ln(D)^5 + g\ln(D)^6$
where duration D is in hrs and average intensity I is in mm/hr

ARI	a	b	c	d	e	f	g	Max % error
1	3.2784987	-.5710389	-.0165812	.0090281	-.0014122	-.0004217	.0000699	.51
2	3.5246018	-.5692175	-.0165572	.0086294	-.0012510	-.0003595	.0000558	.38
5	3.7714986	-.5641582	-.0165377	.0075046	-.0007917	-.0001840	.0000159	.41
10	3.8923220	-.5614792	-.0165273	.0069090	-.0005485	-.0000911	-.0000052	.52
20	4.0334842	-.5592497	-.0165187	.0064133	-.0003461	-.0000138	-.0000228	.61
50	4.1935369	-.5567217	-.0165089	.0058512	-.0001166	.0000739	-.0000427	.71
100	4.3009800	-.5550248	-.0165023	.0054740	.0000375	.0001327	-.0000561	.78
200	4.3998216	-.5534636	-.0164963	.0051269	.0001792	.0001868	-.0000684	.85
500	4.5202663	-.5515613	-.0164889	.0047039	.0003520	.0002528	-.0000834	.93

Overland Flow Travel Time Aid
Table of $t*I^{0.4}$ where t = time in min and I = intensity in mm/h

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	29.76	32.82	36.17	37.93	40.11	42.73	44.59	46.36	48.62
6 min	34.78	38.37	42.31	44.39	46.95	50.03	52.21	54.30	56.96
7 min	39.65	43.74	48.24	50.61	53.54	57.06	59.55	61.94	64.97
8 min	44.38	48.96	54.00	56.65	59.92	63.86	66.65	69.32	72.72
9 min	48.99	54.04	59.60	62.52	66.13	70.47	73.55	76.49	80.24
10 min	53.49	59.00	65.06	68.25	72.18	76.92	80.27	83.48	87.57
12 min	62.19	68.60	75.63	79.32	83.89	89.38	93.27	97.00	101.74
14 min	70.56	77.83	85.79	89.98	95.15	101.37	105.78	110.00	115.37
16 min	78.66	86.75	95.62	100.27	106.03	112.96	117.87	122.57	128.55
18 min	86.50	95.40	105.15	110.27	116.60	124.22	129.61	134.77	141.34
20 min	94.14	103.82	114.43	120.00	126.89	135.18	141.04	146.66	153.81
22 min	101.59	112.04	123.49	129.50	136.93	145.88	152.21	158.28	166.00
24 min	108.87	120.07	132.34	138.79	146.76	156.35	163.14	169.64	177.92
26 min	116.00	127.93	141.02	147.90	156.39	166.62	173.86	180.79	189.62
28 min	122.99	135.65	149.54	156.83	165.85	176.70	184.38	191.74	201.10
30 min	129.86	143.23	157.90	165.61	175.14	186.61	194.72	202.50	212.39
40 min	162.64	179.42	197.88	207.60	219.58	234.01	244.22	254.00	266.46

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF (1987)

Site name: Lansdowne

Site latitude = 31.48 degrees S
longitude = 152.31 degrees E
skewness = .60

2-year ARI, 1 hour intensity = 36.00 mm/hr
12 hour intensity = 9.00 mm/hr
72 hour intensity = 3.20 mm/hr

50-year ARI, 1 hour intensity = 68.00 mm/hr
12 hour intensity = 17.80 mm/hr
72 hour intensity = 6.00 mm/hr

IFD Table for Various ARIs and Durations

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	91.27	112.50	144.63	166.79	197.66	242.45	280.07	321.43	382.72
6 min	85.52	105.41	135.57	156.38	185.35	227.41	262.73	301.58	359.15
10 min	69.93	86.22	111.01	128.13	151.96	186.57	215.65	247.66	295.11
12 min	64.63	79.70	102.66	118.53	140.60	172.67	199.63	229.30	273.30
15 min	58.41	72.04	92.84	107.23	127.24	156.31	180.76	207.68	247.60
18 min	53.57	66.08	85.20	98.43	116.82	143.56	166.05	190.81	227.55
20 min	50.88	62.76	80.95	93.53	111.03	136.47	157.86	181.43	216.39
24 min	46.42	57.27	73.90	85.42	101.42	124.70	144.28	165.86	197.88
30 min	41.33	50.99	65.84	76.13	90.42	111.22	128.73	148.01	176.65
45 min	33.12	40.87	52.84	61.14	72.67	89.45	103.59	119.17	142.32
1.0 hr	28.11	34.71	44.91	51.99	61.82	76.14	88.21	101.52	121.30
1.5 hr	22.53	27.84	36.13	41.91	49.92	61.60	71.47	82.36	98.58
2.0 hr	19.19	23.72	30.87	35.85	42.75	52.84	61.36	70.79	84.83
3.0 hr	15.27	18.89	24.66	28.70	34.28	42.46	49.38	57.04	68.48
4.5 hr	12.14	15.03	19.68	22.95	27.46	34.08	39.69	45.92	55.22
6.0 hr	10.31	12.78	16.77	19.59	23.47	29.17	34.01	39.38	47.41
9.0 hr	8.21	10.17	13.40	15.68	18.81	23.43	27.36	31.73	38.27
12.0 hr	6.98	8.66	11.43	13.39	16.09	20.07	23.46	27.23	32.89
18.0 hr	5.61	6.95	9.13	10.67	12.79	15.90	18.54	21.48	25.87
24.0 hr	4.80	5.94	7.77	9.06	10.84	13.45	15.66	18.11	21.78
30.0 hr	4.24	5.24	6.84	7.97	9.51	11.78	13.70	15.83	19.00
36.0 hr	3.82	4.73	6.15	7.15	8.53	10.55	12.26	14.15	16.96
48.0 hr	3.23	3.99	5.17	6.00	7.14	8.81	10.22	11.77	14.09
72.0 hr	2.50	3.09	3.98	4.60	5.46	6.71	7.76	8.92	10.64

IFD Polynomial: ln I = a + b*ln(D) + c*ln(D)**2 + d*ln(D)**3 + e*ln(D)**4 + f*ln(D)**5 + g*ln(D)**6
where duration D is in hrs and average intensity I is in mm/hr

ARI	a	b	c	d	e	f	g	Max % error
1	3.3434920	-.5550865	-.0151166	.0061009	-.0003528	.0000335	-.0000299	.72
2	3.5542076	-.5538524	-.0144245	.0062123	-.0004656	.0000147	-.0000238	.72
5	3.8120240	-.5487918	-.0115758	.0066694	-.0009291	-.0000625	.0000012	.73
10	3.9585031	-.5458085	-.0098966	.0069389	-.0012023	-.0001080	.0000159	.74
20	4.1317567	-.5431616	-.0084066	.0071780	-.0014447	-.0001483	.0000290	.74
50	4.3401836	-.5399773	-.0066142	.0074656	-.0017363	-.0001969	.0000447	.75
100	4.4873374	-.5377292	-.0053487	.0076687	-.0019422	-.0002311	.0000558	.76
200	4.6278994	-.5355817	-.0041398	.0078627	-.0021389	-.0002639	.0000664	.76
500	4.8059641	-.5328613	-.0026086	.0081084	-.0023881	-.0003053	.0000798	.77

Overland Flow Travel Time Aid
Table of t*I**0.4 where t = time in min and I = intensity in mm/h

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	30.40	33.05	36.54	38.69	41.41	44.94	47.61	50.30	53.94
6 min	35.59	38.69	42.78	45.30	48.48	52.61	55.74	58.90	63.16
7 min	40.59	44.13	48.80	51.67	55.31	60.03	63.60	67.20	72.07
8 min	45.43	49.40	54.63	57.85	61.93	67.22	71.22	75.26	80.72
9 min	50.13	54.51	60.31	63.86	68.37	74.21	78.64	83.11	89.14
10 min	54.72	59.50	65.84	69.72	74.65	81.03	85.87	90.76	97.35
12 min	63.59	69.16	76.53	81.06	86.80	94.24	99.87	105.56	113.25
14 min	72.13	78.44	86.82	91.97	98.48	106.94	113.34	119.81	128.54
16 min	80.38	87.41	96.76	102.51	109.78	119.21	126.36	133.58	143.33
18 min	88.38	96.12	106.42	112.75	120.75	131.14	139.00	146.95	157.69
20 min	96.19	104.61	115.82	122.72	131.44	142.75	151.32	159.98	171.67
22 min	103.80	112.90	125.01	132.46	141.87	154.09	163.34	172.70	185.33
24 min	111.26	121.01	134.00	141.99	152.09	165.19	175.12	185.15	198.70
26 min	118.56	128.95	142.81	151.33	162.10	176.07	186.66	197.36	211.81
28 min	125.74	136.76	151.46	160.50	171.93	186.76	197.99	209.35	224.69
30 min	132.79	144.43	159.97	169.52	181.60	197.27	209.14	221.15	237.35
40 min	166.52	181.14	200.69	212.72	227.90	247.62	262.55	277.66	298.05

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF (1987)

Site name: Krambach

Site latitude = 32.03 degrees S
longitude = 152.16 degrees E
skewness = .05

2-year ARI, 1 hour intensity = 35.50 mm/hr
12 hour intensity = 8.00 mm/hr
72 hour intensity = 2.40 mm/hr

50-year ARI, 1 hour intensity = 65.00 mm/hr
12 hour intensity = 16.10 mm/hr
72 hour intensity = 5.40 mm/hr

IFD Table for Various ARIs and Durations

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	90.12	114.50	143.60	160.25	182.81	212.22	234.55	257.14	287.59
6 min	84.45	107.30	134.58	150.18	171.32	198.88	219.80	240.97	269.51
10 min	69.10	87.79	110.11	122.88	140.18	162.73	179.85	197.17	220.52
12 min	63.88	81.17	101.80	113.61	129.60	150.45	166.28	182.29	203.88
15 min	57.75	73.38	92.03	102.70	117.17	136.01	150.32	164.80	184.32
18 min	52.98	67.31	84.43	94.22	107.48	124.77	137.90	151.18	169.09
20 min	50.33	63.94	80.20	89.50	102.10	118.53	131.00	143.61	160.62
24 min	45.93	58.36	73.19	81.68	93.18	108.17	119.56	131.07	146.60
30 min	40.90	51.97	65.18	72.74	82.98	96.33	106.47	116.72	130.55
45 min	32.80	41.67	52.27	58.33	66.54	77.25	85.38	93.60	104.69
1.0 hr	27.86	35.40	44.40	49.54	56.52	65.62	72.52	79.50	88.92
1.5 hr	21.93	27.93	35.25	39.47	45.15	52.57	58.23	63.96	71.70
2.0 hr	18.45	23.53	29.83	33.47	38.37	44.78	49.67	54.63	61.35
3.0 hr	14.41	18.42	23.51	26.47	30.43	35.62	39.60	43.64	49.12
4.5 hr	11.25	14.41	18.51	20.91	24.10	28.31	31.53	34.82	39.29
6.0 hr	9.43	12.11	15.62	17.69	20.43	24.05	26.84	29.67	33.54
9.0 hr	7.37	9.48	12.31	13.99	16.20	19.13	21.39	23.70	26.85
12.0 hr	6.19	7.97	10.40	11.85	13.75	16.27	18.22	20.22	22.94
18.0 hr	4.77	6.17	8.13	9.31	10.85	12.90	14.50	16.13	18.37
24.0 hr	3.96	5.13	6.81	7.83	9.15	10.92	12.30	13.72	15.66
30.0 hr	3.42	4.44	5.92	6.83	8.00	9.57	10.80	12.07	13.81
36.0 hr	3.02	3.93	5.27	6.09	7.15	8.58	9.69	10.84	12.43
48.0 hr	2.47	3.23	4.35	5.05	5.95	7.17	8.12	9.10	10.47
72.0 hr	1.82	2.39	3.27	3.81	4.51	5.47	6.21	6.99	8.07

IFD Polynomial: ln I = a + b*ln(D) + c*ln(D)**2 + d*ln(D)**3 + e*ln(D)**4 + f*ln(D)**5 + g*ln(D)**6
where duration D is in hrs and average intensity I is in mm/hr

ARI	a	b	c	d	e	f	g	Max % error
1	3.3254345	-.5791118	-.0254017	.0086860	-.0004344	-.0003744	.0000358	.32
2	3.5658514	-.5760585	-.0238711	.0084863	-.0004986	-.0003432	.0000327	.27
5	3.7950754	-.5676832	-.0197026	.0079280	-.0006673	-.0002558	.0000238	.19
10	3.9062036	-.5632577	-.0175000	.0076329	-.0007565	-.0002096	.0000191	.33
20	4.0391230	-.5595794	-.0156692	.0073877	-.0008306	-.0001713	.0000152	.45
50	4.1896416	-.5554140	-.0135961	.0071100	-.0009145	-.0001278	.0000108	.58
100	4.2905740	-.5526210	-.0122059	.0069238	-.0009707	-.0000987	.0000078	.67
200	4.3833486	-.5500536	-.0109281	.0067527	-.0010225	-.0000719	.0000051	.75
500	4.4963010	-.5469278	-.0093724	.0065443	-.0010854	-.0000393	.0000018	.85

Overland Flow Travel Time Aid
Table of t*I**0.4 where t = time in min and I = intensity in mm/h

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	30.27	33.31	36.46	38.09	40.15	42.61	44.34	46.00	48.10
6 min	35.37	38.93	42.64	44.55	46.97	49.86	51.90	53.85	56.32
7 min	40.32	44.38	48.61	50.81	53.56	56.87	59.20	61.42	64.25
8 min	45.14	49.68	54.42	56.87	59.96	63.66	66.27	68.76	71.92
9 min	49.83	54.85	60.07	62.78	66.18	70.27	73.14	75.89	79.38
10 min	54.42	59.89	65.59	68.54	72.26	76.71	79.85	82.84	86.65
12 min	63.29	69.66	76.27	79.69	84.00	89.17	92.81	96.29	100.70
14 min	71.84	79.06	86.54	90.42	95.30	101.16	105.28	109.22	114.22
16 min	80.10	88.15	96.48	100.79	106.23	112.75	117.34	121.72	127.28
18 min	88.12	96.96	106.12	110.86	116.83	123.99	129.04	133.86	139.97
20 min	95.92	105.55	115.50	120.66	127.16	134.95	140.44	145.68	152.32
22 min	103.53	113.92	124.66	130.22	137.24	145.64	151.56	157.22	164.39
24 min	110.97	122.10	133.62	139.57	147.09	156.10	162.45	168.51	176.19
26 min	118.25	130.12	142.39	148.74	156.75	166.35	173.12	179.58	187.77
28 min	125.39	137.98	151.00	157.73	166.24	176.42	183.59	190.45	199.13
30 min	132.41	145.69	159.45	166.57	175.55	186.31	193.89	201.13	210.31
40 min	165.85	182.52	199.83	208.79	220.09	233.63	243.16	252.28	263.83

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF (1987)

Site name: Hannamvale

Site latitude = 31.45 degrees S
longitude = 152.35 degrees E
skewness = .05

2-year ARI, 1 hour intensity = 37.50 mm/hr
12 hour intensity = 9.90 mm/hr
72 hour intensity = 3.40 mm/hr

50-year ARI, 1 hour intensity = 75.00 mm/hr
12 hour intensity = 19.20 mm/hr
72 hour intensity = 7.00 mm/hr

IFD Table for Various ARIs and Durations

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	94.38	120.59	153.56	172.75	198.39	232.05	257.77	283.91	319.34
6 min	88.42	113.02	144.10	162.20	186.37	218.12	242.39	267.07	300.54
10 min	72.29	92.52	118.38	133.51	153.65	180.16	200.44	221.10	249.14
12 min	66.81	85.55	109.62	123.73	142.48	167.18	186.09	205.35	231.52
15 min	60.37	77.36	99.31	112.19	129.30	151.85	169.13	186.75	210.69
18 min	55.36	70.98	91.26	103.18	119.00	139.86	155.86	172.18	194.37
20 min	52.58	67.43	86.78	98.17	113.27	133.18	148.46	164.05	185.25
24 min	47.96	61.55	79.35	89.84	103.73	122.07	136.15	150.52	170.08
30 min	42.69	54.83	70.83	80.28	92.78	109.30	121.99	134.96	152.62
45 min	34.20	43.99	57.05	64.80	75.03	88.56	98.98	109.63	124.16
1.0 hr	29.03	37.38	48.62	55.31	64.12	75.80	84.80	94.01	106.58
1.5 hr	23.51	30.25	39.27	44.62	51.68	61.04	68.24	75.60	85.65
2.0 hr	20.18	25.95	33.64	38.20	44.21	52.17	58.30	64.57	73.11
3.0 hr	16.23	20.86	26.98	30.60	35.39	41.72	46.59	51.56	58.34
4.5 hr	13.04	16.75	21.62	24.49	28.30	33.33	37.19	41.13	46.50
6.0 hr	11.17	14.33	18.48	20.92	24.15	28.42	31.70	35.04	39.60
9.0 hr	8.98	11.52	14.82	16.76	19.33	22.73	25.33	27.98	31.59
12.0 hr	7.70	9.87	12.68	14.32	16.51	19.40	21.61	23.86	26.93
18.0 hr	6.12	7.86	10.15	11.50	13.29	15.65	17.47	19.32	21.85
24.0 hr	5.19	6.68	8.65	9.83	11.37	13.42	14.99	16.60	18.80
30.0 hr	4.56	5.87	7.63	8.68	10.05	11.88	13.29	14.73	16.70
36.0 hr	4.09	5.27	6.87	7.82	9.07	10.73	12.01	13.33	15.12
48.0 hr	3.43	4.42	5.78	6.60	7.67	9.09	10.19	11.32	12.86
72.0 hr	2.62	3.39	4.46	5.11	5.95	7.08	7.95	8.84	10.07

IFD Polynomial: $\ln I = a + b\ln(D) + c\ln(D)^2 + d\ln(D)^3 + e\ln(D)^4 + f\ln(D)^5 + g\ln(D)^6$
where duration D is in hrs and average intensity I is in mm/hr

ARI	a	b	c	d	e	f	g	Max % error
1	3.3780666	-.5431812	-.0035120	.0071444	-.0018880	-.0001290	.0000378	.97
2	3.6301253	-.5422055	-.0054972	.0070186	-.0016515	-.0001158	.0000294	.91
5	3.8912064	-.5395277	-.0109555	.0066718	-.0010009	-.0000792	.0000063	.72
10	4.0191678	-.5381128	-.0138396	.0064885	-.0006571	-.0000598	-.0000058	.62
20	4.1660783	-.5369368	-.0162369	.0063362	-.0003714	-.0000438	-.0000160	.53
50	4.3324406	-.5356051	-.0189515	.0061637	-.0000478	-.0000256	-.0000274	.44
100	4.4439972	-.5347121	-.0207718	.0060480	.0001691	-.0000134	-.0000351	.37
200	4.5465372	-.5338912	-.0224450	.0059417	.0003686	-.0000021	-.0000422	.41
500	4.6713791	-.5328918	-.0244821	.0058122	.0006114	.0000115	-.0000508	.46

Overland Flow Travel Time Aid
Table of $t*I^{0.4}$ where t = time in min and I = intensity in mm/h

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	30.81	33.98	37.43	39.24	41.47	44.16	46.06	47.87	50.18
6 min	36.06	39.78	43.84	45.96	48.59	51.74	53.97	56.10	58.81
7 min	41.14	45.38	50.03	52.46	55.46	59.07	61.62	64.06	67.17
8 min	46.05	50.81	56.02	58.76	62.13	66.18	69.05	71.79	75.28
9 min	50.82	56.08	61.86	64.89	68.62	73.11	76.29	79.33	83.19
10 min	55.47	61.22	67.55	70.87	74.96	79.88	83.36	86.69	90.92
12 min	64.46	71.16	78.57	82.46	87.24	93.00	97.07	100.96	105.92
14 min	73.10	80.71	89.17	93.62	99.07	105.64	110.29	114.74	120.40
16 min	81.44	89.95	99.43	104.42	110.53	117.89	123.09	128.08	134.43
18 min	89.55	98.91	109.39	114.91	121.66	129.79	135.55	141.06	148.08
20 min	97.43	107.64	119.10	125.14	132.52	141.41	147.70	153.72	161.40
22 min	105.14	116.17	128.58	135.13	143.13	152.75	159.57	166.10	174.42
24 min	112.67	124.51	137.87	144.91	153.51	163.87	171.20	178.23	187.18
26 min	120.06	132.69	146.97	154.51	163.70	174.77	182.61	190.13	199.70
28 min	127.32	140.73	155.92	163.94	173.71	185.48	193.82	201.82	212.00
30 min	134.46	148.63	164.71	173.21	183.55	196.02	204.85	213.31	224.10
40 min	168.64	186.48	206.84	217.62	230.71	246.49	257.67	268.39	282.05

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF (1987)

Site name: HALLIDAYS PT- DIAMOND BEACH AREA

Site latitude = 32.03 degrees S
longitude = 152.33 degrees E
skewness = .02

2-year ARI, 1 hour intensity = 38.00 mm/hr
12 hour intensity = 8.10 mm/hr
72 hour intensity = 2.60 mm/hr

50-year ARI, 1 hour intensity = 71.00 mm/hr
12 hour intensity = 16.30 mm/hr
72 hour intensity = 5.60 mm/hr

IFD Table for Various ARIs and Durations

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	95.92	121.92	152.20	169.26	192.43	222.41	245.01	267.74	298.19
6 min	89.90	114.30	142.78	158.83	180.64	208.84	230.11	251.51	280.18
10 min	73.59	93.63	117.20	130.52	148.56	171.93	189.57	207.32	231.12
12 min	68.04	86.61	108.49	120.87	137.63	159.34	175.73	192.23	214.36
15 min	61.53	78.34	98.24	109.51	124.74	144.49	159.41	174.43	194.59
18 min	56.45	71.90	90.24	100.64	114.69	132.90	146.66	160.53	179.13
20 min	53.63	68.32	85.79	95.70	109.09	126.45	139.56	152.78	170.52
24 min	48.96	62.39	78.41	87.51	99.79	115.72	127.77	139.90	156.20
30 min	43.61	55.60	69.96	78.13	89.13	103.42	114.23	125.12	139.76
45 min	34.99	44.64	56.30	62.94	71.88	83.50	92.29	101.16	113.08
1.0 hr	29.73	37.95	47.94	53.65	61.31	71.27	78.82	86.44	96.69
1.5 hr	23.21	29.69	37.68	42.27	48.41	56.42	62.49	68.63	76.90
2.0 hr	19.40	24.85	31.65	35.57	40.80	47.63	52.82	58.07	65.15
3.0 hr	15.03	19.28	24.69	27.82	31.98	37.42	41.56	45.76	51.43
4.5 hr	11.63	14.95	19.23	21.73	25.03	29.36	32.66	36.02	40.56
6.0 hr	9.69	12.48	16.11	18.24	21.04	24.72	27.54	30.40	34.28
9.0 hr	7.51	9.68	12.56	14.26	16.49	19.42	21.67	23.96	27.06
12.0 hr	6.26	8.09	10.53	11.98	13.87	16.37	18.28	20.24	22.89
18.0 hr	4.91	6.35	8.32	9.49	11.02	13.04	14.60	16.19	18.35
24.0 hr	4.12	5.34	7.03	8.03	9.34	11.08	12.42	13.79	15.65
30.0 hr	3.59	4.66	6.15	7.04	8.20	9.74	10.93	12.14	13.80
36.0 hr	3.20	4.15	5.50	6.30	7.35	8.75	9.82	10.92	12.43
48.0 hr	2.65	3.44	4.58	5.27	6.15	7.34	8.25	9.19	10.47
72.0 hr	1.99	2.60	3.48	4.01	4.70	5.63	6.34	7.08	8.09

IFD Polynomial: ln I = a + b*ln(D) + c*ln(D)**2 + d*ln(D)**3 + e*ln(D)**4 + f*ln(D)**5 + g*ln(D)**6
where duration D is in hrs and average intensity I is in mm/hr

ARI	a	b	c	d	e	f	g	Max % error
1	3.3887211	-.5877242	-.0358470	.0073599	.0011055	-.0001685	-.0000387	.33
2	3.6334328	-.5843393	-.0351120	.0072616	.0010729	-.0001569	-.0000394	.29
5	3.8681138	-.5752536	-.0331331	.0069924	.0009874	-.0001247	-.0000417	.27
10	3.9810949	-.5704832	-.0320942	.0068511	.0009426	-.0001078	-.0000429	.29
20	4.1150231	-.5665338	-.0312341	.0067341	.0009054	-.0000938	-.0000439	.31
50	4.2661108	-.5620785	-.0302637	.0066021	.0008635	-.0000780	-.0000450	.33
100	4.3670881	-.5591008	-.0296152	.0065139	.0008354	-.0000674	-.0000458	.35
200	4.4596684	-.5563708	-.0290206	.0064330	.0008097	-.0000578	-.0000465	.36
500	4.5720828	-.5530558	-.0282986	.0063348	.0007785	-.0000460	-.0000473	.38

Overland Flow Travel Time Aid
Table of t*I**0.4 where t = time in min and I = intensity in mm/h

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	31.03	34.16	37.32	38.94	40.99	43.43	45.14	46.77	48.83
6 min	36.27	39.93	43.65	45.56	47.96	50.83	52.84	54.76	57.18
7 min	41.35	45.53	49.78	51.96	54.71	57.99	60.30	62.49	65.25
8 min	46.28	50.96	55.74	58.19	61.27	64.95	67.54	69.99	73.10
9 min	51.09	56.26	61.54	64.25	67.67	71.74	74.59	77.31	80.75
10 min	55.79	61.44	67.22	70.18	73.91	78.36	81.49	84.46	88.22
12 min	64.89	71.47	78.21	81.67	86.02	91.21	94.85	98.32	102.70
14 min	73.66	81.13	88.80	92.74	97.69	103.60	107.74	111.69	116.67
16 min	82.15	90.48	99.06	103.45	108.99	115.59	120.22	124.63	130.21
18 min	90.38	99.56	109.01	113.86	119.97	127.24	132.35	137.21	143.36
20 min	98.40	108.40	118.71	124.01	130.66	138.60	144.17	149.48	156.18
22 min	106.22	117.02	128.18	133.91	141.10	149.69	155.72	161.46	168.71
24 min	113.86	125.45	137.44	143.59	151.32	160.54	167.02	173.18	180.97
26 min	121.35	133.71	146.51	153.08	161.34	171.18	178.09	184.68	193.00
28 min	128.69	141.80	155.40	162.39	171.16	181.62	188.97	195.96	204.80
30 min	135.89	149.75	164.14	171.54	180.81	191.88	199.65	207.05	216.41
40 min	170.23	187.64	205.83	215.20	226.91	240.89	250.71	260.06	271.89

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF (1987)

Site name: Coopernook

Site latitude = 31.50 degrees S
longitude = 152.37 degrees E
skewness = .05

2-year ARI, 1 hour intensity = 38.00 mm/hr
12 hour intensity = 8.90 mm/hr
72 hour intensity = 2.90 mm/hr

50-year ARI, 1 hour intensity = 70.00 mm/hr
12 hour intensity = 17.50 mm/hr
72 hour intensity = 5.70 mm/hr

IFD Table for Various ARIs and Durations

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	96.26	122.03	152.12	169.21	192.51	222.80	245.74	268.90	300.07
6 min	90.22	114.38	142.66	158.72	180.62	209.09	230.65	252.43	281.74
10 min	73.83	93.66	116.98	130.26	148.33	171.83	189.65	207.64	231.88
12 min	68.26	86.62	108.25	120.57	137.33	159.14	175.67	192.38	214.87
15 min	61.72	78.33	97.97	109.16	124.38	144.18	159.20	174.38	194.83
18 min	56.62	71.88	89.96	100.27	114.28	132.52	146.35	160.34	179.18
20 min	53.79	68.29	85.50	95.32	108.66	126.02	139.20	152.52	170.47
24 min	49.09	62.35	78.11	87.11	99.33	115.24	127.32	139.53	155.99
30 min	43.73	55.55	69.65	77.71	88.64	102.89	113.70	124.64	139.39
45 min	35.07	44.58	55.99	62.52	71.37	82.91	91.67	100.54	112.50
1.0 hr	29.79	37.89	47.64	53.23	60.80	70.67	78.17	85.76	96.01
1.5 hr	23.62	30.08	37.99	42.54	48.68	56.70	62.81	69.00	77.37
2.0 hr	19.96	25.45	32.24	36.17	41.44	48.35	53.61	58.95	66.18
3.0 hr	15.70	20.06	25.52	28.70	32.94	38.52	42.77	47.10	52.96
4.5 hr	12.34	15.79	20.18	22.74	26.16	30.65	34.09	37.59	42.34
6.0 hr	10.41	13.33	17.09	19.29	22.22	26.07	29.03	32.04	36.13
9.0 hr	8.19	10.50	13.52	15.30	17.66	20.77	23.16	25.59	28.91
12.0 hr	6.91	8.87	11.46	12.99	15.01	17.68	19.74	21.83	24.69
18.0 hr	5.44	6.99	9.03	10.23	11.83	13.93	15.55	17.20	19.45
24.0 hr	4.59	5.89	7.61	8.62	9.96	11.74	13.10	14.49	16.39
30.0 hr	4.01	5.14	6.64	7.53	8.70	10.25	11.44	12.65	14.31
36.0 hr	3.58	4.59	5.93	6.72	7.77	9.15	10.22	11.30	12.78
48.0 hr	2.97	3.82	4.93	5.59	6.46	7.61	8.49	9.40	10.63
72.0 hr	2.25	2.89	3.73	4.23	4.89	5.76	6.43	7.11	8.04

IFD Polynomial: ln I = a + b*ln(D) + c*ln(D)**2 + d*ln(D)**3 + e*ln(D)**4 + f*ln(D)**5 + g*ln(D)**6
where duration D is in hrs and average intensity I is in mm/hr

ARI	a	b	c	d	e	f	g	Max % error
1	3.3961783	-.5688753	-.0225530	.0073246	-.0001482	-.0001621	-.0000050	.19
2	3.6367818	-.5662227	-.0215327	.0073745	-.0002680	-.0001726	.0000000	.22
5	3.8664912	-.5589792	-.0187340	.0075106	-.0005962	-.0002013	.0000138	.28
10	3.9778760	-.5551519	-.0172551	.0075826	-.0007697	-.0002164	.0000211	.32
20	4.1110086	-.5519706	-.0160259	.0076423	-.0009138	-.0002290	.0000271	.34
50	4.2617687	-.5483682	-.0146340	.0077100	-.0010771	-.0002433	.0000340	.38
100	4.3628630	-.5459526	-.0137006	.0077554	-.0011866	-.0002528	.0000386	.40
200	4.4557864	-.5437321	-.0128427	.0077972	-.0012872	-.0002616	.0000428	.42
500	4.5689200	-.5410288	-.0117981	.0078480	-.0014097	-.0002723	.0000479	.44

Overland Flow Travel Time Aid
Table of t*I**0.4 where t = time in min and I = intensity in mm/h

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	31.07	34.16	37.30	38.93	40.99	43.46	45.19	46.85	48.95
6 min	36.34	39.96	43.65	45.55	47.97	50.86	52.90	54.84	57.30
7 min	41.43	45.56	49.78	51.96	54.72	58.03	60.35	62.57	65.39
8 min	46.38	51.01	55.74	58.18	61.28	64.99	67.60	70.09	73.25
9 min	51.20	56.30	61.54	64.24	67.66	71.76	74.65	77.41	80.90
10 min	55.90	61.48	67.20	70.16	73.90	78.38	81.54	84.55	88.37
12 min	64.99	71.49	78.16	81.61	85.97	91.20	94.88	98.39	102.84
14 min	73.75	81.13	88.71	92.64	97.60	103.53	107.72	111.71	116.78
16 min	82.22	90.45	98.92	103.30	108.84	115.47	120.14	124.60	130.26
18 min	90.44	99.49	108.83	113.66	119.76	127.06	132.21	137.12	143.35
20 min	98.44	108.30	118.48	123.74	130.39	138.35	143.96	149.32	156.11
22 min	106.25	116.90	127.90	133.59	140.77	149.38	155.44	161.23	168.57
24 min	113.89	125.31	137.11	143.22	150.93	160.17	166.68	172.89	180.77
26 min	121.37	133.54	146.14	152.66	160.89	170.74	177.69	184.32	192.73
28 min	128.71	141.63	155.01	161.93	170.67	181.13	188.50	195.54	204.47
30 min	135.92	149.57	163.72	171.04	180.27	191.33	199.13	206.57	216.01
40 min	170.36	187.51	205.35	214.59	226.23	240.17	250.00	259.39	271.29

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF (1987)

Site name: Harrington Village

Site latitude = 31.53 degrees S
longitude = 152.41 degrees E
skewness = .02

2-year ARI, 1 hour intensity = 40.00 mm/hr
12 hour intensity = 8.60 mm/hr
72 hour intensity = 2.70 mm/hr

50-year ARI, 1 hour intensity = 74.00 mm/hr
12 hour intensity = 17.00 mm/hr
72 hour intensity = 5.50 mm/hr

IFD Table for Various ARIs and Durations

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	100.99	127.97	158.45	175.45	198.76	228.80	251.37	274.02	304.27
6 min	94.66	119.99	148.70	164.73	186.69	215.00	236.28	257.63	286.16
10 min	77.50	98.34	122.20	135.57	153.83	177.39	195.12	212.93	236.75
12 min	71.67	90.98	113.18	125.63	142.61	164.54	181.05	197.64	219.83
15 min	64.81	82.32	102.54	113.91	129.38	149.38	164.44	179.58	199.85
18 min	59.47	75.57	94.25	104.75	119.05	137.53	151.45	165.45	184.21
20 min	56.51	71.82	89.63	99.66	113.29	130.92	144.21	157.57	175.48
24 min	51.59	65.59	81.96	91.20	103.73	119.94	132.17	144.47	160.96
30 min	45.96	58.47	73.18	81.49	92.75	107.33	118.33	129.41	144.26
45 min	36.88	46.97	58.97	65.76	74.95	86.86	95.86	104.93	117.10
1.0 hr	31.34	39.95	50.26	56.12	64.03	74.28	82.04	89.86	100.36
1.5 hr	24.51	31.29	39.54	44.25	50.58	58.80	65.03	71.33	79.79
2.0 hr	20.51	26.22	33.23	37.25	42.64	49.65	54.96	60.34	67.58
3.0 hr	15.91	20.37	25.94	29.15	33.42	39.01	43.25	47.54	53.33
4.5 hr	12.33	15.81	20.23	22.78	26.17	30.61	33.99	37.41	42.04
6.0 hr	10.29	13.22	16.95	19.13	22.01	25.78	28.65	31.57	35.51
9.0 hr	7.98	10.27	13.23	14.96	17.25	20.25	22.54	24.87	28.02
12.0 hr	6.67	8.59	11.10	12.58	14.52	17.07	19.02	21.01	23.70
18.0 hr	5.21	6.71	8.70	9.87	11.41	13.43	14.98	16.55	18.69
24.0 hr	4.36	5.62	7.30	8.29	9.59	11.30	12.61	13.95	15.76
30.0 hr	3.79	4.89	6.36	7.23	8.36	9.86	11.01	12.18	13.77
36.0 hr	3.37	4.35	5.67	6.44	7.46	8.80	9.83	10.88	12.31
48.0 hr	2.78	3.60	4.69	5.34	6.19	7.31	8.17	9.05	10.24
72.0 hr	2.08	2.70	3.53	4.02	4.67	5.52	6.18	6.85	7.76

IFD Polynomial: $\ln I = a + b\ln(D) + c\ln(D)^2 + d\ln(D)^3 + e\ln(D)^4 + f\ln(D)^5 + g\ln(D)^6$
where duration D is in hrs and average intensity I is in mm/hr

ARI	a	b	c	d	e	f	g	Max % error
1	3.4416773	-.5857517	-.0340441	.0076529	.0008123	-.0002156	-.0000232	.32
2	3.6845917	-.5823337	-.0335006	.0076435	.0007607	-.0002192	-.0000211	.31
5	3.9144652	-.5731903	-.0320281	.0076162	.0006217	-.0002283	-.0000153	.28
10	4.0249220	-.5683896	-.0312549	.0076018	.0005487	-.0002331	-.0000123	.27
20	4.1567605	-.5644152	-.0306148	.0075900	.0004883	-.0002371	-.0000098	.25
50	4.3054906	-.5599316	-.0298927	.0075766	.0004202	-.0002416	-.0000070	.24
100	4.4048924	-.5569350	-.0294102	.0075676	.0003746	-.0002446	-.0000051	.23
200	4.4960280	-.5541876	-.0289677	.0075594	.0003329	-.0002474	-.0000034	.22
500	4.6066884	-.5508516	-.0284304	.0075495	.0002822	-.0002507	-.0000013	.21

Overland Flow Travel Time Aid
Table of $t*I^{0.4}$ where t = time in min and I = intensity in mm/h

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	31.68	34.83	37.93	39.51	41.53	43.94	45.62	47.22	49.24
6 min	37.03	40.71	44.36	46.21	48.59	51.41	53.39	55.27	57.64
7 min	42.21	46.42	50.59	52.72	55.43	58.66	60.92	63.08	65.79
8 min	47.25	51.96	56.66	59.04	62.09	65.72	68.26	70.68	73.73
9 min	52.16	57.37	62.57	65.21	68.59	72.60	75.42	78.09	81.47
10 min	56.96	62.66	68.35	71.24	74.94	79.34	82.42	85.35	89.05
12 min	66.26	72.90	79.55	82.94	87.26	92.40	96.00	99.43	103.75
14 min	75.22	82.76	90.35	94.22	99.13	104.99	109.10	113.01	117.94
16 min	83.88	92.30	100.80	105.13	110.64	117.19	121.79	126.16	131.68
18 min	92.29	101.57	110.95	115.74	121.81	129.05	134.12	138.95	145.05
20 min	100.48	110.59	120.83	126.07	132.70	140.60	146.14	151.42	158.08
22 min	108.46	119.39	130.48	136.15	143.33	151.88	157.88	163.59	170.80
24 min	116.27	127.99	139.92	146.02	153.73	162.92	169.37	175.51	183.26
26 min	123.91	136.42	149.16	155.68	163.92	173.74	180.63	187.19	195.47
28 min	131.41	144.68	158.23	165.16	173.92	184.36	191.68	198.65	207.46
30 min	138.77	152.80	167.14	174.48	183.75	194.79	202.54	209.92	219.24
40 min	173.84	191.48	209.63	218.94	230.65	244.63	254.43	263.77	275.57

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF (1987)

Site name: Tinonee

Site latitude = 31.90 degrees S
longitude = 152.40 degrees E
skewness = .05

2-year ARI, 1 hour intensity = 35.50 mm/hr
12 hour intensity = 8.10 mm/hr
72 hour intensity = 2.50 mm/hr

50-year ARI, 1 hour intensity = 66.50 mm/hr
12 hour intensity = 16.00 mm/hr
72 hour intensity = 6.00 mm/hr

IFD Table for Various ARIs and Durations

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	89.98	114.60	144.65	161.97	185.29	215.79	239.00	262.53	294.33
6 min	84.32	107.39	135.57	151.82	173.69	202.30	224.07	246.14	275.97
10 min	68.96	87.85	110.97	124.30	142.24	165.71	183.57	201.69	226.18
12 min	63.75	81.21	102.61	114.95	131.55	153.27	169.80	186.57	209.24
15 min	57.62	73.41	92.78	103.95	118.98	138.64	153.61	168.79	189.32
18 min	52.85	67.34	85.12	95.38	109.18	127.24	140.99	154.94	173.80
20 min	50.20	63.97	80.87	90.62	103.74	120.90	133.98	147.24	165.16
24 min	45.81	58.38	73.82	82.73	94.72	110.40	122.35	134.46	150.85
30 min	40.79	51.98	65.75	73.70	84.39	98.38	109.04	119.85	134.47
45 min	32.69	41.67	52.74	59.14	67.74	78.99	87.56	96.26	108.02
1.0 hr	27.76	35.39	44.81	50.26	57.57	67.15	74.45	81.85	91.87
1.5 hr	21.92	27.98	35.55	39.95	45.83	53.55	59.44	65.42	73.53
2.0 hr	18.48	23.61	30.07	33.83	38.86	45.46	50.50	55.62	62.57
3.0 hr	14.48	18.52	23.68	26.69	30.71	35.99	40.03	44.14	49.72
4.5 hr	11.33	14.52	18.63	21.04	24.24	28.46	31.69	34.99	39.46
6.0 hr	9.53	12.22	15.72	17.77	20.50	24.10	26.86	29.67	33.50
9.0 hr	7.47	9.59	12.38	14.02	16.20	19.08	21.29	23.54	26.62
12.0 hr	6.28	8.07	10.45	11.85	13.71	16.17	18.06	19.99	22.62
18.0 hr	4.86	6.29	8.28	9.48	11.04	13.13	14.75	16.41	18.69
24.0 hr	4.04	5.25	7.00	8.07	9.45	11.31	12.75	14.24	16.30
30.0 hr	3.50	4.56	6.13	7.10	8.36	10.05	11.37	12.74	14.62
36.0 hr	3.10	4.05	5.49	6.39	7.54	9.11	10.33	11.60	13.36
48.0 hr	2.54	3.34	4.59	5.37	6.38	7.75	8.83	9.96	11.53
72.0 hr	1.88	2.49	3.49	4.13	4.95	6.08	6.97	7.91	9.22

IFD Polynomial: ln I = a + b*ln(D) + c*ln(D)**2 + d*ln(D)**3 + e*ln(D)**4 + f*ln(D)**5 + g*ln(D)**6
where duration D is in hrs and average intensity I is in mm/hr

ARI	a	b	c	d	e	f	g	Max % error
1	3.3232336	-.5756315	-.0229045	.0085066	-.0005980	-.0003446	.0000356	.28
2	3.5669053	-.5733736	-.0228336	.0081001	-.0004385	-.0002819	.0000215	.15
5	3.8050064	-.5671663	-.0226882	.0069621	.0000129	-.0001061	-.0000181	.25
10	3.9208253	-.5638864	-.0226114	.0063609	.0002515	-.0000133	-.0000391	.40
20	4.0576434	-.5611602	-.0225476	.0058611	.0004497	.0000639	-.0000565	.56
50	4.2125770	-.5580731	-.0224753	.0052952	.0006742	.0001513	-.0000762	.74
100	4.3164699	-.5560030	-.0224268	.0049157	.0008248	.0002099	-.0000895	.86
200	4.4119657	-.5541003	-.0223823	.0045669	.0009632	.0002638	-.0001016	.97
500	4.5282311	-.5517836	-.0223280	.0041422	.0011316	.0003294	-.0001164	1.10

Overland Flow Travel Time Aid
Table of t*I**0.4 where t = time in min and I = intensity in mm/h

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	30.25	33.32	36.56	38.25	40.36	42.89	44.67	46.38	48.54
6 min	35.35	38.95	42.77	44.76	47.24	50.22	52.32	54.33	56.88
7 min	40.30	44.41	48.77	51.04	53.88	57.28	59.68	61.98	64.89
8 min	45.12	49.71	54.60	57.14	60.32	64.12	66.81	69.38	72.65
9 min	49.80	54.87	60.26	63.07	66.57	70.78	73.74	76.58	80.18
10 min	54.38	59.91	65.79	68.85	72.68	77.26	80.50	83.59	87.52
12 min	63.24	69.67	76.50	80.05	84.49	89.81	93.57	97.16	101.72
14 min	71.77	79.07	86.80	90.83	95.86	101.89	106.15	110.22	115.38
16 min	80.02	88.15	96.77	101.25	106.86	113.58	118.32	122.85	128.61
18 min	88.02	96.96	106.44	111.37	117.54	124.93	130.15	135.13	141.46
20 min	95.80	105.54	115.86	121.23	127.94	135.99	141.67	147.10	153.99
22 min	103.40	113.91	125.06	130.85	138.10	146.79	152.93	158.79	166.23
24 min	110.82	122.09	134.05	140.27	148.04	157.37	163.95	170.24	178.22
26 min	118.09	130.10	142.86	149.50	157.79	167.73	174.75	181.46	189.98
28 min	125.23	137.96	151.50	158.55	167.35	177.91	185.36	192.48	201.52
30 min	132.23	145.68	160.00	167.45	176.75	187.91	195.79	203.32	212.88
40 min	165.64	182.53	200.58	209.98	221.70	235.76	245.68	255.17	267.23

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APPENDIX B GUTTER FLOW WIDTHS, PIT CAPACITIES, PRESSURE HEAD CHANGE CO-EFFICIENTS and VELOCITY DISCHARGE DIAGRAMS.

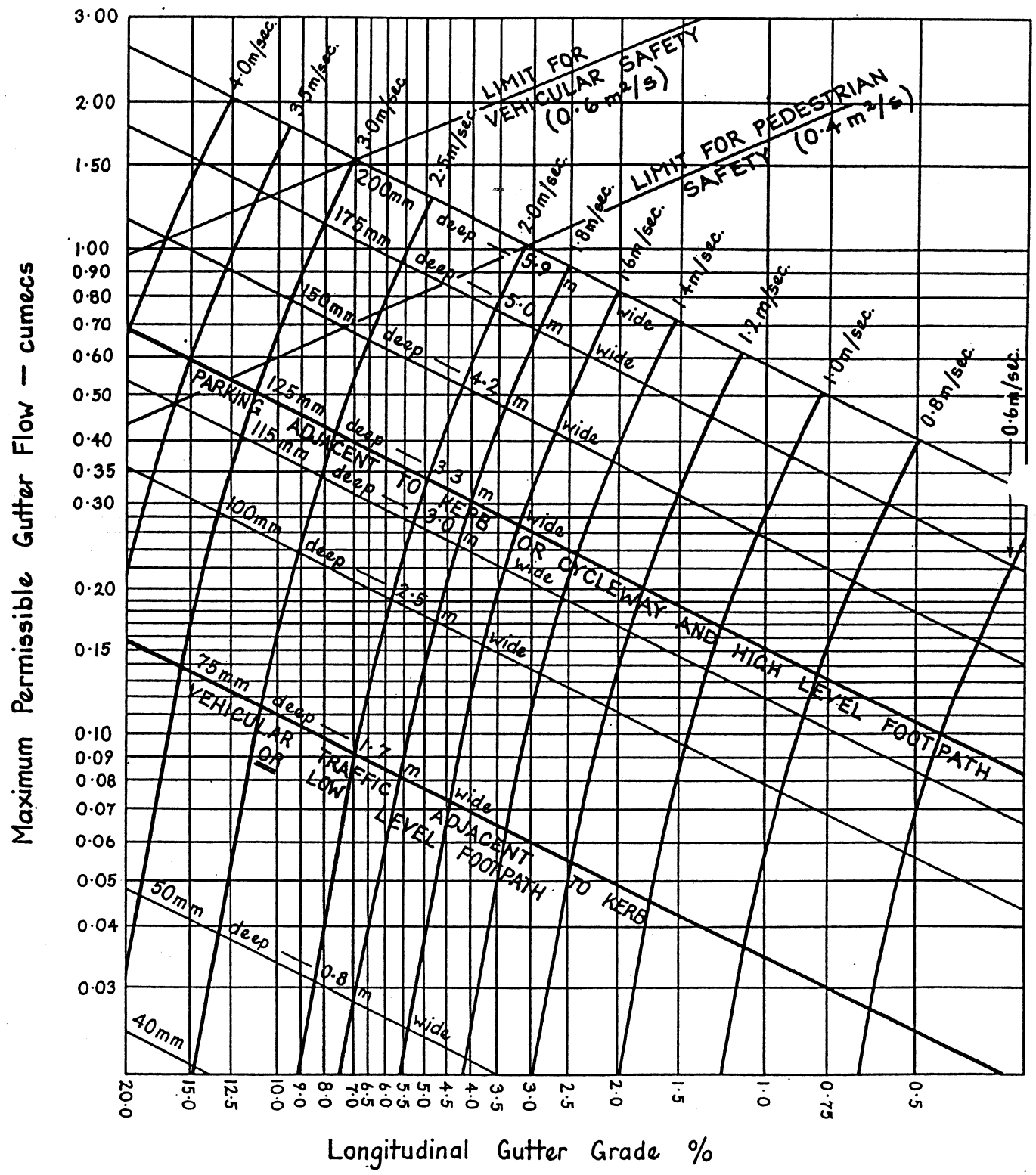


FIGURE F1

MAXIMUM PERMISSIBLE GUTTER FLOW

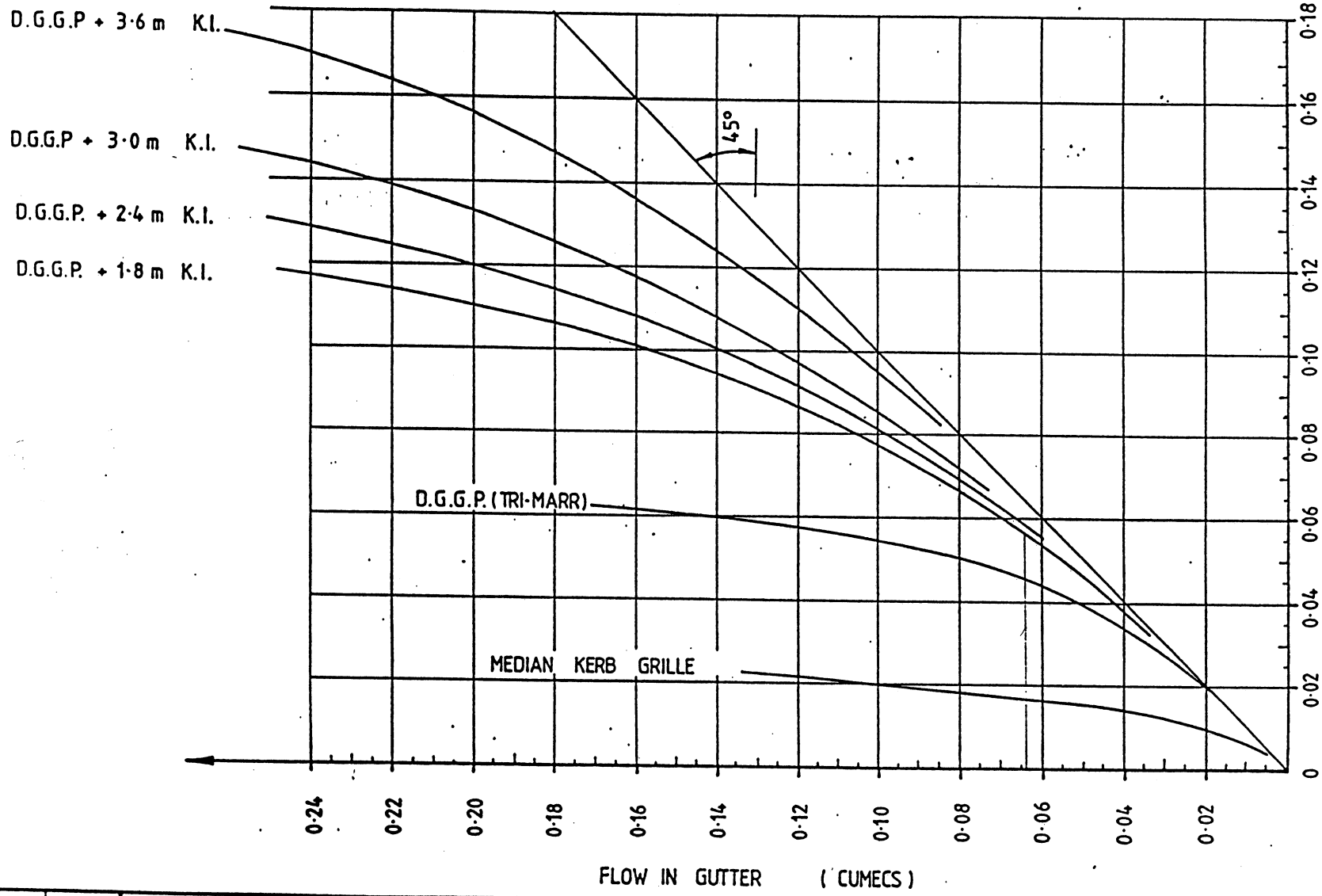


FIGURE G1

SURVEYED		BASE SCALE	BAR SCALE
DRAWN			
CHECKED			
DESIGN ENG.			

GREATER TAREE CITY COUNCIL

STRAIGHT KERB INLET CAPACITIES
FOR ROAD CROSSFALLS BETWEEN 2% AND 6%
LONGITUDINAL GRADES UP TO 10%

Ξ No.

DRAWING No. 292 / 36 A3

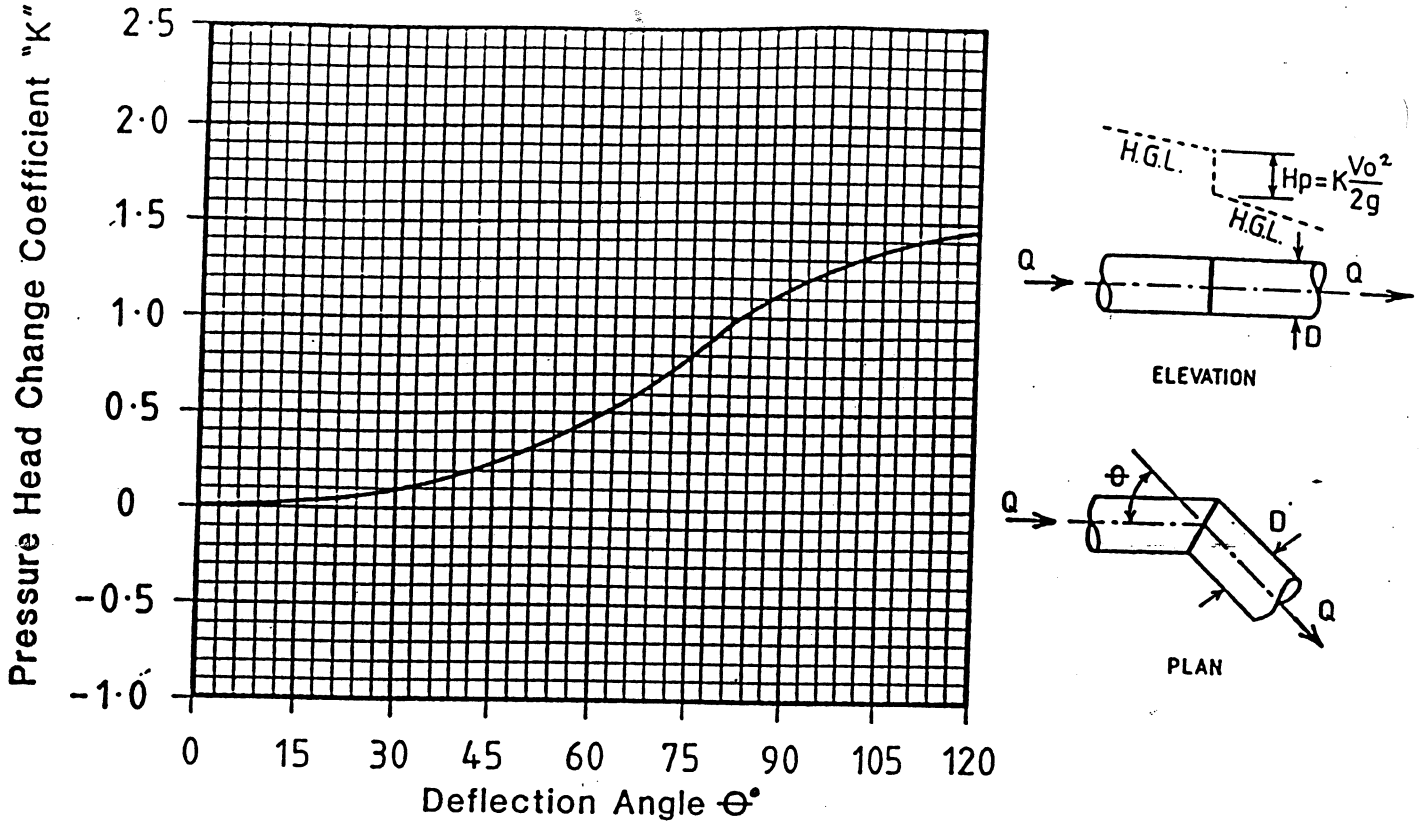


FIGURE H1 PRESSURE HEAD CHANGE COEFFICIENTS FOR MITRE BENDS

INTERPOLATE BETWEEN FIGURES H1 & H2 FOR LESS THAN 90° DEFLECTION

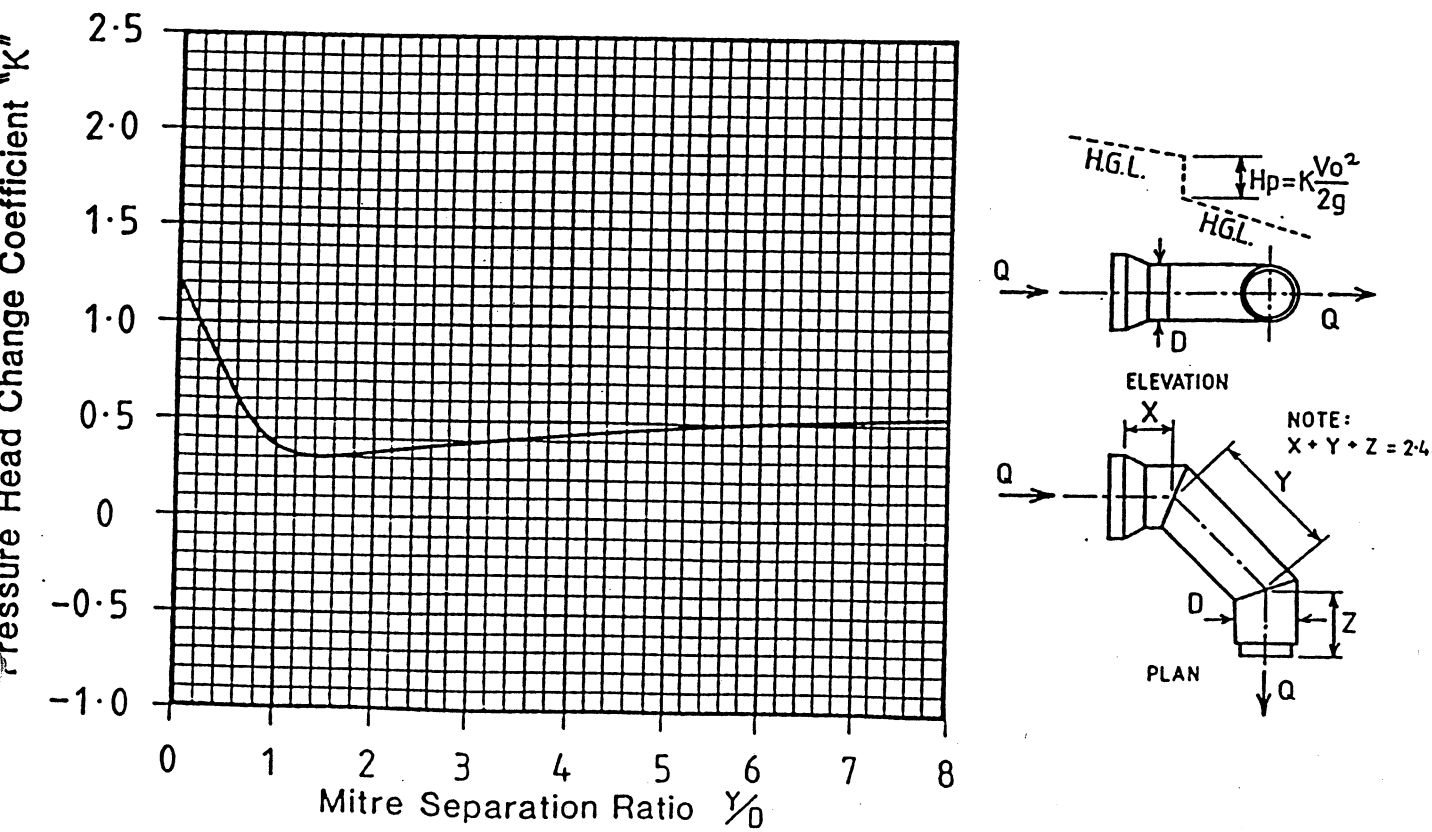


FIGURE H2 PRESSURE HEAD CHANGE COEFFICIENTS FOR 90°COMPOUND BENDS (LOBSTERBACK)

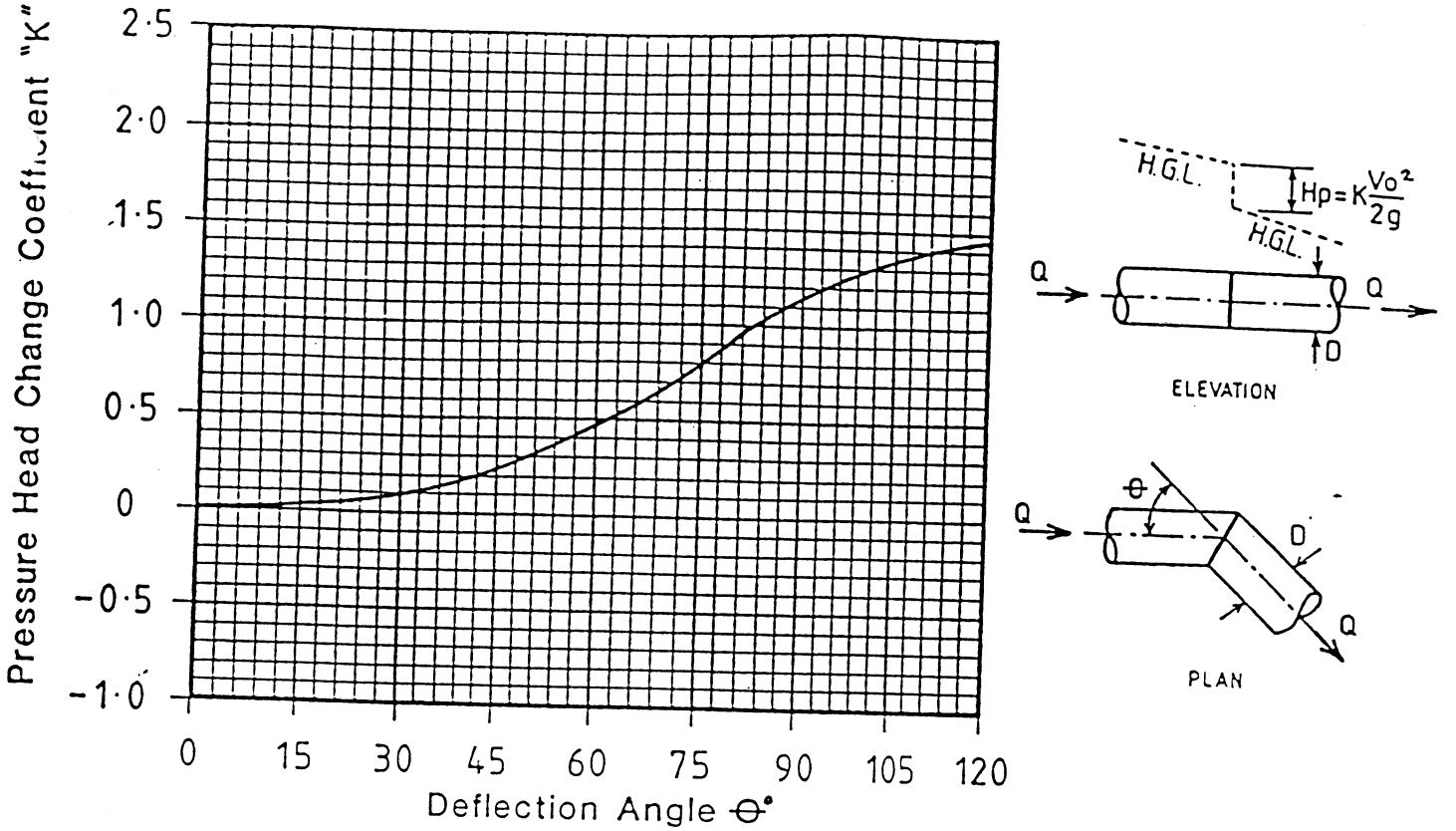


FIGURE H1 PRESSURE HEAD CHANGE COEFFICIENTS FOR MITRE BENDS

INTERPOLATE BETWEEN FIGURES H1 & H2 FOR LESS THAN 90° DEFLECTION

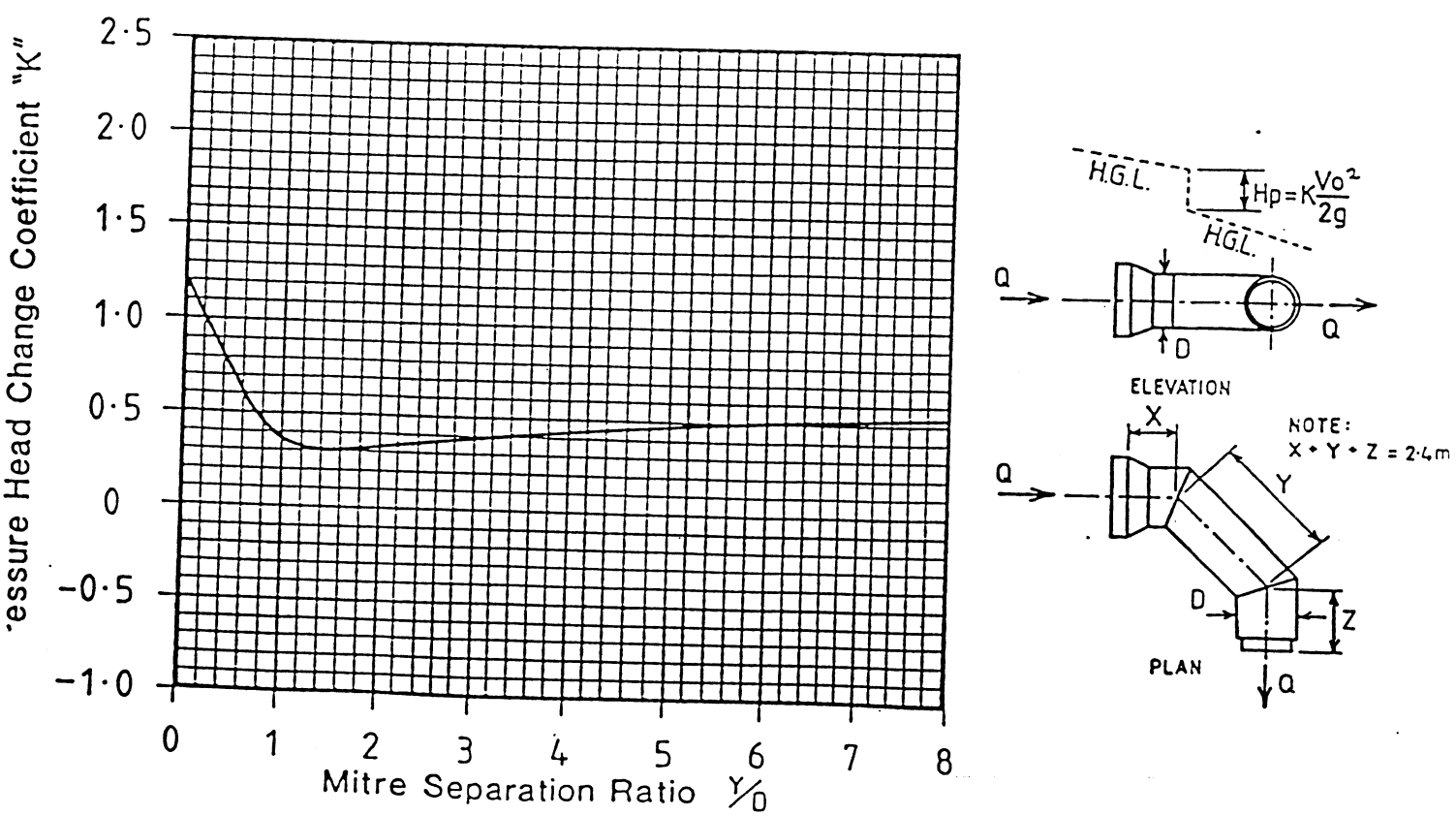


FIGURE H2 PRESSURE HEAD CHANGE COEFFICIENTS FOR 90°COMPOUND BENDS (LOBSTERBACK)

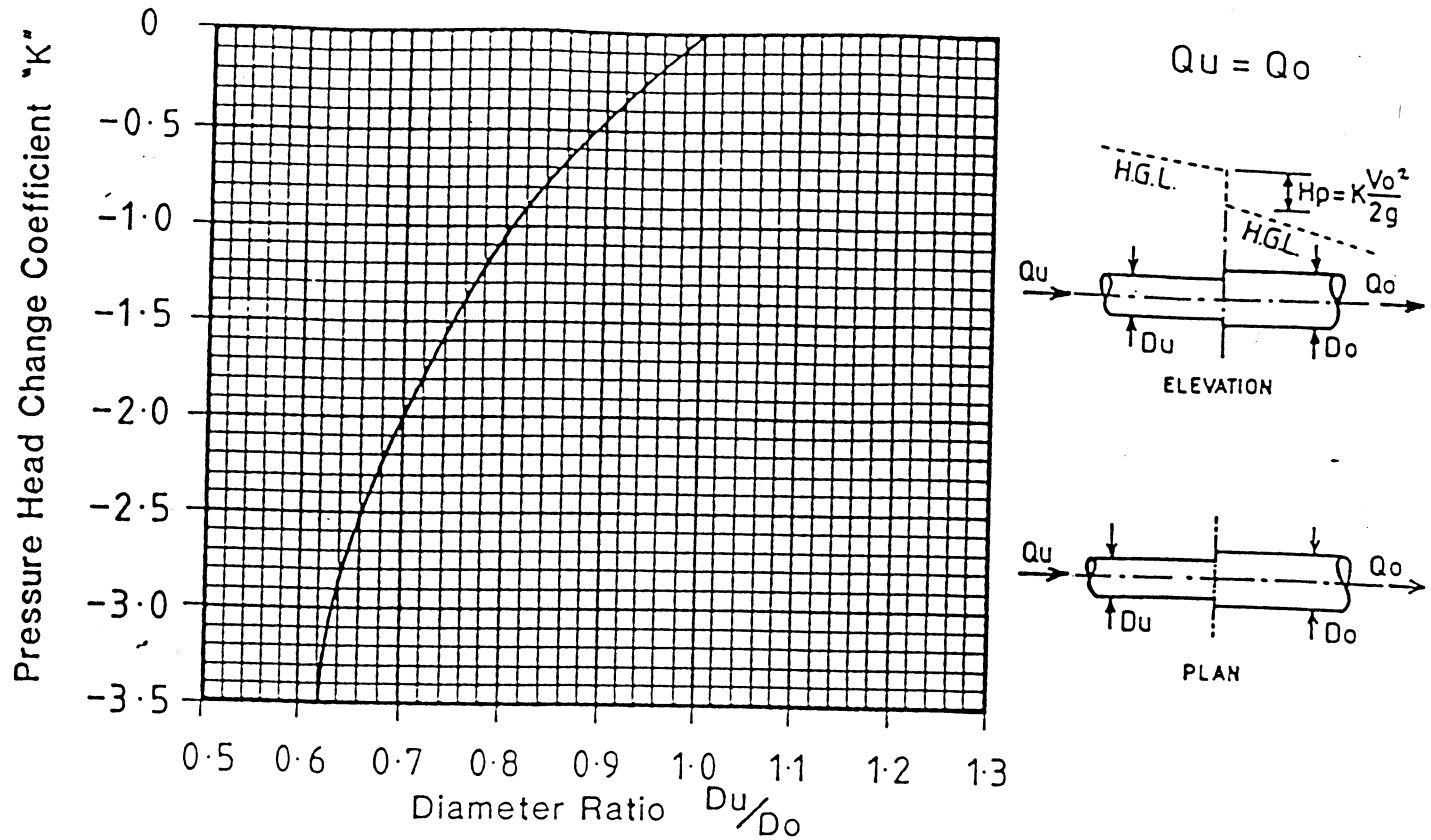


FIGURE H3 : PRESSURE HEAD CHANGE COEFFICIENTS FOR SUDDEN EXPANSIONS

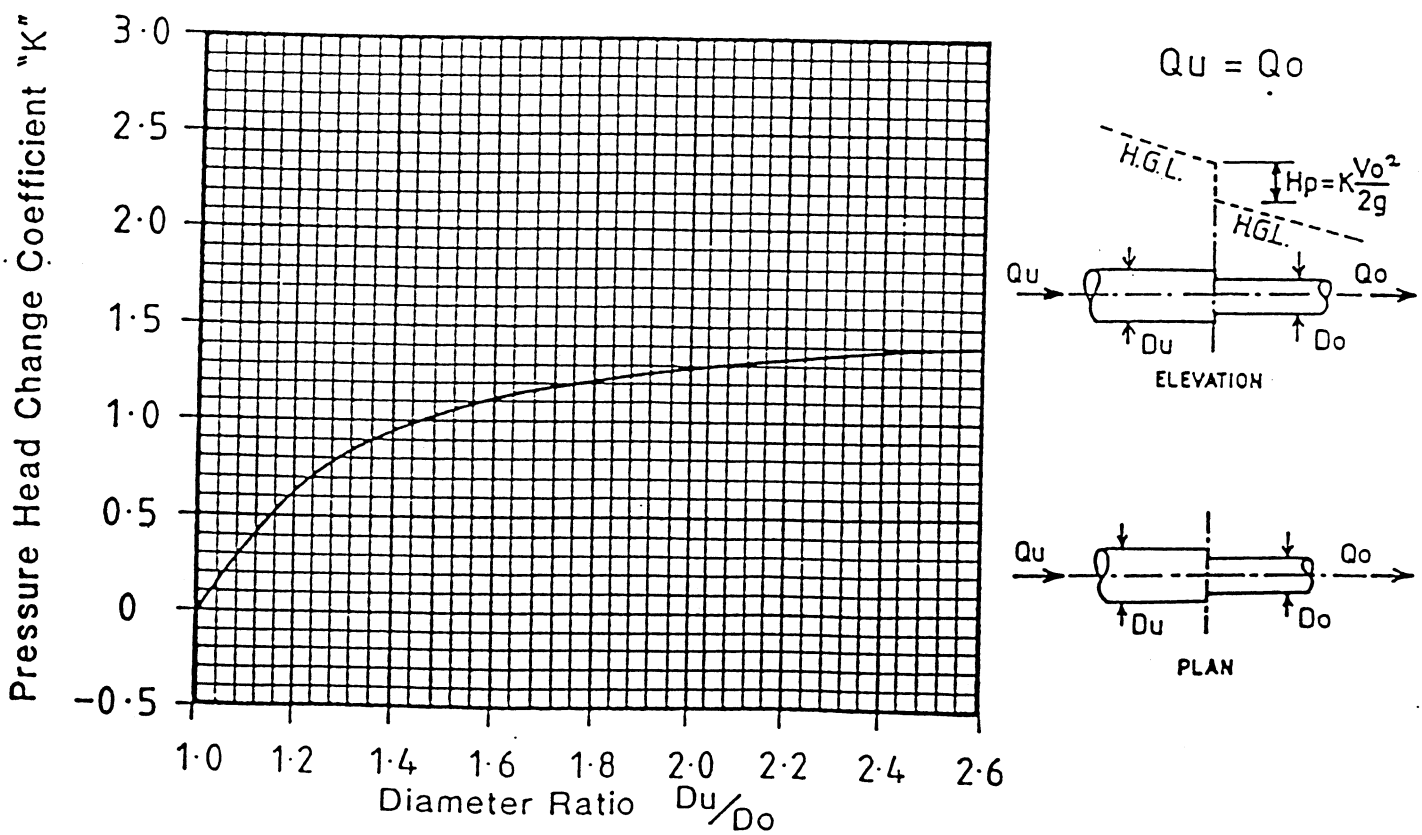


FIGURE H4 : PRESSURE HEAD CHANGE COEFFICIENTS FOR SUDDEN CONTRACTIONS OR REDUCERS

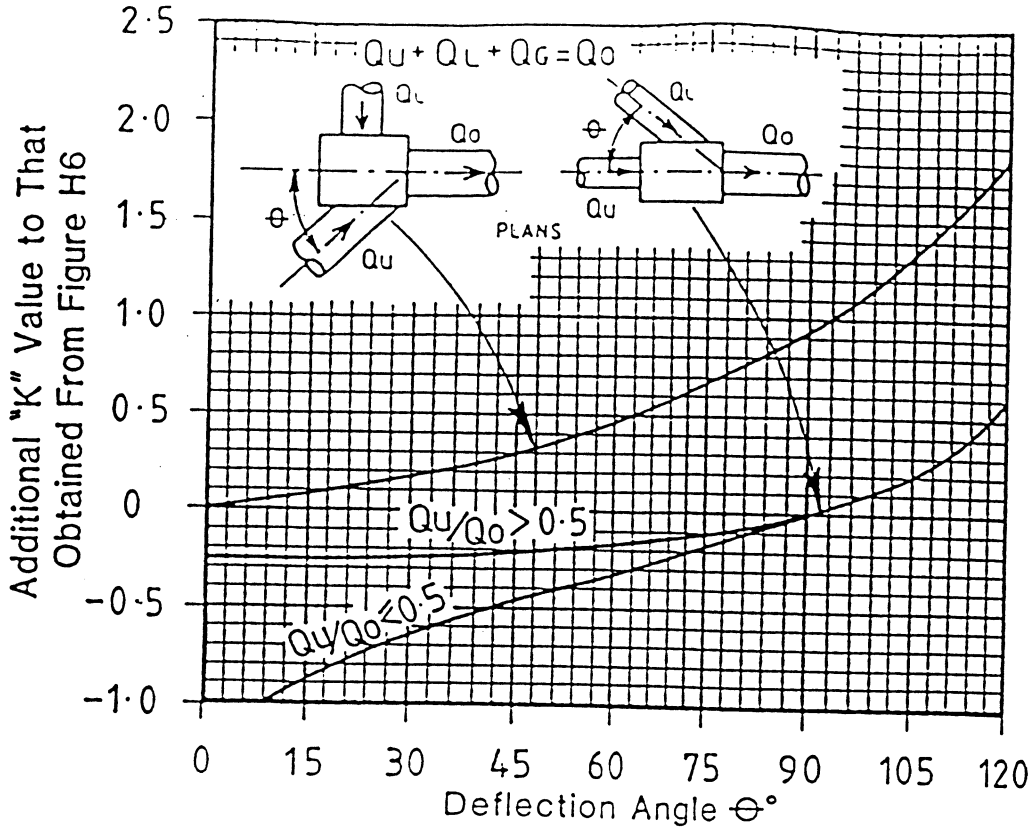


FIGURE H5 : MODIFICATION OF PRESSURE HEAD CHANGE COEFFICIENTS FOR THE ANGLED JUNCTION OF THREE PIPELINES AT PITS

(FIGURES H5 & H6 EQUAL TO CHART 5 IN CIVILCAD VER.4.4, PIPE NETWORK INFORMATION DATA SCREEN)

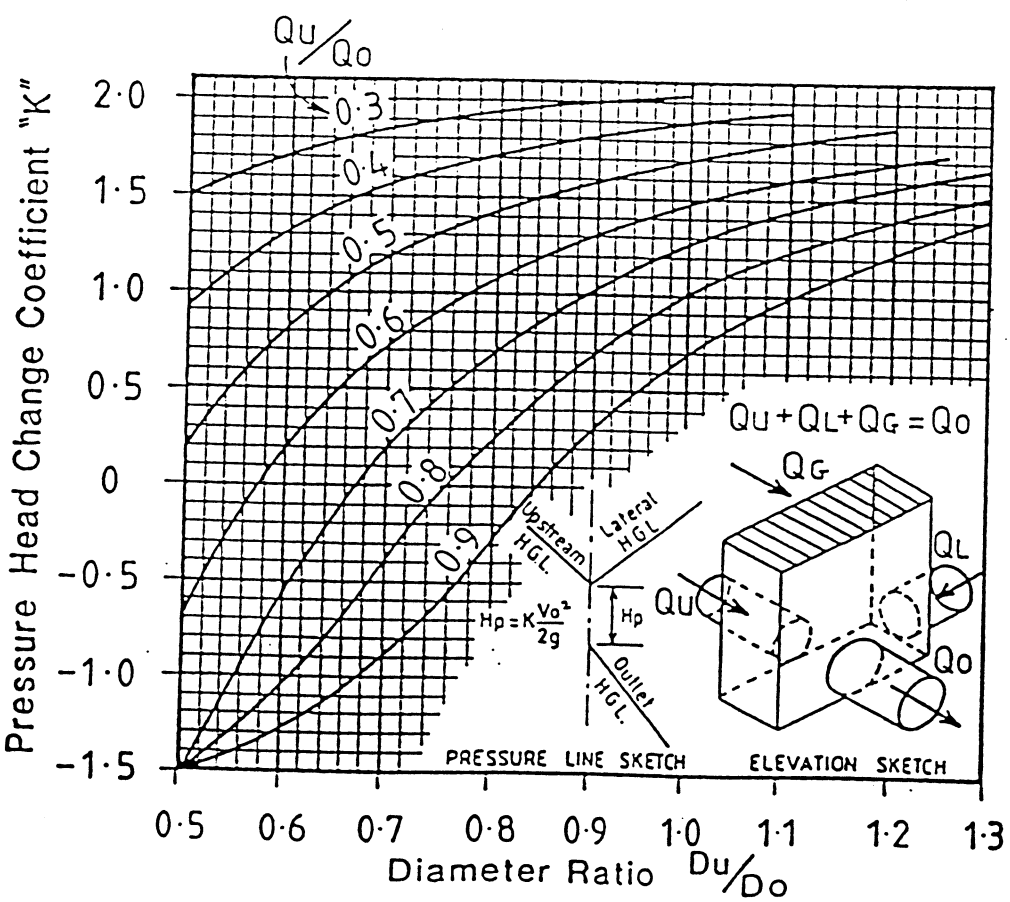


FIGURE H6 : PRESSURE HEAD CHANGE COEFFICIENTS FOR THROUGH PIPELINE JUNCTION PIT WITH PERPENDICULAR LATERAL

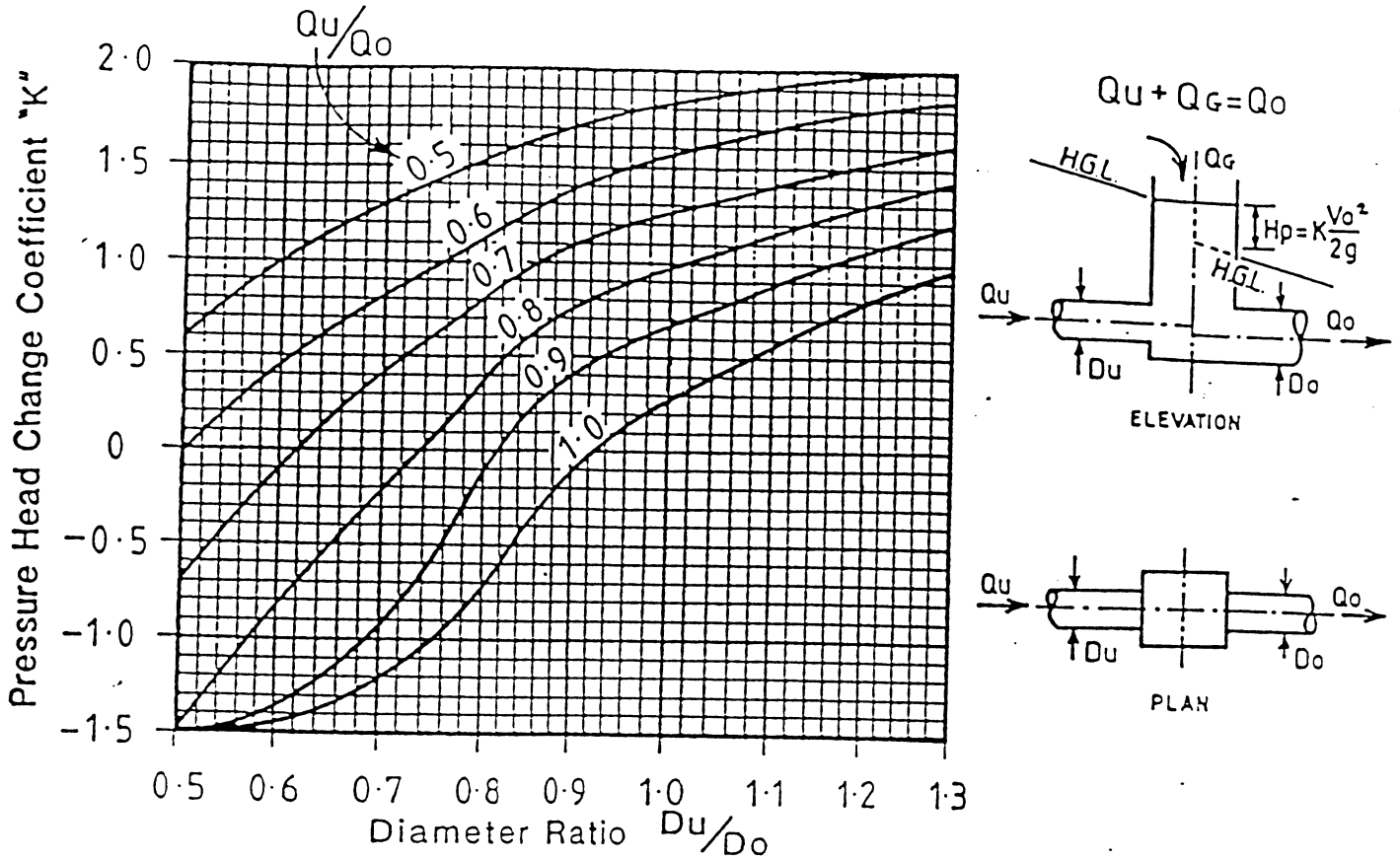


FIGURE H7 : PRESSURE HEAD CHANGE COEFFICIENTS FOR STRAIGHT THROUGH PIPELINES AT PITS

(FIGURES H7 & H8 EQUAL TO CHART 4 IN CIVILCAD VER 4.4, PIPE NETWORK INFORMATION DATA SCREEN)

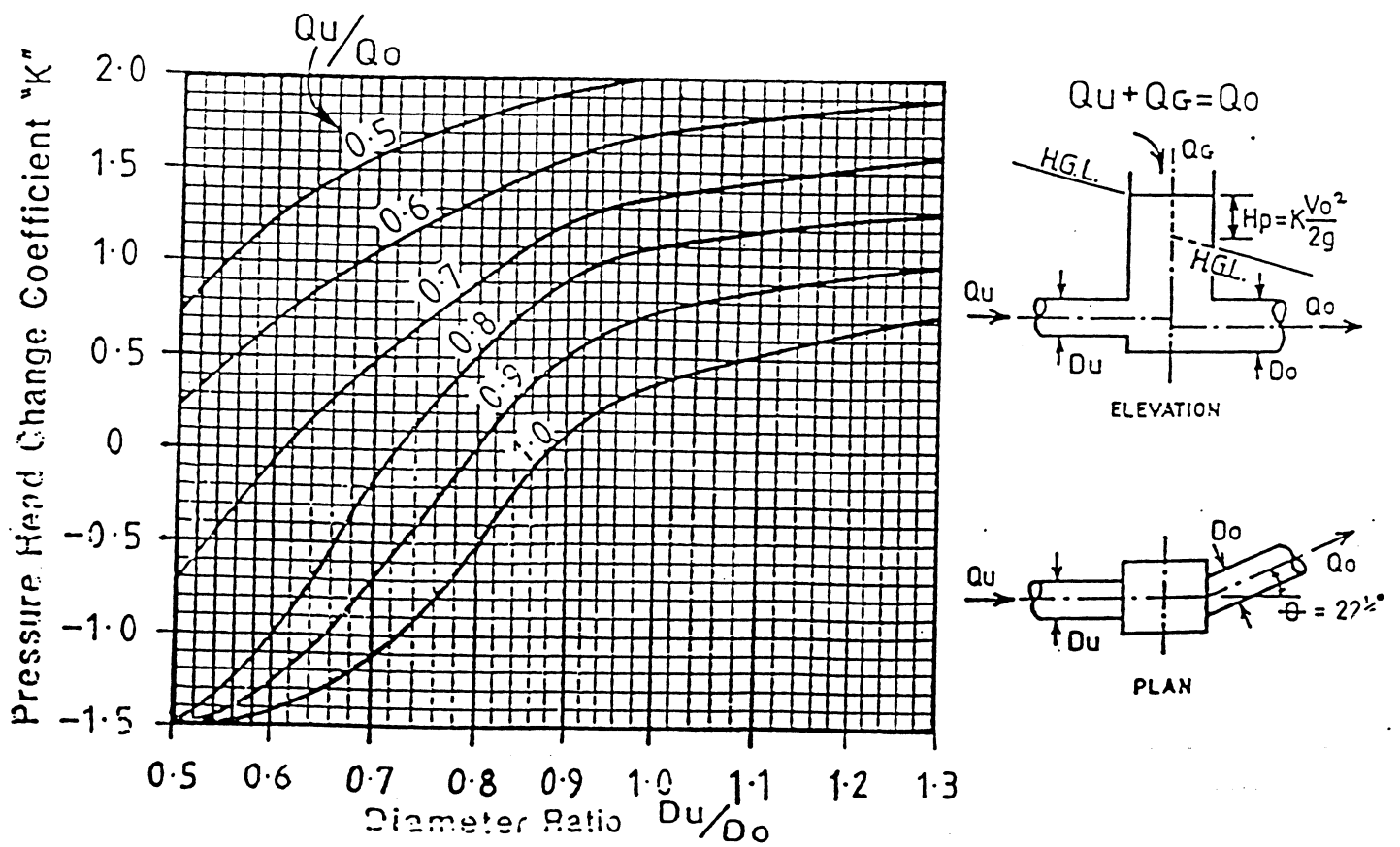
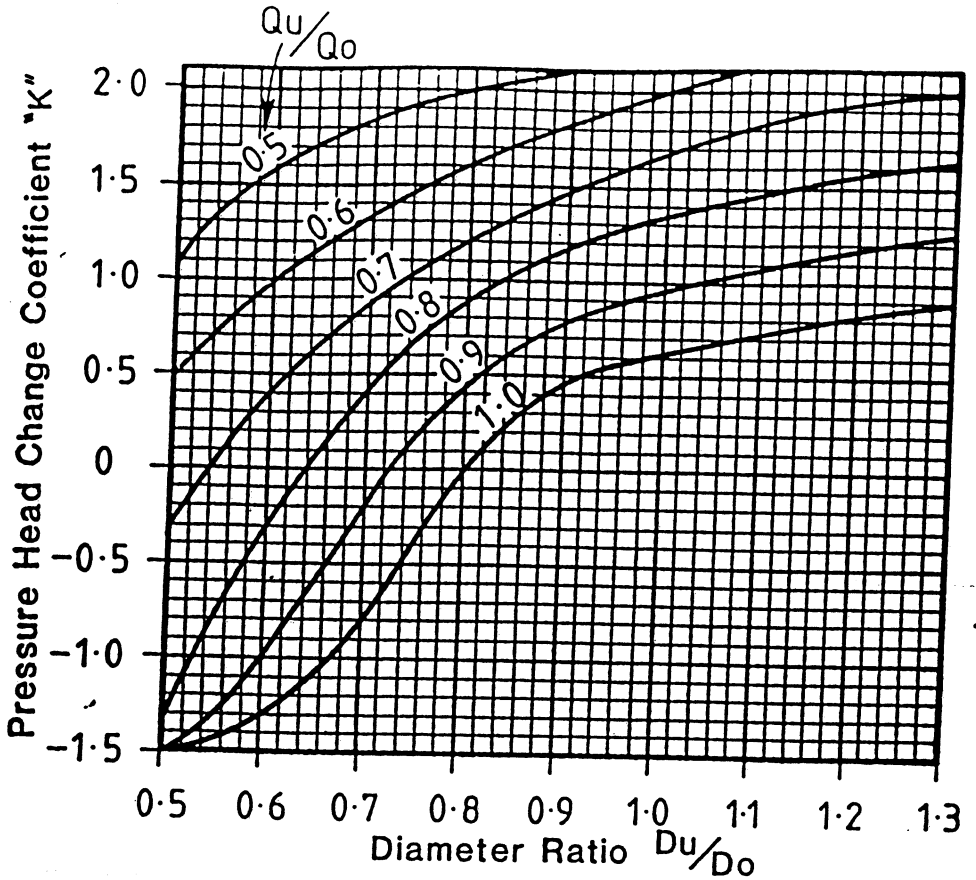


FIGURE H8 : PRESSURE HEAD CHANGE COEFFICENTS FOR 22½ BENDS AT PITS



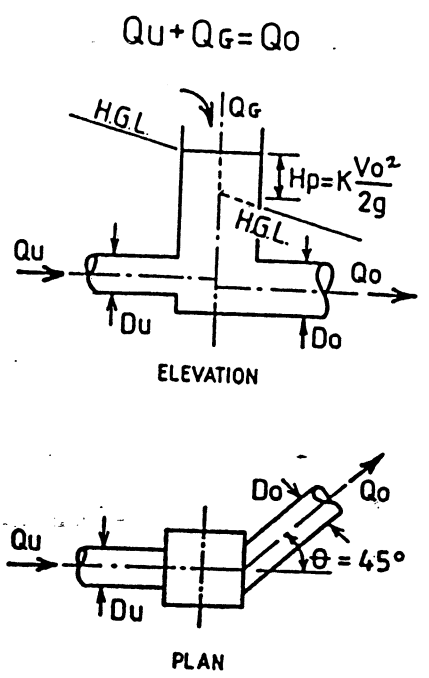
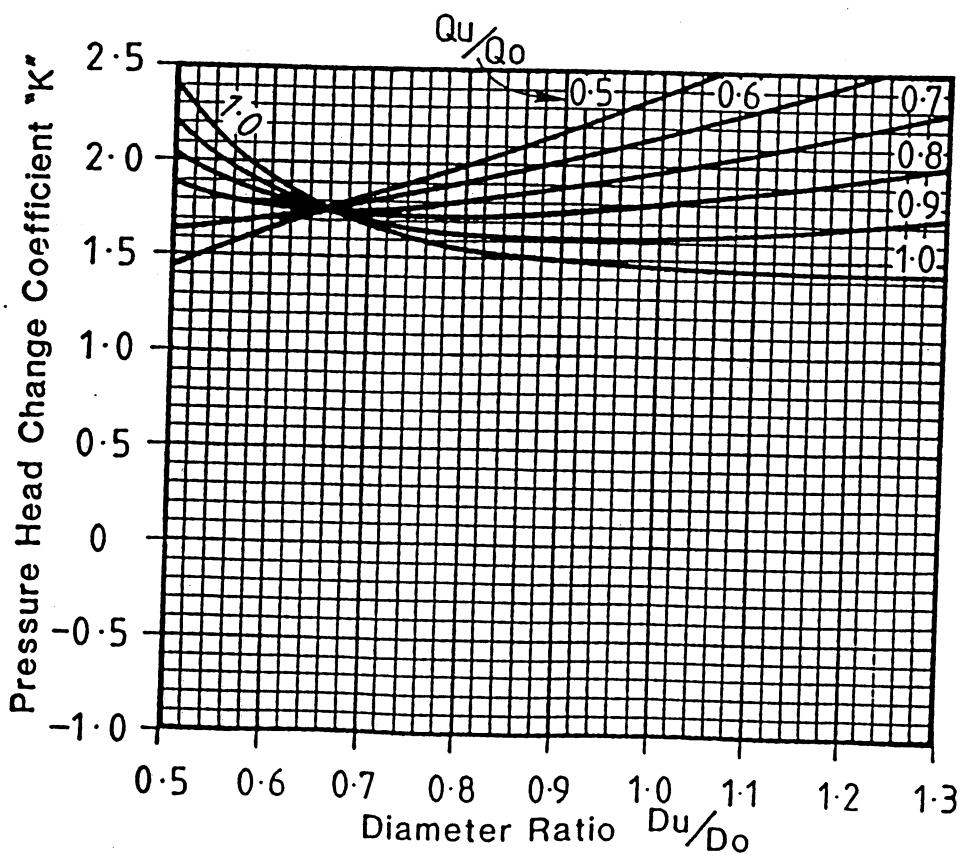


FIGURE H9 : PRESSURE HEAD CHANGE COEFFICIENTS FOR 45° BENDS AT PITS

(FIGURES H9 & H10 EQUAL TO CHART 4 IN CIVILCAD VER 4.4, PIPE NETWORK INFORMATION DATA SCREEN)



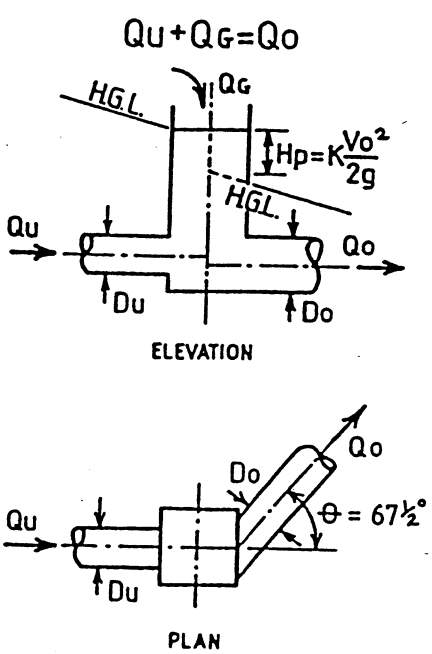


FIGURE H10 PRESSURE HEAD CHANGE COEFFICIENTS FOR 67½° BENDS AT PITS

FIGURE I1

APPENDIX I

Velocity and discharge diagram

Manning n = 0·012

For circular pipes running full but not under head

Computed by $Q = \frac{1.0}{n} AR^{2/3} S^{1/2}$