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Principal:	CITYFY & BFC Pty Ltd	**Job Number:**	1806063
Project Title:	Proposed Residential Development	**Date:**	14 May 2020
Site:	82 Johns Road, Prospect, SA.		

ATTACHMENTS:

SW1 – SW3 - Stormwater Detention Calculations 1:10 Yr ARI, 'Critical Storm' Duration
SW4 – SW6 - Stormwater Detention Calculations 1:100 Yr ARI, 'Critical Storm' Duration
BG1 - Box Gutter Calculations 1:100 Yr ARI

DESIGN:
The pre development flow off the two allotments is 45.77L/s. 100% of the roof and surface area is to be detained within 13 x 1,500L detention tanks for the units, 8 x 1,000L detention tanks for the dwellings, 10,500L underground tank & 3 above ground basins of 21,333L. Total proposed volume is 59,333L. The OSD is to be discharged at 14.64L/sec into the existing SEP. The 0.9 coefficient is used as only the roof area is being considered for detention.

GENERAL NOTES:

1. These calculations are to be read in conjunction with the relevant associated Drawings, Footing Construction Report, Civil Drawings and / or details.

2. All work is to comply with relevant SAA Standards and Guides.

AS 2876-1987: Concrete kerbs and channels (gutters) – manually or machine placed
AS 2200-2006: Design charts for water supply and sewerage
AS/NZS 3500: Plumbing and drainage
AS 3798-1990: Guidelines on earthworks for commercial and residential developments
AS 4000-1997: and AS 2124-1992: General conditions of contract
ARRB Special Report 35: Subsurface drainage of road structures
Australian Rainfall and Run-off Volumes 1 and 2: A guide to flood estimation
Austroads 2008 – Guide to pavement technology
NAASRA 1987 – Pavement design
Storm drainage design in small urban catchments: A handbook for Australian practice
Water Sensitive Urban Design (WSUD) Engineering Procedure: Stormwater
Water Services Association of Australia Code (WSAA).

For and on behalf of
TMK Consulting Engineers

Alex Perez
Civil Engineer

Ref.: 1806063

Date: 15-May-20

Design: ALP

Page: SW1

STORMWATER CALCULATIONS - DETERMINATION OF DETENTION TANK SIZES

Design Storm Intensity Table (mm/hr) - (from http://www.bom.gov.au/cgi-bin/hydro/has/CDIRSWebBasic)

STORM LOCATION Adelaide — Latitude 34°59'S; Longitude 138°44'E

Adelaide

	AVERAGE RETURN INTERVAL (YEARS)						
DURATION	**1**	**2**	**5**	**10**	**20**	**50**	**100**
5 mins	52.60	69.00	89.40	104.00	123.00	151.00	175.00
6 mins	49.10	64.50	83.50	96.70	115.00	141.00	163.00
10 mins	39.80	52.00	66.90	77.10	91.30	112.00	129.00
20 mins	28.30	36.80	46.80	53.40	62.80	76.20	87.30
30 mins	22.70	29.40	37.10	42.30	49.50	59.80	68.30
1 hour	15.20	19.70	24.60	27.90	32.50	39.00	44.40
2 hours	10.10	13.00	16.20	18.30	21.20	25.40	28.90
3 hours	7.92	10.20	12.70	14.30	16.60	19.90	22.50
6 hours	5.24	6.75	8.37	9.44	11.00	13.10	14.90
12 hours	3.45	4.44	5.52	6.23	7.23	8.65	9.83
24 hours	2.22	2.86	3.58	4.05	4.72	5.66	6.44
48 hours	1.38	1.78	2.24	2.55	2.98	3.60	4.11
72 hours	1.02	1.32	1.67	1.90	2.23	2.70	3.10

PRE-DEVELOPMENT

Design ARI (yr) 10 yr
Design Duration (min) 10 min
Design Storm Intensity (mm/hr) **77.10** mm/hr

Design Parameters	**C**	**Area (m^2)**	**% Area Detained**
Roof	0.90	393	0.00
Paving	0.75	2378	0.00
Grass / Landscaping	0.12	0	0.00
Total Area		**2771** m^2	
Weighted C (C_w)*	0.77		

Max pre-development flow $Q_i=\Sigma(CiA/3600)$:

Roof	**7.58** L/s
Paving	**38.20** L/s
Grass / Landscaping	**0.00** L/s
Pre-development flow =	**45.77** L/s

Use Max Allowable Flow = **45.77** L/s

Note: The weighted average value of the runoff coefficient, C_w, includes roof, paving, grassed and landscaped areas of the site.

POST-DEVELOPMENT (*Determine Critical Storm)

Design ARI (yr) 10 yr
Design Duration (min) 40 min
Design Storm Intensity (mm/hr) **37.50** mm/hr

Design Parameters	**C**	**Area (m^2)**	**% Area Detained**	
Roof	0.90	1329	100.00	O
Paving	0.75	858	100.00	O
Grass / Landscaping	0.12	584	0.00	
Total Area		**2771** m^2		
Weighted C (C_w)*	0.69			

Summary of Design Flows

Undetained flow, $Q_u=\Sigma(CiA_u/3600)$:

Roof	**0.00** L/s
Paving	**0.00** L/s
Grass / Landscaping	**0.73** L/s
Design undetained flow =	**0.73** L/s

Max. outflows from detention tanks:

Site water runoff	
Pumped	**0.00** L/s
Piped	**0.00** L/s
Roof water runoff	
Orifice-restricted	**12.44** L/s
Total Max. Design Outflow =	**13.17** L/s

< 45.77 L/s Allowed :. OK

Ref.:	**1806063**
Date:	**15-May-20**
Design:	**ALP**
Page:	**SW2**

STORMWATER CALCULATIONS - STORMWATER RUN-OFF - ORIFICE-RESTRICTED

Time of Concentration, T_C

Design Storm ARI (yr)	10	yr	(from page SW1)
Design Storm Duration (mins)	40	mins	(from page SW1)
Design Storm Intensity, i	37.50	mm/hr	(from page SW1)
=> For run-off calculations, use T_C =	**10.0**	mins	**<=Duration :. Use Tc = 10 mins.**

Design Parameters	**C**	**Area (m^2)**	**% Area Detained**
Roof	0.90	1329	100.00
Paving	0.75	858	100.00
Grass / Landscaping	0.12	584	0.00

Detained flow, $Q_d=\Sigma(CiA_d/3600)$:

Roof	12.46	L/s
Paving	6.70	L/s
Grass / Landscaping	0.00	L/s
Design detained flow =	**19.16**	L/s

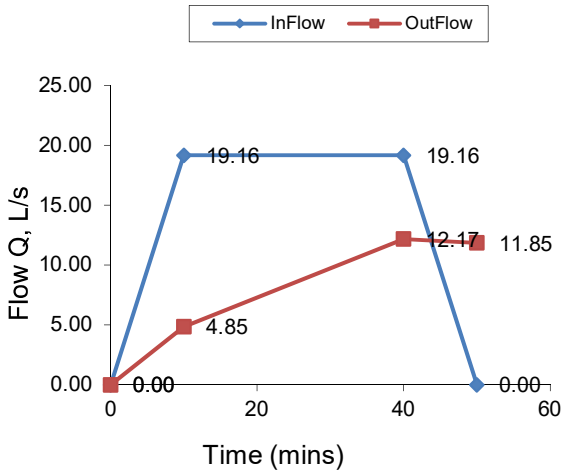
=> Try the following retention tank design parameters:

Max Allowable outflow from storage = **14.00** L/s **(31.04 L/s is still available for outflow)**

Number of orifice detention tanks	1	Each tank volume above orifice	38,000 L
Max. head allowed above orifice	1,500 mm	**=> Each Tank Plan Area =**	25.33 m^2
Outlet coefficient,C_O	0.6		
Orifice diameter, D_O	80 mm	=> Orifice area, A_O =π*(D_O/2)^2	5,027 mm^2

Graph Time v Flow:

Time (mins)	InFlow (L/s)	OutFlow (L/s)
0	0.00	0.00
10	19.16	4.85
40	19.16	12.17
50	0.00	11.85



Max. Calculated Outflow:

$Qmax_{out}$ = **12.44 L/s**

< 14.00 L/s Max. Allowed :. OK

Max. Calculated Head of Water:

H = **892 mm**

< 1,500 mm Max. Allowed :. OK

=> Volume of Water To Be Detained:

V = **22,600 L**

i.e. V = **22.60 m^3**

=>USE

Duration (mins)	Intensity (mm/hr)	Proposed Inflow Rate (L/s)	Proposed Inflow Rate x Duration (L)	Orifice Outflow Rate (L/s)	Orifice Outflow Volume (L)	Net Storage (L)
5	104.00	53.1	15,943	-14.00	-2,520	13,423
6	96.70	49.4	17,789	-14.00	-3,024	14,765
7	91.80	46.9	19,702	-14.00	-3,528	16,174
8	86.90	44.4	21,315	-14.00	-4,032	17,283
9	82.00	41.9	22,627	-14.00	-4,536	18,091
10	77.10	39.4	23,639	-14.00	-5,040	18,599
11	74.73	38.2	25,203	-14.00	-5,544	19,659
12	72.36	37.0	26,623	-14.00	-6,048	20,575
13	69.99	35.8	27,897	-14.00	-6,552	21,345
14	67.62	34.6	29,025	-14.00	-7,056	21,969
15	65.25	33.3	30,008	-14.00	-7,560	22,448
16	62.88	32.1	30,846	-14.00	-8,064	22,782
17	60.51	30.9	31,539	-14.00	-8,568	22,971
18	58.14	29.7	32,086	-14.00	-9,072	23,014
19	55.77	28.5	32,488	-14.00	-9,576	22,912
20	53.40	27.3	32,745	-14.00	-10,080	22,665
25	47.85	24.5	36,677	-14.00	-12,600	24,077
30	42.30	21.6	38,908	-14.00	-15,120	23,788
35	39.90	20.4	42,817	-14.00	-17,640	25,177
40	***37.50***	***19.2***	***45,990***	***-14.00***	***-20,160***	***25,830***
45	35.10	17.9	48,427	-14.00	-22,680	25,747
50	32.70	16.7	50,129	-14.00	-25,200	24,929
55	30.30	15.5	51,095	-14.00	-27,720	23,375
60	27.90	14.3	51,325	-14.00	-30,240	21,085
75	25.50	13.0	58,637	-14.00	-37,800	20,837
90	23.10	11.8	63,742	-14.00	-45,360	18,382
120	18.30	9.4	67,329	-14.00	-60,480	6,849
150	16.30	8.3	74,964	-14.00	-75,600	- 636

Ref.: 1806063

Date: 15-May-20

Design: ALP

Page: SW3

CRITICAL STORM DURATION
ORIFICE OUTLOW

Critical Storm Duration = 40 mins
Max Storage Volume = 25,830 Litres

***Notes:** This calculation is used for determining the critical storm duration at the location shown on the main calculation sheet for the case where the maximum outflow rate from the tank orifice is as shown in the table.

The Net Storage Volume values shown in this table are approximate. The design uses results obtained from calculations where the effects of the change in head in the storage tank and the Time of Concentration have been included.

The critical storm results are shown highlighted in bold italics.

TMK CONSULTING ENGINEERS

Ref.: 1806063
Date: 15-May-20
Design: ALP
Page: SW4

STORMWATER CALCULATIONS - DETERMINATION OF DETENTION TANK SIZES

Design Storm Intensity Table (mm/hr) - (from http://www.bom.gov.au/cgi-bin/hydro/has/CDIRSWebBasic)

STORM LOCATION Adelaide — Latitude 34°59'S; Longitude 138°44'E

Adelaide

	AVERAGE RETURN INTERVAL (YEARS)						
DURATION	**1**	**2**	**5**	**10**	**20**	**50**	**100**
5 mins	52.60	69.00	89.40	104.00	123.00	151.00	175.00
6 mins	49.10	64.50	83.50	96.70	115.00	141.00	163.00
10 mins	39.80	52.00	66.90	77.10	91.30	112.00	129.00
20 mins	28.30	36.80	46.80	53.40	62.80	76.20	87.30
30 mins	22.70	29.40	37.10	42.30	49.50	59.80	68.30
1 hour	15.20	19.70	24.60	27.90	32.50	39.00	44.40
2 hours	10.10	13.00	16.20	18.30	21.20	25.40	28.90
3 hours	7.92	10.20	12.70	14.30	16.60	19.90	22.50
6 hours	5.24	6.75	8.37	9.44	11.00	13.10	14.90
12 hours	3.45	4.44	5.52	6.23	7.23	8.65	9.83
24 hours	2.22	2.86	3.58	4.05	4.72	5.66	6.44
48 hours	1.38	1.78	2.24	2.55	2.98	3.60	4.11
72 hours	1.02	1.32	1.67	1.90	2.23	2.70	3.10

PRE-DEVELOPMENT

Design ARI (yr) 10 yr
Design Duration (min) 10 min
Design Storm Intensity (mm/hr) **77.10** mm/hr

Design Parameters	**C**	**Area (m^2)**	**% Area Detained**
Roof	0.90	393	0.00
Paving	0.75	2378	0.00
Grass / Landscaping	0.12	0	0.00
Total Area		**2771**	**m^2**
Weighted C (C_w)*	0.77		

Max pre-development flow $Q_i=\Sigma(CiA/3600)$:

Roof	**7.58** L/s
Paving	**38.20** L/s
Grass / Landscaping	**0.00** L/s
Pre-development flow =	**45.77** L/s

Use Max Allowable Flow = **45.77** L/s

Note: The weighted average value of the runoff coefficient, C_w, includes roof, paving, grassed and landscaped areas of the site.

POST-DEVELOPMENT (*Determine Critical Storm)

Design ARI (yr) 100 yr
Design Duration (min) 90 min
Design Storm Intensity (mm/hr) **36.65** mm/hr

Design Parameters	**C**	**Area (m^2)**	**% Area Detained**	
Roof	0.90	1329	100.00	O
Paving	0.75	858	100.00	O
Grass / Landscaping	0.12	584	0.00	
Total Area		**2771**	**m^2**	
Weighted C (C_w)*	0.69			

Summary of Design Flows

Undetained flow, $Q_u=\Sigma(CiA_u/3600)$:

Roof	**0.00** L/s
Paving	**0.00** L/s
Grass / Landscaping	**0.71** L/s
Design undetained flow =	**0.71** L/s

Max. outflows from detention tanks:

Site water runoff	
Pumped	**0.00** L/s
Piped	**0.00** L/s
Roof water runoff	
Orifice-restricted	**13.92** L/s
Total Max. Design Outflow =	**14.64** L/s

< 45.77 L/s Allowed :. OK

STORMWATER CALCULATIONS - STORMWATER RUN-OFF - ORIFICE-RESTRICTED

Time of Concentration, T_C

Design Storm ARI (yr)	100	yr	(from page SW4)
Design Storm Duration (mins)	90	mins	(from page SW4)
Design Storm Intensity, i	36.65	mm/hr	(from page SW4)
=> For run-off calculations, use T_C =	**10.0**	mins	**<=Duration :. Use Tc = 10 mins.**

Design Parameters	C	Area (m^2)	% Area Detained
Roof	0.90	1329	100.00
Paving	0.75	858	100.00
Grass / Landscaping	0.12	584	0.00

Detained flow, $Q_d=\Sigma(CiA_d/3600)$:

Roof	12.18	L/s
Paving	6.55	L/s
Grass / Landscaping	0.00	L/s
Design detained flow =	**18.73**	L/s

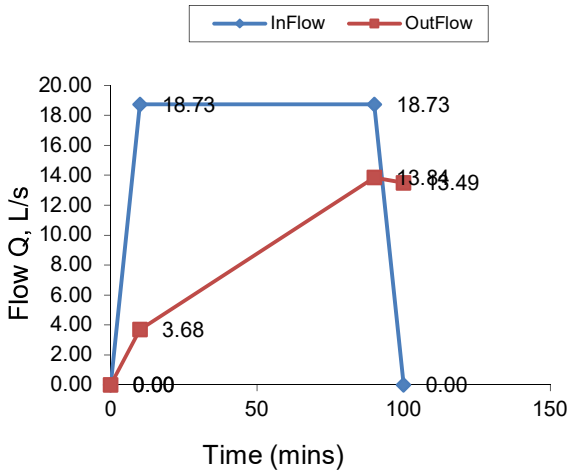
=> Try the following retention tank design parameters:

Max Allowable outflow from storage = **14.00** L/s **(31.06 L/s is still available for outflow)**

Number of orifice detention tanks	1	Each tank volume above orifice	59,333 L
Max. head allowed above orifice	1,500 mm	**=> Each Tank Plan Area =**	39.56 m^2
Outlet coefficient,C_O	0.6		
Orifice diameter, D_O	80 mm	=> Orifice area, A_O =π*(D_O/2)^2	5,027 mm^2

Graph Time v Flow:

Time (mins)	InFlow (L/s)	OutFlow (L/s)
0	0.00	0.00
10	18.73	3.68
90	18.73	13.84
100	0.00	13.49



Max. Calculated Outflow:

$Qmax_{out}$ = **13.92 L/s**

< 14.00 L/s Max. Allowed :. OK

Max. Calculated Head of Water:

H = **1,116 mm**

< 1,500 mm Max. Allowed :. OK

=> Volume of Water To Be Detained:

V = **44,136 L**

i.e. V = **44.14 m^3**

=>USE

Duration (mins)	Intensity (mm/hr)	Proposed Inflow Rate (L/s)	Proposed Inflow Rate x Duration (L)	Orifice Outflow Rate (L/s)	Orifice Outflow Volume (L)	Net Storage (L)
5	175.00	89.4	26,828	-14.00	-2,520	24,308
6	163.00	83.3	29,985	-14.00	-3,024	26,961
7	154.50	78.9	33,159	-14.00	-3,528	29,631
8	146.00	74.6	35,811	-14.00	-4,032	31,779
9	137.50	70.3	37,942	-14.00	-4,536	33,406
10	129.00	65.9	39,551	-14.00	-5,040	34,511
11	124.83	63.8	42,100	-14.00	-5,544	36,556
12	120.66	61.7	44,393	-14.00	-6,048	38,345
13	116.49	59.5	46,431	-14.00	-6,552	39,879
14	112.32	57.4	48,212	-14.00	-7,056	41,156
15	108.15	55.3	49,738	-14.00	-7,560	42,178
16	103.98	53.1	51,008	-14.00	-8,064	42,944
17	99.81	51.0	52,023	-14.00	-8,568	43,455
18	95.64	48.9	52,782	-14.00	-9,072	43,710
19	91.47	46.7	53,285	-14.00	-9,576	43,709
20	87.30	44.6	53,532	-14.00	-10,080	43,452
25	77.80	39.8	59,634	-14.00	-12,600	47,034
30	68.30	34.9	62,822	-14.00	-15,120	47,702
35	64.32	32.9	69,018	-14.00	-17,640	51,378
40	60.33	30.8	73,993	-14.00	-20,160	53,833
45	56.35	28.8	77,746	-14.00	-22,680	55,066
50	52.37	26.8	80,278	-14.00	-25,200	55,078
55	48.38	24.7	81,589	-14.00	-27,720	53,869
60	44.40	22.7	81,678	-14.00	-30,240	51,438
75	40.53	20.7	93,187	-14.00	-37,800	55,387
90	***36.65***	***18.7***	***101,132***	***-14.00***	***-45,360***	***55,772***
120	28.90	14.8	106,329	-14.00	-60,480	45,849
150	25.70	13.1	118,194	-14.00	-75,600	42,594
180	22.50	11.5	124,173	-14.00	-90,720	33,453
210	21.23	10.9	136,713	-14.00	-105,840	30,873
240	19.97	10.2	146,923	-14.00	-120,960	25,963
270	18.70	9.6	154,802	-14.00	-136,080	18,722
300	17.43	8.9	160,352	-14.00	-151,200	9,152
330	16.17	8.3	163,571	-14.00	-166,320	- 2,749

Ref.: 1806063

Date: 15-May-20

Design: ALP

Page: SW6

CRITICAL STORM DURATION
ORIFICE OUTLOW

Critical Storm Duration = 90 mins
Max Storage Volume = 55,772 Litres

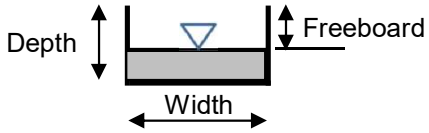
***Notes:** This calculation is used for determining the critical storm duration at the location shown on the main calculation sheet for the case where the maximum outflow rate from the tank orifice is as shown in the table.

The Net Storage Volume values shown in this table are approximate. The design uses results obtained from calculations where the effects of the change in head in the storage tank and the Time of Concentration have been included.

The critical storm results are shown highlighted in bold italics.

BOX GUTTER & DOWNPIPE SPECIFICATIONS

INPUT DATA:



Gutter Geometry

Design Storm Event – ARI =	100	years
Design Storm Event – Duration =	5	minutes
Gutter width =	0.400	metres
Gutter depth =	0.100	metres
Gutter freeboard =	0.025	metres
Box gutter sump depth (below gutter invert) =	0.100	metres
Longest gutter run =	4.70	metres
Downpipe diameter =	0.150	metres

Cross section area of downpipe, A_{pipe} =	0.0177	m^2
Design water section area in box gutter, A_{box} =	0.03	m^2
Roughness coefficient, n =	0.009	
Fittings head loss coefficient, k =	2.5	
Average gradient, s =	0.005	

DETERMINE FLOWS:

A_{roof} =	64	m^2	(The largest roof area contributing runoff into a downpipe/sump)
C =	1.08		(Runoff coefficient (C_{10}*F_y))
I =	175	mm/hr	

Q_{roof} = CIA_{roof} / 3600 =	**3.36**	**L/Sec**	
Q_{box} = $A_{box} R^{2/3} S^{1/2} / n$ =	**33.90**	**L/Sec**	***:. OK. Qbox > Qroof***
where $R = A_{box} / P_{box\ (wetted\ perimeter)}$ =	*0.05*	*metres*	

CHECK ENTRY INTO DOWNPIPE AND WATER LEVEL BUILD-UP:

$V = (Q_{roof} / A_{pipe}) / 1000$ = **0.190 m/s**

Velocity head required = $kV^2/2g$ =	0.005	m
Depth required due to length of gutter fall =	0.024	m
Adopted freeboard =	0.025	m
Total gutter & sump depth required =	***0.053***	***m***
Selected gutter & sump depth =	***0.200***	***m***

:. Box Gutter size is OK

ADOPT:

0.400 m wide x 0.100 m Deep Box Gutter
0.150 m Diameter Downpipes
0.100 m Deep Box Gutter Sumps