

APPENDIX 3:

Local Water Management Strategy – Addendum Report

Our Reference: 286-01 Parkland Heights LWMS Addendum

**Civil Engineering
Project Coordination
Urban & Regional Planning**

22 February 2018

mortons@urbansolutions.net.au
www.urbansolutions.net.au

MUS Pty Ltd t/as:
Mortons - Urban Solutions
ABN: 39 116 375 065

City of Rockingham
PO Box 2142
Rockingham DC WA 6967

Attention: Damien Slack

Dear Damien,

Re: Parkland Heights – LWMS Hydrologic and Hydraulic Modelling Engineering Summary (Addendum to Lot 1507 Eighty Road Baldivis LWMS, Report Number 10/174, date 14 Dec 2011)

Further to our discussion regarding the proposed Parkland Heights Neighbourhood Centre (NC), detailed hydrologic and hydraulic modelling has been prepared to analyse the effect of the Parkland Heights Neighbourhood Centre on the constructed infrastructure downstream, and identify whether the approved LWMS (dated 14 Dec 2011) should be amended to guide the Parkland Heights Neighbourhood Centre development and the adjacent stages.

MUS has completed the drainage modelling and analysed the results, following which it was deemed that a complete LWMS amendment will not be necessary and this Engineering Summary Report can be an addendum/appendix to the approved LWMS dated Dec 2011.

Hydrologic and hydraulic modelling has been undertaken to determine the peak flow rates and retention requirements of the proposed Neighbourhood Centre, in addition to checking the retention capacity of the constructed drainage basins, downstream of the catchment. As a quick overview, our modelling indicates that only 2.3% of the total Neighbourhood Centre catchment area is required for stormwater retention up to the 100 Year 6 Hour ARI event, this being the equivalent of 270m³ of storage per hectare of Neighbourhood Centre (Commercial) Catchment Area.

Alternatively, should the City accept our proposal to retain the critical 10 Year ARI (10 Year 1 Hour) storm event within the Neighbourhood Centre, and allow storms greater than 10 Year ARI events to overflow downstream, then the retention requirement for the Neighbourhood Centre would be 1.8% of the total NC catchment area, being the equivalent of 217m³ of storage per hectare. This option does not impose any adverse impact to the downstream infrastructure, as it will be demonstrated in this report and in the attached drawings.

Modelling of the drainage system for Parkland Heights has been undertaken using the computer software package XPSWMM. XPSWMM is an urban drainage design software package capable of carrying out both hydrologic and hydraulic modelling of urban catchments. The following sections outline the assumptions made and results calculated from our modelling.

GOLD COAST

Suite 9/19 Short Street
(PO Box 2484)
Southport Q 4215
tel: 07 5571 1099

PERTH

Unit 4/100 Railway Road
Subiaco WA 6008
tel: 08 9380 9700

SUNSHINE COAST

6 Osterley Avenue
Caloundra Q 4551
tel: 07 5499 7000
fax: 07 5499 7712



1. GENERAL

Detailed surface water modelling of the drainage system was undertaken using the stormwater modelling software XPSWMM to provide details of the required retention volumes for all interconnecting sub-catchment areas west of and including Nairn Drive. Design storms are between 1 year and 100 years ARI, and the storm durations investigated varied between 10 minutes and 72 hours.

The stormwater model considers the existing/as-constructed development of Parkland Heights Stages 1 to 5, and also considers future development within Stage 6 and the Neighbourhood Centre area of interest.

The detailed modelling also considers the conveyance system, and information such as water level, flow, velocity, and velocity depth factor, typical to that of a UWMP as the majority of the catchment has been constructed.

2. IFD:

Using the principals of AR&R 1987, a site-specific IFD table was generated in XP-SWMM for modelling of Parkland Heights post development. The Rainfall IFD data utilised in our model is presented below:

DURATION	1 year	2 year	5 year	10 year	20 year	50 year	100 year
5Mins	59.2	78.1	103	121	146	182	214
30Mins	24.4	31.6	39.8	45.3	53.3	64.7	74.3
1Hr	16	20.5	25.4	28.8	33.5	40.3	45.9
6Hrs	5.01	6.39	7.76	8.66	10	11.8	13.4
12Hrs	3.21	4.1	4.96	5.53	6.36	7.53	8.49
24Hrs	2.07	2.65	3.2	3.57	4.11	4.87	5.5
48Hrs	1.31	1.68	2.04	2.28	2.64	3.14	3.55
72Hrs	0.98	1.25	1.53	1.71	1.98	2.35	2.68

Table 1: Parkland Heights IFD (mm/h)

3. CATCHMENT AREA:

As per the approved LWMS, Sketch 28601-NC-SK001 Rev A shows the post-development sub-catchment areas within the study area. The entire catchment area ultimately discharges into POS F's retention basins B5 & B6. Whereas, basins B7, B8, B9 and S5, within POS G, C, and E, respectively, serve as bio-retention and stormwater detention basins for the respective sub-catchment areas.

Under the approved LWMS, the proposed Neighbourhood Centre was a mixed-use area consisting of residential, high-density development, and commercial space. This area was also divided into 3 sub-catchments and is connected to basins B7, B8, and B9.

From our modelling and calculation check, there is little spare capacity within the existing drainage basins, B5 & B6, during the critical 100 Year ARI (6 hours) storm event. However, the district oval and the remaining area within POS F do possess significant storage and infiltration capacity which previously was not considered in the approved LWMS, for major events such as the 20 Year and 100 Year ARI events.

Our modelling and bulk earthworks design envisaged that the northern portion of the Neighbourhood Centre (3.46ha) can overflow on to Brockwell Street then connect into Basin B8, and the southern portion (1.69ha) can overflow on to Arpenteur Drive and Chelsea Way then connected into Basin B7.

4. RUNOFF:

To convert the region's rainfall pattern and the tabled rainfall intensity into a runoff hydrograph for proposed post development catchments, the following assumptions were made. The runoff models were determined based on the following assumptions of impervious area percentage for 5 types of Land-use.

POST DEVELOPMENT LAND-USE	PERCENTAGE OF IMPERVIOUS AREA
Road Reserve	80%
Lot < 300m ²	80%
Lot > 300m ²	80%
POS	20%
Commercial (Neighborhood Centre)	90%

Table 2: Post Development Land-use, Percentage of Impervious Area

Based on our estimates, we believe the Road Reserve percentage of impervious area is approximately 64% to 70%. However, and impervious percentage of 80% has been adopted as this is commonly used within the industry, stemming from the Rational Method Runoff Coefficient for Road Reserves.

Lot percentage of impervious area is based on measurements of the constructed Lots through Parkland Heights. It is recognized that the Impervious Area within Lots is connected to other pervious and soakage areas, such as soakwells and garden beds. Therefore, a separate loss model was created for Lot Impervious areas, as it is different to all other impervious areas which are assumed to be directly connected to the street storm-water conveyance system.

In accordance with the latest AR&R Guidelines, we've assumed that the catchments area has been receiving rainfall throughout the winter period, prior to the arrival of the storm event of interest. Therefore, 20% of the POS area was assumed to be impervious which consists of 10% wetted area, and 10% for paved or hardstand area within the POS.

With regards to the Neighborhood Centre (commercial area), as the development planning is still conceptual, we have conservatively assumed 90% impervious in our modelling for the purpose of this report. It is recommended that this percentage of impervious be refined at UWMP and detailed design stage.

The above assumptions are considered conservative, and refinement of these assumptions can be reviewed and approved at the detailed design phase, which could highlight additional drainage capacity within the downstream infrastructure.

5. LOSS MODEL:

The following Uniform Loss Model was applied to all Impervious, Pervious, and Lot Impervious Areas. The use of 3m/day continuing loss is based on permeability test results for the sandy fill materials that will be sourced from Parkland Heights. In 2009, geotechnical

testing undertaken by SKM found the sandy material at Parkland Heights to have an infiltration rate from 4.3m/day to 5.8m/day. Furthermore, these sandy materials have recently been placed over the Guildford Formation at the North Baldivis Development Area and initial infiltration tests carried out over North Baldivis Bulk Earthwork areas have shown an average infiltration rate of 5m/day prior to installation of subsoil drainage. Mortons Urban Solutions (MUS) believes 3m/day continuing loss is conservative and suitable for this development with the consideration for clogging over time.

All Lot impervious areas are assumed to be connected to drainage soakwells, and from our assessment of varying Lot sizes (320m² to 660m²) and the correlating number of soakwells, it was established that the Initial Loss varies between 18mm to 26mm, and Continuing Loss varies between 1.7mm/h to 2.5mm/h. As a result, an average Initial Loss and Continuing Loss of 21mm and 2mm/h, respectively, has been adopted for all Lot Impervious Areas.

Initial Loss is the storage capacity of the Soakwell and Continuing Loss is the infiltration rate through the soakwell base. It is recognised that soakwells do have sidewall infiltration capability, however, it is difficult to translate this into a loss model as side infiltration varies based on the depth of water within the soakwell during the storm event.

Loss Model	Initial Loss	Continuing Loss
Impervious Area	Nil.	Nil.
Pervious Area	9mm	3m per day
Lot Impervious Area	21mm	0.048m per day

Table 3: Loss Model Assumptions

We recognised that ARR 2016 recommended using 60% to 80% of the pre-development storm initial loss, which is supplied by ARR Data Hub (data.arr-software.org/). This would equate a Pervious Area's Initial Loss of 18mm to 24mm for this proposed urban catchment. However, we have proceeded with caution for sites such as this, where there is no measurable surface runoff that would enable us in calibrating our Hydrological Model. As a result, we have assumed 9mm initial loss for all Pervious Areas.

6. HYDRAULICS:

The majority of the Parkland Heights Development area west of Nairn Drive, has been constructed with the exception of Stage 6 and the Neighbourhood Centre. Stage 6 detailed design is complete and the final submission is currently with the City for review and approval. As a result, the majority of the hydraulic model was set-up based on as-constructed or detailed design information.

The development area west of Nairn Drive contains 7 storm-water detention and retention basins. Basin B10 was not considered as part of this investigation as it is unrelated to the proposed Neighbourhood Centre development.

For the purpose of our preliminary analysis, it was assumed that 1.8% of the Neighbourhood Centre will be used for stormwater drainage retention, being the equivalent of 217m³ of storage per hectare of Neighbourhood Centre (Commercial) Catchment Area. This will be adequate to retain up to and including the critical 10 Year ARI storm-event.

It is envisaged the Neighbourhood Centre stormwater detention infrastructure could be in the form of; garden swales, soakwells, or underground storage chambers (such as Stormtech polypropylene chambers).

The highest detention basin/swale in the overall catchment is Swale S5 which has been designed to capture up to and including the critical 10 Year ARI storm-event. During the 100-year ARI storm-events Swale S5 will overflow then convey to Basin B9 via Arpenteur Drive and Furnivall Parade's pit and pipe system.

All other basins have also been designed for capture up to and including the critical 10 Year ARI storm-event. Basin B9 will also overflow to Basin B8 during the 100 Year ARI storm-event, via overland flow running across POS C. Then in turn Basin B8 will overflow into a grated pit at the southern end of POS C, then link into the existing pit and pipe system along Peckham Blvd, and ultimately discharge into Basin B6.

In accordance, with the approved LWMS, Basin B6 is allowed to overflow into the Playing Field during 100 Year ARI storm events. Based on our calculation, the water level within the Playing Field would only reach approximately 7mm in depth during the critical 100-year ARI event.

Our modelling shows spare capacity within Basin B7 to detain runoff from Arpenteur Drive and the southern area of the Neighbourhood Centre. Without taking any runoff from the Neighbourhood Centre, Basin B7 water level will only reach 0.4m during the critical 100 Year ARI storm-event. However, with the Neighbourhood Centre retaining the 10 Year ARI and allowing the 100 Year to overflow into Basin B7, then water level within this basin will reach 0.85m, still well below the basin's maximum capacity.

From our analysis, Basin B7 is unlikely to overflow into Basin B5, and Basin B5 will have the capacity to retain up to and including the critical 100 Year ARI event, with the maximum water level at the design limit of 1.2m. As for other major storm events greater than 100 Year ARI, storm-water will overtop a low point along Eight Road and move west toward the wetland.

The volume of infiltration was modelled by using XPStorm based on 4.3m/day infiltration rate and variable infiltration area based on the depth of water during the storm event. The estimated emptying time is presented in Table 4 below and Sketch 28601-NC-SK004 Rev A.

Basin	1 Year 1 Hour ARI Emptying Time (hours)	100 Year 6 Hour ARI Emptying Time (hours)
S5	3	6
B5	1	8
B6	6	9
B7	1	4
B8	2	4
B9	2	4

Table 4: Basins Emptying Time

In accordance with City of Rockingham Planning Policy 3.4.1 – Public Open Space, MUS' modelling has checked for compliance with the following conditions:

- A maximum of 25% site area of any parcel of POS may be covered by any body of water a frequency of inundation of 1 in 10 years.
- The base of detention basin be a minimum of 0.5m above the post-development groundwater level.

- Flood depth of 1.2m maximum for storm up to the critical 100-Year event.

Refer to sketch 28601-NC-SK002 to SK004 for MUS' modelling results, for 5, 10, and 100 Year ARI storm-events, with the assumption that the Neighbourhood Centre will retain up to and including the critical 10 Year 1 Hour storm event onsite.

7. Water Quality

Stormwater runoff within Parkland Heights will be captured and infiltrated at source within one of the designated Drainage Basins, and Groundwater Quality and Surface Water Quality Management shall be as per the approved LWMS.

The Neighbourhood Centre stormwater runoff for frequent events up to the 1-year 1-hour ARI will be managed and treated prior to entering the Drainage Retention Basin/Cells. Treatment can be in the form of Planted Swales or Tree Pits within Carpark areas. Detailed design of these treatment trains will be finalised at UWMP Stage and be subjected to City of Rockingham review and approval.

8. Conclusions

MUS' detailed modelling of Parkland Heights' catchment areas shows no adverse impact from the proposed Neighbourhood Centre to the downstream infrastructure nor noted any necessary changes to the overall drainage strategy. Therefore we believe that a complete amendment of the approved LWMS will not be necessary, and this engineering letter report shall serve as an appendix to the approved LWMS.

With conservative assumptions in the runoff and loss model, there is still capacity within the existing infrastructure to accommodate for overflow from the Neighbourhood Centre, for events greater than the 10 Year ARI. Therefore, it is recommended that the Neighbourhood Centre detains the Critical 10 Year ARI (10 Year 1 Hour) storm-event onsite, and for greater storm-events, overflow from the Neighbourhood Centre is allowed via overland flow or via a pit and pipe system. The design of the Neighbourhood Centre detention and overflow system is to be investigated at Detailed Design and UWMP Phase.

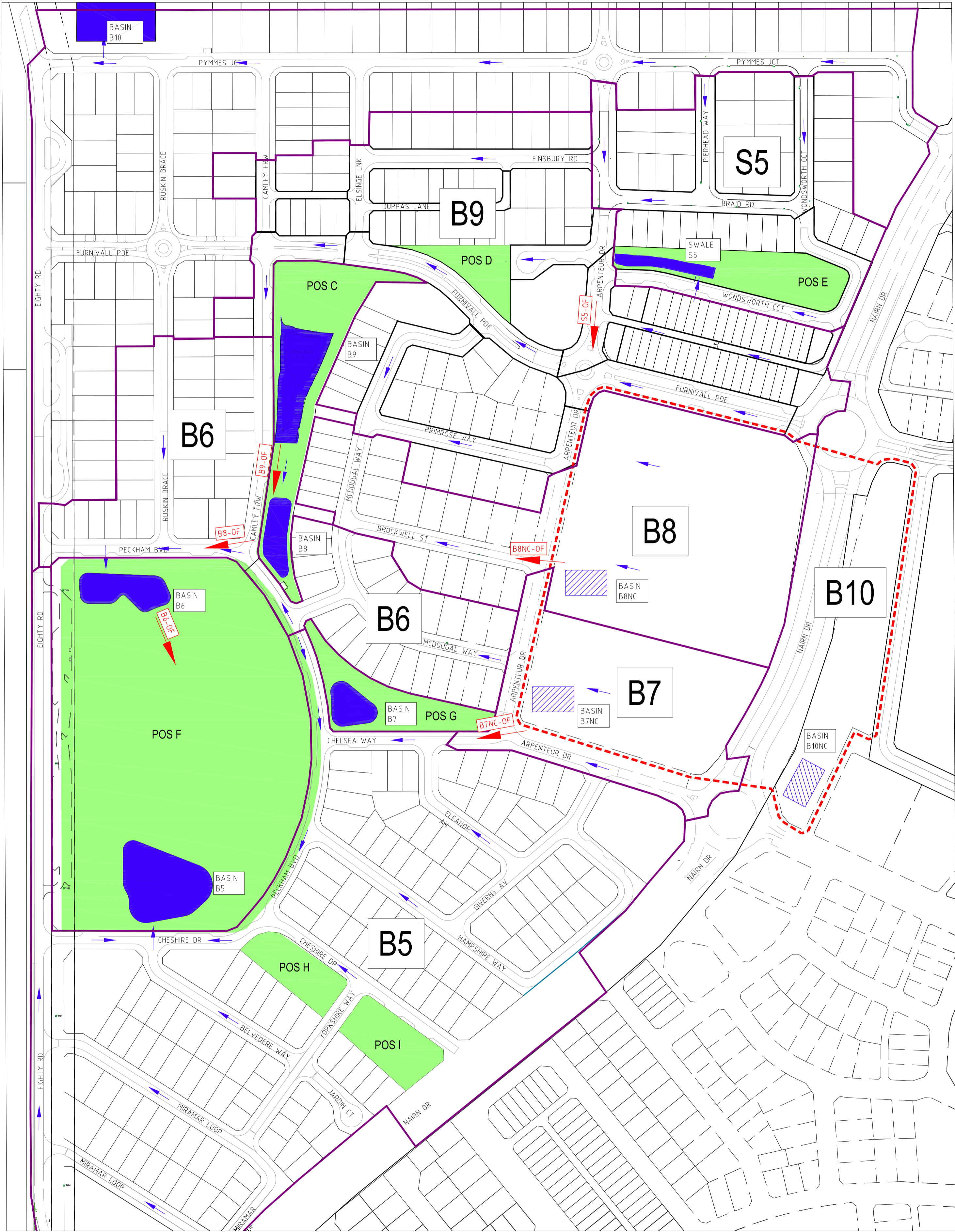
As part of this investigation, we've now calculated and detailed overflow conditions for all basins and swales west of Nairn Drive, which was previously not demonstrated in the approved LWMS. This information is presented on Sketch 28601-NC-SK004 Rev A.

We trust this engineering summary report satisfied the City's requirements, and resolves any concern with regards to the proposed Neighbourhood Centre's drainage strategy. Should you have any further queries or would like to review the drainage model in more detail, please do not hesitate to contact the undersigned.

Yours faithfully,



Christopher Le
Development Manager - Engineering
Mortons Urban Solutions



LEGEND

- SW — PROPOSED STORMWATER DRAINAGE
- SW — EXISTING STORMWATER DRAINAGE
- - - - - NEIGHBOURHOOD CENTRE BOUNDARY
- BASIN AREAS
- PUBLIC OPEN SPACE AREA
- ▶ DRAINAGE FLOW ARROW
- ▶ 100YR DRAINAGE FLOW ARROW
- ▨ UNDERGROUND DRAINAGE STORAGE /BASIN
- B8 CATCHMENT AREA

TABLE 1 - CATCHMENT AND LAND USE

CATCHMENT	TOTAL AREA ha	POS ha	ROAD RESERVE (80%)ha	LOTS<300m ² (80%)ha	LOTS>300m ² (80%)ha	COMMERCIAL (90%)ha
S5	3.764	0.568	1.192	n/a	2.004	n/a
B5	14.115	0.598	5.465	n/a	8.051	n/a
B6+POS F	9.992	5.759	1.346	n/a	2.8868	n/a
B7+POS G	3.03	0.512	0.858	n/a	n/a	1.659
B8	5.145	n/a	0.526	n/a	1.159	3.46
B9+POS C	9.869	1.769	3.082	0.831	4.187	n/a
B10	1.15	n/a	n/a	n/a	n/a	1.15

TABLE 2 - LOSS MODEL ASSUMPTIONS

	LOT IMPERVIOUS	PERVIOUS	OTHER IMPERVIOUS
INITIAL LOSS (mm)	21	9	0.00
CONTINUING LOSS (mm/h)	2	125	0.00

TABLE 3 - CATCHMENT PERVIOUS AND IMPERVIOUS AREAS

CATCHMENT	TOTAL IMPERVIOUS ha	TOTAL PERVIOUS AREA ha	TOTAL OTHER IMPERVIOUS ha
S5	1.603	1.094	1.067
B5	6.441	3.182	4.492
B6+POS F	2.309	5.454	2.229
B7+POS G	0.00	0.748	2.282
B8	0.927	0.676	3.542
B9+POS C	3.35	3.038	3.485
B10	1.15	0.115	1.035


TABLE 4 - POST DEVELOPMENT LAND USE AND PERCENTAGE OF IMPERVIOUS

LAND USE	% IMPERVIOUS
ROAD RESERVE	80%
LOT<300m	80%
LOT>300m	80%
POS	20%
COMMERCIAL (NC)	90%

TABLE 5 - BASIN DATA

BASIN	STATUS	BASE INVERT RL m(AHD)	TOP OVERFLOW RL m(AHD)	CAPACITY m ³
S5	PROPOSED	20.25	21.40	490
B5	CONSTRUCTED	3.40	4.60	3170
B6	CONSTRUCTED	4.35	5.20	960
B7	CONSTRUCTED	8.23	9.40	795
B8	CONSTRUCTED	8.00	8.57	670
B9	CONSTRUCTED	9.50	10.25	1390
B8NC	PROPOSED	13.63	14.83	750
B7NC	PROPOSED	13.90	15.10	360
B10NC	PROPOSED	13.20	14.40	250


PROJECT NAME

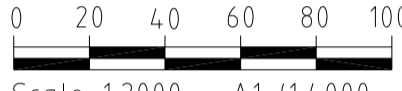
**PARKLAND HEIGHTS**


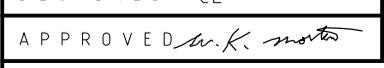
STAGE 06

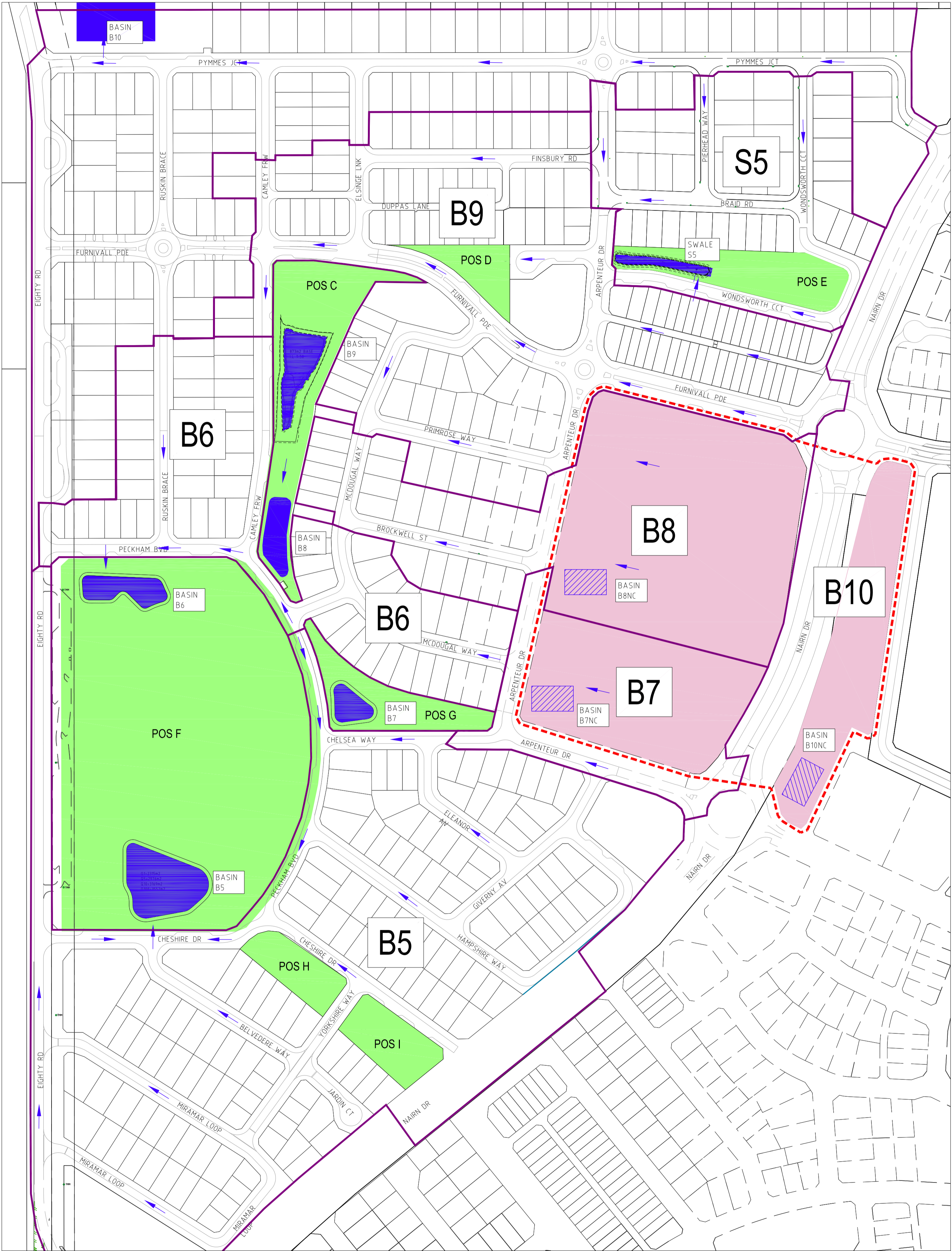
CLIENT

Rockingham Park Pty Ltd


NORTH


Scale 1:2000 - A1 (14,000 - A3)

ISSUES		DATE
TENDER		
COUNCIL		
WATER CORPORATION		
CONSTRUCTION		
B	22-02-18	BASIN DATA B10NC ADDED TO TABLE
A	06-12-17	INITIAL ISSUE
PRE DATE	AMENDMENT	
COPYRIGHT IS VESTED IN MORTONS URBAN SOLUTIONS AND WRITTEN CONSENT IS REQUIRED PRIOR TO REPRODUCTION. COPYRIGHT MORTONS URBAN SOLUTIONS 2000 . DO NOT SCALE FROM THIS DRAWING.		
WAPC 152391		
ASSOCIATED CONSULTANTS		
DRAWING TITLE		
DRAINAGE CATCHMENT PLAN NEIGHBOURHOOD CENTRE		
 MORTONS urbansolutions Civil Engineering Project Coordination		
MUS Pty Ltd T/As: Mortons-Urban Solutions ABN 39 116 375 065		Postal Address U4 100 Railway Road Subiaco 6008
Email: mortons@urbansolutions.net.au Website: www.urbansolutions.net.au Tel 08 9380 9700		Perth Office U4 100 Railway Road Subiaco 6008
DESIGNED CL	DRAWN SM	
APPROVED 		DATE 1-12-17
DRAWING NUMBER		AMEND.
28601-NC-SK001		B



LEGEND

- NEIGHBOURHOOD CENTRE BOUNDARY
- NEIGHBOURHOOD CENTRE LOTS
- BASIN AREAS
- PUBLIC OPEN SPACE AREA
- RESIDENTIAL LOTS AND ROAD RESERVE
- DRAINAGE FLOW ARROW
- UNDERGROUND DRAINAGE STORAGE/BASIN
- CATCHMENT AREA

CRITICAL 5 YR ARI (5Y1H) STORMWATER RETENTION AND DETENTION MODELLING RESULTS

BASIN	MAX VOLUME m ³	MAX DEPTH m	MAX WATER LEVEL m(AHD)	MAX FLOOD AREA m ²	EMPTY TIME h	MAX OVERFLOW RATE m ³ /s
S5	204	0.82	21.10	510	5	nil
B5	642	0.30	3.70	2260	3	nil
B6	209	0.31	4.70	962	6	nil
B7	117	0.25	8.50	513	2	nil
B8	67	0.20	8.20	397	2	nil
B9	575	0.41	9.90	1832	3	nil
B8NC	663	1.06	14.70	625	6	nil
B7NC	318	1.06	14.90	300	6	nil
B10NC	220	1.06	14.40	208	6	nil

PROJECT NAME



PARKLAND
HEIGHTS

STAGE 06

CLIENT

Rockingham Park Pty Ltd



0 20 40 60 80 100m
Scale 1:2000 - A1 (14,000 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
WATER CORPORATION		
CONSTRUCTION		

B	22-02-18	BASIN B10NC DATA ADDED TO TABLE
A	06-12-17	INITIAL ISSUE

PRE DATE	AMENDMENT
----------	-----------

COPYRIGHT IS VESTED IN MORTONS URBAN SOLUTIONS AND
WRITTEN CONSENT IS REQUIRED PRIOR TO REPRODUCTION.
COPYRIGHT MORTONS URBAN SOLUTIONS 2000 .
DO NOT SCALE FROM THIS DRAWING.

WAPC 152391

ASSOCIATED CONSULTANTS

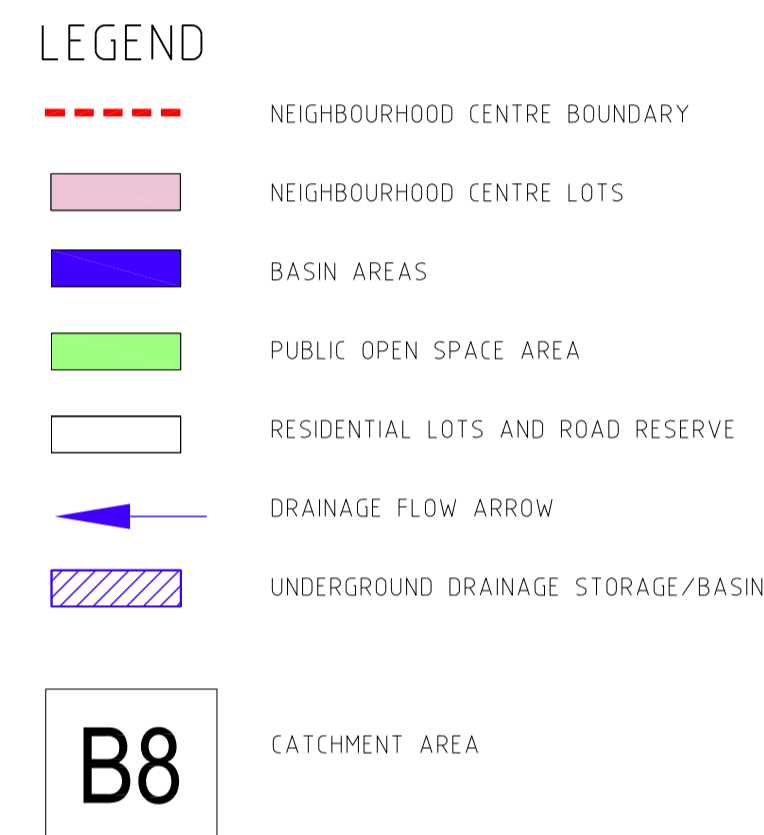
DRAWING TITLE

DRAINAGE CATCHMENT
PLAN
NEIGHBOURHOOD CENTRE
5yr ARI PLAN

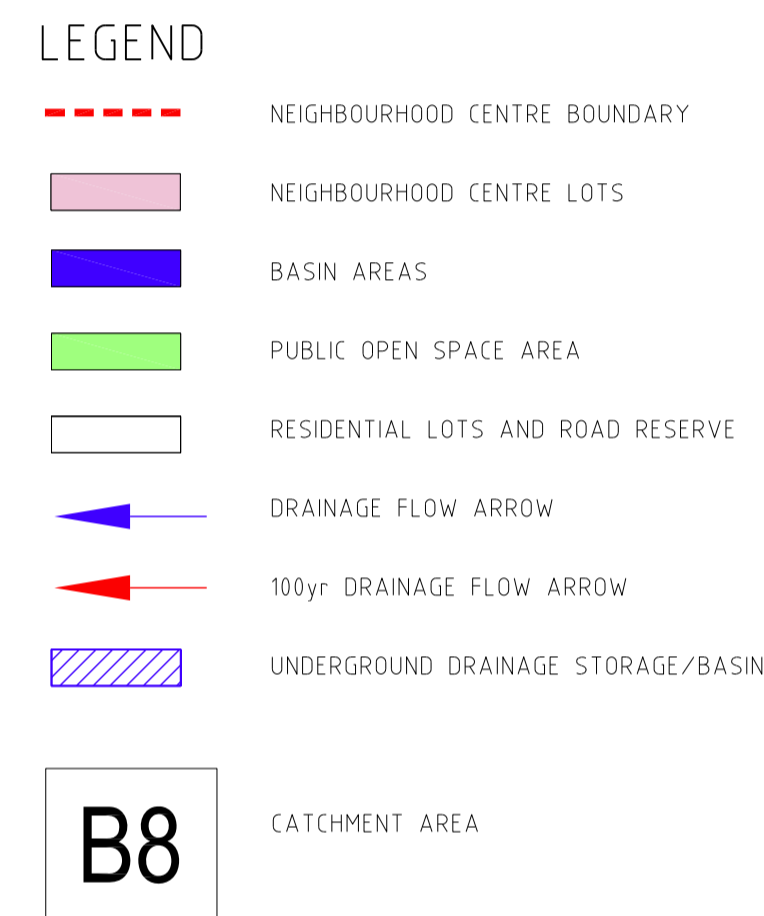
MORTONS
urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN: 39 116 375 065
Postal Address
U4 100 Railway Road
Subiaco 6008
Perth Office
U4 100 Railway Road
Subiaco 6008
Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel: 08 9380 9700

DESIGNED CL	DRAWN SM
APPROVED <i>[Signature]</i>	DATE 1-12-17
DRAWING NUMBER	AMEND.
28601-NC-SK002	B


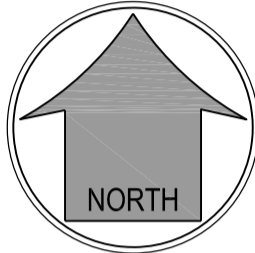

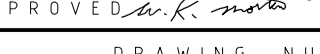


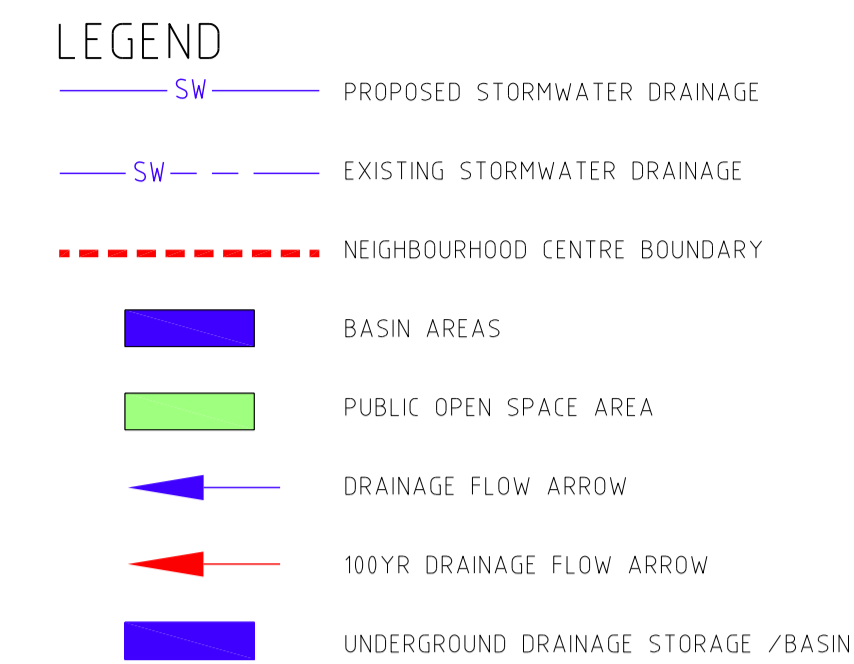
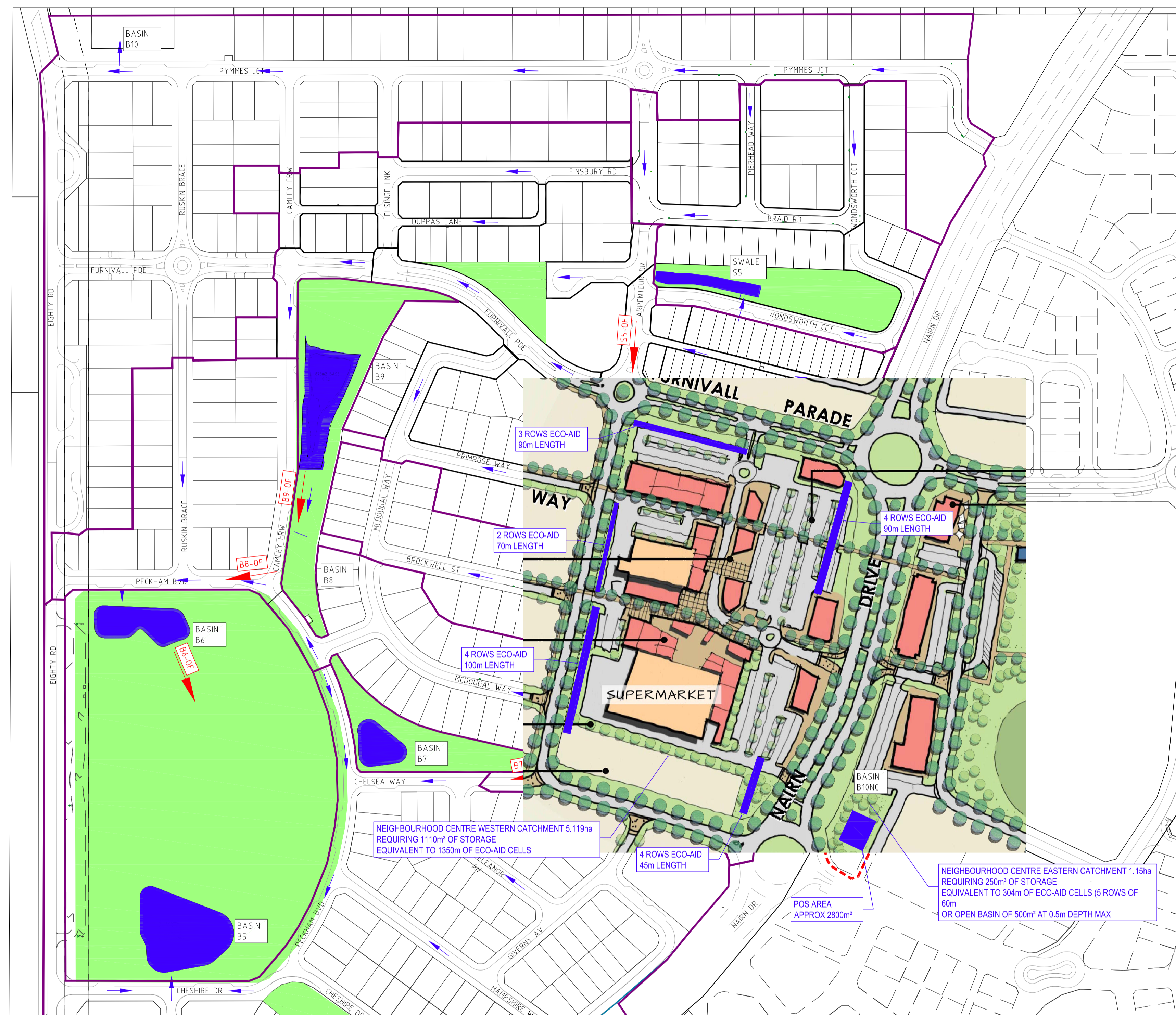
BASIN	MAX VOLUME m ³	MAX DEPTH m	MAX WATER LEVEL m(AHD)	MAX FLOOD AREA m ²	EMPTY TIME h	MAX OVERFLOW RATE m ³ /s
S5	269	0.94	21.20	609	5	nil
B5	919	0.42	3.82	2352	3	nil
B6	304	0.40	4.75	1112	6	nil
B7	135	0.29	8.52	529	2	nil
B8	97	0.26	8.26	444	2	nil
B9	734	0.49	10.0	2010	3	nil
B8NC	749	1.20	14.83	625	7	nil
B7NC	359	1.20	15.10	300	7	nil
B10NC	248	1.20	14.40	208	7	nil



BASIN	MAX VOLUME	MAX DEPTH	MAX WATER LEVEL	MAX FLOOD AREA	EMPTY TIME	MAX OVERFLOW RATE m ³ /s
	m ³	m	m(AHD)	m ²	h	
S5	492	1.20	21.45	813	6	0.21
B5	3173	1.20	4.60	3000	8	nil
B6	1068	0.92	5.27	1584	9	0.326
B7	509	0.85	9.08	808	4	nil
B8	672	1.03	9.03	1066	4	0.278
B9	1393	0.78	10.28	2615	4	0.289
B8NC	750	1.20	14.93	625	7	0.316
B7NC	360	1.20	15.10	300	7	0.153
B10NC	250	1.20	14.40	208	7	nil
DISTRICT OVAL	39	0.007	5.007	5602	0.5	nil

BASIN	MAX FLOW RATE m ³ /s	MAX DEPTH m	MAX VELOCITY m/s	VxD FACTOR	CONVEYANCE SYSTEM
S5-OF	0.21	0.09	1.46	0.13	ROAD PAVEMENT
B7NC-OF	0.153	0.098	0.89	0.087	ROAD PAVEMENT,PIPES
B8NC-OF	0.316	0.152	0.76	0.112	ROAD PAVEMENT,PIPES
B8-OF	0.278	n/a	2.49	n/a	PITS AND PIPES
B9-OF	0.289	0.026	0.04	0.034	POS AREA
B6-OF	0.326	n/a	n/a	n/a	POS AREA

PROJECT NAME		
<div></div> <div>PARKLAND HEIGHTS</div> <div>STAGE 06</div>		
CLIENT		
Rockingham Park Pty Ltd		
<div></div> <div>020406080100m</div> <div>Scale 1:2000 - A1 (1:4000 - A3)</div>		
ISSUES		
DATE		
TENDER		
COUNCIL		
WATER CORPORATION		
CONSTRUCTION		
B	22-02-18	BASIN B10NC DATA ADDED TO TABLE
A	6-12-17	INITIAL ISSUE
PRE DATE		
AMENDMENT		
COPYRIGHT IS VESTED IN MORTONS URBAN SOLUTIONS AND WRITTEN CONSENT IS REQUIRED PRIOR TO REPRODUCTION. COPYRIGHT MORTONS URBAN SOLUTIONS 2000 . DO NOT SCALE FROM THIS DRAWING.		
WAPC 152391		
ASSOCIATED CONSULTANTS		
DRAWING TITLE		
DRAINAGE CATCHMENT PLAN NEIGHBOURHOOD CENTRE 100yr ARI PLAN		
<div></div> <div>MORTONS urbansolutions Civil Engineering Project Coordination</div> <div>MUS Pty Ltd T/As: Mortons-Urban Solutions ABN 39 116 375 065</div> <div>Postal Address U4 100 Railway Road Subiaco 6008</div> <div>Email: mortons@urbansolutions.net.au Website: www.urbansolutions.net.au Tel 08 9380 9700</div> <div>Perth Office U4 100 Railway Road Subiaco 6008</div>		
DESIGNED CL		DRAWN SM
APPROVED 		DATE 1-12-17
DRAWING NUMBER		
AMEND.		
28601-NC-SK004		
B		

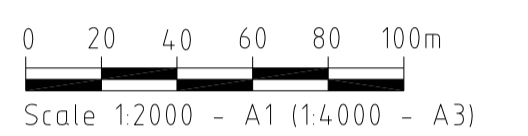
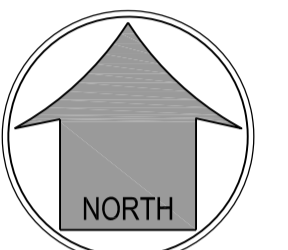


PARKLAND HEIGHTS

STAGE 06

CLIENT

Rockingham Park Pty Ltd



ISSUES	DATE	
TENDER		
COUNCIL		
WATER CORPORATION		
CONSTRUCTION		

A	21-02-18	INITIAL ISSUE

PRE	DATE	AMENDMENT
-----	------	-----------

COPYRIGHT IS VESTED IN MORTONS URBAN SOLUTIONS AND
 WRITTEN CONSENT IS REQUIRED PRIOR TO REPRODUCTION.
 COPYRIGHT MORTONS URBAN SOLUTIONS 2000 .
 DO NOT SCALE FROM THIS DRAWING.

WAPC 152391

ASSOCIATED CONSULTANTS

D R A W I N G T I T L E

CONCEPT
DRAINAGE STORAGE AREA
PLAN
NEIGHBOURHOOD CENTRE



MUS Pty Ltd T/As: Mortons-Urban Solutions ABN: 39 116 375 065	Postal Address U4 100 Railway Road Subiaco 6008
---	---

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au Perth Office
Website: www.urbansolutions.net.au U4 100 Railway Road
Tel 08 9380 9700 Subiaco 6008

Perth Office
U4 100 Railway Road
Subiaco 6008

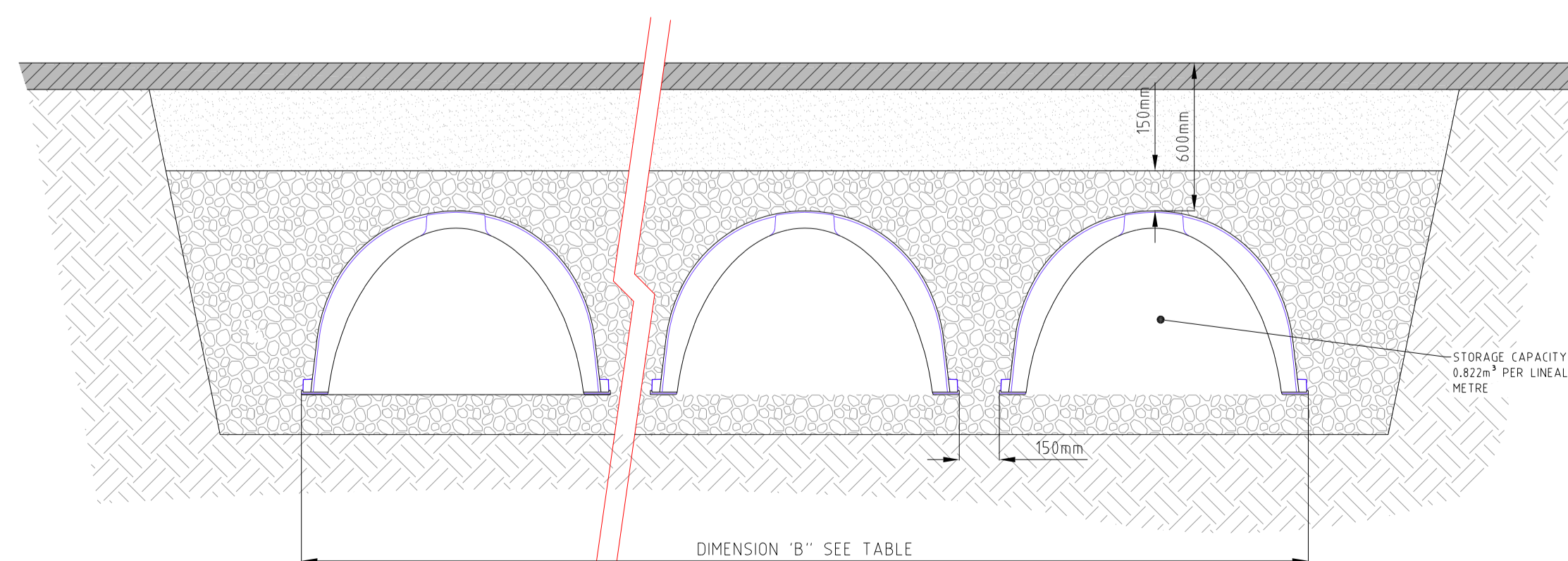
DESIGNED	CL	DRAWN	SM
----------	----	-------	----

APPROVED <i>W.K. Martin</i>	DATE 1-12-17
-----------------------------	--------------

DRAWING	NUMBER	AMEND.
---------	--------	--------

DRAWING NUMBER
28601-NC-SK005

A



No OF CELLS	BASE WIDTH(B)
1	1.76m
2	3.07m
3	4.38m
4	5.69m

ARI for Baldivis							
DURATION	1 Year	2 years	5 years	10 years	20 years	50 years	100 years
5Mins	59.2	78.1	103	121	146	182	214
6Mins	55.1	72.8	95.9	112	135	169	198
10Mins	44	57.9	75.3	87.7	105	130	152
20Mins	30.7	40	51	58.6	69.2	84.7	97.8
30Mins	24.4	31.6	39.8	45.3	53.3	64.7	74.3
1Hr	16	20.5	25.4	28.8	33.5	40.3	45.9
2Hrs	10.2	13.1	16.1	18	20.9	25	28.3
3Hrs	7.85	10	12.3	13.7	15.9	18.9	21.4
6Hrs	5.01	6.39	7.76	8.66	10	11.8	13.4
12Hrs	3.21	4.1	4.96	5.53	6.36	7.53	8.49
24Hrs	2.07	2.65	3.2	3.57	4.11	4.87	5.5
48Hrs	1.31	1.68	2.04	2.28	2.64	3.14	3.55
72Hrs	0.98	1.25	1.53	1.71	1.98	2.35	2.68

actual rainfall in event							
1 Year	2 years	5 years	10 years	20 years	50 years	100 years	
4.9	6.5	8.6	10.1	12.2	15.2	17.8	
5.5	7.3	9.6	11.2	13.5	16.9	19.8	
7.3	9.7	12.6	14.6	17.5	21.7	25.3	
10.2	13.3	17.0	19.5	23.1	28.2	32.6	
12.2	15.8	19.9	22.7	26.7	32.4	37.2	
16.0	20.5	25.4	28.8	33.5	40.3	45.9	
20.4	26.2	32.2	36.0	41.8	50.0	56.6	
23.6	30.0	36.9	41.1	47.7	56.7	64.2	
30.1	38.3	46.6	52.0	60.0	70.8	80.4	
38.5	49.2	59.5	66.4	76.3	90.4	101.9	
49.7	63.6	76.8	85.7	98.6	116.9	132.0	
62.9	80.6	97.9	109.4	126.7	150.7	170.4	
70.6	90.0	110.2	123.1	142.6	169.2	193.0	

SAND AREAS USE 1200mm DEEP SOAKWELLS

Block size			Calculation formula
Block size	320	m2	
Block % impervious	80%		
impervious area	256	m2	Block size * block % impervious
Rainfall depth	0.016	m	year 1 hr rainfall event / 1000
Total rainfall volume	4.096	m3	Rainfall depth * Impervious area
Infiltration rate	3	m/day	
Infiltration rate	0.1250	m/hr	Infiltration rate (m/d) / 24
Number off	2	each	
Tank diameter	1.8	m	
Tank depth	1.2	m	
Tank bottom area	5.089	m2	(Tank diameter/2)*(Tank diameter/2)*PI*No of Soakwells
Tank Volume	6.107	m3	Tank bottom area * Tank depth
Infiltration per hour	0.636	m3	Tank bottom area * Infiltration rate
Total storage + infiltration	6.743	m3	Infiltration per hour + Tank volume

Block size	370	m2	
Block % impervious	80%		
impervious area	296	m2	Block size * block % impervious
Rainfall depth	0.016	m	year 1 hr rainfall event / 1000
Total rainfall volume	4.736	m3	Rainfall depth * Impervious area
Infiltration rate	3	m/day	
Infiltration rate	0.1250	m/hr	Infiltration rate (m/d) / 24
Number off	2	each	
Tank diameter	1.8	m	
Tank depth	1.2	m	
Tank bottom area	5.089	m2	(Tank diameter/2)*(Tank diameter/2)*PI*No of Soakwells
Tank Volume	6.107	m3	Tank bottom area * Tank depth
Infiltration per hour	0.636	m3	Tank bottom area * Infiltration rate
Total storage + infiltration	6.743	m3	Infiltration per hour + Tank volume

Block size	420	m2	
Block % impervious	80%		
impervious area	336	m2	Block size * block % impervious
Rainfall depth	0.016	m	year 1 hr rainfall event / 1000
Total rainfall volume	5.376	m3	Rainfall depth * Impervious area
Infiltration rate	3	m/day	
Infiltration rate	0.1250	m/hr	Infiltration rate (m/d) / 24
Number off	2	each	
Tank diameter	1.8	m	
Tank depth	1.2	m	
Tank bottom area	5.089	m2	(Tank diameter/2)*(Tank diameter/2)*PI*No of Soakwells
Tank Volume	6.107	m3	Tank bottom area * Tank depth
Infiltration per hour	0.636	m3	Tank bottom area * Infiltration rate
Total storage + infiltration	6.743	m3	Infiltration per hour + Tank volume

Block size	470	m2	
Block % impervious	80%		
impervious area	376	m2	Block size * block % impervious
Rainfall depth	0.016	m	year 1 hr rainfall event / 1000
Total rainfall volume	6.016	m3	Rainfall depth * Impervious area
Infiltration rate	3	m/day	
Infiltration rate	0.1250	m/hr	Infiltration rate (m/d) / 24
Number off	2	each	
Tank diameter	1.8	m	
Tank depth	1.2	m	
Tank bottom area	5.089	m2	(Tank diameter/2)*(Tank diameter/2)*PI*No of Soakwells
Tank Volume	6.107	m3	Tank bottom area * Tank depth
Infiltration per hour	0.636	m3	Tank bottom area * Infiltration rate
Total storage + infiltration	6.743	m3	Infiltration per hour + Tank volume

Block size	520	m2	
Block % impervious	80%		
impervious area	416	m2	Block size * block % impervious
Rainfall depth	0.016	m	year 1 hr rainfall event / 1000
Total rainfall volume	6.656	m3	Rainfall depth * Impervious area
Infiltration rate	3	m/day	
Infiltration rate	0.1250	m/hr	Infiltration rate (m/d) / 24
Number off	3	each	
Tank diameter	1.8	m	
Tank depth	1.2	m	
Tank bottom area	7.634	m2	(Tank diameter/2)*(Tank diameter/2)*PI*No of Soakwells
Tank Volume	9.161	m3	Tank bottom area * Tank depth
Infiltration per hour	0.954	m3	Tank bottom area * Infiltration rate
Total storage + infiltration	10.115	m3	Infiltration per hour + Tank volume

Block size	570	m2	
Block % impervious	80%		
impervious area	456	m2	Block size * block % impervious
Rainfall depth	0.016	m	year 1 hr rainfall event / 1000
Total rainfall volume	7.296	m3	Rainfall depth * Impervious area
Infiltration rate	3	m/day	
Infiltration rate	0.1250	m/hr	Infiltration rate (m/d) / 24
Number off	3	each	
Tank diameter	1.8	m	
Tank depth	1.2	m	
Tank bottom area	7.634	m2	(Tank diameter/2)*(Tank diameter/2)*PI*No of Soakwells
Tank Volume	9.161	m3	Tank bottom area * Tank depth
Infiltration per hour	0.954	m3	Tank bottom area * Infiltration rate
Total storage + infiltration	10.115	m3	Infiltration per hour + Tank volume

Block size	660	m2	
Block % impervious	80%		
impervious area	528	m2	Block size * block % impervious
Rainfall depth	0.016	m	year 1 hr rainfall event / 1000
Total rainfall volume	8.448	m3	Rainfall depth * Impervious area
Infiltration rate	3	m/day	
Infiltration rate	0.1250	m/hr	Infiltration rate (m/d) / 24
Number off	3	each	
Tank diameter	1.8	m	
Tank depth	1.2	m	
Tank bottom area	7.634	m2	(Tank diameter/2)*(Tank diameter/2)*PI*No of Soakwells
Tank Volume	9.161	m3	Tank bottom area * Tank depth
Infiltration per hour	0.954	m3	Tank bottom area * Infiltration rate
Total storage + infiltration	10.115	m3	Infiltration per hour + Tank volume

Note: 3 no. 1.8m diameter x 1.2m deep soak wheels can service a lot of 790 m2.

Initial Loss Calc for Lot Area:

$$IL = \frac{\text{Total Soakwell Storage} + \text{Infiltration (1h)}}{\text{Block Size} \times \text{block \% impervious}}$$

e.g.

$$IL_{320} = \frac{6.743 \text{ m}^3}{320 \text{ m}^2 \times 0.8} = 26 \text{ mm}$$

Continuing Loss Calc for Lot Area:

$$CL = \frac{\text{Soakwell Infiltration per hour}}{\text{Block Size} \times \text{block \% impervious}}$$

e.g.

$$CL_{320} = \frac{0.636 \text{ m}^3}{320 \text{ m}^2 \times 0.8} = 2.5 \text{ mm/h}$$

$$IL_{320} = 26 \text{ mm}$$

$$CL_{320} = 2.5 \text{ mm/h}$$

$$IL_{370} = 22 \text{ mm}$$

$$CL_{370} = 2.1 \text{ mm/h}$$

$$IL_{420} = 20 \text{ mm}$$

$$CL_{420} = 1.9 \text{ mm/h}$$

$$IL_{470} = 18 \text{ mm}$$

$$CL_{470} = 1.7 \text{ mm/h}$$

$$IL_{520} = 24 \text{ mm}$$

$$CL_{520} = 2.3 \text{ mm/h}$$

$$IL_{570} = 22 \text{ mm}$$

$$CL_{570} = 2.1 \text{ mm/h}$$

$$IL_{660} = 19 \text{ mm}$$

$$CL_{660} = 1.8 \text{ mm/h}$$

Average Initial Loss for Lot
Impervious Area = 21.5 mm

Average Continuing Loss for Lot
Impervious Area = 2.05 mm/h

Based on 3m/day infiltration rate

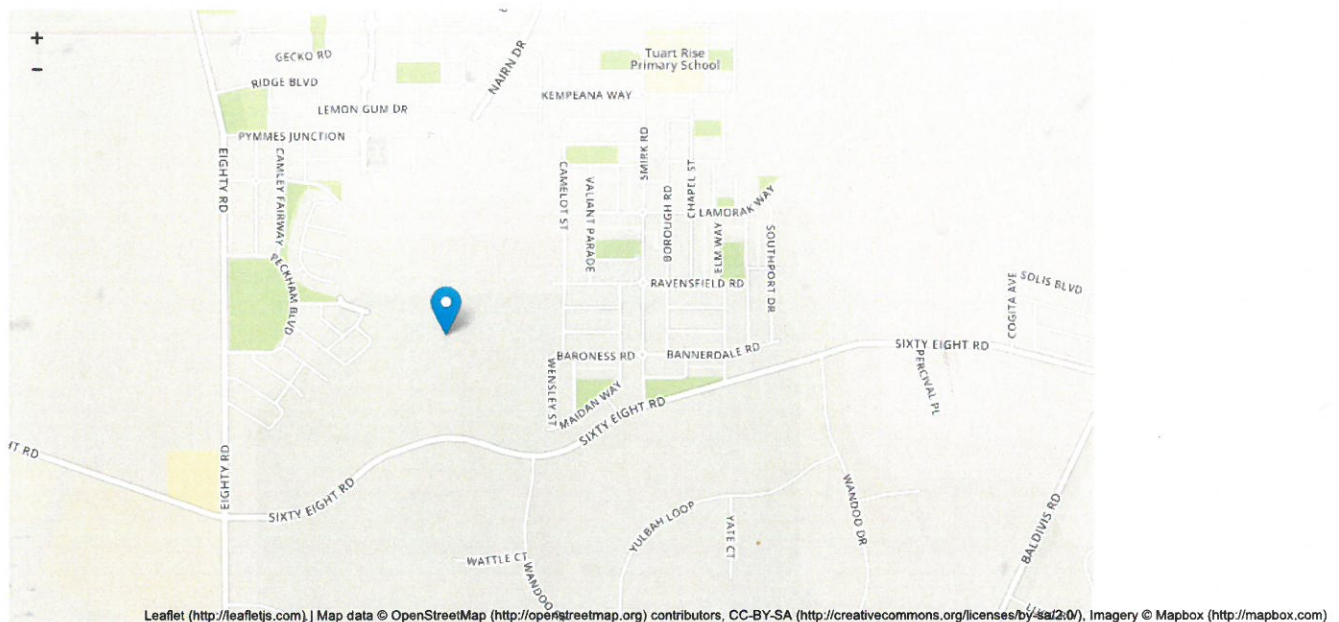
Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude 115.806

Latitude -32.361

Selected Regions (clear)



Region Information

Data Category	Region
River Region	Murray River (Wa)
ARF Parameters	SW WA
Temporal Patterns	Southern and South Western Flatlands (West)

Data

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR USE** in urban areas

Storm Initial Losses (mm)

ARR 2016 Recommended 60% to 80% of $\frac{30.0}{2.9}$

Storm Continuing Losses (mm/h)

Section 3.5.3

Layer Info

Time Accessed 15 January 2018 07:15PM

Version 2016_v1

BOM IFD Depths

Click here (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-32.361288&longitude=115.806202&sdmin=true&sdhr=true&sdday=true&user_label=) to obtain the IFD depths for catchment

centroid from the BoM website

Layer Info