

Shepparton North Shopping Centre Stormwater Management

Prepared for: Lascorp

25 January 2017

Table of Contents

1	Introduction.....	3
2	Site Description	4
2.1	Proposed Development.....	5
2.2	Previous Flood Retardation Advice	6
3	Flood Retention Calculation	9
4	Water Quality Treatment	13
5	Recommendations.....	13

Figure 1: Site.....	4
Figure 2: Proposed Development Layout	5
Figure 3: Previous Catchment Definition	6
Figure 4: 2005 Drainage Strategy Plan	7
Figure 5: Boyd Calculation for developed site	9
Figure 6: Flow path to Yakka Basin.....	11

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1 Introduction

Biofilta Pty Ltd was engaged by Lascorp to address the stormwater management requirements of a proposed supermarket and associated commercial development in north Shepparton.

This report details the preliminary stormwater management proposal for the development and is consistent with previous studies and reports undertaken by others for the wider catchment which the subject site is located.

Based on calculations undertaken by Biofilta and through discussion with Council's Engineering team, drainage for the development will be directed to the south and into the "Yakka Basin" with provision of appropriate storage volume.

While final engineering details will be presented as a condition of permit, the strategy and concept is submitted in this report for approval to ensure that the required infrastructure is agreed with Council.

2 Site Description

The subject site is located in north Shepparton and is bounded to the north by Ford Road and Nurmurkah Road to the west. Part of the southern boundary abuts Doddy Street and some existing commercial properties.

The eastern boundary is currently vineyard farming land.

Figure 1 below shows the current aerial view of the site and indicates an approximate total developed area of 4.5ha.

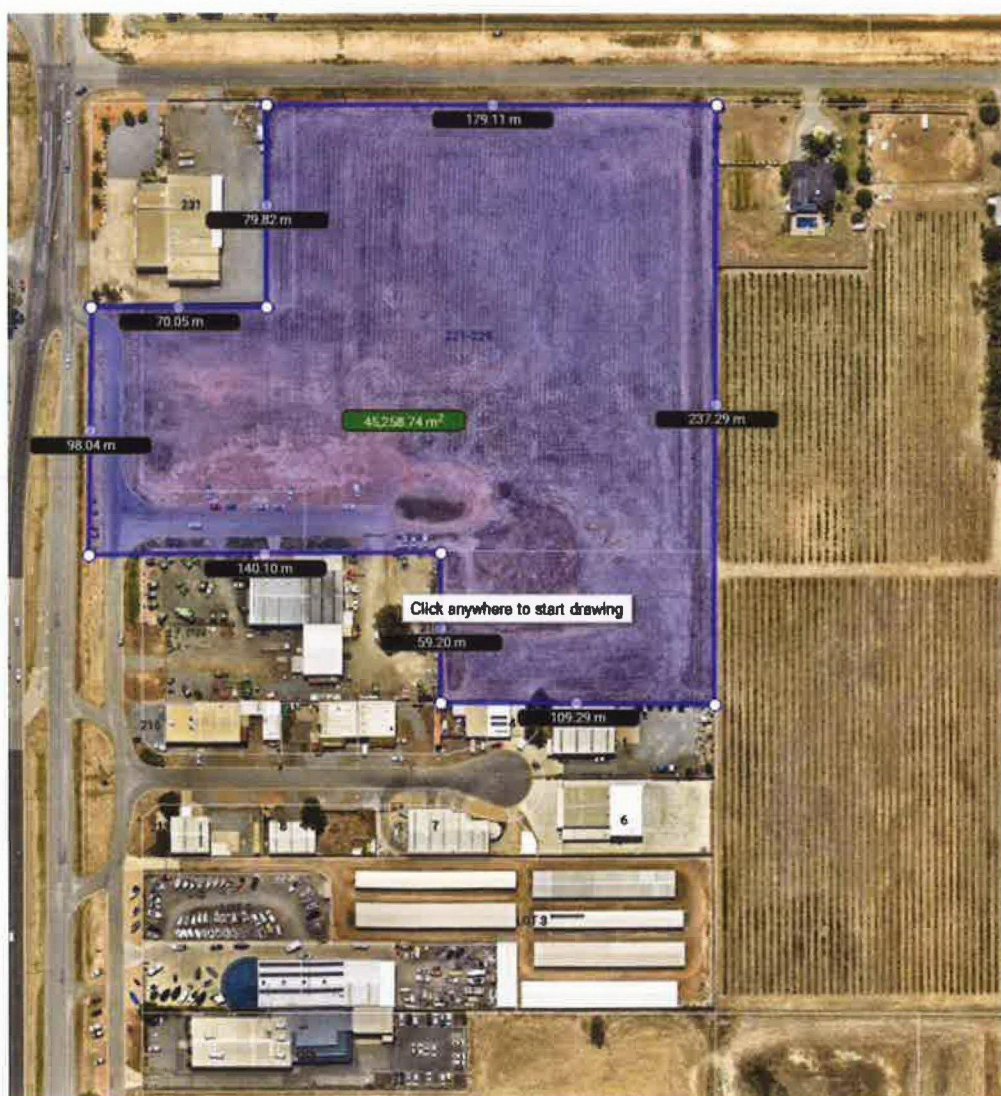


Figure 1: Site

2.1 Proposed Development

The proposed development indicates a supermarket, speciality shops and car parking.

To the south will be a child care centre and in the south east corner, a yet to be determined residential/mixed use building.

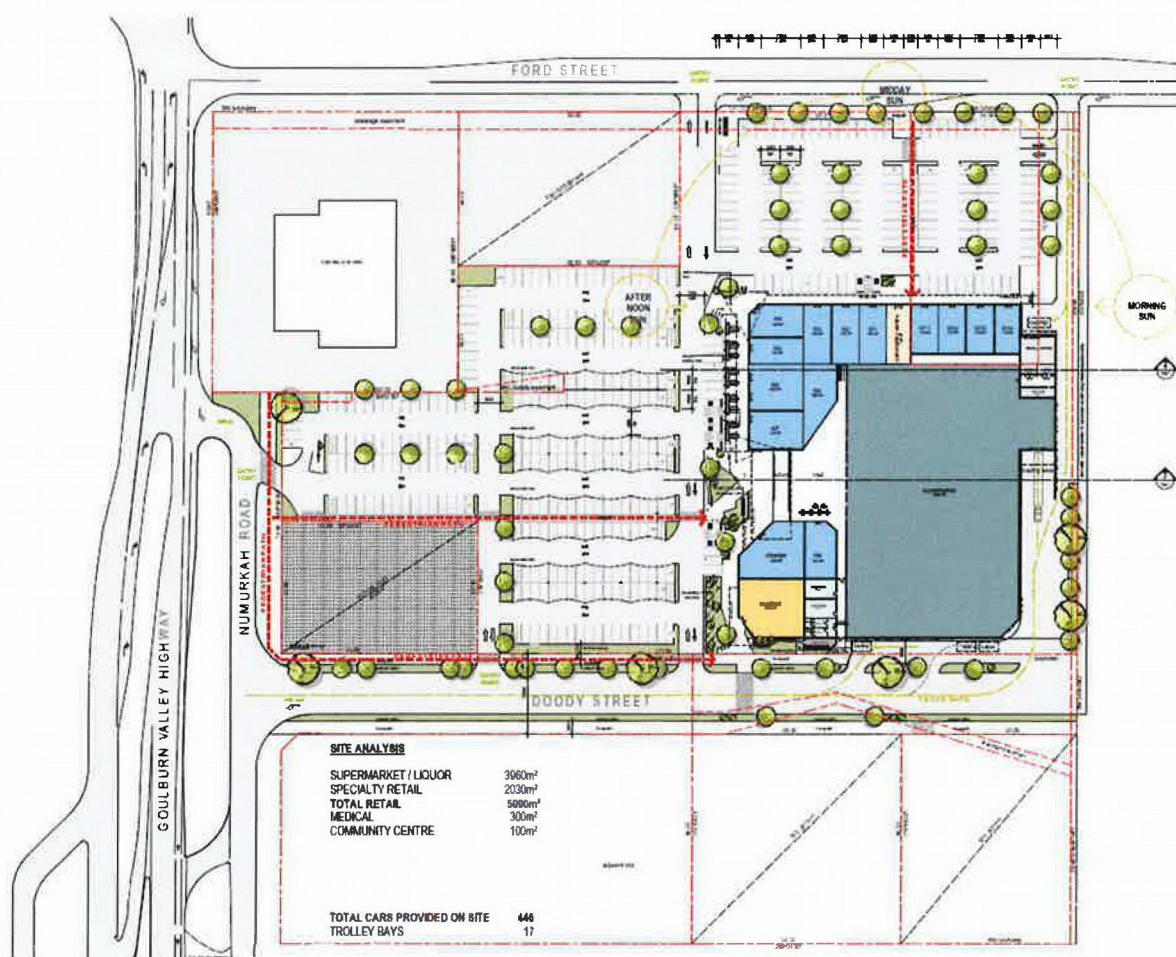


Figure 2: Proposed Development Layout

From a drainage perspective, it is assumed that the coefficient of runoff will vary from a standard 0.35 to 0.9 to represent the increased imperviousness nature.

2.2 Previous Flood Retardation Advice

Calculations were previously undertaken for the entire Yakka Basin catchment which the subject site is located.

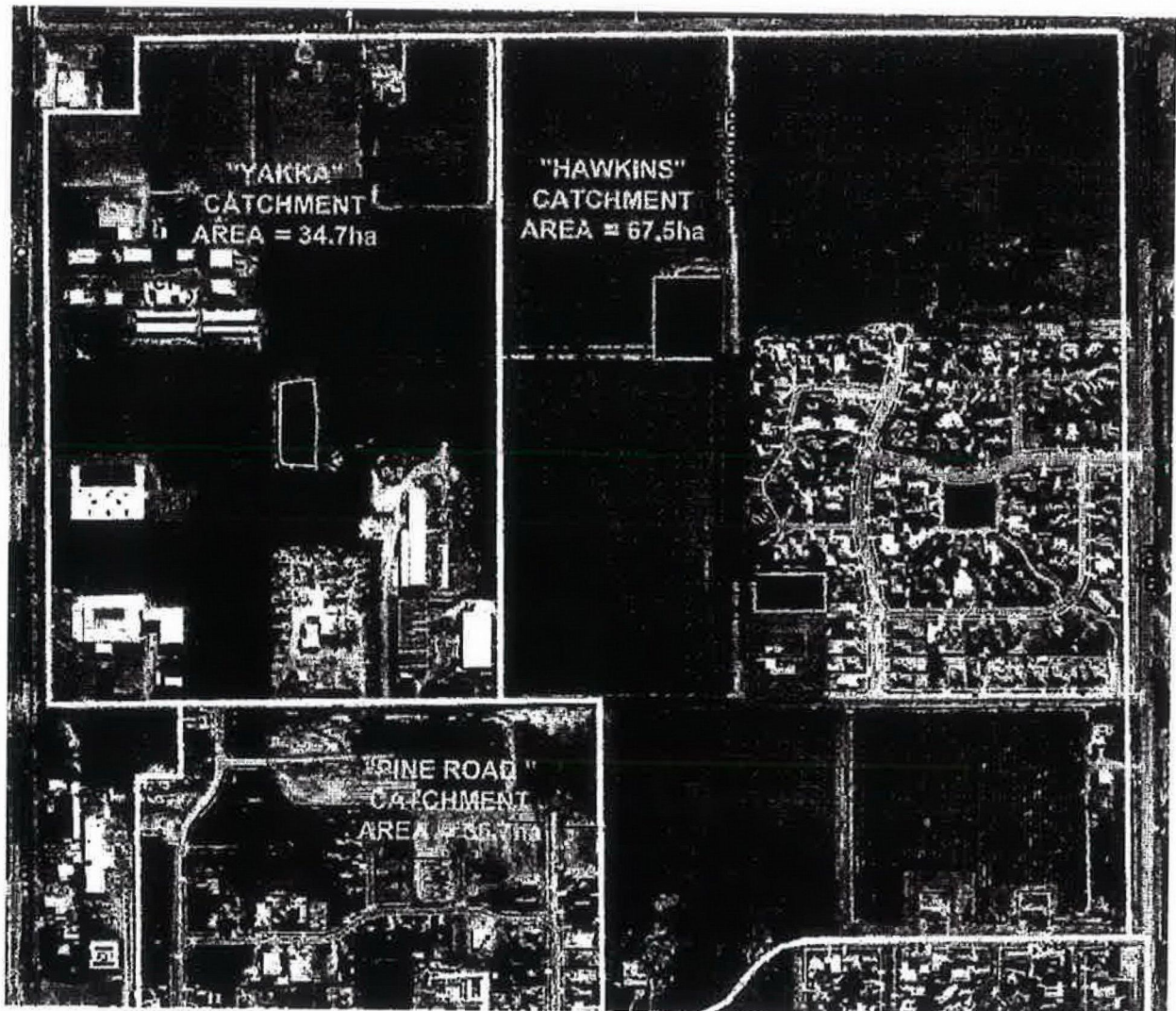


Figure 3: Previous Catchment Definition

The subject site is located in the northern portion of the "Yakka" basin catchment and represents approximately 13% of the Yakka basin catchment.

From previous studies, drainage from the entire catchment has been designed to flow in a southerly direction to the Yakka Basin “D” zone which will eventually be expanded and linked to the adjacent Hawkins Basin to the east once the full catchment is developed.

A full drainage concept plan is shown below:

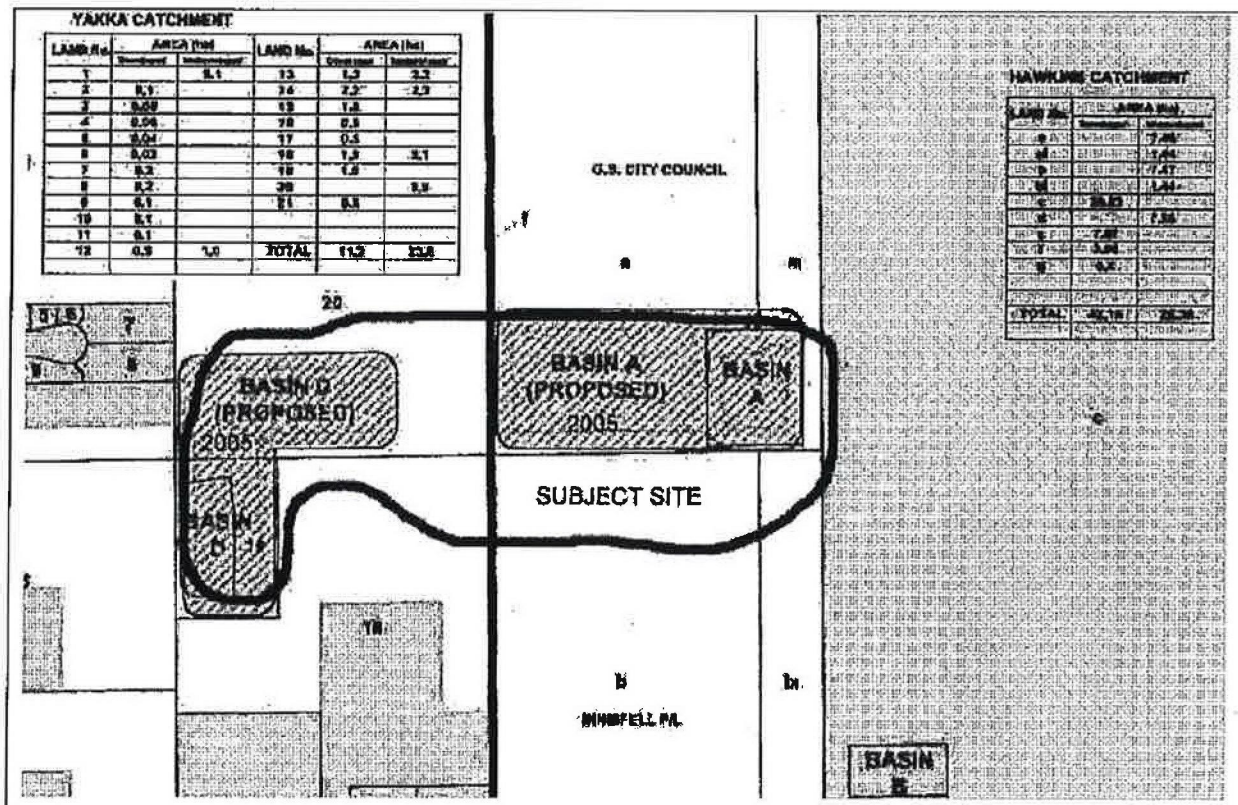


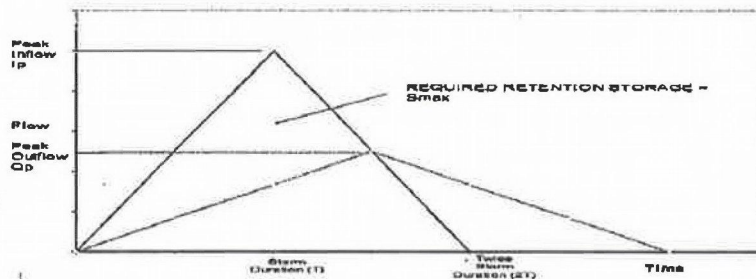
Figure 4: 2005 Drainage Strategy Plan

In the interim, only part of the Yakka Basin “D” has been constructed.

Flow from the Yakka Basin is pumped via an existing 100mm rising main to the north and along the eastern boundary of the subject site, across Ford Road and into the GMW drain.

Previous reports state that the current pump station has a capacity of 10 litres per second from the Yakka D Basin.

Advice from previous studies is based on using the Boyd retention volume formula:



$$S_{\max} = V_1 (1 - Q_p / I_p)$$

(Boyd's Formula)

S_{\max} = Maximum Volume of temporary Storage (m^3)

V_1 = Volume of inflow flood (m^3)

I_p = Peak discharge of inflow hydrograph (m^3/s)

Q_p = Peak discharge of outflow hydrograph (m^3/s)

Calculations for the entire Yakka catchment are as follows:

YAKKA CATCHMENT

Sub Catchment*	Area *	100 Yr Runoff Coeff*	Effective Area
Existing Developed Areas	11.2	0.9	10.08
Area 1	5.1	0.9	4.59
Area 20	8.9	0.9	8.01
Area 12 (Part)	1	0.9	0.9
Area 13 (Part)	3.2	0.9	2.88
Area 14 (Part)	2.2	0.9	1.98
Area 18 (Part)	3.1	0.9	2.79
Total	34.7		31.23

* As defined by Earthtech May 2006

100 Year Effective Catchment Area = $\Sigma CA =$

31.2 ha

Restricted outflow requirement =

0.04 m^3/s
(1.2 l/s per ha)

Probable pump capacity (existing) =

0.01 m^3/s

Storage requirement is highest value of S_{\max} calculated in the table below
Critical storm duration is the storm duration when S_{\max} occurs

Continue table until a clear S_{\max} is calculated

Storm Duration (Hrs)	Storm Duration (min)	100 Year Intensity (mm)	I_p (m^3/s)	Q_p (m^3/s)	V_1 (m^3)	S_{\max} (m^3)
0.25	15	104.5	9.07	0.01	8159	8150
0.5	30	70.7	6.13	0.01	11040	11022
0.75	45	54.9	4.76	0.01	12859	12832
1	60	45.4	3.94	0.01	14178	14142
2	120	28.1	2.44	0.01	17551	17479
3	180	21	1.62	0.01	19675	19507
4	240	17.1	1.46	0.01	21361	21217
5	300	14.5	1.26	0.01	22642	22462
7	420	11.4	0.99	0.01	24622	24470
9	540	8.54	0.83	0.01	25814	25490
12	720	7.79	0.68	0.01	29184	28762
16	1080	5.88	0.51	0.01	33054	32406
24	1440	4.82	0.42	0.01	36127	35263
30	1800	3.95	0.34	0.01	37008	35029

Therefore 24 hour storm is critical

Storage Required = 35263 m^3

(note: If no outflow allowed, storage requirement = 38000 m^3 (which is what is specified in May 2006 Earthtech report))

Pump Capacity = 0.01 m^3/s (Approx - Based on rising main size - to be confirmed)

Pumping only occurs if receiving GMW Drain is no full, otherwise no pumping occurs.

Jon Griffin confirmed 28/3/08 that requirement is to provide no Freeboard to 24 hour event allowing 1.2 l/s/ha outflow (very restricted outflow)

From the above, we see that the Yakka Basin provides for 35,263m³ of retardation volume and currently, only 11.2ha or 32% has been developed.

The subject land represents only 13% of the catchment area for the basin.

3 Flood Retention Calculation

Based on the latest GMW requirements, all flow up to and including the 1 in 100 year, 24hour volume must be held on site and can only be pumped out at a rate of 1.2 litres per second per ha.

For the subject site, this equates to an permissible outflow of $4.5 \times 1.2 = 5.4$ l/sec.

Using a storm duration of 1440 minutes with an intensity of 4.82mm/hr, the required storage volume to be made available is as follows:

Boyd's Formula

S = V(1-Q/L)							
S	Max volume	Where	Cdev	0.9			
V	Volume of inflow flood m3		Qpermissible	0.0054			
Lp	Peak discharge of inflow hydrograph						
Qp	Peak discharge of outflow hydrograph						
For 100year ARI 24hr event		Area	4.5 ha				
		Effective area	4.05 ha				
Duration (hr)	Duration (min)	Intensity (mm/hr)	Lp	Qp	V	Sm3	
24	1440	4.82	0.054	0.0054	4,685	4,218	

Figure 5: Boyd Calculation for developed site

A total basin volume of 4,218m3 is required.

Calculations undertaken by Council's engineering consultants were found to be within close agreement to Biofilta's volume and therefore not in dispute.

Transfer of stormwater to the basin for all flows up to the 1 in 100 year ARI will require either a swale to convey the flows from the hardstand surfaces. It is understood that provision for the conveyance on adjacent land will be facilitated by Council.

Peak flows were calculated using the IFD values from the BoM website and undertaking the following calculations:

Area	4.5	ha
Flow Path Length	285	m
Ave Flow Velocity	1	m/s
Time to Flow Path	7	Mins
Tc	0.196	Hrs
	11.8	Mins

ARI	Intensity (mm/hr)	C	Q (m3/s)
1	35.4	0.5	0.221
2	46.4	0.67	0.389
5	62.4	0.75	0.585
10	72.5	0.8	0.725
20	85.7	0.85	0.911
50	103.9	0.9	1.168
100	118.3	0.9	1.331

Peak flows in the 1 in 100 year ARI are 1.331m3/s which need to be conveyed to the Yakka Basin.

As the Yakka Basin is effectively the legal point of discharge for the site, a drainage easement will need to be created to convey the flows to the basin.

The distance from the southernmost corner of the subject site to Yakka Basin is shown overleaf to be approximately 150m.



Figure 6: Flow path to Yakka Basin

The existing easement is understood to be only 1.2m wide to accommodate the rising main pipe to Ford Road.

Conveyance of the peak flows via a swale would require a 3m strip of land at a minimum or be piped.

Basic calculations of each option are:

Pipe Capacity - Mannings Formula			
RCP pipe diameter =	1.05 m	Length	280
RCP pipe radius =	0.525 m	Drop	1
Wetted perimeter =	3.2991 m	Slope	0.003571
Area =	0.866014 m ²		
Hyd radius =	0.2625 m		
slope =	0.003571		
Mannings n =	0.013		
Capacity =	1.63 m ³ /s		
Velocity =	1.88 m/s		

Mannings calculation of capacity of a trapezo.

Drain Depth	0.6 m		
Base width	1 m		
Slope	0.003571		280
side slopes	1 in	3	
Area	1.68 m ²		
ss length	1.90 m		
Wetted Perim.	4.79 m		
R	0.35 m		
mannings n	0.030		
Capacity	1.66 m ³ /s		
velocity	0.99 m/s		

The peak flood flow from the site can therefore be conveyed with either a 1050mm diameter pipe with a 1m fall or via a 600mm deep swale with 1m base and a 1m fall to the basin.

Based on available grades, it would be preferable if a swale drain could be constructed subject to landowner agreement to convey the flows to the basin.

4 Water Quality Treatment

The previous reports suggest that once the Yakka catchment is completed, there will be enough flow to maintain a water quality treatment wetland and this will eventually join up with the Hawkins Basin wetland.

It is recommended that the basin operates as a dry retarding basin and that any future wetland construction occurs only after sufficient catchment is developed to provide water quality treatment if the Council deems this necessary based on their own water quality modelling.

In our opinion, the basin will remove significant amounts of suspended solids given its size and long settling periods while the pump removes at small flow rates.

Agreement has been reached in terms of cost contribution for infrastructure for the water quality treatment and Yakka Basin contribution works to provide a precinct scale solution that will also join with the Hawkins Basin to the east.

It is acknowledged that the Yakka Basin pump station will require upgrade to cope with the ultimate flows to the GMW drain on the north side of Ford Road.

Biofilta have worked with Council and its consultants to minimise the footprint of the precinct basin scheme within the parameters of Council's IDM. It is understood that the recommendations made in relation to location and bettering is currently being incorporated into the Scheme layout.

5 Recommendations

Biofilta recommends that Council support the development proposal on the basis that the site can be drained to the Yakka D basin with the following recommendations:

- Discharge of treated stormwater be connected to the Yakka D basin as the legal point of discharge;
- Storage volume of 4,218m³ of storage volume be provided in the Yakka D basin to accommodate the retardation of the 1 in 100 year 24hour storm event volume in conjunction with flows from the ultimate development Scheme.
- In paying a cost contribution to the Scheme, the development site will have no onsite requirement for water quality treatment or retardation.
- Existing pumping system to be upgraded by Council to accommodate the long term Drainage Scheme objectives;
- Conveyance via an easement created along the eastern boundary of the subject site or adjoining property (by agreement) be supported with the width to be determined during the detailed design phase of the project;