Neil M Craigie Pty Ltd
ACN 074 582 282 ABN 29 074 582 282

Waterway Management Consultants

WESTBROOK PSP 92

SURFACE WATER MANAGEMENT STRATEGY

For: Watsons P/L

13 March 2013

Director ***Neil McKinnon Craigie*** *BE(Civil), MEngSci, MIEAust, CPEng*

Email: nmcraigie@bigpond.com
40 Jamieson Court, Cape Schanck, Vic. 3939, Australia
Mobile: 0427 510 053

TABLE OF CONTENTS

1. INTRODUCTION

The Westbrook PSP 92 area comprises the lands bounded by the Werribee River to the north, Armstrong Road to the east, Ballan Road to the south and the Outer Melbourne Transport Corridor (OMTC) to the west, as shown on Figure 1.

This surface water management strategy (SWMS) report has been prepared at the request of Watsons P/L who are acting for the Bozzo properties which form the bulk of the landholdings in PSP 92.

Surface water drainage outfalls occur in several locations to the east across the Regional Rail Link (RRL) and south across Ballan Road into the Manor Lakes Estate, while small parts of the area fronting the high verge of the Werribee River drain out to the river.

The report summarises current drainage planning for the area and presents a strategy to manage all drainage from PSP 92 that conforms with known requirements. Key drainage management assets are shown on Figure 1.

Melbourne Water (MW) is responsible for main drainage assets with catchments greater than 60 ha. Smaller catchments will remain the responsibility of Wyndham City Council (WCC).

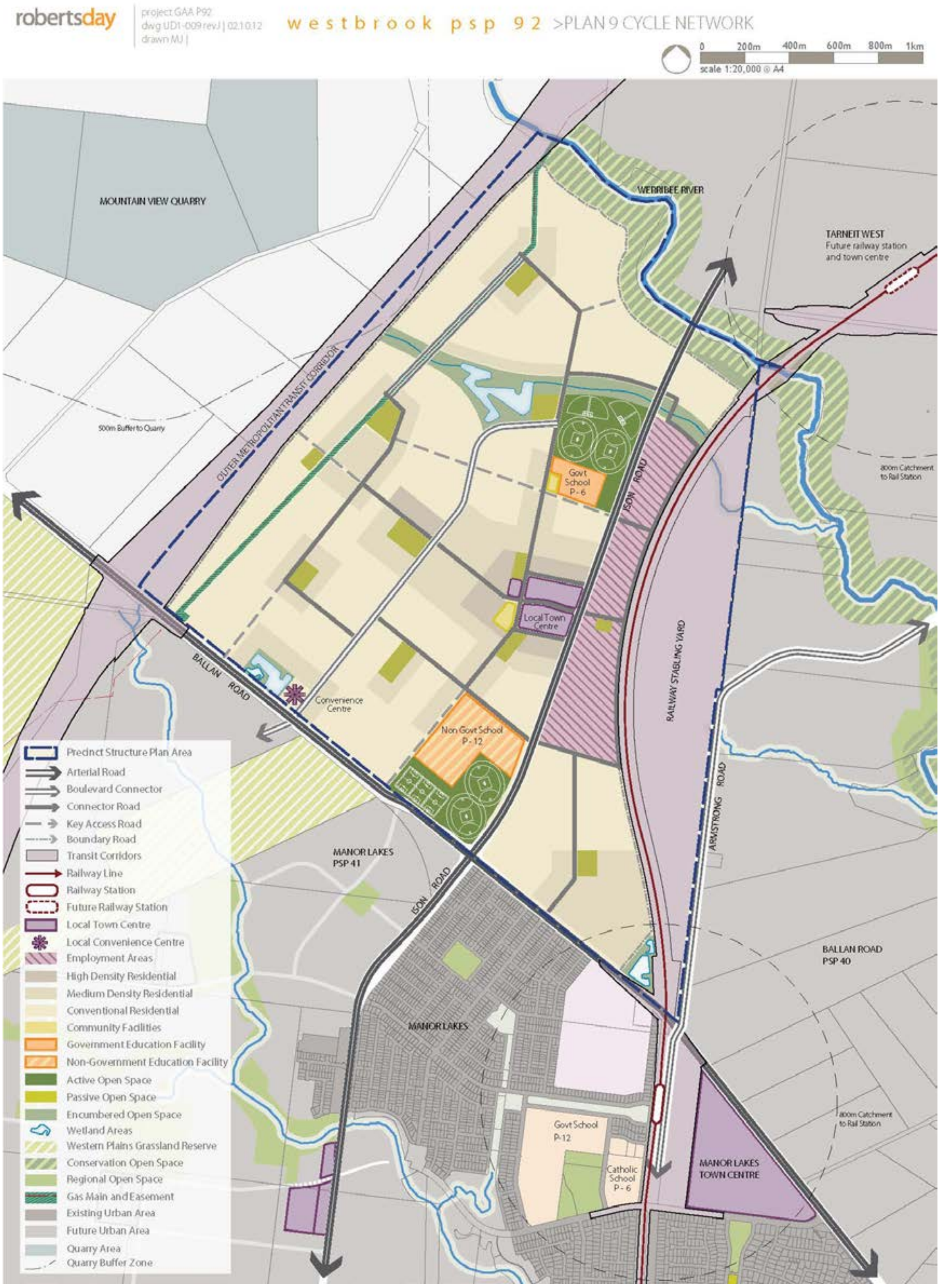

Figure 1 Westbrook PSP 92

2. MELBOURNE WATER DRAINAGE PLANNING FOR PSP 92

Melbourne Water (MW) is the authority responsible for major drainage planning in the area. Discussions have been held with MW officers to confirm requirements. Figure 2 has been supplied by MW to summarise current drainage scheme planning and agreed RRL crossings.

MW officers have advised that the RRL bridges and culverts are currently being constructed and hence these structures will form the ultimate outlets for easterly drainage outlets from PSP 92. Referring to Figure 2 and moving northwards the RRL outlets which affect PSP 92 are those numbered K140 at Ballan Road, K130, K120, K110 (passing through the proposed railway stabling yards) and K100. The latter is a bridge crossing whilst the others are pipes and culverts.

Figure 3 shows the catchment areas which have been assumed by MW to drain to each of the RRL crossings.

K140 has been designed as a syphon underpass of the RRL which is cut under Ballan Road. An interim sediment basin/retarding basin is currently being built to protect the syphon from rural catchment drainage. Additional sediment storage will be required to suit proposed development.

In regard to current Drainage Scheme (DS) planning for the various catchments MW officers have tentatively advised that requirements will be as set out in Table 1.

Thus no further investigation is needed for those parts of the PSP 92 area draining across the RRL in the Strathaird Park DS, nor for any development areas which may have to be drained direct to the Werribee River.

This report therefore focusses on requirements for the Werribee River Lower DS catchment (RRL K100), the Werribee West DS catchment (RRL K140), and the two Ballan Road catchments (the Pedder Street Drain DS and the Quandong Park DS).

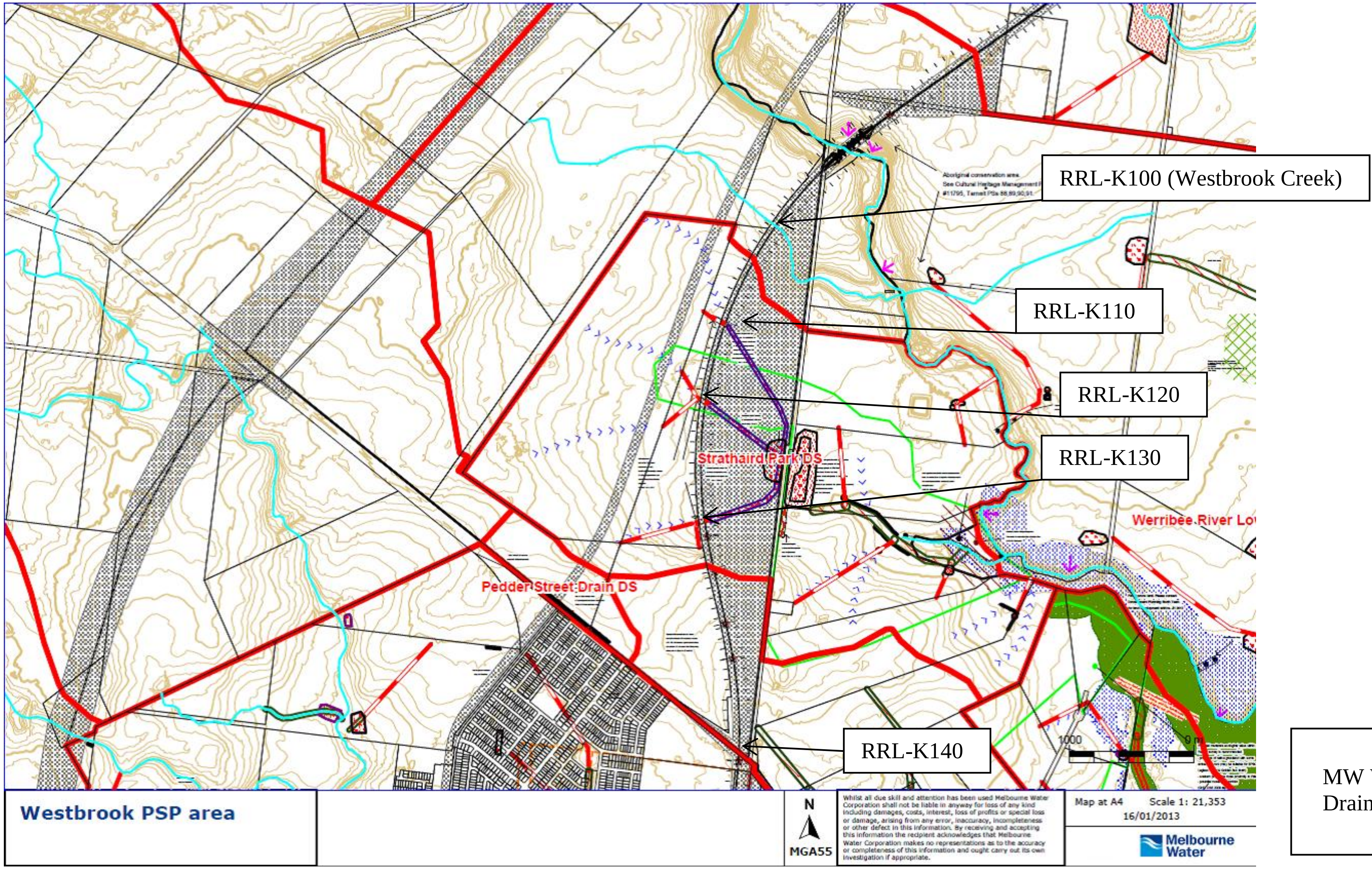

Figure 2
MW Westbrook PSP area Drainage Catchments and proposed assets

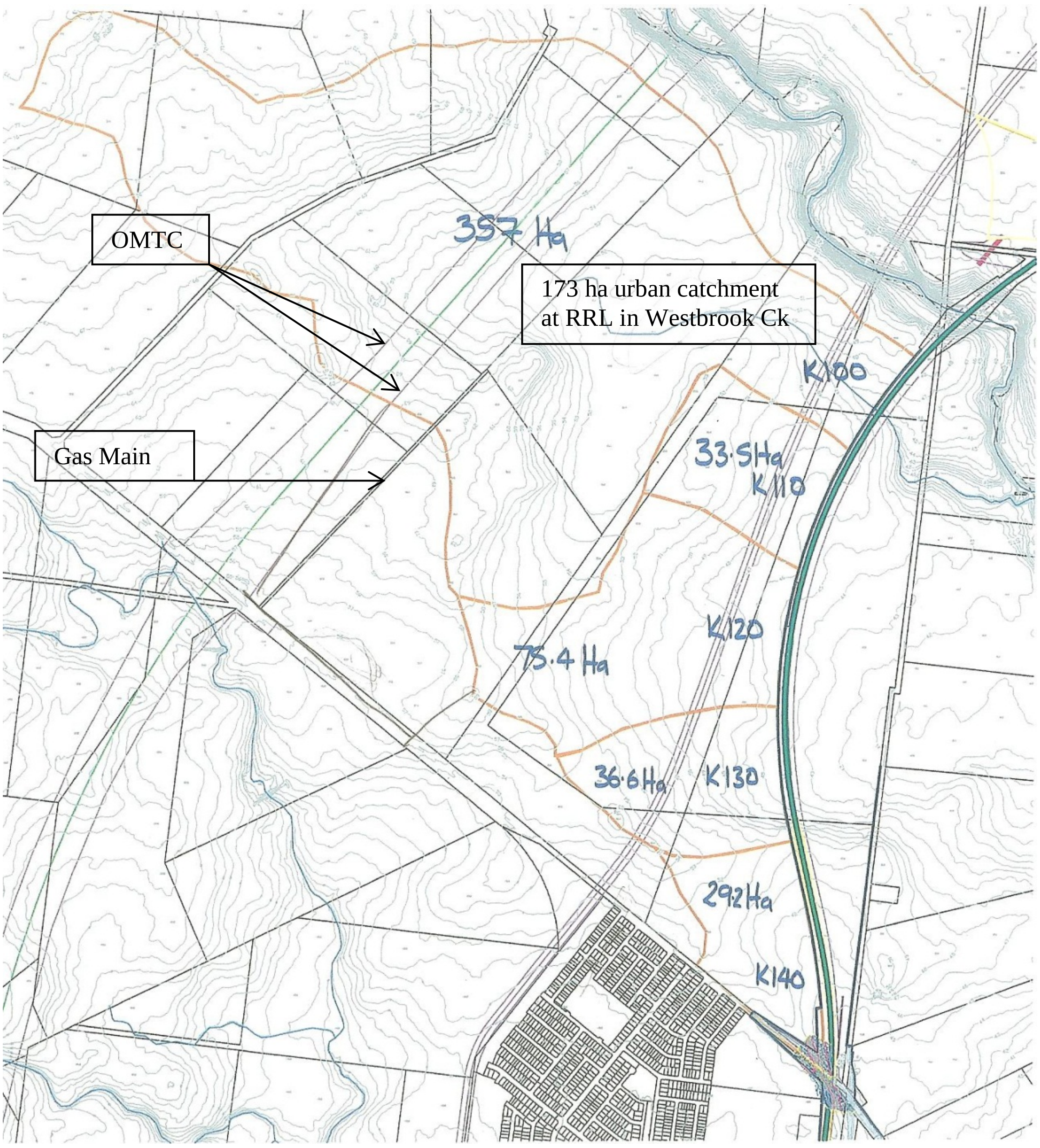

Figure 3
Catchments areas adopted by MW
for RRL crossings design

TABLE 1 MW Drainage Planning Requirements for PSP 92 Catchments

MW DS	Catchment	Catchment Area (ha)			Flow Retardation Requirement				Water Quality Treatment Requirement		
		Within PSP 92	Upstream of PSP 92	Total	None required (DS contributions only)	Maintain rural flows for ecological protection (<=2 years ARI)	Maintain rural flows for <=100 years ARI	Other	None required (DS contributions only)	Best Practice Standards	Other
Werribee West Drain DS 7716	RRL K140	29.2	-	29.2				RB capacity to suit RRL syphon for 100 yr ARI			70% TSS removal at least in RB-higher treatment if possible.
Strathaird Park DS 8017	RRL K130	36.6	-	36.6	✔				✔		
	RRL K120	75.4	-	75.4	✔				✔		
	RRL K110	33.5	-	33.5	✔				✔		
	Railway Stabling Yards		-					Construct all drainage lines		✔	
Pedder St Drain DS 7726	Ballan Rd		-	32.0	✔					✔	
Quandong Park DS 7730	Ballan Rd			70.0			✔			✔	
Werribee River Lower DS 8001	RRL K100	173	184	357		✔				✔	
	Werribee River frontages	TBA	-	TBA		✔				✔	

3. WERRIBEE RIVER LOWER DS

3.1 Existing Flooding Constraints and Opportunities

The OMTC defines the extent of developable land in this catchment. The OMTC and the land to the west are assumed to remain in rural conditions for the purposes of design of the drainage works downstream. Total developable land to the RRL is 173 ha with the balance rural land area, including the OMTC, of 184 ha.

Within the Bozzo land the dominant drainage control is the former ephemeral wetland which covers most of the land below about 51.5 m AHD (approximately 15 ha) and has a direct catchment of some 139 ha within PSP 92. An artificial drain was built through the wetland at its northerly end many years ago to improve drainage capacity to the very flat land but it is still subject to inundation in wet seasons. The open drain merges into the natural waterway which crosses Hobbs Road and outfalls to the Werribee River.

> *Note: For the purposes of this report the waterway crossing the RRL at K100 is referred to as Westbrook Creek.*

Remnant flora and fauna values in and around the ephemeral wetland are now low due to the artificial drainage works. Given its natural morphology the former wetland presents an ideal opportunity to be modified as a stormwater treatment wetland.

3.2 Wetland Sizing

The PSP plan shown on Figure 1 indicates the 139 ha urban catchment will be predominantly conventional residential in nature for which average impervious is assumed to be 60%.

Given that control of major flood discharges is not specifically required by MW for this catchment, the size of the wetland can be determined using best practice water quality treatment objectives, with the airspace overhead then being utilised for flow mitigation, to best possible practical extent for ecological protection.

The wetland outlet will be formed as an integral component of the culverts at the local road crossing west of Ison Road on Figure 1. The balance land downstream of this crossing on the south side of the waterway will largely be active open space to Ison Road and then industrial to the RRL. Along the north side of the waterway, residential development is proposed.

To minimise number of assets to be maintained it is considered that the wetland should be sized to achieve best practice outcomes for the whole catchment including the 35 ha of land downstream, subject to the latter achieving not less than 70% TSS removal at outlets, so as to protect the waterway (and the River downstream) from sediment discharge.

With extended detention depth set at 300 mm and Melbourne Airport 1996 6 minute rainfall data, trial and error runs with MUSIC showed that best practice water quality treatment will be achieved with a wetland water surface area of not less than 2.5 ha (including 0.3 ha inlet pond/s) plus downstream sediment basin water surface area of 0.15 ha.

To avoid the need for two separate sediment basins on either side of the creek it is suggested that the better option would be to form the basin online to the waterway at the entry to the culverts. To ensure compliance with velocity restrictions the water surface area is increased to 2,500 m^2.

Based on the available topographic data the Normal Top Water Level (NTWL) for the wetland will be about 50.0 m AHD. Final levels will be subject to geotechnical testing and detail design of inlet drainage systems and the ultimate waterway form downstream.

3.3 Hydrologic Modelling

The RORB model subarea structure is shown on Figure 4. The hydrologic storage and rainfall model parameters were derived using relations adopted by Melbourne Water for the northern and western suburbs as follows.

$K_c = 1.19\ A^{0.56} = 2.40$, m=0.8,
Initial Loss =15 mm, Pervious Area Runoff Coefficient (CRO) values:
$CRO_{100} = 0.6$, $CRO_{50} = 0.55$, $CRO_{20} = 0.5$, $CRO_{10} = 0.4$, $CRO_{5} = 0.30$, $CRO_{2} = 0.25$, $CRO_{1} = 0.20$

The model predictions are compared with Rational Method as per Australian Rainfall and Runoff (Adams Equation) results in the table below. It is considered the model parameters are adequate.

TABLE 1 Peak Flow Estimates in m3/s (Duration in hours)			
Method	**1 yr ARI**	**10 yr ARI**	**100 yr ARI**
Rational Method	1.4	4.9	9.9
RORB	0.8 (36)	3.9 (9)	10.6 (9)

Table 2 summarises results at key locations for 1 and 100 year ARI existing conditions and developed conditions-assuming no retardation storage. Major increases in peak discharges will occur with development in the absence of flow mitigation.

It may be noted that the 100 year ARI developed conditions flow at the RRL of 18.4 m^3/s is well short of the bridge capacity to be provided under the RRL by future excavation (30 m^3/s).

TABLE 2 Peak Flow Estimates in m3/s (Duration in hours) No Retardation Storage				
Location	**1 yr ARI**		**100 yr ARI**	
	Exist	**Developed**	**Exist**	**Developed**
Gas Main Crossing	0.5 (12)	1.1 (1.5)	7.6 (2)	8.4 (9)
WLRB outlet	0.7 (30)	2.4 (1)	10.3 (9)	18.8 (1.5)
RRL	0.8 (36)	2.5 (9)	10.6 (9)	18.4 (1)

The proposed wetland water surface area of 2.5 ha in total provides significant opportunity for multi-purpose use of the airspace overhead for flow mitigation. To assess how significant this might be a stage-storage relation was derived assuming NTWL of 50.0 m, top of extended detention depth of 50.35 m, and upper limit flood level of 52.00 m. The RORB model was then run in trial and error mode to assess the most suitable arrangement of culverts under the proposed road crossing. It was found that 4 no. 1200 mm diameter pipes would suffice.

The results which are summarised in Table 3 show that there is sufficient capacity to very closely match future peak discharges to the waterway downstream to those for existing conditions.

Hence there is ample scope to refine the storage-discharge controls for the WLRB to best suit downstream ecological protection requirements and surrounding development levels, as well as presenting an opportunity for the ultimate excavation works proposed under the RRL bridge to be scaled back.

TABLE 3 RORB Model Results Developed Conditions with Westbrook WLRB								
ARI (years)	**Gas Main**		**WLRB**				**At RRL**	
	Peak Flow (m3/s)	**Critical Duration (hrs)**	**Peak Flood Level (m)**	**Peak Storage Volume (m3)**	**Peak Discharge (m3/s)**	**Critical Duration (hrs)**	**Peak Flow (m3/s)**	**Critical Duration (hrs)**
1	1.1	25 m	50.47	11,900	1.2	12	1.4	36
10	3.5	9	50.99	27,100	3.9	9	4.3	9
100	8.4	9	51.66	51,400	10.0	9	10.8	9

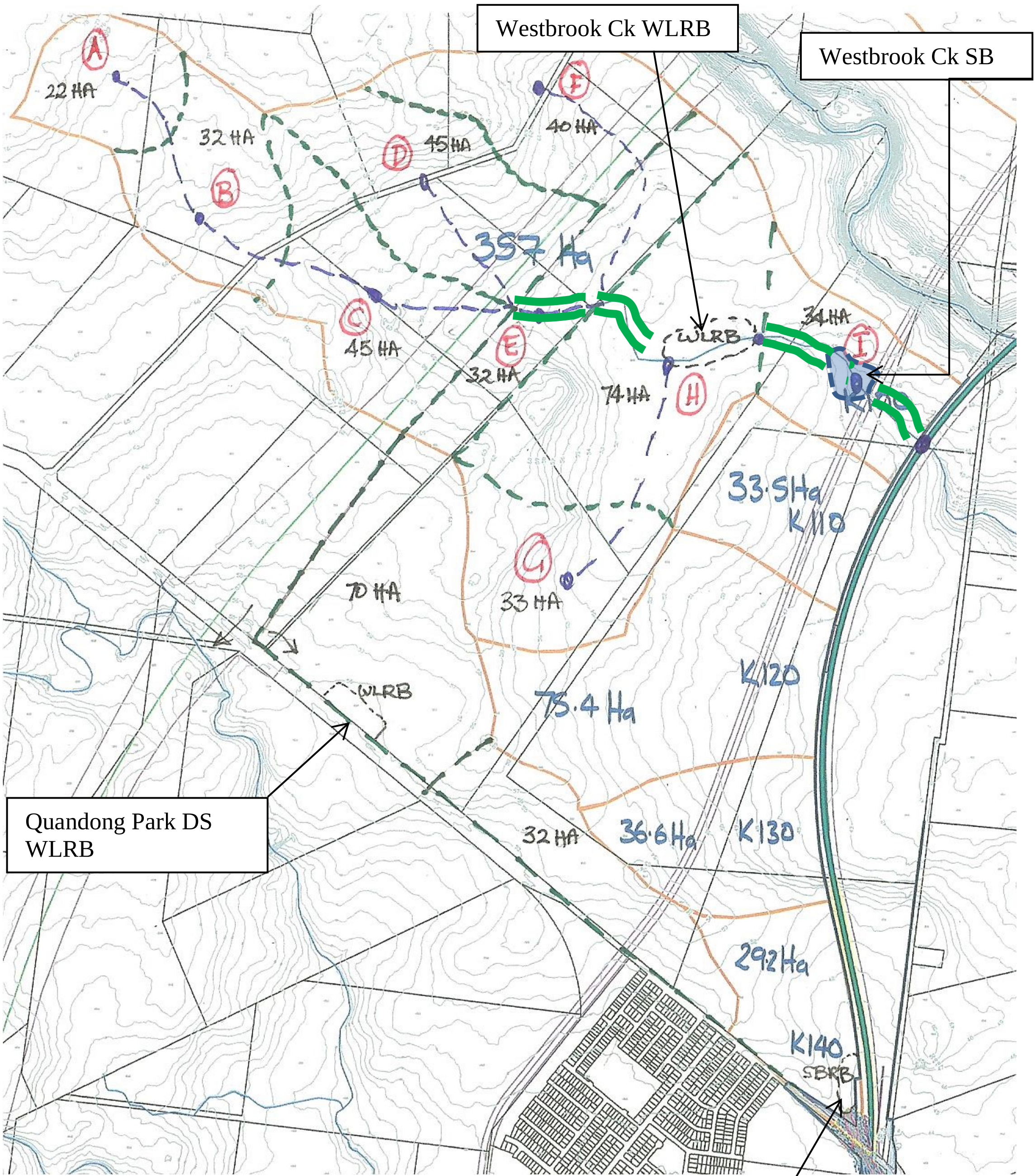

Figure 4 **Westbrook Creek RORB Model Structure and PSP Surface Water Management Assets and Waterway Reserves**

Werribee West Drain DS (K140) WLRB

3.4 Stormwater Quality Treatment

Best practice urban stormwater quality treatment standards must be achieved as a minimum to protect Werribee River and Port Phillip Bay. These are currently 80% removal of the typical urban load for Total Suspended Solids (TSS), 45% removal for Total Phosphorus and Total Nitrogen (TP and TN) and 70% for gross pollutants.

The MUSIC model results for Westbrook Creek are listed in Table 4 using MW's 1996 reference year 6 minute data sequence for Melbourne Airport. The best practice load removal requirements are met by the wetland and sedimentation basin combined.

TABLE 4 MUSIC Model Results (Westbrook PSP 92 MA 1996 6 min)

Asset/Parameter	Input Loads	Residual Loads	Load removal in asset
Westbrook Creek WLRB			
Flow (ML/yr)	606	579	27
Suspended Solids (Kg/yr)	107,000	34,100	72,900
Total Phosphorus (Kg/yr)	224	95	129
Total Nitrogen (Kg/yr)	1,690	1,010	680
Gross Pollutants (kg/yr)	18,200	0	18,200
Westbrook Creek SB			
Flow (ML/yr)	671	669	2
Suspended Solids (Kg/yr)	52,300	34,000	18,300
Total Phosphorus (Kg/yr)	132	121	11
Total Nitrogen (Kg/yr)	1,280	1,270	10
Gross Pollutants (kg/yr)	3,670	0	3,670
Urban Development loads		**Best Practice Removal Requirement**	
Flow (ML/yr)	533	-	
Suspended Solids (Kg/yr)	102,000	81,600	
Total Phosphorus (Kg/yr)	210	95	
Total Nitrogen (Kg/yr)	1,540	693	
Gross Pollutants (kg/yr)	21,200	14,840	
Total catchment Loads			
Flow (ML/yr)	697	669	28
Suspended Solids (Kg/yr)	125,000	34,000	91,000
Total Phosphorus (Kg/yr)	260	121	139
Total Nitrogen (Kg/yr)	1,960	1,270	690
Gross Pollutants (kg/yr)	21,900	0	21,900

3.5 Land Take

Asset/ Waterway	Reach	Water Surface Area (ha)	Hydraulic Width (m)	Reserve Length (m)	Reserve Width (m)	Reserve Area (ha)
Westbrook Creek	OMTC to Gas Main	-	25	340	45	1.5
	Gas Main to WLRB	-	25	300	45	1.4
	WLRB to SB	-	25	400	45	2.0
WLRB		2.50	-	-	-	5.5
SB		0.25	-	125	65	0.8
Total at K100						11.2

4. WERRIBEE WEST DRAIN DS 7716

4.1 Existing Flooding Constraints and Opportunities

The RRL syphon crossing defines the limiting capacity for discharge from this 29.2 ha catchment.

A hydraulic gradeline analysis was completed from the design plans to compile a stage-discharge relation for the syphon. It was found that maximum capacity at the nominal 100 year ARI level of 45.20 m (0.6 m below confining bank level) was 0.7 m^3/s.

The RORB model was then used in trial and error fashion to determine the required volume of flood storage to maintain outflows to this figure or less. It was found that water surface area of 0.65 ha was needed at NTWL 43.80 m to create the required volume in the smallest land take footprint.

Coincidentally this water surface area matches wetland area needed to comply with best practice objectives. Hence by constructing a wetland of this size the syphon discharge controls are achieved and the developed catchment area of 29.2 ha would not attract any contributions to the DS for either water quality or quantity management.

4.2 Hydrologic Modelling

A single subarea structure was used to assess storage requirements. The hydrologic storage and rainfall model parameters were derived using relations adopted by Melbourne Water for the northern and western suburbs as follows.

K_c= 1.19 $A^{0.56}$ = 0.60, m=0.8,
Initial Loss =15 mm, Pervious Area Runoff Coefficient (CRO) values:
CRO_{100} = 0.6, CRO_{50} = 0.55, CRO_{20} = 0.5, CRO_{10} = 0.4, CRO_5 = 0.30, CRO_2 = 0.25, CRO_1 = 0.20

The water surface area of 0.65 ha comprised 0.15 ha inlet pond and 0.5 ha macrophyte zone. NTWL was set at 43.80 m to match the RRL design, and top of extended detention depth was set at 44.1 m.

The results which are summarised in Table 5 show that the design constraints posed by the syphon are met in the 100 year ARI event.

TABLE 5 RORB Model Results
Developed Conditions with Werribee West Drain WLRB

ARI (years)	WLRB			
	Peak Flood Level (m)	Peak Storage Volume (m3)	Peak Discharge (m3/s)	Critical Duration (hrs)
100	45.00	10,100	0.6	9

4.3 Stormwater Quality Treatment

The MUSIC model results are listed in Table 6 using MW's 1996 reference year 6 minute data sequence for Melbourne Airport. The best practice load removal requirements are met by the 0.65 ha wetland.

TABLE 6 MUSIC Model Results
(Werribee West Drain DS WLRB)

Asset/Parameter	Input Loads	Residual Loads	% Load removal in asset
Flow (ML/yr)	90	84	7
Suspended Solids (Kg/yr)	18,000	3,370	81
Total Phosphorus (Kg/yr)	37	11	69
Total Nitrogen (Kg/yr)	256	134	48
Gross Pollutants (kg/yr)	3,590	0	100

4.4 Land Take

Asset/ Waterway	Reach	Water Surface Area (ha)	Hydraulic Width (m)	Reserve Length (m)	Reserve Width (m)	Reserve Area (ha)
Werribee West Drain DS WLRB		0.65	-	-	-	1.4

5. QUANDONG PARK DS 7730

5.1 WLRB Sizing

Table 1 defines the requirements for this 70 ha catchment. Peak flows are to be maintained at existing conditions values for all events up to and including 100 years ARI and best practice water quality treatment is to be achieved.

The most land-efficient means of achieving these two objectives are via a WLRB on the Ballan Road frontage as shown on the PSP (Figure 1). Inlet flows will be piped to the WLRB with overland flows conveyed in roads.

Based on the results in the other catchments a wetland water surface area sized to achieve best practice water quality treatment will create sufficient active flood storage volume in the overhead airspace to also achieve the flow mitigation objective. Hence sizing is quickly determined using the MUSIC model.

Adopting extended detention depth of 300 mm, an inlet pond volume of 2,500 m^3 and macrophyte area of 1.1 ha, the MUSIC model results listed in Table 7 show that best practice load removal requirements are met.

TABLE 7 MUSIC Model Results
(Quandong Park DS WLRB)

Asset/Parameter	Input Loads	Residual Loads	% Load removal in asset
Flow (ML/yr)	216	203	6
Suspended Solids (Kg/yr)	40,100	8,020	80
Total Phosphorus (Kg/yr)	82	27	67
Total Nitrogen (Kg/yr)	627	343	45
Gross Pollutants (kg/yr)	8,590	0	100

The wetland will have a nominal NTWL of 53.5 m which is 1.5 m lower than the overtopping level of Ballan Road based on 1 m basemap contours. All levels, including the pipeline outlet across Ballan Road will be confirmed as part of a future functional design.

5.2 Land Take

Asset/ Waterway	Reach	Water Surface Area (ha)	Hydraulic Width (m)	Reserve Length (m)	Reserve Width (m)	Reserve Area (ha)
Quandong Park DS WLRB	-	1.35	-	-	-	3.0

6. PEDDER STREET DRAIN DS

Table 1 defines the requirements for this 32 ha catchment. Peak flows are not required to be controlled but best practice water quality treatment is to be achieved.

Given the small catchment size the treatment assets used will require the approval of Wyndham City Council (WCC) as the ongoing manager. From past experience WCC are more likely to favour wetland assets than bioretention systems, especially if the latter are proposed throughout the road networks.

However at this time all options must remain open. The primary options are assessed in terms of land take below.

The WLRB option

If WCC direct that a wetland be used on the Ballan Road frontage then this will affect land take in the PSP.

The results from other catchments show that a wetland sized for best practice will also provide airspace storage sufficient to maintain flows at existing conditions values.

The MUSIC model shows that a water surface area of 0.65 ha in a reserve of 1.4 ha will be required.

The Sediment Basin/Bioretention Option

An alternative approach which can reduce land take would be to provide a sedimentation basin of sufficient size to ensure reasonable protection of a downstream bioretention filter.

The MUSIC model shows that a 1,500 m^2 water surface area sediment basin will remove >=70% TSS and a 400 m^2 filter area will then achieve best practice. Filter depth is 0.6 m with mean particle size of 0.45 mm and hydraulic conductivity of 180 mm/hr.

Land take for this treatment option reduces to about 0.7 ha but required outfall invert depth increases by nearly 1 m compared with the WLRB option.

The Streetscape Bioretention Option

Providing distributed bioretention systems throughout the street and POS network will essentially eliminate additional land take but at the expense of increased complexity and cost of maintenance.

Neil M Craigie
BEng(Civil), MEngSci, MIEAust, CPEng