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Consulting Engineers & Surveyors

MORWELL NORTH-WEST DCP DRAINAGE - WR04

DRAINAGE REVIEW

26 July 2017

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APPENDICES

DOCUMENT ISSUE

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EXECUTIVE SUMMARY

The work in this report provides definition to the concept contained within the Morwell North-West Development Contributions Plan ("DCP") for the northern internal catchment and proposed combined retarding basin/wetland system (WR04).

This will allow the Latrobe City Council to –

1. Have an independent assessment of hydraulic flows for the area of the DCP
2. Be able to identify 1 in 100 year flood levels required in the reserve to cater for required storage volume.
3. Be able to show and define the connected elements of the WR04 basin –
    a. Inlet Structure
    b. Main Storage – weir, batters, floors
    c. Main wetlands within the Main Storage (WR-04)
    d. Outlet Structure
    e. Sedimentation basin and designated drying area for maintenance purposes.
4. Have updated information about sizing of Wetland/Retarding basin WR-04
5. Have technical information for the WR04 basin that shows –
    a. Storage levels including Normal Water level and Freeboard.
    b. Sedimentation Basin sizing
    c. Wetland Sizing
    d. Sediment Drying area requirements
    e. Functional information for later detailed design and construction
6. For roads –
    a. Enable road levels to be determined around the Basin Storage
    b. Enable decisions to be made on the use of minor retaining walls around the edges of the Basin Storage at road reserve interfaces
7. Enable strategy to be put in place for dealing with developers as to –
    a. How detailed design is to be undertaken in a coordinated way
    b. How construction is to be undertaken in a coordinated way
8. Improve the basis for costing of DCP items and Council works

The main points arising from the drainage review for design are –

1. The Functional Design has defined the required extent and levels for the extent of the main retarding basin storage within this catchment.
2. The extent of required basin storage is larger than the available space as provided on the development plan layout. This requires adjustment to the development plan layout.
3. Definition of levels has been achieved for the 1 in 100 year rainfall event passing through this catchment, enabling Council to control the level requirements for future development adjacent to the WR04 basin/wetland.
4. The volume of the Basin Storage that is required is 6,310m^3 for a 1 in 100 year storm. This Main Storage maintains pre-development flows by retarding (storing) outflows during the peak runoff period, thereby mitigating potential flooding.
5. The WR04 basin and WSUD assets takes up all of the available space set aside as reserve area (0.9232ha) in the DCP and requires additional land take from 2 northern parcels of land. The developable area encroached by the additional basin area totals 0.3427ha in area.
6. The main wetland has to be within the Main Storage and will be inundated by high flows.
7. Development flows will be captured as part of a traditional pit and pipe network within the road reserve and conveyed to the WR04 basin.
8. Preliminary treatment is proposed in the form of a Sedimentation Basin. The surface area that is required is 1,050m.
9. A weir and outfall pipe (675mm dia) has to be located in the embankment at the north end of the Basin Storage.
10. DCP Pits and Pipes have been allowed for between the Basin Outlet and Jason St. Pipes will follow the proposed road network.
11. Apart from the weir, inlet & outlet structures and pipe outfall, no other additional drainage infrastructure has been allowed for as compared to the DCP.

To enable this review to take place, PGA undertook field survey and civil engineering design, collaborating with Water Technology for hydrologic modelling of the waterway as it currently exists.

Arising from the water quality modelling, changes from the CPG calculated areas to the Water Technology calculated areas are shown in Table 1.

Table 1

ELEMENT	STORAGE		WATER QUALITY (treatment area)	
	W-T	CPG	W-T	CPG
WR-04	6,310m^3	5,400m^3	Wetland - 5,200m^2 Sed. Basin – 1,050m^2	3,200m^2

Other points arising from this work are –

1. There is a consequent change to the Net Developable Area.
2. The estimated costs of the construction differ from those presented in the DCP.
3. There is a need to identify strategy towards construction of the drainage works –
    a. For coordination and logistics; and
    b. Because the works are located on private land.

REPORT ON FINDINGS

1. INTRODUCTION

The Morwell North West Development Contributions Plan ("DCP") covers an area between Latrobe Road and Maryvale Road as shown in ***Appendix 1***. This includes a main drainage corridor which was part of a previous drainage study completed by PGA and Water Technology in 2016.

The focus of this design project is for the northern internal catchment and proposed combined retarding basin/wetland system (WR04) including the extent of drainage infrastructure that is required to manage drainage flows for a 1 in 100 year rainfall event. This will enable Council to control required levels of roads and lots within the catchment.

Following a route survey of the proposed reserve set aside for basin WR04 for modelling purposes, initial concepts were able to be modelled and then finalised into the attached Functional Plans. In this work, PGA collaborated with Water Technology who carried out the specialised hydrologic modelling (refer to separate Water Technology report).

Section 2 provides comment on particular aspects of the Functional Layout Plans.

Section 3 identifies changes that are consequential for calculation of the Net Developable Area on which distribution of costs is based.

Section 4 identifies the costs of the drainage infrastructure identified in this report for updating of the DCP cost schedule.

2. FUNCTIONAL DESIGN

2.1. General

In the set of Functional Layout Plans –

- Plan views identify the spatial extent of the required retarding basin works; and notes on those works. In this respect separate linework is shown for –
  - The outline base features of channels and retarding basin on top of existing features and contours.
  - The extent of the water surface for the 1 in 100 year event.
  - The extent of the freeboard at 0.3m above the 1 in 100 year water surface.
  - The extent of temporary cut or fill batters to match the existing land surfaces from the freeboard line.
  - The proposed road reserves boundaries contained in the DCP.
- Cross-sections at various points are a vertical representation of Storage & Sedimentation basins, wetland and similarly identify –
  - Floors for the storage basin, sedimentation basin and drying area and future wetland;
  - Flood level for the 1 in 100 year event;
  - Level of freeboard 0.3m above the level of the 1 in 100 year event.
  - Existing land surface levels.
  - Permanent batters at the edges of channels and the retarding basin at 1 in 5 up to the freeboard line. This slope is suitable for mowing purposes.
  - How temporary batters extend upwards at 1 in 5 from the freeboard line. These batters are to be adjusted later for road and verge design.

Council will reference the levels for the water surface at the 1 in 100 year rainfall event for development control purposes.

2.2. Catchment Analysis

The initial strategy for the northern internal catchment proposed that the entire study area was to drain towards the proposed WR04 retarding basin. A review of the site area survey suggests that due to a ridge line within the overall catchment the area to the north known as the Upper Catchment would require significant filling in order to grade drainage infrastructure and road network back to the WR04 retarding basin.

Refer ***Appendix 2*** for plan showing catchment contributing to study site WR04 and the Upper catchment which will drain to the north. For purpose of this study into WR04 the upper catchment has been detached, high level modelling has been undertaken by Water Technology for the upper catchment. An approximate attenuation flood storage volume has been outlined in the drainage report to assist council with the future DCP for this area.

2.3. WR04 Retarding Basin

The original concept proposed to set aside different areas within the study area for stormwater treatment and attenuation. Discussions with Latrobe City Council determined that this was not preferred as the DCP had a single drainage reserve set aside.

Refer ***Appendix 3*** for functional control plans to be read in conjunction with the following section of the report.

The outcomes from the flood modelling recommend an attenuation flood storage volume of 6,310 cubic metres. Comments on this section are –

- The area required for retarding basin storage exceeds the available space provided on the development layout plan.
- Land constraints on the south side of the drainage reserve parcel mean that the additional area required is to be taken from developable land parcels on the northern side.
- The retarding basin dimensions are - basin floor area of 8506m^2, a basin depth of 0.7m will provide the required storage volume with 300mm freeboard provided above the normal water level.
- Side batters are 1 in 6 up to the proposed 100 year flood level. Batters have been shown on the plans to extend up in a temporary batter of 1 in 5 to match the existing ground surface. Final levels and shape will occur following detailed design of surrounding roads at a future time by others.
- The 100 year flood level is contained within the proposed drainage reserve, acceptable freeboard will need to be provided within the road reserve & to the future allotments.
- Latrobe City Council requires a 2.5m setback from the road reserve to the retarding basin which has been incorporated.

The WR04 retarding basin at its downstream end will have –

- An embankment through which a low flow pipe outlet is required, comprising a 675mm diameter reinforced concrete pipes and accompanying endwall structures.
- A concrete weir (20m width) above the embankment to allow for any flows higher than the 1 in 100 year rainfall event to pass over the embankment. Detailed design must include scour protection.

The outcomes from the water quality analysis recommend preliminary treatment are provided in the form of a sediment basin and tertiary treatment by a wetland system. Comments on this section are –

- The sediment basin is to be located directly downstream of the minor storm event inlet to the drainage reserve.
- An area of 960m^2 is required based on permanent pool depth of 1.1m and extended detention depth of 0.5m (overall depth of sedimentation basin is 1.6m)
- To achieve best practice treatment performance indicators a wetland surface area of 5,200m^2 is required for the study area catchment.
- The wetland may include siltation ponds and deeper ponds as well as shallow treatment areas.
- All of the sediment basin and wetland will be inundated by flood flows.
- An area of 2,000m^2 has been set aside in the drainage reserve for sediment drying during periodic clean outs.

2.4. Outfall

Pits and Pipes have been allowed for between the Basin Outlet and Jason St to outfall flows from the study site. Pipes will follow the proposed road network as indicated on the functional control plans.

3. CHANGE TO NET DEVELOPMENT AREA

Alteration is required to the value of Net Developable Area ("NDA") on which the DCP apportionment to owners is based. This is due to –

- The need to increase the drainage reserve area available for WR04 attenuation storage and treatment systems.

These adjustments are as follows –

- Drainage Reserve area set aside as per DCP base is 0.9232ha
- Drainage Reserve area required for WR04 retarding basin and water quality treatment systems is 1.2659ha
- Therefore the additional Drainage Reserve area required is 0.3427ha.
- The extended drainage reserve to the north encroaches on two properties. The area breakdown is:
    - 0.1730ha (Western property next to Jason St)
    - 0.1697ha (Eastern property)

4. ESTIMATED COSTS

Table 2 identifies the items for incorporation in the DCP spreadsheet as a result of the functional design. These are current estimates except for the main retarding basin WR-04 where the 2013 rates have been used for storage and treatment areas. The current adjusted 2016 rate for this item should be adopted.

TABLE 2

DR Drainage		Quantity	Unit	Rate	Cost
WR_04 East of Jason Street	Treatment area approx. 0.52ha	5200	sqm	$93	$483,600.00
	Retardation storage approx. 6600cbm	6600	cbm	$47	$310,200.00
Pipes (675mm dia. RCP)	Inlet & Outlet to WR04	297	lm	$625	$185,625.00
Pits (900x600mm)		7	No.	$2,000	$14,000.00
Headwalls (incl. Apron)	@ Inlets and Outlets	3	No.	$9,500	$28,500.00

5. CONCLUSIONS

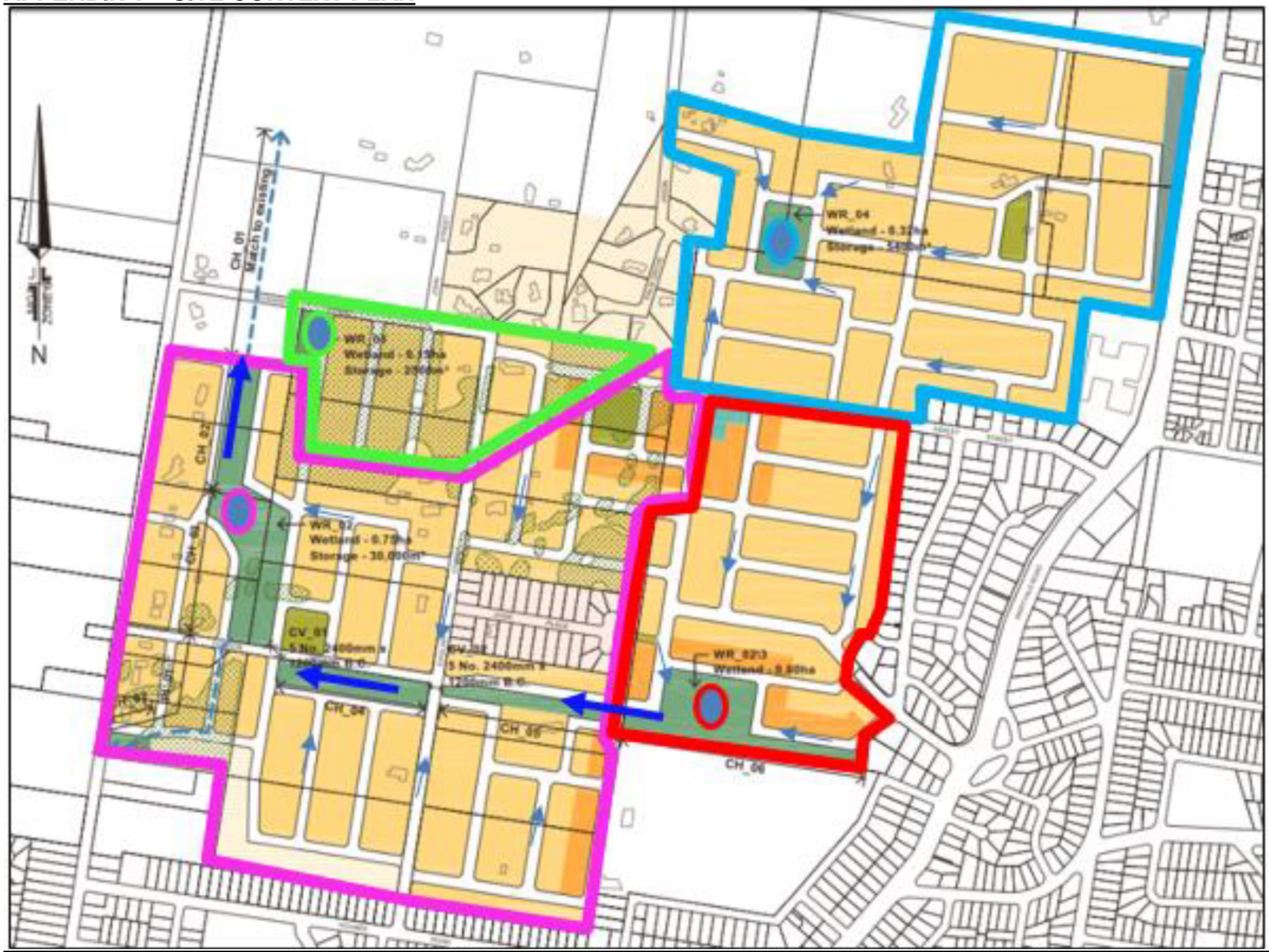
The Functional Plans developed by PGA in conjunction with modelling carried out by Water Technology provide the basis for Latrobe City Council to confidently assess and control development activities in a coordinated way within the northern internal catchment of the Morwell North Development Plan area.

The Drainage Strategy outlined in the drainage report prepared by Water Technology and the Functional Control Plans prepared by Paroissien Grant & Associates need to be maintained and coordinated through the detailed designs developed by others for individual developments or for final design of drainage facilities necessary for the DCP area.

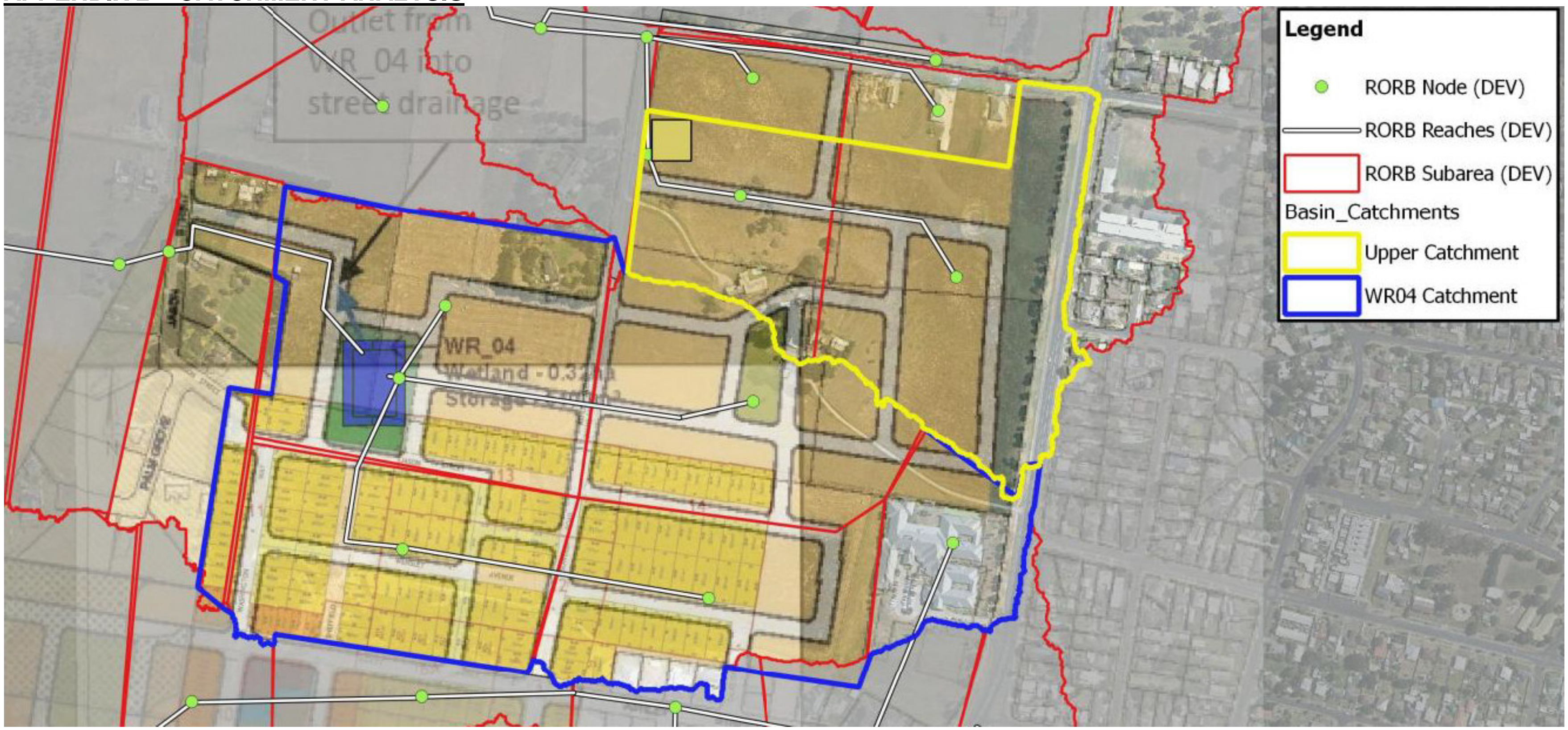
Changes to costs and Net Developable areas will need to be made to the DCP schedules as identified.

Jarrod Wilson
Civil Design Manager
Paroissien Grant and Associates Pty Ltd

APPENDIX 1 – SITE CONTEXT PLAN



APPENDIX 2 – CATCHMENT ANALYSIS



APPENDIX 3 – FUNCTIONAL DESIGN PLANS

Refer to the drawing set.

Report

Morwell North-West DCP Drainage- WR04

Paroissien Grant and Associates Pty Ltd

June 2017

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1 INTRODUCTION

Latrobe City Council is currently overseeing the development for a large Greenfield area north west of the Morwell CBD. Drainage within this area will be controlled via a formal DCP (Developer Contribution Plan). Water Technology has been commissioned to undertake a detailed drainage investigation of the region covered by the proposed DCP and to investigate flooding issues across the site, in consideration of the proposed development. The drainage investigation is intended to provide sufficient detail to demonstrate the feasibility of the proposed Water Sensitive Urban Design (WSUD) and stormwater management for the study area.

This report follows on from, and builds upon a previous study “Morwell North-West DCP Drainage Report - 3926-01_R03v02” completed by Water Technology in 2016.

1.1 Site Location

The study area consists of approximately 134 Ha of irregularly shaped land west of Maryvale Road, south of Old Melbourne Road and east of Latrobe Road (Figure 1-1) Generally, the land drains from east to the west with the entire study area draining to a single outlet (designated waterway) found at the northern end of Latrobe Road. This waterway drains west via the Morwell River diversion system through the Yallourn mine before discharging into the Latrobe River. Further detail on catchment characteristics can be found in the previous study report.

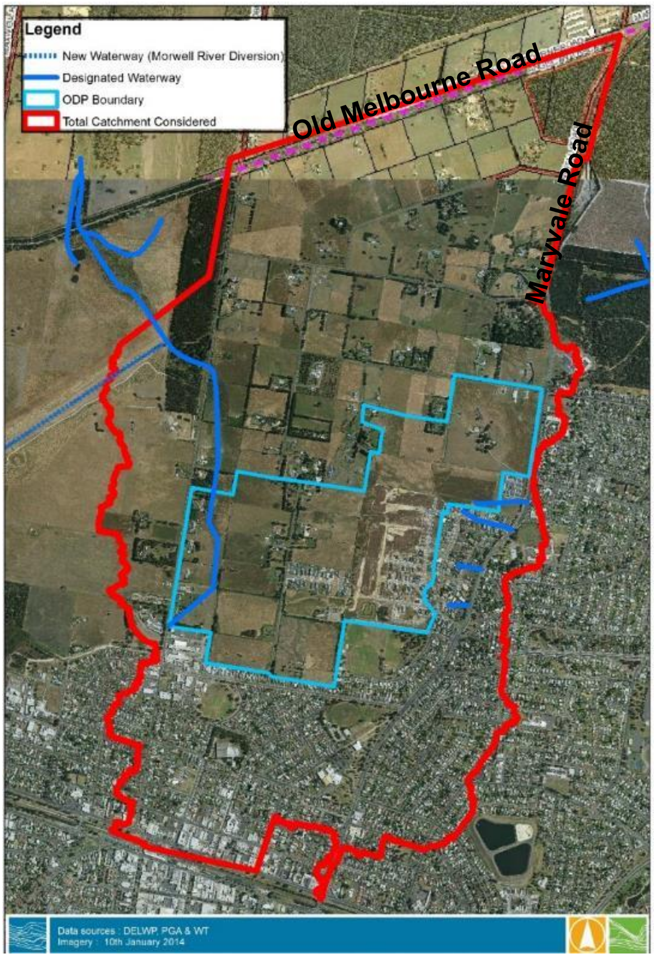

FIGURE 1-1 OVERALL STUDY AREA

2 SUMMARY OF PAST WORK

The focus of this investigation is the northern internal catchment within the previous DCP study area (blue polygon in Figure 2-1). Nomenclature from the original drainage strategy by CPG was carried into the drainage work by Water Technology in 2016. In the area of interest of this study, a combined retarding basin / wetland system (WR04) was proposed to manage the pressures from development. The retarding basin was sized used hydrologic modelling (RORB) and the wetland was sized using water quality modelling software (MUSIC).

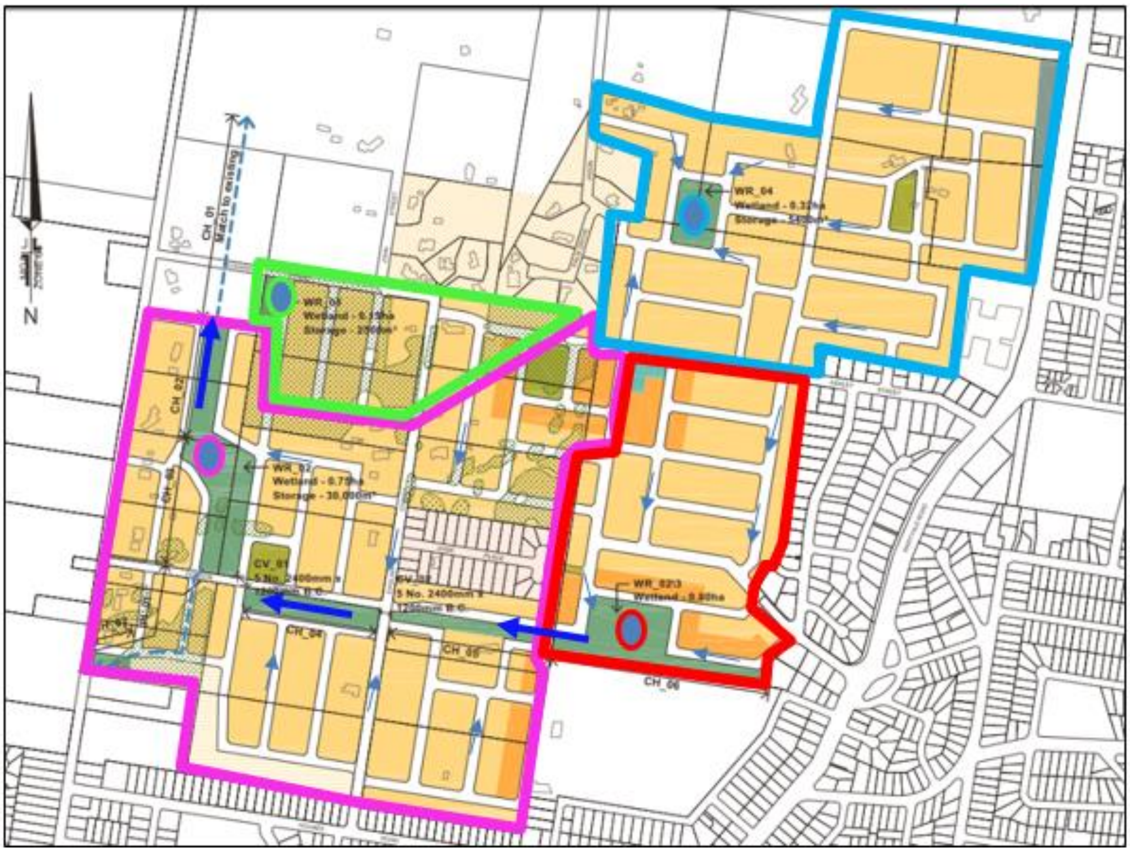

FIGURE 2-1 INTERNAL CATCHMENT BREAK UP

2.1 Basin Sizing

RORB hydrologic modelling was used to size a retarding basin to meet statutory peak flow reduction requirements. Key design features determined in this process are shown in Table 2-1 and Table 2-2. Critically, this strategy assumed all the land within the Blue polygon in Figure 2-1 would be routed through the WR04 basin. This arrangement led to a larger storage requirement that previous drainage analysis by CPG.

TABLE 2-1 FLOOD STORAGE SIZING AND STORAGE PERFORMANCE IN THE 1% AEP EVENT

Basin name (CPG)	Flood Storage (m^3)	RORB Flow 1% AEP event (m^3/s)			Difference (m^3/s)
		Existing Conditions	Developed Conditions	Mitigated Conditions	
WR04	11,000	0.82	7.49	0.79	-0.03

TABLE 2-2 PROPOSED OUTLET ARRANGEMENTS

Basin name (CPG)	Basin Depth (m)	Outlet pipe Size (m) RCP	Number of pipes	Invert of pipe(s) (m AHD)	Weir width (m)	Weir Invert (m AHD)
WR04	1.5	0.375	1	78.5	40	79.98
		0.450	1	78.5		

2.2 Treatment

The previous study considered, at a high-level, options for treating stormwater within the WR04 catchment area. An end of the line system consisting of a sedimentation pond and wetland was proposed to treat stormwater runoff generated in the WR04 catchment. Again, the analysis assumed all the land within the Blue polygon in Figure 2-1 would be routed through the WR04 WSUD features.

Details of the designed sedimentation basin are shown in Table 2-3.

TABLE 2-3 WR04 SEDIMENTATION BASIN DETAILS

Details	Sedimentation Basin
Surface Area	1,300 m^2
Extended Detention Depth	0.5 m
Permanent Pool Depth	1.0 m
Permanent Pool Volume	650 m^3
Percentage of Suspended Solids Removal	95%
Contributing Urban Catchment Area	38.54 Ha
Clean Out Frequency	8.4 years

A wetland of 4,500 m^2 following the sediment pond was designed to treat the runoff generated within the new development to best practice levels.

TABLE 2-4 WR04 WETLAND DETAILS

Design Element	Details
Area	4,500 m^2
Extended detention depth	0.5 m
Permanent pool depth	Varies (Average depth = 0.5 m)
Permanent pool volume	2,250 m^3

3 SCOPE OF WORK

The following scope has been adopted in this study:

3.1 Data collection & collation

- Site visit by Water Technology staff member;
- Review of available information.

3.2 Hydrologic Analysis

- Brief review of the hydrology relevant to WR04 basin.

3.3 WSUD (Water Quality) Analysis

- Brief review of the existing MUSIC model to confirm the required water quality treatment.

3.4 Concept Design

- Integrate findings of hydrological analysis (attenuation and water quality) for WR04 basin into the site constraints of the OPD.

3.5 Hydraulic Analysis

- Review the previously constructed existing conditions hydraulic model (TUFLOW) confirming the conditions at the proposed site of WR04 and the receiving waters are accurately represented in the model;
- Development of a developed conditions hydraulic model (TUFLOW) to test PGA groups first pass functional design of WR04 basin and wetland;
- Provide feedback to PGA group about their first pass functional design recommending changes to optimise the hydraulic performance of the basin; and
- Final model run showing proof of concept of PGA groups functional design.

3.6 Concept design and hydraulic modelling memo

- Compilation of a brief project memo summarising work undertaken by Water Technology, key to this output will be a concise summary suitable for direct inclusion in any PGA reporting outputs; and,
- Post PGA's review of Water Technology's draft report, recommended amendments will be reviewed and incorporated into the final study memo.

4 SITE VISIT

Multiple site visits were undertaken to help the project team understand the existing drainage conditions within the study area. Emphasis was put into understanding the downstream conditions as this system did not discharge into a well-defined formal drainage line. Water Technology also sought informal advice on existing drainage concerns from council Engineering staff during the initial stages of the project. The following points were noted on the current arrangement of the drainage system:

- Upstream catchment overland flows currently tend to accumulate at the end of Jason Street;
- Open drains (swales) have been implemented at Palm Grove and Jason Street to convey stormwater (see Figure 4-1);
  - These features appeared well maintained, potentially with land owner input;
- Overland flows which flowed into Jason Street from catchments to the east tended to head west adjacent 29 and 30 Jason Street. Flowing through a Φ450mm RCP; and
- A significant amount of overland flow moves through private land (30 and 12 Jason Street as well as 85 John Street) before flowing north along John Street via swales on either side of the road (see Figure 4-2), to a local low point (around 30 and 25 Johns Street) at this point, overland flows combine with other catchments from the east and flow west towards Latrobe Street;
  - Cross drainage features are found in John Street (between 85 and 80 John Street) which picks up some overland flow from Jason Street and conveys it from east to west;
  - Another significant crossing is found at the low point on John Street (around 30 and 25 John Street), site visit records show this is duel cell box culvert crossing (600mm{h} x 1200mm{w}).

FIGURE 4-1 TYPICAL DRAINAGE CONDITIONS IN JASON STREET

FIGURE 4-2 TYPICAL DRAINAGE CONDITIONS IN JOHN STREET

5 UPDATED STRATEGY

5.1 Review of previous strategies and plans

Upon review of the previous planning information the following points were noted (specific to WR04 catchment and the adjacent catchment to the north);

- Drainage strategy – Coomes Consulting, June 2010
  - The strategy nominates that - In the Middle Catchment (with reference to Figure 5-1) the minor and major system will consist of an underground pipe and overland flow along the road network of roadways. Drainage reserve in the north west used to attenuate flows up to the 1%AEP event. Treatment of stormwater is proposed to be achieved with a wetland approximately 0.45Ha in size;
  - The strategy nominates that - In the Upper Catchment, the minor and major system will consist of an underground pipe and overland flow along the road network of roadways. The outfall for the site is at the corner of Crinigan Road and Ashley Street. Larger allotments have been assumed in this catchment with onsite detention (lot level) controls proposed for stormwater attenuation. No treatment is proposed in this catchment with a note that offsets will be required by using oversized wetlands in the Upper and Middle catchments;
- Morwell North West Development Plan FINAL - CPG October 2010;
  - The plan notes *"The small north-east catchment on the south side of Crinigan Road comprises 3 Ha. (the upper catchment) east of Maryvale Road and 12Ha within the Development Plan area that is contained within one landholding. The stormwater treatment obligations for this catchment have been factored into the sizing of the four wetlands in the other sub-catchments and therefore no further treatment is required within this catchment*".

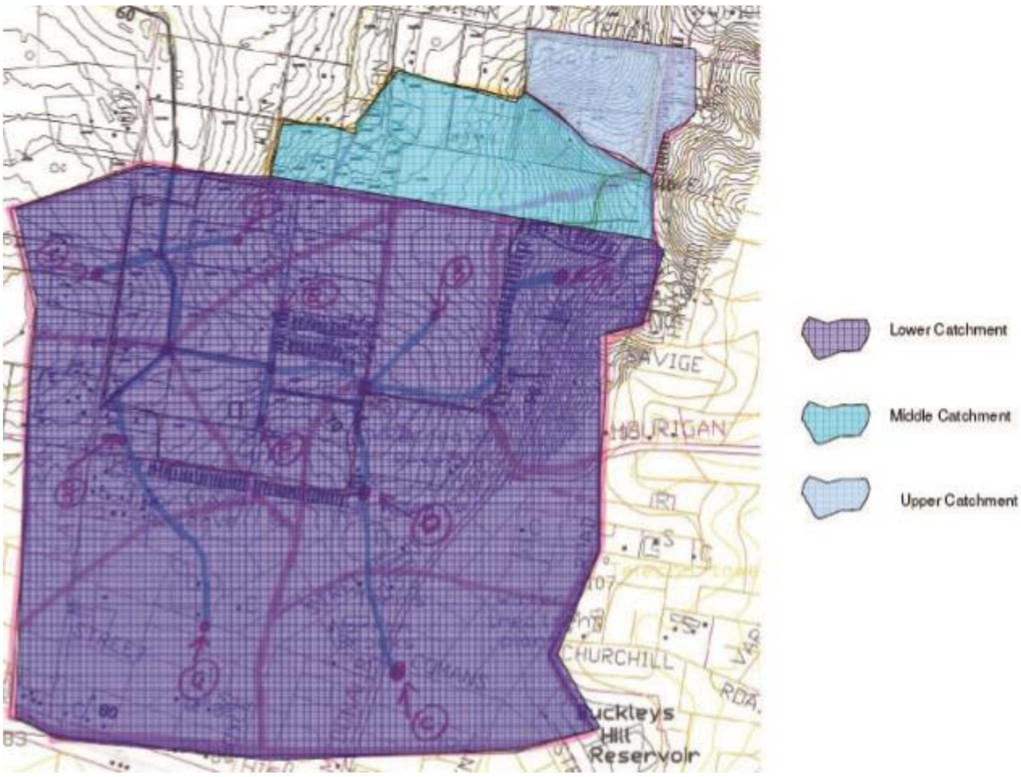

FIGURE 5-1 CATCHMENT DELINATATION BY COOMES CONSULTING

5.2 Implications for the current design work

It is the project teams understanding that;

- The drainage strategy by Coomes is the only document where the assumption of lower density lots in the Upper Catchment is referenced;
  - LCC would like to pursue an option which accommodated standard residential development in the Upper Catchment;
  - This will require a reserve to be created inside the Upper Catchment to accommodate treatment and attenuation features;
- Other WSUD assets designed in some past projects (some now constructed, assets WR02/3, WR02 and WR03) do not include additional treatment to offset the water quality impacts of the of the Upper Catchment;
  - Water Technology's 2016 study attempted to treat both the Middle and Upper catchments in a single WR04 WSUD / attenuation system, this solution would require significant filling to drain the entire catchment area to the centralised drainage asset.
- Some lots in the Upper Catchment were already subdivided into lower density lifestyle lots, the lots (6 on Crinigan Road) had (or will have) permit conditions which included lot level treatment and attenuation requirements;
  - These lots could be removed from the Upper Catchment drainage strategy.

5.3 Design response

After discussion with LCC Engineering and Planning staff including Ray Bright and Lucy Lane, the following assumptions were taken into the concept design work by Water Technology;

- 6 low density lots fronting Crinigan Road where removed from the drainage strategy, while the Gippsland Water Reserve area adjacent Maryvale road was included in drainage calculations;
- A new drainage reserve was required in the Upper Catchment;
  - Water Technology have sized (at a high level) drainage features for this reserve;
- Major drainage systems (overland flows) will follow existing catchment boundaries (significant land re-grading is unlikely);
- Where practicable, both catchment and parcel boundaries should be considered in developed conditions catchment delineation;
  - This has led to slight different assumptions for the major and minor system's drainage alignments.

6 HYDROLOGY

The RORB model developed in the previous project was used as the primary hydrological tool in this updated work. Changes in the model were limited to the Middle and Upper catchments as depicted in Figure 6-1. Calibrations and design assumptions from the previous study have been carried through to this investigation. For further information on model schematisation and calibration see the previous study report (3926-01_R03v01).

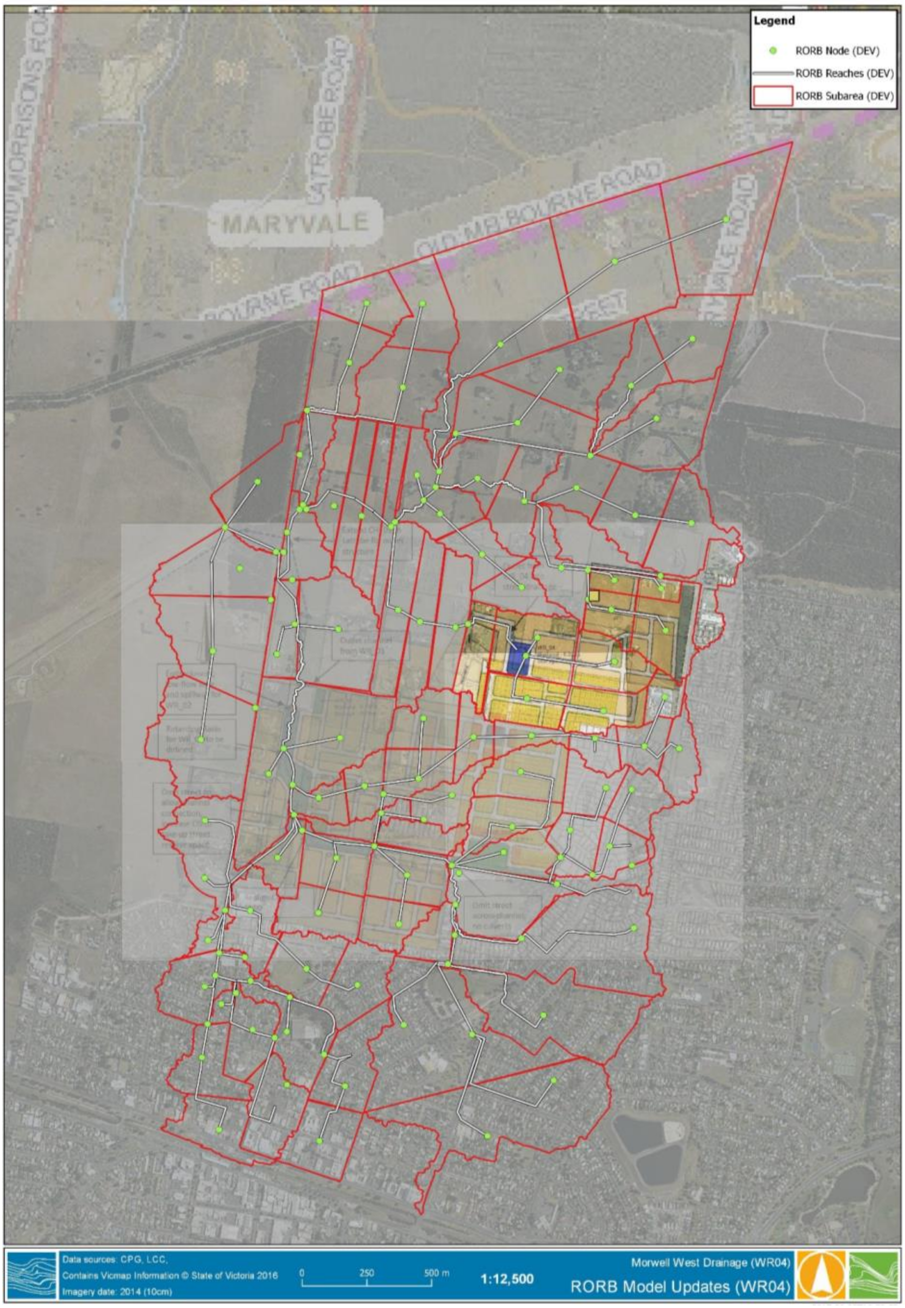

FIGURE 6-1 RORB MODEL IDENTIFYING THE AREA WHERE THE MODEL HAS BEEN MODIFIED

6.1 Discussion – Middle Catchment

The initial strategy originally proposed by CPG involved all of the area inside WR04's catchment to drain to the retarding basin. A review of the site conditions suggests that, without significant filling, this may be a challenge. If natural levels within the area are to be generally retained, a small portion of the study area will not be able to be serviced using a gravity based drainage system. It is envisaged that some of this land could be filled to drain to the proposed basin but this is unlikely to be possible for the land to the north west land which fronts Jason Street.

Options to overcome this problem include:

- Allowing some of the area to free drain with the proposed retarding basin sized to compensate for the additional runoff from the area which free drains;
- Lots which cannot connect to the proposed basin are required to have lot level storage features to manage the additional runoff generated from development;
- Treatment and attenuation features are relocated outside of the study area (potentially south of Jason Street).

In this body of work, it has been assumed that the land that cannot be practicably drained to the centralised reserve area will be able to free drain. This approximate area is shown in Figure 6-2 and represents only a small portion of the overall land proposed for development. Hydraulic modelling discussed in later sections has shown the impacts of arrangement.

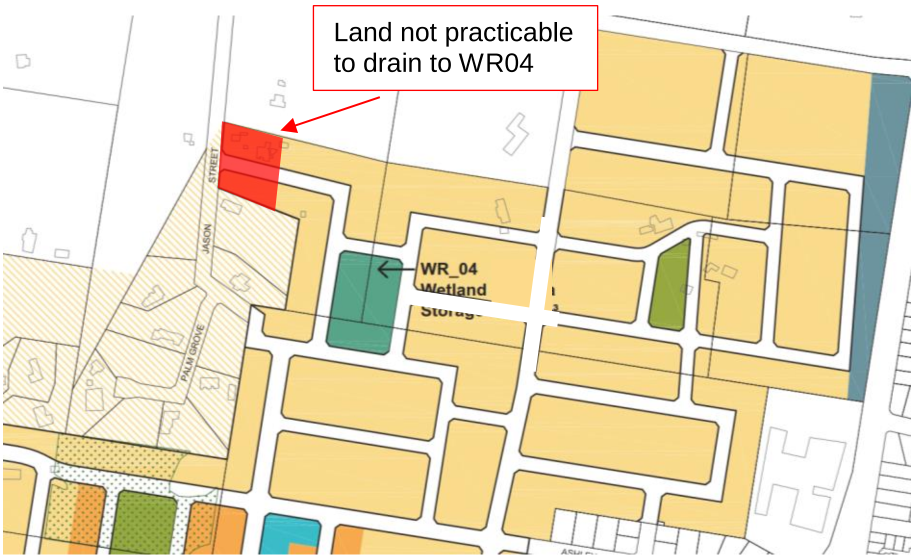

FIGURE 6-2 LAND EXCLUDED FROM THE DRAINAGE STRATEGY

6.2 Developed Conditions RORB modelling

RORB model sub-catchment break up was revised to meet the agreed design assumptions discussed in Section 5.3. The RORB model arrangement in the area of interest is shown in Figure 6-3. Runoff characteristics (FI, reach type, etc.) for developed conditions were consistent with the previous study.

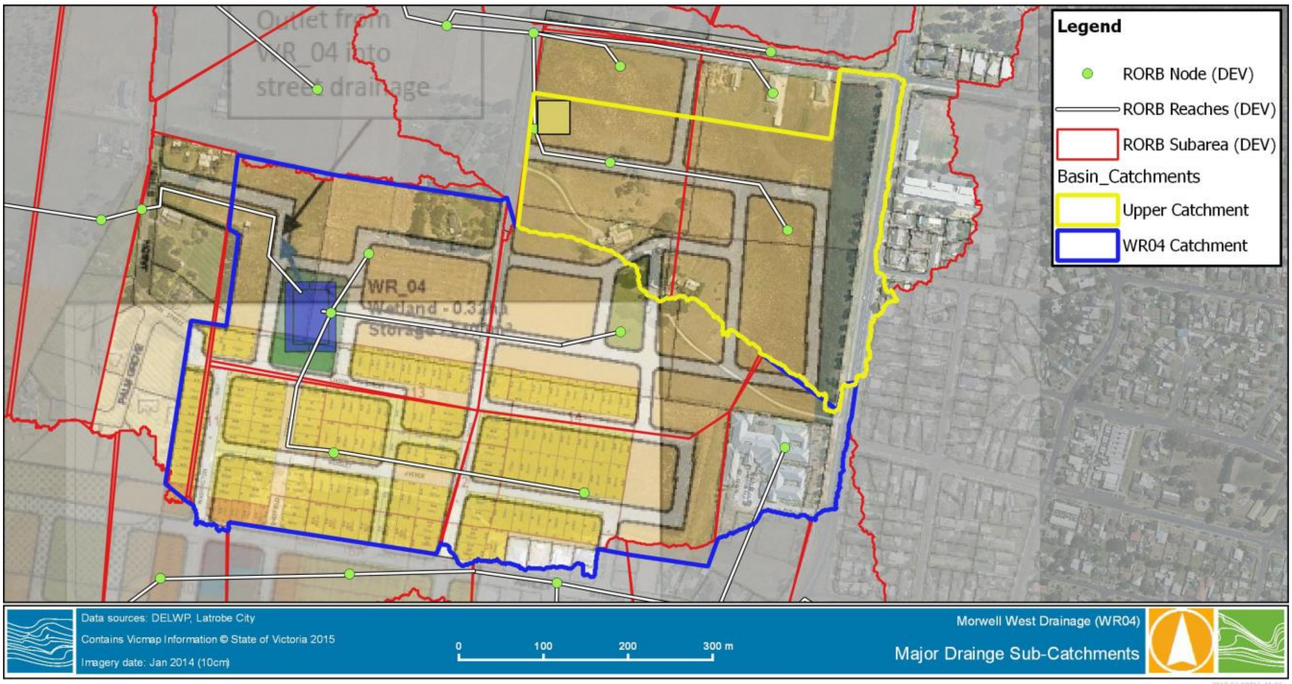

FIGURE 6-3 CONTRIBUTING CATCHMENTS

6.2.1 WR04 Basin Arrangement

The following basin feature (as described in Table 6-1, Table 6-2 and Table 6-3) was sized in the updated RORB model. The depths and volumes **do not** include freeboard. This will be discussed in the concept design chapter.

TABLE 6-1 WR04 FLOOD STORAGE SIZING AND STORAGE PERFORMANCE IN THE 1% AEP EVENT

Basin name (CPG)	Attenuation Flood Storage (m³)	RORB Flow 1% AEP event (m³/s)			Difference (m³/s)
		Existing Conditions	Developed Conditions	Mitigated Conditions	
WR04	6,310	0.82	3.38	0.78	-0.04

TABLE 6-2 WR04 PROPOSED OUTLET ARRANGEMENTS

Basin name (CPG)	Maximum Basin Depth (m)	Outlet pipe Size (m) RCP	Number of pipes	Land Take* (m²)
WR04	1.0	0.675	1	7130

* at maximum basin depth, lake take including freeboard requirements will be greater

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TABLE 6-3 STAGE / STORAGE RELATIONSHIP USED IN RORB

Basin Depth (m)	Basin Volume (m³)	Surface Area (m²)
0	0	5,460
0.1	554	5,618
0.2	1,124	5,778
0.3	1,709	5,940
0.4	2,312	6,104
0.5	2,930	6,270
0.6	3,566	6,438
0.7	4,218	6,608
0.8	4,887	6,780
0.9	5,574	6,954
1	6,278	7,130
1.1	7,000	7,308
1.2	7,740	7,488
1.3	8,497	7,670

6.2.2 Upper Catchment Basin

As discussed in Section 5.2, for the upper catchment to have standard residential development, a new treatment and attenuation system was required. A simple system has been designed in RORB as part of this study to provide indicative volumetric and land take requirements. A simple Rational Method peak flow estimate was undertaken to determine the existing peak flow for the system. The results are shown in Table 6-4,

Table 6-5 and Table 6-6. It should be noted that while presented in the same manner as the WR04 results, the same rigor was not applied to this concept design. These results should be used with caution and are not suitable for detailed cost estimate purposes. It is recommended these results are revisited in a separate drainage assessment.

TABLE 6-4 UPPER CATCHMENT FLOOD STORAGE SIZING AND STORAGE PERFORMANCE IN THE 1% AEP EVENT

Basin name (CPG)	Attenuation Flood Storage (m³)	RORB Flow 1% AEP event (m³/s)			Difference (m³/s)
		Existing Conditions	Developed Conditions	Mitigated Conditions	
Upper Catchment	1,060	0.58	1.99	0.58	0.00

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TABLE 6-5 UPPER CATCHMENT PROPOSED OUTLET ARRANGEMENTS

Basin name (CPG)	Maximum Basin Depth (m)	Outlet pipe Size (m) RCP	Number of pipes	Land Take* (m²)
Upper Catchment	0.97	0.6	1	1,520

** at maximum basin depth, lake take including freeboard requirements will be greater*

TABLE 6-6 UPPER CATCHMENT STAGE STORAGE RELATIONSHIP USED IN RORB

Basin Depth (m)	Basin Volume (m³)	Surface Area (m²)
0	0	728
0.1	76	794
0.2	159	863
0.3	249	935
0.4	346	1,010
0.5	451	1,088
0.6	564	1,169
0.7	684	1,252
0.8	814	1,339
0.9	952	1,428
1.0	1,100	1,520
1.3	2,000	1,814

7 WATER QUALITY

The water quality analysis undertaken in the previous study was reviewed and considered in the context of the overall strategy and constraints posed by topography and layout of the OPD. This review determined that integrating the previously designed treatment system into the WR04 reserve area would involve a land take too great to fit within the proposed retarding basin floor. The previous strategy (from 2016) involved treating all the catchment area from the WR04 and Upper Catchments. Discussions with council have identified that having a separate WSUD system in the upper catchment would be their preferred approach to meeting best practice stormwater treatment.

7.1 Minor drainage system catchment analysis

Considering the preferred option for multiple WSUD features within the study area, Water Technology have reviewed catchment characteristics and determined new contributing catchments for the 2 features sized (Figure 7-1). Catchment properties for this area are described in Table 7-1. It is noted that the catchment delineation between the minor and major drainage systems are slightly different to the major drainage system assumptions. These changes were made to reflect the proposed road network and to make the strategy complimentary to existing parcel boundaries within the ODP.

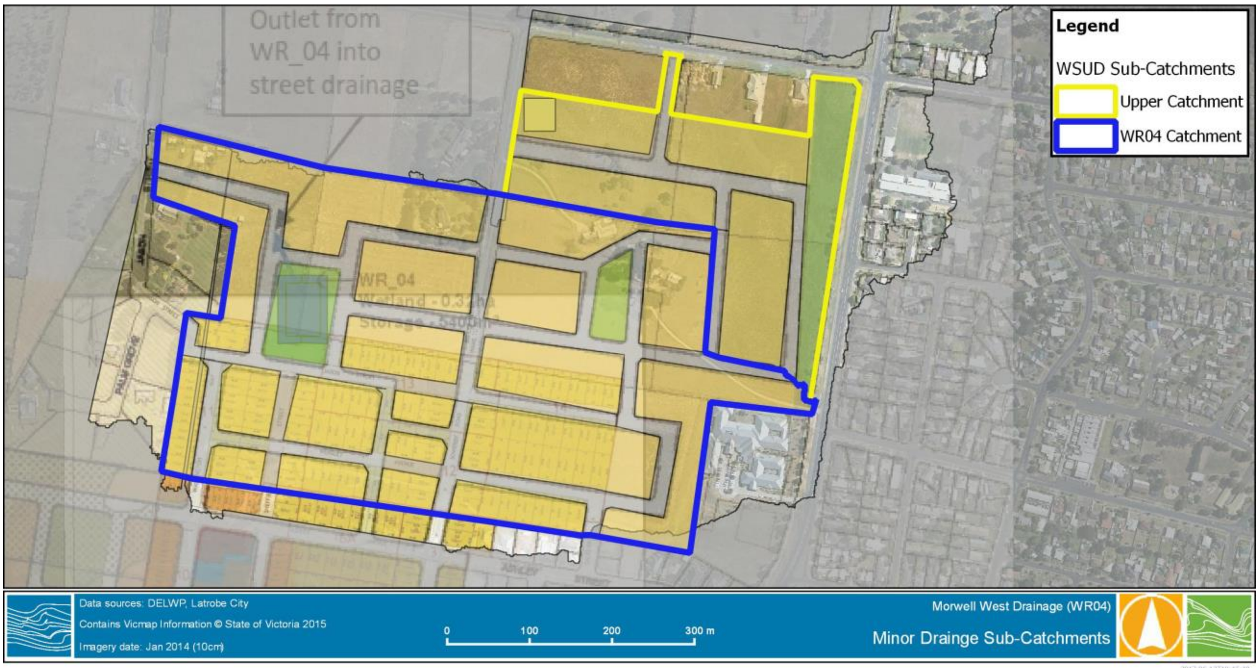

FIGURE 7-1 CATCHMENT BREAK UP

TABLE 7-1 WSUD CATCHMENT PROPERTIES

Catchment	Area (Ha)	Percentage Impervious (%)
WR04	25.79	66
Upper Catchment	8.01	57
Total	33.80	64

7.2 Preliminary Treatment - Sedimentation Basin Sizing

Fair and Geyer Equation (10.3 WSUD Stormwater Technical Manual (2004)) was used to size sedimentation basins for the WR04 and Upper catchment systems. The sedimentation basin was sized to:

- Capture 95% of coarse particles ≥ 125 µm diameter for a design flow equivalent to three month ARI peak flow;
- Require desiltation every five years;
- Have a maximum depth of 1.0 m with 0.5 m Extended Detention Depth.

The results of this analysis are show in Table 7-2. Typical representative sedimentation basin cross-sectional detail is shown in Figure 7-2.

TABLE 7-2 SEDIMENTATION BASIN DETAIL

Details	WR04	Upper Catchment
Surface Area	1,050 m^2	290 m^2
Extended Detention Depth	0.5 m	0.5 m
Permanent Pool Depth	1 m	1 m
Permanent Pool Volume	873 m^3	199 m^3
Percentage of Suspended Solids Removal	95%	95 %
Contributing Urban Catchment Area	25.8 Ha	8.0 Ha
Clean Out Frequency	10.2 years	9.0 years

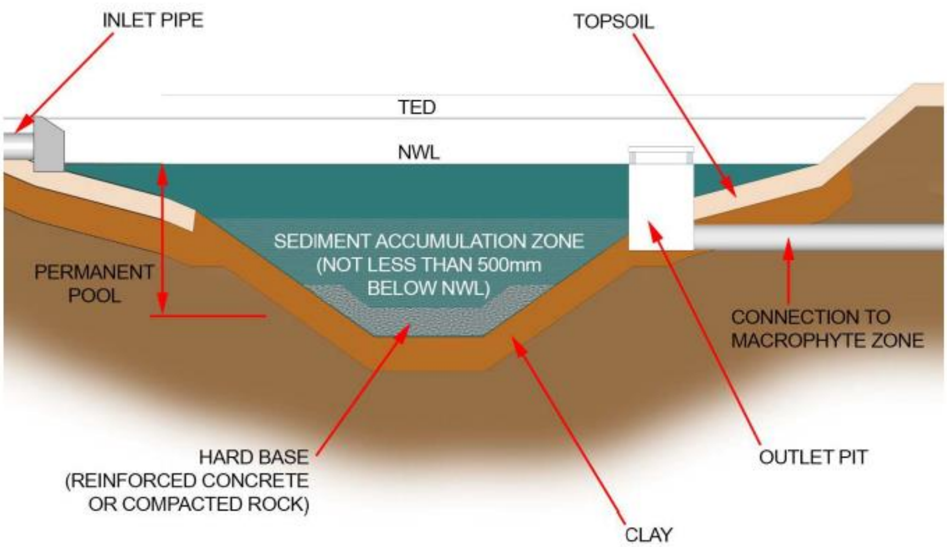

FIGURE 7-2 TYPICAL DETAILS – SEDIMENT POND (SOURCE: MELBOURNE WATER'S WETLAND GUIDELINES 2015)

7.3 Tertiary Treatment sizing

MUISC modelling was used to size two size the tertiary treatment systems (wetlands) for WR04 catchment and Upper Catchment areas.

The treatment train components were modelled using the MUSIC (Model for Urban Stormwater Improvement Conceptualisation) modelling program. The predicted performance of the treatment train has been assessed against the targets described in the Urban Stormwater Best Practice Guidelines (CSIRO). These specify the removal of key pollutants as follows:

- 80% of total suspended sediments;
- 45% of total nitrogen;
- 45% total phosphorous; and,
- 70% gross pollutants.

A MUSIC model was established in line with the current Melbourne Water MUSIC Guidelines with the proposed WSUD features for the site. The model was run using local 6-minute rainfall data. The base model was informed by previous MUSIC models built by Water Technology within Morwell.

7.3.1 WR04 – Wetland Sizing

The anticipated treatment performance of a wetland system with a surface area of 5,200 m^2 is shown Table 7-3. A design flow of 1.1 m^3/s (1 year ARI/ 100% AEP) was adopted as the high flow bypass in the MUSIC modelling.

7.3.2 Upper Catchment – Wetland Sizing

The anticipated treatment performance of a wetland system with a surface area of 1500m^2 is shown Table 7-3. A design flow of 0.31 m3/s (1 year ARI/ 100% AEP) was adopted as the high flow bypass in the MUSIC modelling.

7.3.3 Concept design

Typical wetland details are shown in Figure 7-3 and Figure 7-4.

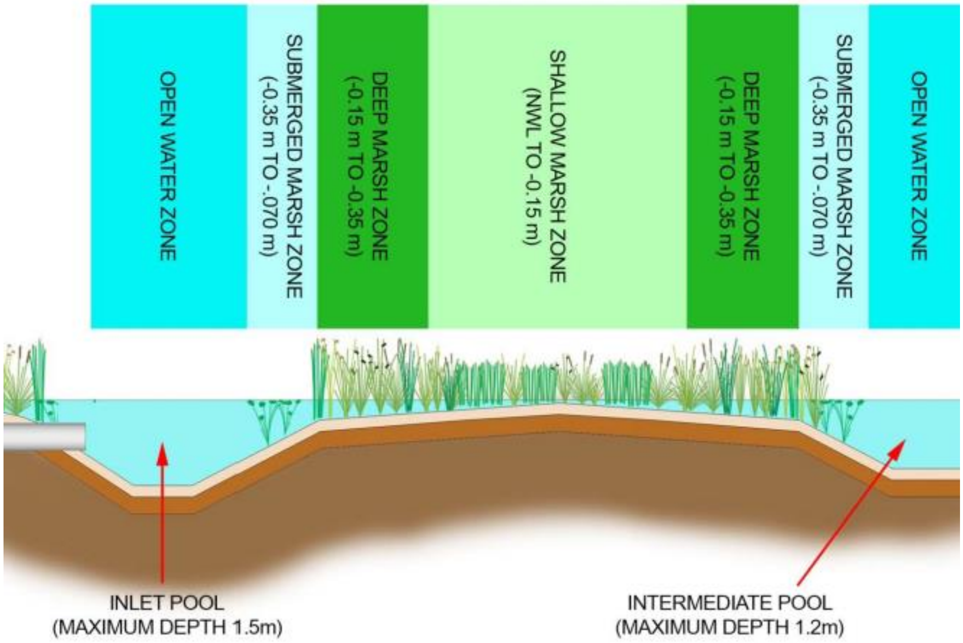

FIGURE 7-3 TYPICAL DETAILS – WETLAND MACROPHYTE PLANTING ZONES (SOURCE: MELBOURNE WATER'S WETLAND GUIDELINES 2015)

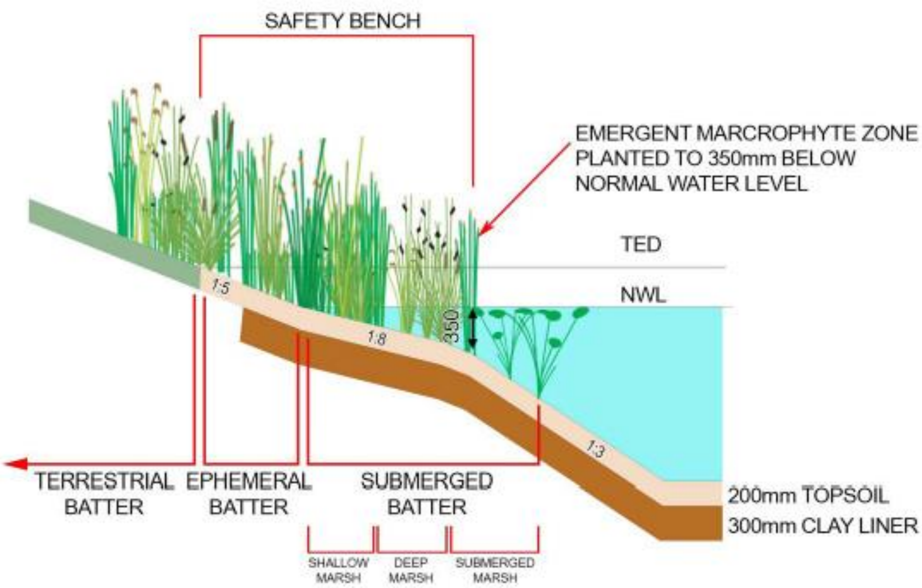

FIGURE 7-4 TYPICAL DETAILS – WETLAND EDGES WITH SAFETY BENCH (SOURCE: MELBOURNE WATER'S WETLAND GUIDELINES 2015)

7.4 System treatment effectiveness

The treatment train effectiveness of the proposed WSUD systems is shown in Table 7-3. It shows that both systems meet best practice targets, with Nitrogen treatment the determinate pollution source.

TABLE 7-3 TREATMENT TRAIN PERFORMANCE

Parameter	WR04 MUSIC load reduction results for local catchment (%)	Upper catchment MUSIC load reduction results for local catchment (%)	Best Practice Target (%)
Total Suspended Sediments	91	90	80
Total Phosphorus	73	73	45
Total Nitrogen	45	45	45
Gross Pollutants	99	99	70

7.5 WSUD Maintenance Requirements

The design will need to consider accessibility, safety and maintenance. This may include:

- Access for excavation vehicles (eg. via a maintenance access ramp);
- Reinforced concrete or compacted rock hard base;
- Maintenance track, including minimum turning circle appropriate to the types of maintenance vehicles to be used;
- Frequency of inspection and clean-outs; and
- Dedicated sediment de-watering areas.

7.6 Detailed design WSUD Considerations

Considerations will need to be given at the detailed design stage to:

- Wetland Bathymetry, and wetland zonation;
- Inlet and outlet configurations, including dewatering arrangements, transfer and balance pipes;
- Scouring and erosion management (ie velocity checks); and
- Plant selection.

8 HYDRAULIC MODELLING

8.1 Flood Model Setup

A TUFLOW model was created using LiDAR topography and site visit observations. Further details of the flood model setup are provided in Appendix C. The model used the "direct inflow" method to apply the hydrology from the RORB model to the hydraulic model. Using this approach requires the modeller to select where to apply the inflows, in each case inflows were applied at localised low points where overland flows are understood to exist. Using this approach did mean that the flood mapping results were only considered accurate downstream of where the flows were applied and did not produce results for the entire contributing catchment. This approach is considered conservative but fit for purpose for this investigation.

8.2 Existing Flood Conditions

The existing conditions model included all culverts and crossovers identified during the site visit. Feature inverts were assumed with all features set up to match the LiDAR inverts. The model was run for the 1h, 2h, 3h and 6h events. These durations were selected as they included the critical duration from the hydrology and events either side of it.

Existing conditions inflows from the land proposed for development (the WR04 catchment) were applied to the model in the rural land upstream of Jason Street, with overland flows allowed to move through the grazing land before impacting the low density lots along Jason Street and Palm Grove. 1% AEP flood mapping results showed:

- Overland flows moving west entering both Jason Street (predominately in lots 41 and 29) and Palm Grove (lots 9 and 13);
  - Flood depths on residential lots in this area was typically less than 200mm deep with the exception to this on lot 41 Jason Street where a small area is inundated up to 300mm deep;
- Overland flow crosses Jason Street adjacent lots 29 and 30. Flood water blocks the road at this location but is less than 200mm deep. Given catchment sizes and localised topographic conditions, it is expected this condition would not last a long time during a 1%AEP event;
- Shallow over land flows move west from this location towards John Street. Overland flows are not concentrated in this area and are typically less than 200mm deep;
- Once overland flows impact John Street, the overland paths split with some flood flows continuing west impacting Lot 60 John Street. The balance of overland flow diverts north heading toward the formal crossing under John Street (adjacent lots 25 and 30 John Street);
  - Overland flows which reach the John Street crossing combine with other catchment flows from the north before flowing west towards Latrobe Street.
- The overland flow path between John and Latrobe Street's is well defined (flood extents around 60m wide) with flood depths reaching over 400mm in isolated locations; and
- Once overland flows reach Latrobe Street they combine with significant catchment flows from Morwell township and other land to the north of the WR04 catchment. Flood depths behind Latrobe Street (as shown in the previous study) are significant at over 1m deep in places.

The draft 1% AEP flood modelling results were provided to LCC for comment, preliminary feedback suggested the results were an accurate representation of overland flow paths in the area.

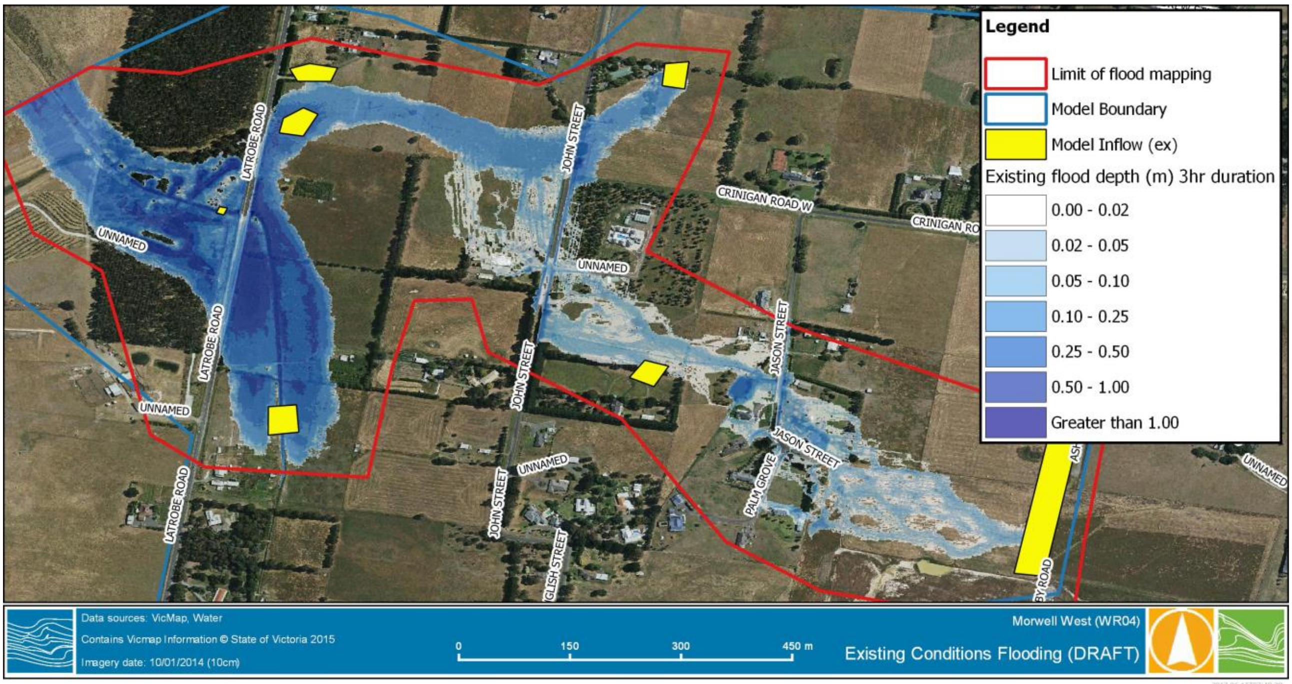

FIGURE 8-1 EXISTING CONDITIONS 1% AEP (3HOUR) FLOOD DEPTH RESULTS – STUDY AREA

8.3 Future (developed) Conditions

The retarding basin proposed in the hydrology chapter was integrated in the hydraulic model to describe the impacts on the overall system. Changes in the model included:

- Updated hydrology (developed flows) added to the model, with the inflow to the retarding basin applied directly to the basin feature, i.e. no routing through the subdivision was modelled;
- Rectangular retarding basin sited within the WR04 ODP reserve area;
  - Basin adopted included a 65m x 118m footprint with maximum depth 1.3m;
  - Basin Stage/Storage/land take relationship is shown in Table 8-1; and
- A basin outlet consisting of a single Φ675RCP routed from the basin to downstream of Jason Street (approximate longitudinal grade of 1%);

TABLE 8-1 STAGE STORAGE ARRANGEMENT MODELLED IN 1ST PASS ASSESSMENT

Depth (m)	Indicative Stage (mAHD)	Storage (m^3)	Indicative Plan Area (m^2)	Comment
1.3	78.8	8,516	7,692	Freeboard
1.2	78.7	7,750	7,611	
1.1	78.6	7,000	7,381	
1.0	78.5	6,272	7,173	Approximate peak water level in the RORB modelling
0.9	78.4	5,565	6,980	
0.8	78.3	4,876	6,794	
0.7	78.2	4,206	6,612	
0.6	78.1	3,554	6,436	
0.5	78.0	2,919	6,263	
0.4	77.9	2,301	6,093	
0.3	77.8	1,700	5,924	
0.2	77.7	1,116	5,757	
0.1	77.6	549	5,590	
0	77.5	1	5,251	NWL in the wetland

8.3.1 General Results discussion

The developed conditions 1%AEP results show much improved (reduced) flooding for residents of Jason Street and Palm Grove (see Figure 8-2). With overland flows now routed through the basin, the impacts from the external catchment east of the Jason Street and Palm Grove is removed. Not captured in this modelling is the localised flows in Jason Street and Palm Grove, so it is acknowledged that during a 1%AEP event, residents in the area will still see some stormwater impacts but nothing like they had prior to the upstream drainage works in the WR04 reserve. As shown in Figure 8-3, downstream of Jason Street, the flood mapping results are generally the same as existing conditions or better (reduced flood impacts). The exception to this is a small area immediately downstream of the retarding basin outlet. It is envisaged that these changes (afflux) could be removed with further refining of the outlet concept however this is not considered a worthwhile task until the project moves to the detailed design phase.

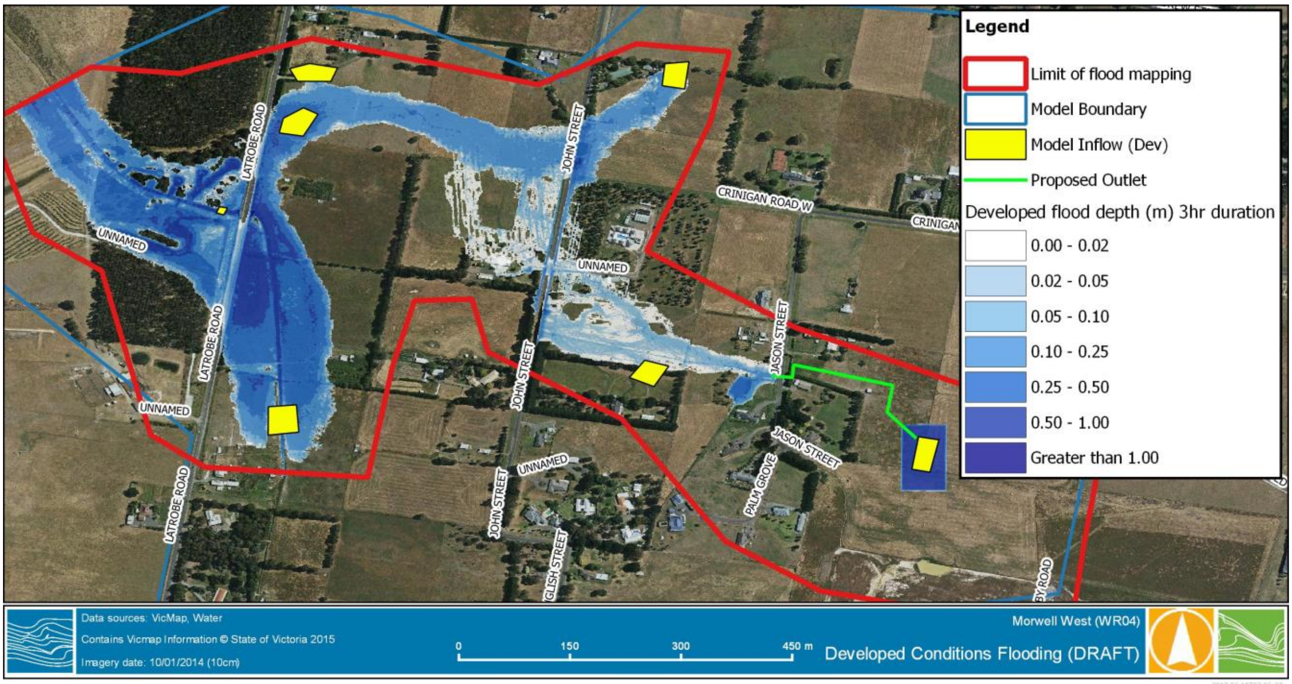

FIGURE 8-2 DEVELOPED CONDITIONS 1% AEP (3HOUR) FLOOD DEPTH RESULTS – STUDY AREA

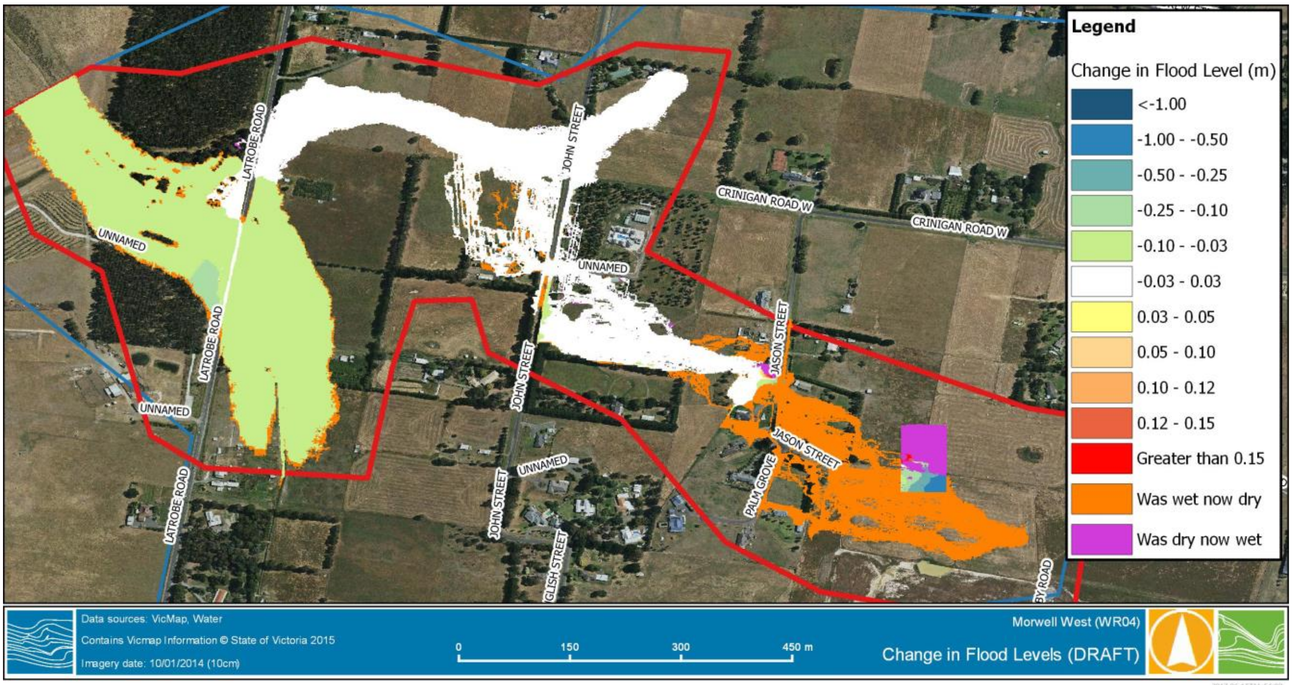

FIGURE 8-3 1% AEP (3HOUR) FLOOD AFFLUX RESULTS – STUDY AREA

8.3.2 Basin Performance

Largely, the proposed basin performed the same in the hydraulic model as in the hydrological modelling. The following was noted:

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- Peak piped flow from the basin outlet was recorded at 0.81m³/s (2-hour event) which compares well with the hydrological models estimate of 0.78 m³/s and remains at a level less than or equal to the existing conditions.
- Peak basin depths were largely consistent with RORB estimates;
  - 1hr event 0.92m (78.42 mAHD);
  - 2hr event 0.97 (78.47 mAHD);
  - 3hr event 0.89 (78.39 mAHD); and
  - 6hr event 0.97 (78.47 mAHD);
- Critical event durations were common with the 2hr event using the most storage and producing the peak basin outflow;
- Peak volume used in the 1%AEP event hydraulic model was approximately 6,100m³ which compared well to 6,310 m³ in the RORB model; and
- No direct impacts are observed from the free draining land within the OPD (with reference to Figure 6-2).

9 CONCEPT DESIGN

Hydrological analysis in this project has established existing and developed flows through the DCP region and greater study area. It has also determined storage requirements (attenuation) to meet best practice targets (Table 9-1). Analysis of site flows from both the hydrology and hydraulic modelling were used to iteratively design a system that met best practice design criteria. The concept design focused on the WR04 drainage system. MUSIC modelling was used to size WSUD features and the results of this analysis are shown in Table 9-2. An overall concept for the catchment area is shown in Figure 9-1.

TABLE 9-1 FLOOD STORAGE SIZING AND OUTLET ARRANGEMENTS

Basin name (CPG)	Flood Storage (m³)	Indicative basin floor (mAHD)	Basin Depth* (m)	Outlet pipe Size (m) RCP	Number of pipes	Indicative Invert of pipe(s) (m AHD)	Weir Invert (m AHD)
WR04	6,310	77.5	1.3	0.675	1	77.5	78.75

* Basin depth includes 300m freeboard, basin depth in the critical 1%AEP storm is approximately 1m.

TABLE 9-2 WSUD FEATURE DETAIL

Feature	Sed Basin		Wetland		
	Sed-Basin Surface Area (m²)	Max depth (m) inc. Extended Detention (ED)	Surface Area (m²)	Max depth* (m) inc. Total Extended Detention (TED) (m)	Normal Water Level (mAHD)
WR04	1,050	1.5	5,200	1.5*	77.5

* Wetland depths will vary to accommodate best practice bathymetry requirements, the WR04 wetland was designed with a TED 0.5m and an average wetland depth of 1m.

FIGURE 9-1 CONCEPT DESIGN (PLAN VIEW)

10 NEXT STEPS

Water Technology see the next steps in this process to include:

- The PGA design team review the study finding and ground truth them against their understanding of the system;
- PGA provide the report to Latrobe City council for comment and endorsement;
- PGA group undertake a preliminary functional design of the WR04 catchment features and supply them to Water Technology for testing in our hydraulic model;
- If required, small changes be adopted based on the observed performance of the functionally designed basin in the hydraulic model;
- PGA supply the final design to Water Technology to demonstrate its compliance with best practice design guidelines and statutory requirements; and
- Water Technology finalise our design report and supply it to PGA group.

1. REFERENCES

CPG (via Coomes consulting) - June 2010. Morwell North West Development Plan (Background Analysis: Final)

CPG (October 2010) Morwell North West Development Plan FINAL-

CPG (March 2010) Heritage Boulevard Site Stormwater Management Plan

CGP (via Latrobe City Council) (2015), Heritage Boulevard Landscape Master Plan

Gold Coast City Council (2007). Water Sensitive Urban Design Guidelines. June. www.goldcoast.qld.gov.au/gcplanningscheme_policies/policy_11.html#guidelines.

Ian Barker Gardens from (May 2013), Amended Endorsed Landscape Plans.

Latrobe City Council (2015), Land ownership map

Latrobe City Council (2015), Planning Permit 2011/116/B

Melbourne Water (2011), 2D Modelling Guidelines for Melbourne Water

Melbourne Water (2005). WSUD Engineering Procedures: Stormwater. Collingwood, Victoria: CSIRO Publishing.

Melbourne Water (2010). MUSIC Guidelines. Recommended and modelling approaches for MUSIC users.

Melbourne Water (2013). WSUD maintenance guidelines. A guide for asset managers. http://www.melbournewater.com.au/Planning-and-building/Forms-guidelines-and-standard-drawings/Documents/WSUD-Maintenance-manager-guidelines.pdf

Melbourne Water (2015). Design, Construction and Establishment of Constructed Wetlands: Design Manual, Draft, 2015.

PGA (2015) “Modelling Brief” Morwell West Drainage Investigation

Water Technology (October 2015) Morwell North-West DCP Drainage Report – Interim Report – Hydrology.

Water Technology (November 2015) Morwell North-West DCP Drainage Report – Interim Report – Water Quality.

APPENDIX A
TUFLOW MODEL PARAMETERS

The single precision version of the latest TUFLOW release was used for all simulations.

The hydraulic model has four main inputs:

- Topography data;
- Boundary conditions;
- Hydraulic structures; and
- Surface Roughness.

10.1.1.1 Topography Data

The model extent and setup is shown in Figure A-1. LiDAR was used to create the digital terrain model.

A grid size of 1 m was adopted to ensure adequate detail of the waterways and floodplain features while maintaining reasonable model run times. Where required, 2d zsh layers were used to accurately define key floodplain features.

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FIGURE A-1 FLOOD MODEL SETUP EXISTING CONDITONS

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FIGURE A-2 FLOOD MODEL SETUP DEVELOPED CONDITONS

10.1.1.2 Boundary Conditions

7 inflow boundaries were applied throughout the model. Where broad sheet overland flow paths (no defined inflow channel) occurred, inflows were placed in the centre of the drainage reserve.

Design hydrographs were adopted from the RORB modelling work.

The major downstream boundary in the model (west of Latrobe Street) was modelled with a Level (H) verses Flow (Q) boundary. This boundary type let water out of the model at a steady rate which match the localised channel slope.

10.1.1.3 Key Hydraulic Structures

The following key structures were included in the model:

- John Street crossing: this crossing was modelled as a 1D element, sizes and levels were based on site visit observations; and
- Latrobe Road culvert crossing: modelled as 1D elements, sizes and levels were based on PGA survey.

10.1.1.4 Surface Roughness

Areas with different roughness types were identified from aerial photos. The roughness parameters used in the study are shown in Table 1-1

TABLE 1-1 HYDRAULIC MODEL ROUGHNESS PARAMETERS

Land Use	Manning's 'n' value
Residential - Urban (higher density) - when building footprints and remainder of parcel are modelled together	0.35
Industrial/Commercial or large building	0.30
Open Space or Waterway - minimal vegetation	0.035
Open Space or Waterway - moderate vegetation	0.06
Open Space or Waterway - heavy vegetation	0.09
Paved Surface/Roads	0.02
Drainage Easement	0.05
Open Water	0.02
Open Water with reedy vegetation	0.065

10.1.1.5 TUFLOW Model Checks

The following checks were undertaken on TUFLOW model parameters and outputs:

- 2D grid size: Given the size of the study area, a grid size of 1 m was used get the best accuracy from the data available. Where required, zsh layers were used to represent key 2d elements;
- 2D time step: The 2D time step is 0.5 second for the 1 m grid, ½ of the grid size;
- 1D time step: The 1D time step is 0.5 seconds;
- Model mass errors: The mass errors for all models were within acceptable levels for the scope of the work;
- Warning messages: Checked and found to be suitable for the system conditions.
- Errors messages: None.

Based on the above checks, we consider the TUFLOW model to meet the requirements as outlined in the Melbourne Water's 2D Modelling Guidelines (2012).

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