Former Brickworks
78 Middleborough Road
Burwood

Stormwater Strategy

Reeds Consulting

18 January 2018

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WHITEHORSE PLANNING SCHEME

This plan is approved pursuant to Clause 43.04 Schedule 6 of the Whitehorse Planning Scheme. This document forms part of the Development Plan for the former brickworks site at 78 Middleborough Road, Burwood East.

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1 Introduction

Reeds Consulting Pty Ltd has engaged Incitus to undertake a Stormwater Strategy for the subdivision and development of the Former Brickworks, located at 78 Middleborough Road, Burwood.

The 20 ha parcel of land is located approximately 15 km east of Melbourne in Burwood. The site is bounded by Middleborough Road to the west, Eley Road to the north, existing development to the east and Burwood Highway to the south. The site is covered by the City of Whitehorse's Development Plan Overlay DPO6. The site is not located within Melbourne Water Development Services Scheme, however will be referred to Melbourne Water under the Planning and Environment Act (1987) and the Subdivisions Act (1988). The site is illustrated in **Figure 1.1** below.

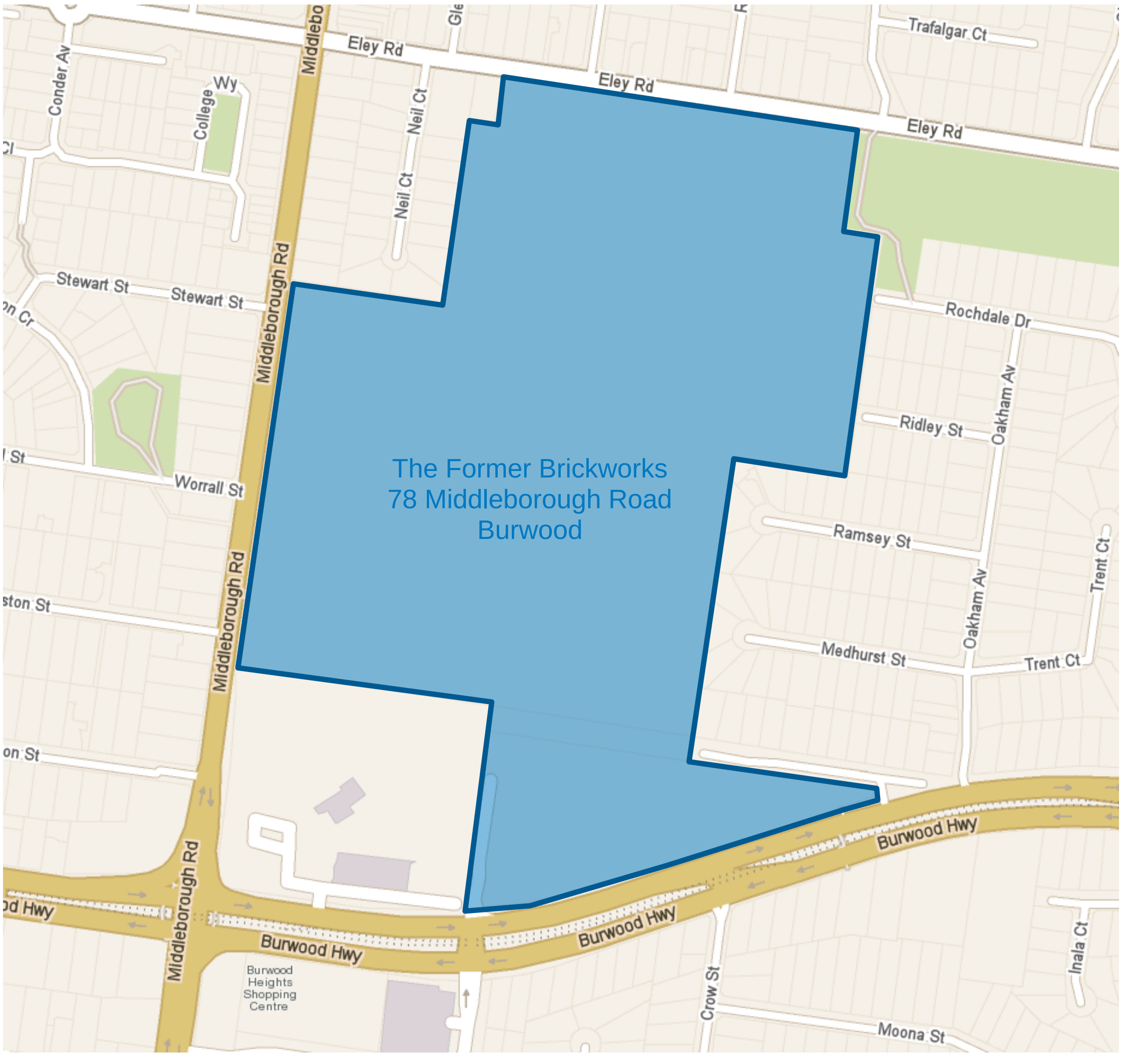


Figure 1.1 The Former Brickworks, 78 Middleborough Road, Burwood

Urbanisation leads to an increase in stormwater runoff and a subsequent increase in pollutant wash-off. It also has detrimental effects on the receiving waterways. In determining the urban structure, it is critical that assets required for drainage purposes are determined early so that the impacts from the increase of stormwater runoff due to urbanisation can be mitigated and all new development can proceed without the risk of flooding, of flooding neighbouring properties and without impacting on the natural environment, receiving waterways and ultimately, Port Phillip Bay.

Undertaking a drainage assessment of the catchment that identifies the quantity of runoff, the conveyance of this runoff, the need to retard the runoff and the treatment and / or reuse of the runoff will assist in determining the assets and / or land-take required for the stormwater management of this catchment. It will also identify the location of all stormwater assets.

Liveability and resilience should be incorporated into all new developments. With respect to stormwater management, this involves utilising the stormwater as an asset for the community whilst ensuring fundamentals such as flood protection, safety with respect to flow management and water supply security are maintained. This can be achieved through incorporation of best planning practices for stormwater management during the development of the urban structure.

This Stormwater Strategy for the development of the Former Brickworks at 78 Middleborough Road Burwood outlines a management plan for the stormwater that is generated from the urbanisation of the land. It identifies the assets required to manage the increased surface water runoff from urbanisation and sets a framework to achieve the intent of the stormwater assets. The surface water management for the site has been optimised and designed to achieve multiple benefits for the community and the environment.

2 Catchment Characteristics

The land at 78 Middleborough Road Burwood is located on the east side of Middleborough Road, north of the Burwood Highway, and is 20 ha in size. The average annual rainfall for the region is approximately 720 mm. The land is a disused brickworks site and has had significant modification to the pre-European catchment form.

The topography is varied with some isolated depressions from former quarrying activities. The site generally drains towards an existing Melbourne Water retarding basin, the Eley Road Retarding Basin, located adjacent to the north-east corner of the development. A small catchment abutting Eley Road will drain into the Melbourne Water Eley Road Main Drain and approximately 0.17 ha of developed catchment (0.47 ha of existing land-use catchment) abutting Eley Road in the north-west corner will connect to the existing Council drainage system.

The development has an external catchment of approximately 27 ha contributing to the site from the south and the east. Of this catchment, 23 ha is contributing from south and adjacent to Burwood Highway and 4 ha is contributing from existing development located to the east. The site is not currently subject to any Special Building Overlays or Land Subject to Inundation Overlays, which indicates that it does not currently experience any flooding. However, the exclusion of flooding overlays from this site may be due to the current land use associated with the parcels.

Figure 2.1 depicts the general site characteristics.

Figure 2.1 Catchment Characteristics of 78 Middleborough Road, Burwood

Figure 2.2 depicts the current drainage catchments based on existing topography.

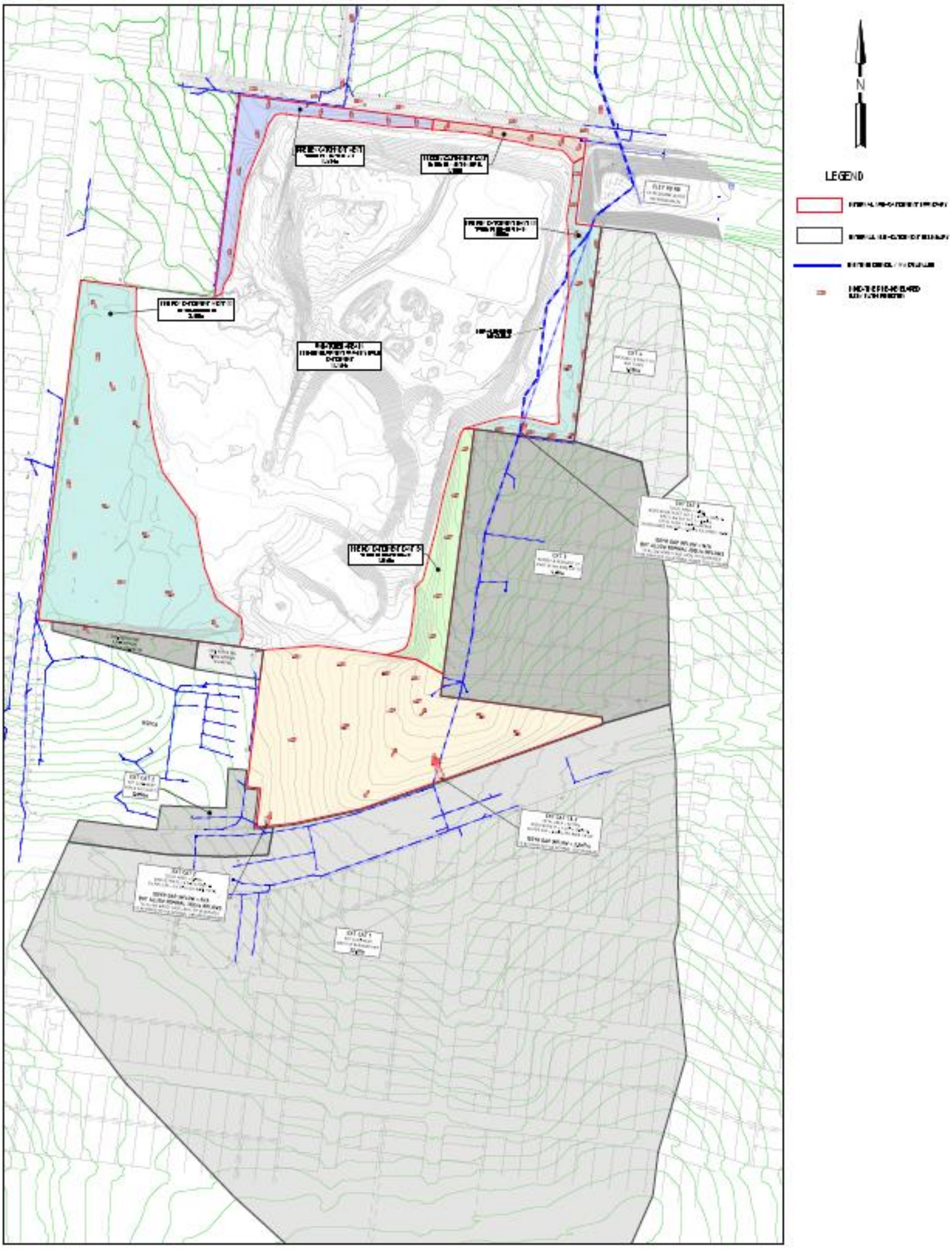


Figure 2.2 Current Drainage Catchments of 78 Middleborough Road, Burwood

3 Stormwater Quantity

The drainage system for the development of the Former Brickworks at 78 Middleborough Road Burwood will be designed to prevent property flooding occurring in a 1% Annual Exceedance Probability (AEP) storm event and the stormwater runoff can be safely conveyed through the development. To achieve this, the development will adopt a minor / major drainage system philosophy.

The development will be designed to ensure that the minimum level of service achieved with respect to drainage. For the minor system, the requirements for capture and conveyance must be achieved. For the major system, minimum freeboard requirements must be achieved for allotments and safe conveyance of overland flow is provided. This is applicable for all flow paths including road reserves, through public open space areas, through retail precincts and through retirement villages and unit developments.

The development is required to provide continuity for all flow paths for rainfall events up to and including the 1% AEP design storm. The development must avoid the obstruction of the flow path caused by fences, landscaping and buildings. Should obstructions occur within the flow path, the development must demonstrate compliance with safety criteria and ensure that no adverse effects are created for neighbouring properties. The development is required to provide suitable escape routes for all design flows generated from rainfall up to and including the 1% AEP storm event.

The 1% AEP flood levels associated with the neighbouring properties shall not be increased due to the urbanisation associated with the development of this site.

3.1 Minor Drainage System

The minor drainage system will consist of a subsurface pipe network designed to capture and convey all stormwater runoff generated from the catchment for rainfall events up to and including the 10% Annual Exceedance Probability (AEP) design storm for residential catchments and the 5% AEP design storm for commercial catchments.

As the localised catchments have an area less than 60 ha, the system will be designed in accordance with the City of Whitehorse design requirements and / or the Victorian Planning Authority's Engineering Design and Construction Manual. The minor drainage system must be designed so that the pit inlet adopts a 50% blockage and still captures the required flow rates.

3.2 Major Drainage System

The primary objective of the major drainage system is to provide flood protection for the allotments based on the 1% AEP storm event and to ensure the overland flow can be safely conveyed through the development. This will be via overland flow paths contained within road reserves. The overland flow magnitudes will be determined based on the difference between the 1% AEP design flows and the capacity of the minor drainage system, accounting for pit blockages in accordance with the Australian Rainfall and Runoff (2016).

The development is not located within a Melbourne Water Development Services Schemes (DSS) and no regional scale retardation has been provided for the development of this land. Therefore, the development must include on-site retardation to mitigate the stormwater runoff discharging from the site. Melbourne Water has specified the allowable discharge from the development as the capacity of the downstream drainage infrastructure ensuring there is no increase in the peak flood elevation or peak outflow for the 1% AEP design storm associated with the Eley Road Retarding Basin.

The development of the Former Brickworks will be designed so that all finished floor levels will be set a minimum of 300 mm above the 1% AEP flood level in Central Park drainage reserve, or 600 mm above the 1% AEP flood level in the Eley Road Retarding Basin, or 300 mm above the overland flow conveyed through the road reserves, whichever is greater.

3.2.1 On-site Retardation

The City of Whitehorse and Melbourne Water require the development of 78 Middleborough Road Burwood to limit the stormwater runoff discharging from the site to the capacity of the downstream drainage system.

Melbourne Water provided Reeds Consulting with a hydrologic runoff routing model for the catchment. RORB was adopted as the design runoff routing model for generation of flows and simulation of storages catchment. RORB generates catchment runoff based on the selection of local rainfall intensity frequency duration data and appropriate loss models. This model has been revised to reflect the development of 78 Middleborough Road Burwood. The RORB model adopts the storage function $S=kQ^m$.

The catchment plan indicating boundaries and reach lengths is included in **Appendix A**. A summary of the parameters adopted in the model is also included in **Appendix A**.

The model conveys the stormwater runoff generated from the developed catchment, including the external southern catchment, to the Central Park retarding basin. The external catchment to the east, as well as Catchment I and Catchment J have been routed directly to the Eley Road Retarding Basin.

Melbourne Water have advised that the development of the parcel must not result in any increase in peak elevation for the 1% AEP design storm in the Eley Road Retarding Basin and no increase in the peak discharge for the 1% AEP design storm in the Eley Road Retarding Basin.

The original model supplied by Melbourne Water indicates that Eley Road Retarding Basin has a current 1% AEP design storm elevation of 84.45 m AHD and a peak discharge in the 1% AEP design storm of 8.75 m^3/s.

The Central Park Retarding Basin is required to mitigate the peak flows generated from the urbanisation of the site. Interactive modelling was undertaken to determine the storage volume required to restrict the discharge from the retarding basin to 300 l/s. It has been determined that this discharge, together with the urbanised catchments downstream of the Central Park Retarding Basin connecting directly to the Eley Road Retarding Basin, will not result in any increase in flood levels or discharge from the downstream receiving asset.

The model accepted by Melbourne Water resulted in a peak storage volume of 10,000 m^3 in the Central Park Retarding Basin with a peak elevation of 87.63 m AHD and a peak discharge of 0.29 m^3/s for the 1% AEP design storm event.

This data was then used to develop a conceptual design, from which an elevation / storage relationship was developed based on the terrain model created. The elevation / discharge relationship from the basin has been determined using the orifice equation until the spillway level is reached, and then the weir equation combined with the orifice equation. This data has been incorporated in the RORB model to refine the output. The elevation / storage / discharge relationship for the Central Park Retarding Basin are listed in **Table 3.1**.

Table 3.1 Central Park Retarding Basin Elevation / Storage / Discharge Relationship

Elevation (m AHD)	Storage (m3)	Peak Discharge (m3/s)
84.8	0	0
85.0	145.10	0.04
85.2	293.65	0.09
85.5	765.48	0.14
86.0	2,689.0	0.19
86.5	4,904.9	0.23
87.0	7,340.5	0.26
87.5	10,013	0.29
88.0	12,957	0.32

The outputs from the Central Park Retarding Basin for all storm events are listed in **Table 3.2**.

Table 3.2 Central Park Retarding Basin Outputs

Storm Event	Peak Elevation (m AHD)	Peak Storage (m^3)	Peak Discharge (m^3/s)	Time to Peak Elevation (hrs)	Time to Empty RB (hrs)
1 EY (1 year ARI)	85.68	1,440	0.15 (9hr)	6	10.5
39% AEP (2 year ARI)	85.81	1,900	0.17 (2hr)	1.8	5.4
18% AEP (5 year ARI)	86.09	3,100	0.20 (2hr)	1.8	7.2
10% AEP (10 year ARI)	86.33	4,110	0.22 (2hr)	2.0	8.5
5% AEP (20 year ARI)	86.68	5,770	0.24 (2hr)	2.0	10.6
2% AEP (50 year ARI)	87.12	7,980	0.27 (2hr)	2.0	13
1% AEP (100 year ARI)	87.51	10,100	0.29 (2hr)	2.08	15.1
0.5% AEP (200 year ARI)	87.95	12,700	0.32 (2hr)	2.08	17.5
0.2% AEP (500 year ARI)	88.10	13,600	1.20 (1.5hr)	1.08	17.3

Note: EY is Exceedance per year, ARI is Average Recurrence Interval, AEP is Annual Exceedance Probability. Storm duration for peak discharge is shown in parenthesis. Time to empty is from the start of the storm until flood level is contained in pond.

The results indicate 10,100 m^3 of storage is required to retard all events up to the 1% AEP design storm to a discharge that will not result in an increase in flood elevation or peak discharge from the downstream receiving Eley Road Retarding Basin. The results also indicate that the 0.5% AEP is still contained within the retarding basin, and that for most events the basin will empty in less than one day from the start of the storm event.

A sensitivity analysis was undertaken assuming a 50% blockage for the outlet of Central Park Retarding Basin. The analysis indicated for a 1% AEP storm event, that the blockage resulted in a marginal increase in flood level of 180 mm, an increase in volume stored of 700 m^3, and a reduction in outflow of almost 50%.

The reduction in flow is due to the controlled outlet structure, and blockage of the outlet will only reduce the peak discharge from the basin, until the basin spills over the road reserve bounding it. The peak outflow will remain at the peak level for an extended duration, increasing the outflow hydrograph and subsequent time to empty the basin from the start of the storm event.

The increase in flood level within the basin will be contained within the freeboard for all events up to and including the 1% AEP design storm. The analysis indicated that the 0.5% AEP storm event will just be contained in the Central Park Retarding Basin with a 50% blockage on the outlet, and that the basin will only spill in events greater than this.

The Central Park Retarding Basin will contain flood warning signs to appropriate standards.

Figure 3.1 illustrates the proposed layout for the Central Park Retarding Basin.

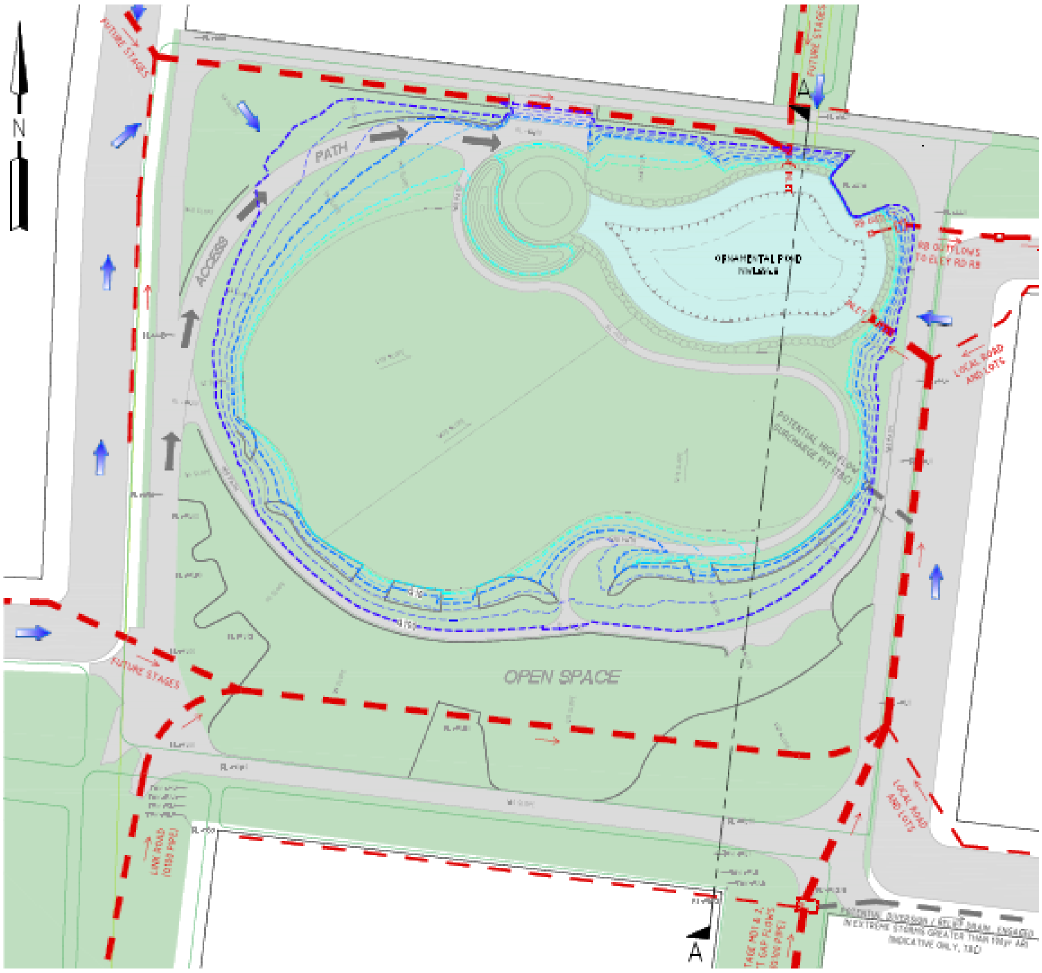


Figure 3.1 The Proposed Central Park Retarding Basin Layout

3.2.2 Peak Development Flows

The peak development flows are generated from the development of the site. **Figure 3.2** illustrates the major catchments and flow paths for the development.

Figure 3.2 The Former Brickworks Burwood Major Catchments

External Catchment 1

External Catchment 1 is located south of the development, encompassing a section of the Burwood Highway and development to the south. The area of External Catchment 1 is approximately 22.1 ha. The peak 1% AEP design flow for the catchment is approximately 4.4 m^3/s. It is estimated that approximately 2.9 m^3/s of this flow will be conveyed overland. The flow will be conveyed through the development via the road reserves towards Central Park Retarding Basin.

External Catchment 2

External catchment 2 is located south of the development, encompassing a section of the Burwood Highway and the existing RSPCA site. The area of External Catchment 2 is approximately 0.69 ha. The peak 1% AEP design flow for the catchment is approximately 0.2 m^3/s. It is estimated that this flow will be conveyed via the drainage network, however an allowance has been made for an overland flow of approximately 0.1 m^3/s in the event of inlet blockages. The flow will be conveyed through the development via the road reserves towards Central Park Retarding Basin.

External Catchment 3

External Catchment 3 is located east of the development, encompassing an existing residential area around Ramsey Street, Medhurst Street and Old Burwood Road. The area of External Catchment 3 is approximately 4.3 ha. The peak 1% AEP design flow for the catchment is approximately 1.1 m^3/s. It is anticipated that the peak 1% AEP design flow will be conveyed via a realigned Council drain through the development, however a preliminary conservative allowance has been made for 0.2 m^3/s to be conveyed overland in the event of inlet blockages. The flow will be conveyed through the development towards the existing Eley Road Retarding Basin.

External Catchment RSPCA NW

External Catchment RSPCA NW is located south of the site, adjacent to Middleborough Road and encompasses part of the existing RSPCA site. The area of External Catchment RSPCA NW is 0.2 ha. The flows generated from the catchment will be captured and conveyed through the development via the pipe drainage network.

External Catchment RSPCA NE

External Catchment RSPCA NE is located south of the site, adjacent to External Catchment RSPCA NW and encompasses part of the existing RSPCA site. The area of External Catchment RSPCA NE is 0.15 ha. The flows generated from the catchment will be captured and conveyed through the development via the pipe drainage network.

Catchment A

Catchment A is an internal catchment encompassing the Central Park Retarding Basin. The area of Catchment A is approximately 1.47 ha. The peak 1% AEP design flow entering the Central Park Retarding Basin for the total catchment is 10.5 m^3/s. The peak 1% AEP design flow discharging from the Central Park Retarding Basin and Catchment A is 0.29 m^3/s. This flow will be conveyed via a pipe drain to the existing Eley Road Retarding Basin.

Catchment B

Catchment B is an internal catchment located adjacent to Catchment A. The area of Catchment B is approximately 2.94 ha. The peak 1% AEP design flow for Catchment B is approximately 0.9 m^3/s. It is estimated that up to 0.5 m^3/s of this flow will be conveyed overland. The flow will be conveyed through the development via the road reserves towards Central Park Retarding Basin.

Catchment C

Catchment C is an internal catchment located adjacent to Catchment B. The area of Catchment C is approximately 1.82 ha. The peak 1% AEP design flow for Catchment C is approximately 0.6 m^3/s. It is estimated that up to 0.3 m^3/s of this flow will be conveyed overland. The flow will be conveyed through the development via the road reserves and discharge into Central Park Retarding Basin.

Catchment D

Catchment D is an internal catchment located adjacent to Middleborough Road encompassing the proposed retail section. The area of Catchment D is approximately 2.51 ha. The peak 1% AEP design flow for Catchment B is approximately 1.2 m^3/s. The retail section is to be serviced by 5% AEP internal drainage system, and prior to outfall to Catchment E, the drainage outfall and grated inlet pits will be upsized to capture and convey the 1% AEP design flows. The flow will be conveyed through the development via the drainage system towards Central Park Retarding Basin.

Catchment E

Catchment E is an internal catchment located adjacent to Catchment D and encompassing the Urban Plaza and apartments precinct. The area of Catchment E is approximately 1.61 ha. Catchment E is required to convey the flows generated from the external RSPCA catchments as well as Catchment D. The peak 1% AEP design flow for the total catchment is approximately 1.6 m^3/s. Catchment D and E will be serviced by upsized 1% AEP drainage system in Urban Plaza, which will be a high amenity area. The flow will be conveyed through the development towards Central Park Retarding Basin.

Catchment F

Catchment F is an internal catchment located adjacent to Catchment A and External Catchment 3. The area of Catchment E is approximately 2.39 ha. Catchment F will convey the runoff generated from the internal Catchment G and External Catchment 1. The peak 1% AEP design flow for the total catchment is approximately 4.0 m^3/s. It is estimated that a limited portion of this flow will be conveyed overland to ensure flood protection is achieved and the safe conveyance of gap flows. The flow will be conveyed through the development towards Central Park Retarding Basin.

Catchment G

Catchment G (Ryman site) is an internal catchment located adjacent to Catchment F and External Catchment 1. The area of Catchment G is approximately 2.43 ha. Catchment G will convey the runoff generated from the External Catchment 1. The peak 1% AEP design flow for the total catchment is approximately 3.4 m^3/s. Prior to discharge into Catchment F, gap flows will be captured and conveyed in the subsurface drainage network. The subsurface drainage network capturing and conveying the runoff form this catchment will be sized to convey the 1% AEP design flow. The flow will be conveyed through the development towards Central Park Retarding Basin.

Catchment H

Catchment H is an internal catchment encompassing Link Road. The area of Catchment H is approximately 1.94 ha. Catchment H will convey runoff from External Catchment 2 and External RSPCA NE catchment. Flows from Catchments D and E will cross Catchment H and discharge into Catchment C, together with the runoff from Catchment H. The peak 1% AEP design flow for the total catchment is approximately 2.3 m^3/s. It is estimated that up to 1.2 m^3/s of this flow will be conveyed overland. The flow will be conveyed through the development via the road reserves towards Central Park Retarding Basin.

Catchment I

Catchment I is an internal catchment located adjacent to Catchment A, Catchment B and External Catchment 4. The area of Catchment I is approximately 2.23 ha. Catchment I will convey the runoff generated from the External Catchment 3 and the flows discharging from the Central Park Retarding Basin. The peak 1% AEP design flow for the total catchment is approximately 1.6 m^3/s. It is estimated that up to 0.8 m^3/s of this flow will be conveyed overland. The flow will be conveyed through the development via the road reserves towards Eley Road Retarding Basin.

Catchment J East

Catchment J East is an internal catchment located adjacent to Catchment B and Catchment I and abutting Eley Road. The area of Catchment J East is approximately 0.82 ha. The peak 1% AEP design flow for Catchment J East is approximately 0.4 m^3/s. The flow from Catchment J East will discharge into the Eley Road Retarding Basin.

Catchment J West

Catchment J West is an internal catchment located adjacent to Catchment B and abutting Eley Road. The area of Catchment J West is approximately 0.17 ha. The peak 1% AEP design flow for the Catchment J West is approximately 0.06 m^3/s. The runoff from Catchment J West will be captured and conveyed through the Council drainage system in Eley Road. The runoff generated from this catchment is equivalent to the pre-developed flow captured and conveyed by the Council drainage system in Eley Road.

3.3 Overland Flow Safety

It is imperative that the development conveys the overland flows safely along road reserves. This requires ensuring the overland flow along major flow paths complies with Melbourne Water's floodway safety requirements. The recommended safety limits for residential streets are as follows:

For continuously grading streets:

- Vav.dav <= 0.35 m^2/s
- dav <= 0.30 m

For undulating streets with a saw-tooth grade:

- Crests Vav.dav <= 0.35 m^2/s
- Crests dav <= 0.30 m
- Dips Vav.dav <= 0.30 m^2/s
- Dips dav <= 0.60 m

For the minimum road grades to comply with the engineering standards, the maximum overland flow which can be conveyed along a typical 16 m road reserve is 4 m^3/s. The maximum overland flow which can be fully contained within the road reserve is 3 m^3/s. These figures have been based on 1 dimensional steady state hydraulic modelling using the software program HEC-RAS.

Some of the access streets within the Former Brickworks site are proposed to be 14 m road reserves. The maximum overland flow which can be safely conveyed along these 14 m road reserves based on the profile depicted in **Figure 3.3** is 4 m^3/s. This is for the minimum road grades to comply with the engineering standards, and up to a longitudinal grade of 1 in 50. The maximum overland flow which can be fully contained within the road reserve at a longitudinal grade of 1 in 200 is approximately 1.5 m^3/s. The maximum overland flow which can be fully contained within the road reserve at a longitudinal grade of 1 in 50 is approximately 3 m^3/s. These figures have been based on 1 dimensional steady state hydraulic modelling using the software program HEC-RAS.

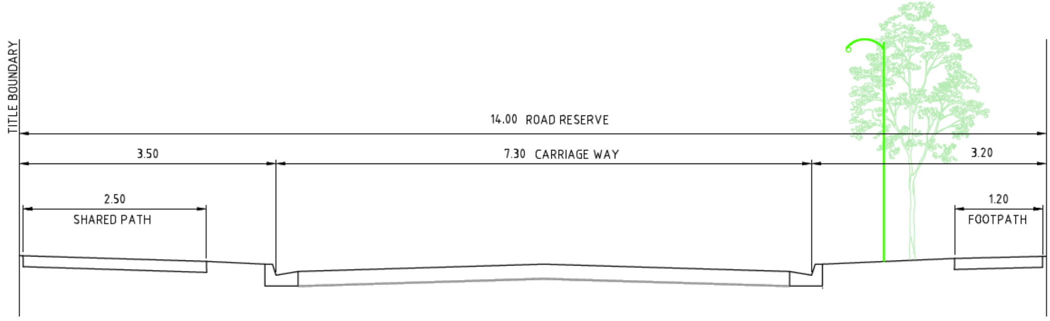


Figure 3.3 Typical Cross Section for 14 m Residential Access Street

Figure 3.4 illustrates a typical cross section from the hydraulic model for the 14 m wide access street. The section is extracted from a longitudinal grade of 1 in 50, and the water surface profile relates to a flow equivalent to 1.5 m^3/s.

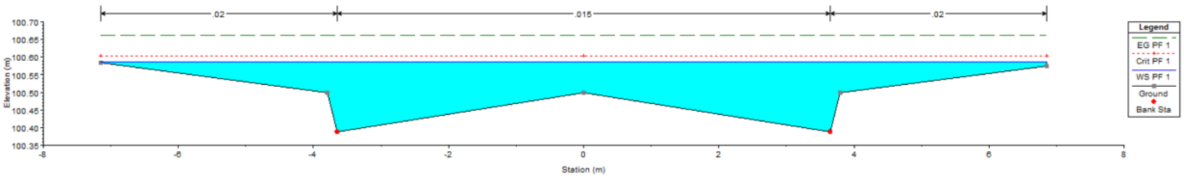


Figure 3.4 Typical Cross Section for 14 m Residential Access Street from the Hydraulic Model

Link Road within the Former Brickworks site is proposed to have a 25.9 m road reserve, or greater. The maximum overland flow which can be safely conveyed Link Road based on the profile depicted in **Figure 3.5** is approximately 6.5 m^3/s. This is for the minimum road grades to comply with the engineering standards, and up to a longitudinal grade of 1 in 50. The maximum overland flow which can be fully contained within the road reserve at a longitudinal grade of 1 in 200 is approximately 2 m^3/s. The maximum overland flow which can be fully contained within the road reserve at a longitudinal grade of 1 in 50 is approximately 4 m^3/s. These figures have been based on 1 dimensional steady state hydraulic modelling using the software program HEC-RAS.

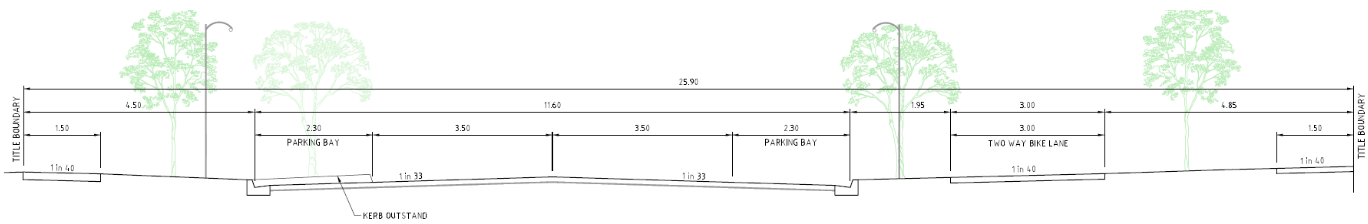


Figure 3.5 Typical Cross Section for Link Road

Figure 3.6 illustrates a typical cross section from the hydraulic model for the Link Road. The cross sectional profile modelled was based on the profile that resulted in the smallest capacity to convey gap flows. The section is extracted from a longitudinal grade of 1 in 50, and the water surface profile relates to a flow equivalent to 4 m^3/s.

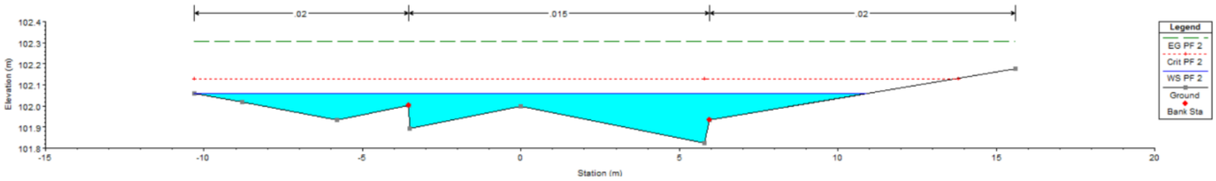


Figure 3.6 Typical Cross Section for Link Road from the Hydraulic Model

The development will not exceed the safety limits for the access streets or Link Road for the overland flow conveyed along the road reserves. When safe conveyance of gap flows overland cannot be achieved, or minimum freeboard to overland flow flood levels cannot be achieved; the subsurface drainage network will be oversized to accommodate an increase flow conveyance than the minimum level of service required. The development will supply Council with hydraulic modelling of overland flow along all streets used as flow paths throughout the design phase of the development.

The development must also provide safe conveyance of flows through public open space areas. A typical shared path has been analysed at the steepest grades (longitudinal and cross sectional) compliant with the Disability Discrimination Act has been used to determine the maximum flow which can be safely conveyed overland around these paths. The maximum has been determined to be 1.3 m^3/s. Overland flows in excess of this must be captured and conveyed via subsurface drainage systems.

Figure 3.7 illustrates a typical cross section from the hydraulic model for the shared path between Link Road and the Central Park Retarding Basin. The cross sectional profile modelled was based on the profile that resulted in the smallest capacity to convey gap flows. The section is extracted from a longitudinal grade of 1 in 14, and the water surface profile relates to a flow equivalent to 1.3 m^3/s.

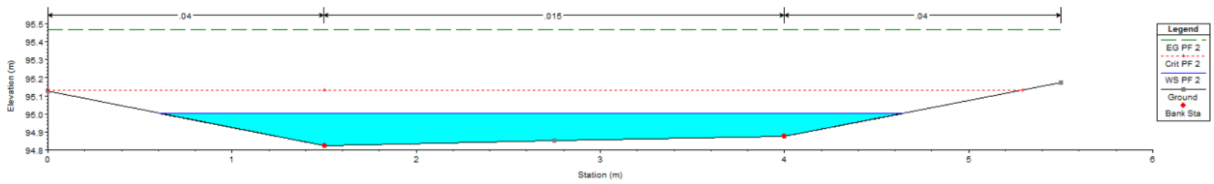


Figure 3.7 Typical Cross Section for Shared Path from the Hydraulic Model

Figure 3.8 depicts the location of the typical road profiles used to assess the safe conveyance of flows overland through the development.

Figure 3.8 Location of the Typical Road Cross Sections Used in Safety Check

4 Stormwater Quality Treatment

The State Environment Protection Policy (Waters of Victoria) defines the required water quality conditions for urban waterways. The aim of stormwater quality treatment is to reduce typical pollutant loads from urban areas to Best Management Practices as defined in the following targets:

Table 4.1 Best Practice Pollutant Reduction Targets

Pollutant	Performance Objective
Total Suspended Solids (TSS)	80% reduction from typical urban load
Total Phosphorous (TP)	45% reduction from typical urban load
Total Nitrogen (TN)	45% reduction from typical urban load
Gross Pollutants (GP)	70% reduction from typical urban load

Source: Urban Stormwater: Best Practice Environmental Management Guidelines – Victorian Stormwater Committee, 1999.

Clause 56.07-4 of the Victorian Planning Provisions requires that all new residential subdivisions treat the stormwater runoff generated from the development to best practice pollutant reduction targets.

Typically, Melbourne Water would provide catchment scale treatment for industrial developments that are located within Development Services Schemes, however this catchment is not within a scheme.

The development can provide on-site treatment to achieve best practice pollutant reduction targets or pay Melbourne Water a stormwater quality offset contribution to help fund alternative treatment in the greater catchment. The current rate payable to Melbourne Water for offsetting stormwater quality treatment on-site in the City of Whitehorse is $31,503 per hectare of residential development.

The provision of treatment on-site within a development where possible is preferable due to the environmental and community benefits derived from the reduction in pollutant loadings contributing to the receiving waterways. The development of the Former Brickworks at 78 Middleborough Road Burwood proposes the inclusion of on-site treatment for the development.

The development will include an ornamental pond with sediment capture capability to provide pre-treatment to the stormwater runoff from the pipe drainage network located in Central Park Retarding Basin.

The development will also provide a constructed wetland within the Eley Road Retarding Basin drainage reserve. The constructed wetland will include a gross pollutant trap and sediment pond upstream to form a treatment train. The retail area will provide on-site treatment to best practice targets. Catchment J will discharge from the system without treatment, however the balance of the site will over-treat to meet best practice pollutant reduction targets for the development, providing a holistic approach to treatment.

Table 4.2 outlines the treatment parameters proposed.

Table 4.2 The Former Brickworks Treatment Parameters

Pollutant	Central Park RB Sediment Basin	Eley Rd RB Sediment Basin	Eley Rd RB Wetland
Contributing Catchment (ha)	17.11	19.34	19.34
Area at NWL (m^2)	690	420	2,880
Permanent Pool Volume (m^3)	490	190	1,150
Extended Detention Depth (mm)	500	350	350
Approximate NWL (m AHD)	84.80	78.80	78.50

The treatment performance for the development has been simulated using the software package MUSIC (Model for Urban Stormwater Improvement Conceptualisation). **Figure 4.1** illustrates the MUSIC model layout for the development.

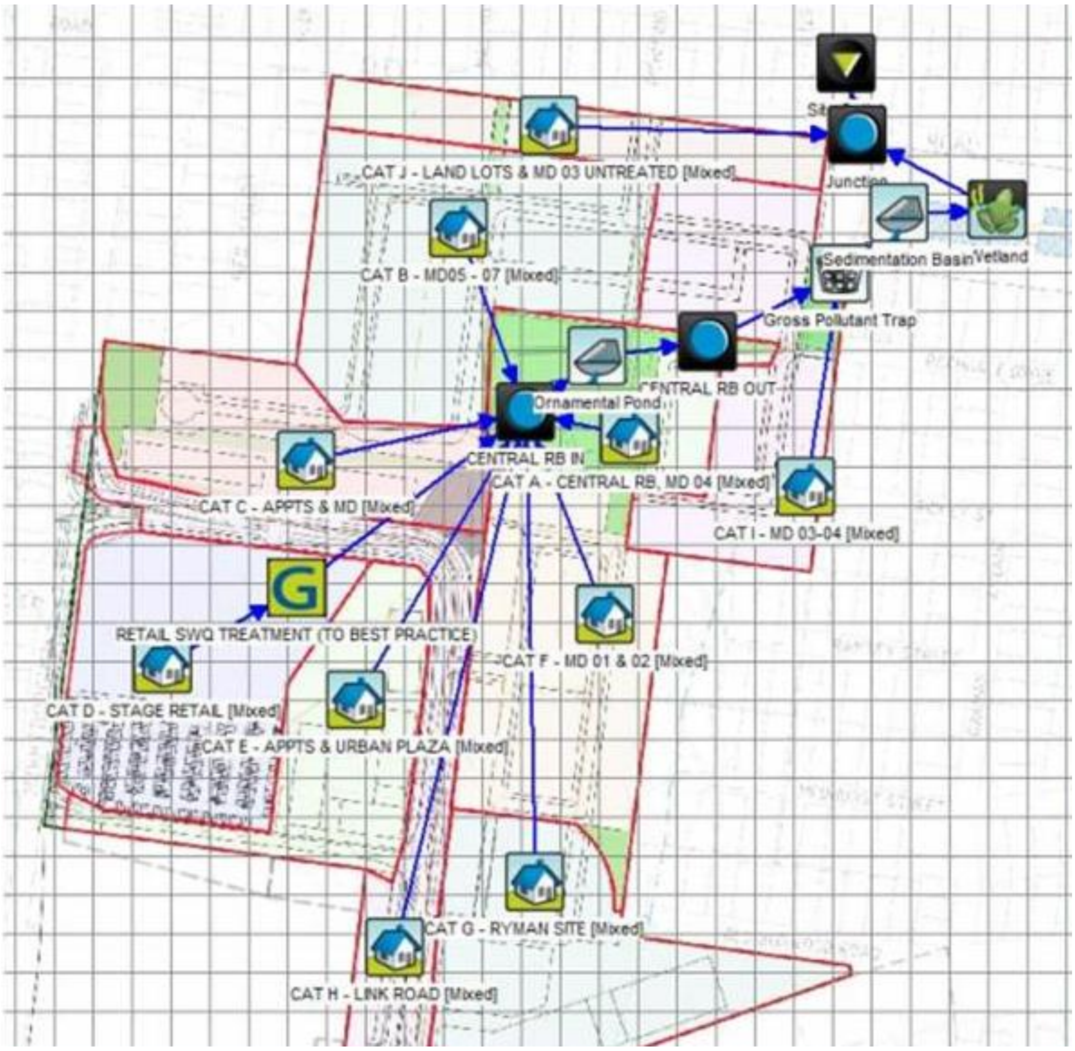


Figure 4.1 MUSIC Model Layout

Table 4.3 outlines the pollutant reduction target and the performance of the treatment proposed.

Table 4.3 The Former Brickworks Treatment Performance

Pollutant	Catchment Source Load (kg/yr)	Catchment Residual Load (kg/yr)	% Reduction for Site Pollutant Loads
Total Suspended Solids (TSS)	19,600	2,470	87.4%
Total Phosphorous (TP)	40.5	11.8	70.9%
Total Nitrogen (TN)	290	157	46.0%
Gross Pollutants (GP)	4,210	200	95.2%

The proposed inclusion of the treatment within the Eley Road Retarding Basin drainage reserve is illustrated in **Figure 4.2**. Melbourne Water has accepted the treatment proposal within this drainage reserve.

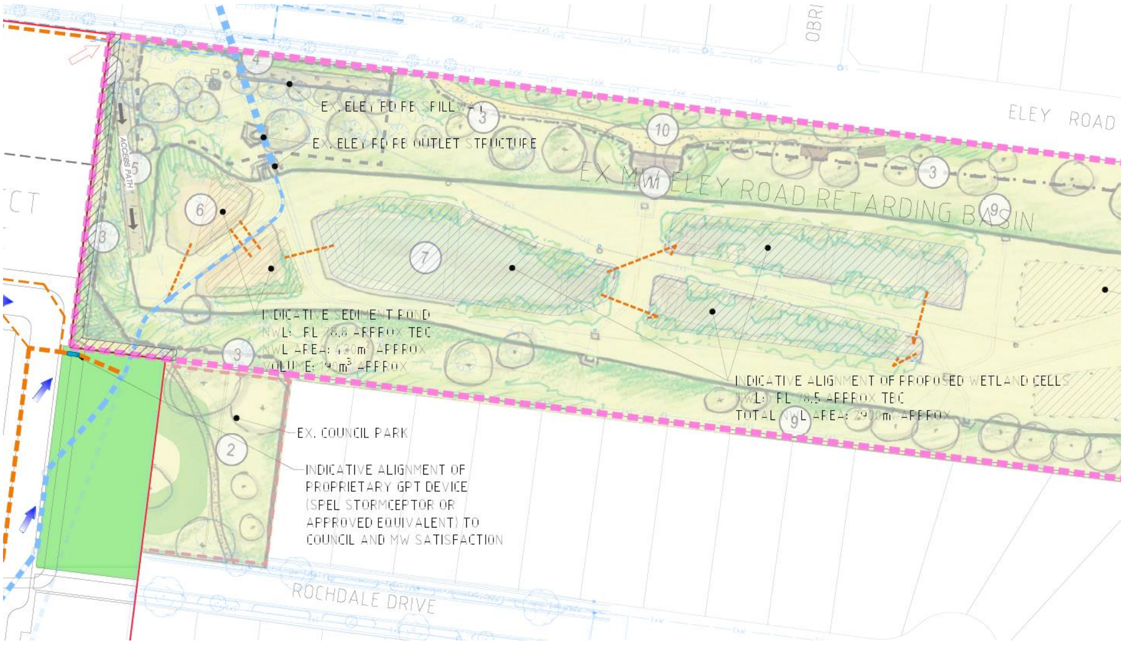


Figure 4.2 Proposed Treatment Layout within the Eley Road Retarding Basin Drainage Reserve

Melbourne Water will take responsibility for the water quality associated with the development utilising the Eley Road retarding basin site as per correspondence provided to Reeds Consulting.

5 Outfall Arrangement

The outfall for the development is the Eley Road Retarding Basin. The hydrologic modelling indicates that there is no increase in flood elevation or peak discharge from the Eley Road Retarding Basin when the site is fully urbanised and has constructed the Central Park Retarding Basin.

A small catchment of approximately 0.17 ha will discharge directly to the Council drainage system located in Eley Road. Based on feature survey undertaken for the existing site conditions, it has been determined that a catchment of 0.47 ha currently discharges to the Council system at this location. The small 0.17 ha catchment will generate the a marginally lower magnitude of stormwater runoff when urbanised to the existing 0.47 ha catchment.

As the permanent outfall works are existing, no temporary outfall works are required for this development.

6 Conclusion

The development of the Former Brickworks at 78 Middleborough Road Burwood is required to meet the drainage standards specified by the City of Whitehorse, Victorian Planning Authority and Melbourne Water.

The development will provide pipe drainage infrastructure to convey the 10% AEP design flows and minimise nuisance flooding occurrences in regular rainfall events. The gap flows, i.e. the difference between the 1% AEP design flows and the pipe flows, will be safely conveyed through the development along road reserve corridors.

Ultimate development of the overall catchment will include provision for conveyance of flows from the external catchment contributing to the site.

As the existing road and drainage infrastructure downstream of the Former Brickworks site does not have the capacity to safely convey the flows generated from the developed catchment; the development will provide a retardation basin within the site located at Central Park. The basin will be designed to contain all events up to and including the 1% AEP design storm with freeboard. A sensitivity analysis of the basin indicated that, even with a 50% blockage of the outlet, the basin will not spill until the design storm exceeds a 0.5% AEP storm event.

Allotments will achieve relevant freeboard from the 1% AEP flood levels associated the overland flows in road reserves or drainage reserves, whichever is greater.

The development will provide treatment to achieve best practice pollutant reduction targets. The treatment assets include a gross pollutant trap, two sediment basins and a constructed wetland to be located within Melbourne Water's Eley Road Retarding Basin drainage reserve.

The outlet for development is existing and free draining.

The modelling undertaken to develop this strategy has been based on indicative and conceptual plans. Detailed modelling matching the detailed design needs to be provided throughout the course of development of the site.

7 References

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2016, Australian Rainfall and Runoff: A Guide to Flood Estimation, © Commonwealth of Australia (Geoscience Australia)

CSIRO, 2006, Urban Stormwater: Best Practice Environmental Management Guidelines

Engineers Australia, 1987, Australian Rainfall and Runoff

Growth Areas Authority, April 2011, Engineering Design and Construction Manual

Laurenson EM, Mein RG and Nathan RJ, October 2007, RORB Version 6 Runoff Routing Program User Manual, Monash University Department of Civil Engineering in conjunction with Sinclair Knight Merz Pty Ltd and the support of Melbourne Water Corporation

Melbourne Water, 2017, Planning and Building website page

Melbourne Water, 2014, Constructed Wetlands Design Manual, Final Draft

Melbourne Water, 2016, Guidelines for the Use of MUSIC

Melbourne Water, 2005, WSUD Engineering Procedures: Stormwater

Appendix A – RORB Parameters

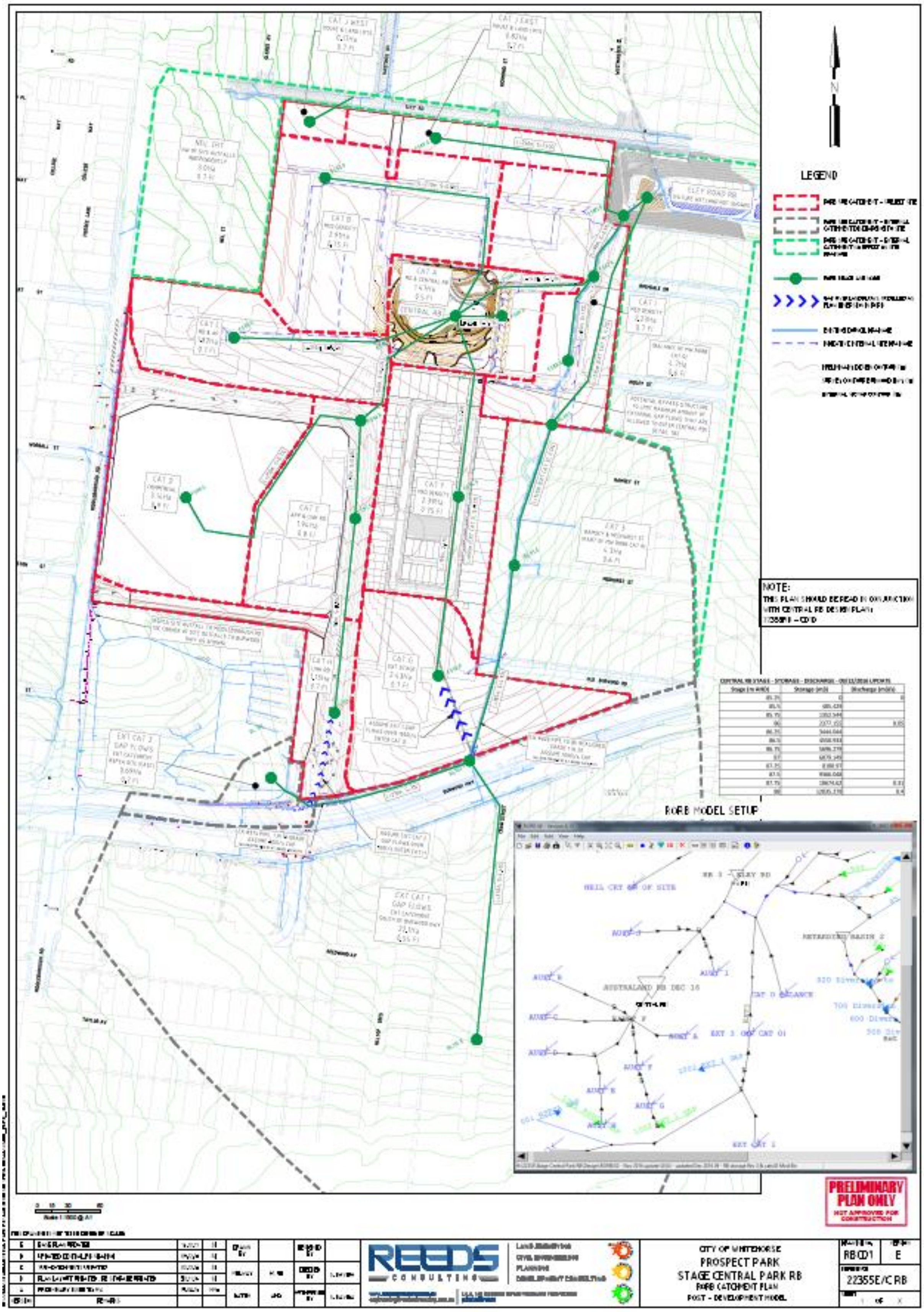
RORB File	D Mod Eley RB INCL AUSTRALAND SITE_May 2017 05 update Central RB Rev 6 - flood duration check.catg
kc	3.73
m	0.8
IL	15 mm
RoC	0.6 (100 year ARI)
Rainfall Location	City of Whitehorse
Temporal Pattern	Filtered
Aerial Pattern	Uniform
Aerial Reduction Factor	AR&R Bk II
Loss Factor	Variable Losses

ARI Loss Factors

Location	1yr ARI	2yr ARI	5yr ARI	10yr ARI	20yr ARI	5yr ARI	100yr ARI	200yr ARI	500yr ARI
Initial Loss	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop. Loss	0.2	0.25	0.3	0.4	0.5	0.55	0.6	0.65	0.7

IFD Parameters

Location	City of Whitehorse
$^{2}I_{1}$	18.95
$^{2}I_{12}$	4.18
$^{2}I_{72}$	1.21
$^{50}I_{1}$	37.2
$^{50}I_{12}$	7.22
$^{50}I_{72}$	2.28
Skew	0.36
F2 Value	4.28
F50 Value	14.97
Zone	1


LEGEND
RORB MODEL SETUP
NOTE:
THIS PLAN SHOULD BE READ IN CONJUNCTION WITH CENTRAL RB DESIGN PLANS
PRELIMINARY PLAN ONLY
NOT APPROVED FOR CONSTRUCTION
REEDS CONSULTING
CITY OF WHITEHORSE
PROSPECT PARK
STAGE CENTRAL PARK RB
RORB CATCHMENT PLAN
POST - DEVELOPMENT MODEL
RBCD1
E
22355E/C RB

Appendix B – Intensity Frequency Duration Data

Burwood Intensity Frequency Duration Polynomial Coefficients

ARI	Polynomial Coefficients						
	a	b	c	d	e	f	g
1	2.65229273	-5.83E-01	-1.73E-02	8.90E-03	-1.29E-03	-3.79E-04	5.63E-05
2	2.92075205	-5.92E-01	-1.86E-02	8.67E-03	-1.09E-03	-3.30E-04	4.49E-05
5	3.18930864	-6.12E-01	-2.21E-02	7.97E-03	-3.44E-04	-1.75E-04	-1.04E-06
10	3.33296418	-6.23E-01	-2.37E-02	7.23E-03	3.99E-05	-5.42E-05	-2.96E-05
20	3.49902058	-6.32E-01	-2.52E-02	6.25E-03	4.83E-04	1.06E-04	-6.97E-05
50	3.69428802	-6.44E-01	-2.68E-02	5.74E-03	8.39E-04	2.07E-04	-9.54E-05
100	3.82933307	-6.52E-01	-2.83E-02	5.44E-03	1.13E-03	2.67E-04	-1.12E-04

Burwood Intensity Frequency Duration Table

Duration	Average Storm Recurrence Interval (Years)						
	1	2	5	10	20	50	100
5 mins	47.39	62.98	86.07	101.84	122.83	153.02	178.19
6	44.33	58.88	80.32	94.99	114.60	142.69	166.02
7	41.80	55.47	75.50	89.19	107.54	133.75	155.48
8	39.64	52.56	71.38	84.22	101.45	126.02	146.36
9	37.76	50.04	67.80	79.90	96.14	119.28	138.41
10	36.10	47.81	64.66	76.10	91.47	113.36	131.44
11	34.63	45.83	61.86	72.73	87.33	108.12	125.27
12	33.30	44.05	59.36	69.72	83.63	103.44	119.77
13	32.10	42.44	57.11	67.01	80.30	99.24	114.83
14	31.01	40.98	55.06	64.55	77.29	95.43	110.37
15	30.01	39.64	53.19	62.31	74.54	91.97	106.31
16	29.09	38.41	51.48	60.25	72.03	88.81	102.61
17	28.24	37.27	49.89	58.36	69.73	85.91	99.22
18	27.45	36.21	48.43	56.62	67.59	83.23	96.08

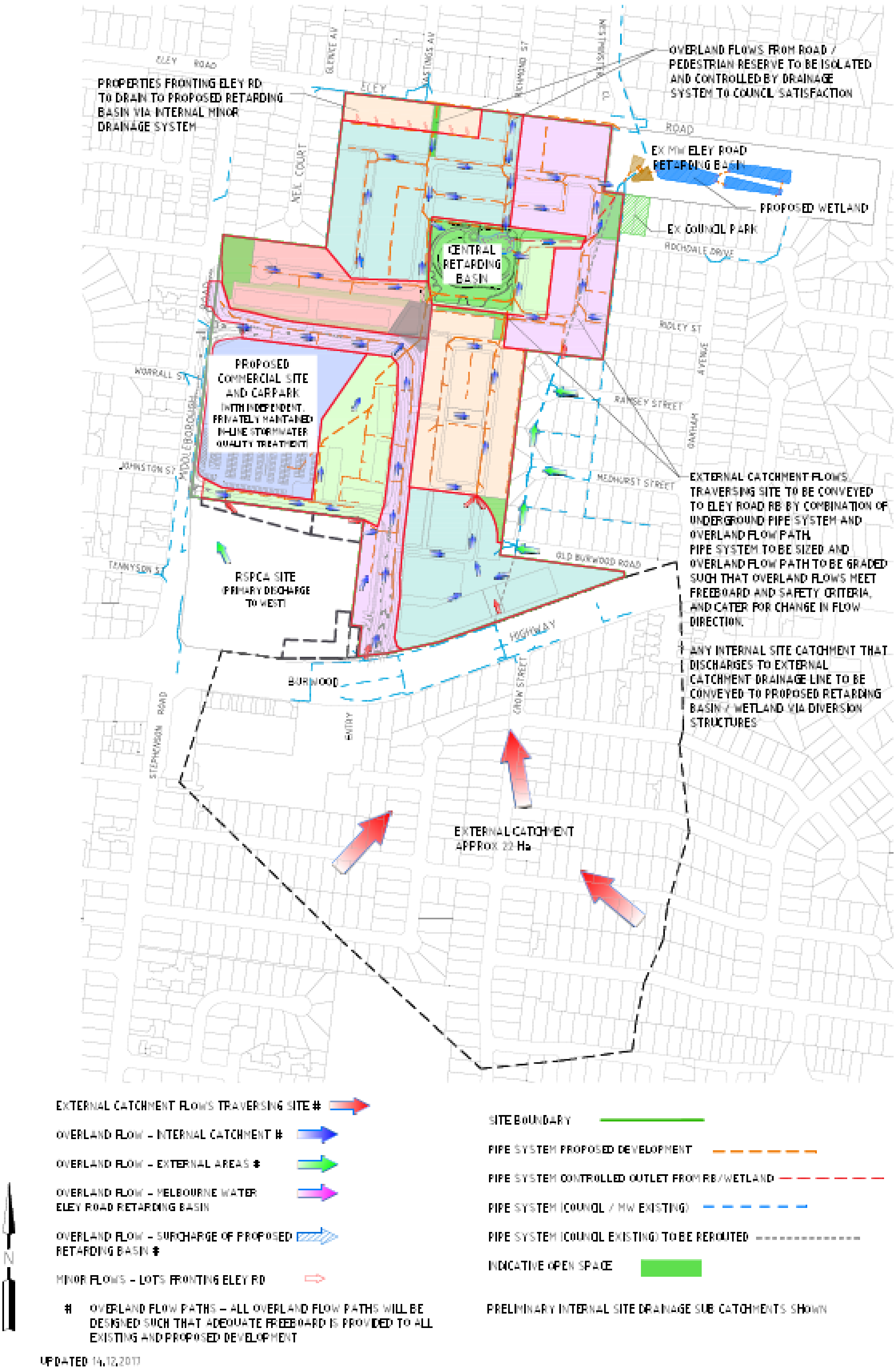
Duration	Average Storm Recurrence Interval (Years)						
	1	2	5	10	20	50	100
19	26.72	35.23	47.07	54.99	65.62	80.75	93.19
20	26.03	34.32	45.80	53.48	63.79	78.45	90.50
21	25.39	33.46	44.62	52.07	62.07	76.31	87.99
22	24.79	32.65	43.51	50.75	60.47	74.30	85.65
23	24.22	31.90	42.47	49.52	58.97	72.42	83.46
24	23.68	31.18	41.49	48.35	57.56	70.66	81.40
25	23.18	30.51	40.56	47.25	56.23	68.99	79.46
26	22.70	29.87	39.69	46.21	54.97	67.42	77.64
27	22.25	29.27	38.86	45.23	53.78	65.94	75.91
28	21.81	28.69	38.07	44.30	52.65	64.53	74.27
29	21.40	28.15	37.32	43.41	51.58	63.20	72.72
30	21.01	27.62	36.61	42.57	50.57	61.93	71.24
35	19.30	25.35	33.50	38.89	46.14	56.42	64.83
40	17.91	23.50	30.98	35.92	42.56	51.97	59.66
45	16.75	21.96	28.89	33.45	39.60	48.29	55.39
50	15.77	20.65	27.12	31.37	37.09	45.19	51.79
55	14.92	19.53	25.60	29.58	34.95	42.53	48.71
60	14.19	18.56	24.27	28.02	33.08	40.22	46.03
75	12.45	16.25	21.15	24.36	28.69	34.79	39.75
90	11.17	14.56	18.88	21.69	25.50	30.85	35.19
2 hrs	9.41	12.24	15.75	18.03	21.13	25.46	28.96
3	7.39	9.56	12.18	13.86	16.16	19.36	21.93
4.5	5.80	7.47	9.42	10.66	12.36	14.72	16.61
6	4.88	6.27	7.85	8.85	10.23	12.14	13.66
9	3.81	4.88	6.08	6.83	7.87	9.30	10.44
12	3.19	4.08	5.08	5.69	6.55	7.73	8.67
18	2.47	3.15	3.93	4.41	5.08	6.00	6.73

Duration	Average Storm Recurrence Interval (Years)						
	1	2	5	10	20	50	100
24	2.04	2.61	3.27	3.67	4.25	5.03	5.65
36	1.54	1.98	2.50	2.83	3.29	3.92	4.42
48	1.25	1.61	2.05	2.33	2.72	3.25	3.69
72	0.91	1.18	1.52	1.74	2.03	2.44	2.78

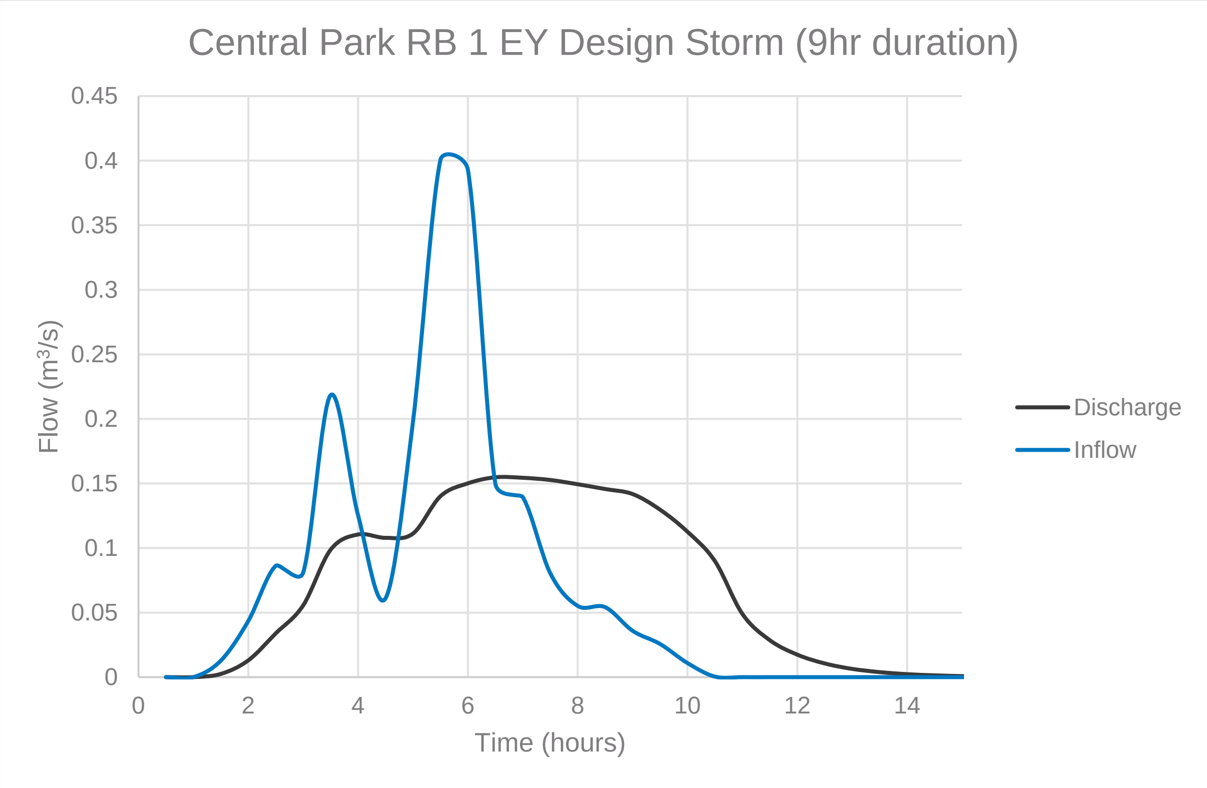
Appendix C – Flow Computations

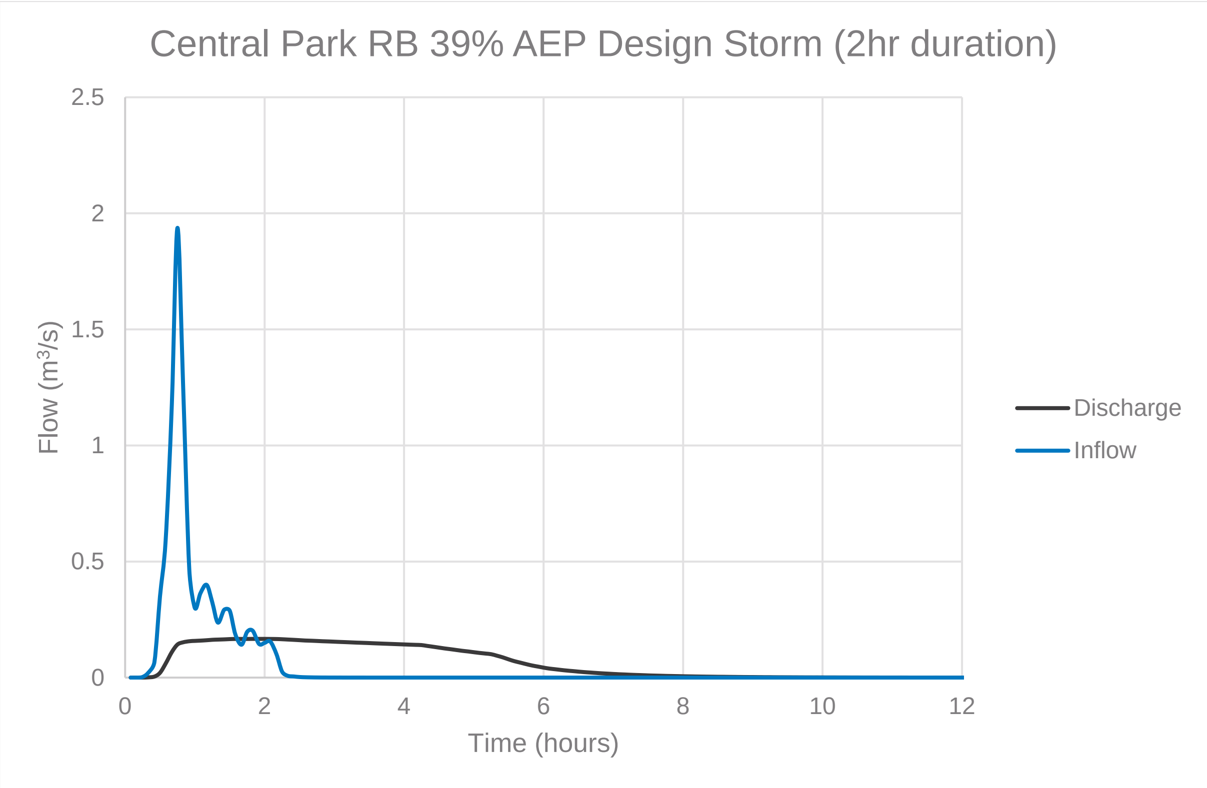
Catchment	Tc (mins)	Area (ha)	C	Ae (ha)	ΣAe (ha)	I_{100} (mm/hr)	Q_{100} (m^3/s)
A							10.50
B	10	2.9	0.850	2.50	2.50	131.44	0.91
C	9	1.8	0.810	1.47	1.47	138.41	0.57
D	5	2.5	0.990	2.48	2.48	178.19	1.23
E	8	1.6	0.900	1.45	4.00	143.62	1.60
F	17	2.4	0.850	2.03	3.98	99.84	4.00
G	16	2.4	0.810	1.94	1.94	102.61	3.45
H	9	1.9	0.810	1.57	5.63	139.54	2.28
I	12	2.2	0.810	1.81	4.86	119.77	1.62
J East	6	1.0	0.810	0.80	0.80	166.02	0.37
J West	6	0.2	0.810	0.14	0.14	166.02	0.06

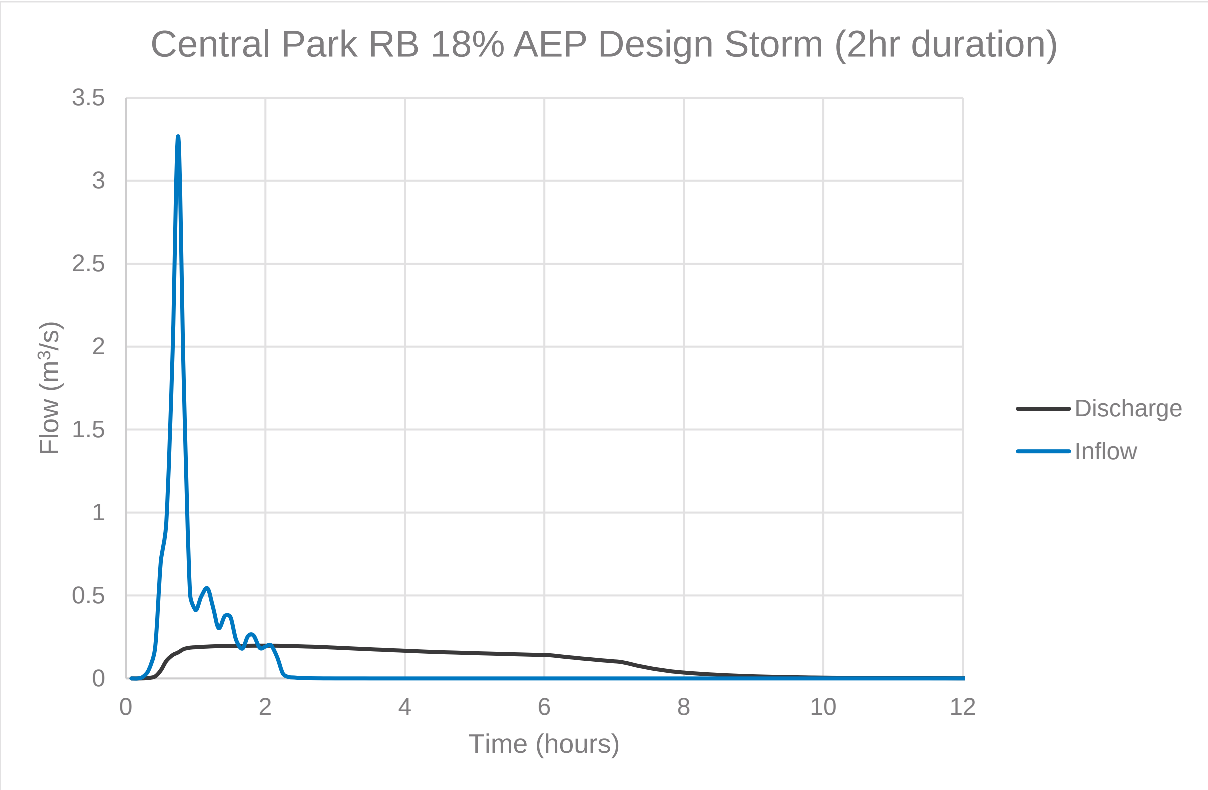
Appendix D – Flow Paths

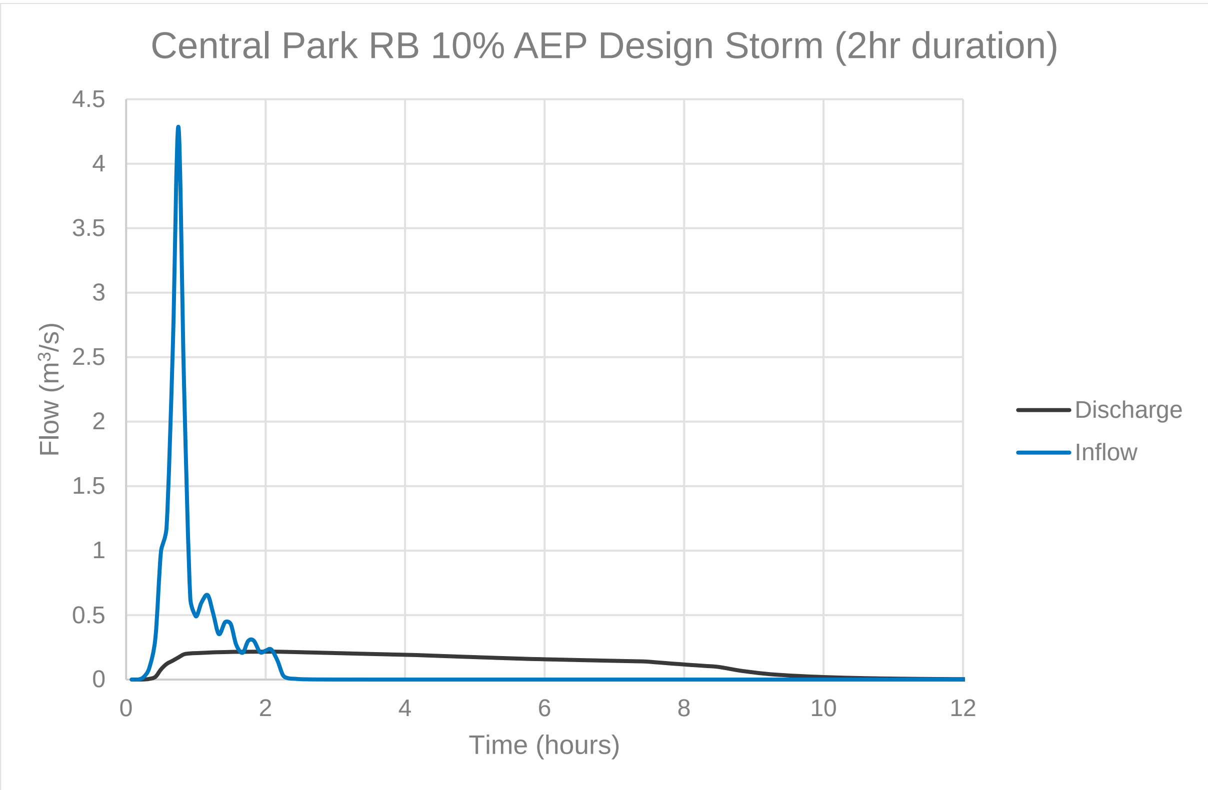

OVERLAND FLOWS FROM ROAD / PEDESTRIAN RESERVE TO BE ISOLATED AND CONTROLLED BY DRAINAGE SYSTEM TO COUNCIL SATISFACTION
PROPERTIES FRONTING ELEY RD TO DRAIN TO PROPOSED RETARDING BASIN VIA INTERNAL MINOR DRAINAGE SYSTEM
ELEY ROAD
EX MW ELEY ROAD RETARDING BASIN
PROPOSED WETLAND
EX COUNCIL PARK
ROCHDALE DRIVE
CENTRAL RETARDING BASIN
NEIL COURT
GLENICE AV
RICHMOND ST
RIDLEY ST
RAMSEY STREET
MEDHURST STREET
OLD BURWOOD ROAD
WORRALL ST
JOHNSTON ST
TENNYSON ST
MIDDLEBOROUGH ROAD
PROPOSED COMMERCIAL SITE AND CARPARK (WITH INDEPENDENT, PRIVATELY MAINTAINED IN-LINE STORMWATER QUALITY TREATMENT)
RSPCA SITE (PRIMARY DISCHARGE TO WEST)
EXTERNAL CATCHMENT FLOWS TRAVERSING SITE TO BE CONVEYED TO ELEY ROAD RB BY COMBINATION OF UNDERGROUND PIPE SYSTEM AND OVERLAND FLOW PATH. PIPE SYSTEM TO BE SIZED AND OVERLAND FLOW PATH TO BE GRADED SUCH THAT OVERLAND FLOWS MEET FREEBOARD AND SAFETY CRITERIA, AND CATER FOR CHANGE IN FLOW DIRECTION.
ANY INTERNAL SITE CATCHMENT THAT DISCHARGES TO EXTERNAL CATCHMENT DRAINAGE LINE TO BE CONVEYED TO PROPOSED RETARDING BASIN / WETLAND VIA DIVERSION STRUCTURES
BURWOOD HIGHWAY
CROW STREET
ENTRY
STEPHENSON ROAD
EXTERNAL CATCHMENT APPROX 22 Ha
EXTERNAL CATCHMENT FLOWS TRAVERSING SITE #
OVERLAND FLOW - INTERNAL CATCHMENT #
OVERLAND FLOW - EXTERNAL AREAS #
OVERLAND FLOW - MELBOURNE WATER ELEY ROAD RETARDING BASIN
OVERLAND FLOW - SURCHARGE OF PROPOSED RETARDING BASIN #
MINOR FLOWS - LOTS FRONTING ELEY RD
SITE BOUNDARY
PIPE SYSTEM PROPOSED DEVELOPMENT
PIPE SYSTEM CONTROLLED OUTLET FROM RB / WETLAND
PIPE SYSTEM (COUNCIL / MW EXISTING)
PIPE SYSTEM (COUNCIL EXISTING) TO BE REROUTED
INDICATIVE OPEN SPACE
N
OVERLAND FLOW PATHS - ALL OVERLAND FLOW PATHS WILL BE DESIGNED SUCH THAT ADEQUATE FREEBOARD IS PROVIDED TO ALL EXISTING AND PROPOSED DEVELOPMENT
PRELIMINARY INTERNAL SITE DRAINAGE SUB CATCHMENTS SHOWN
UPDATED 14.12.2017

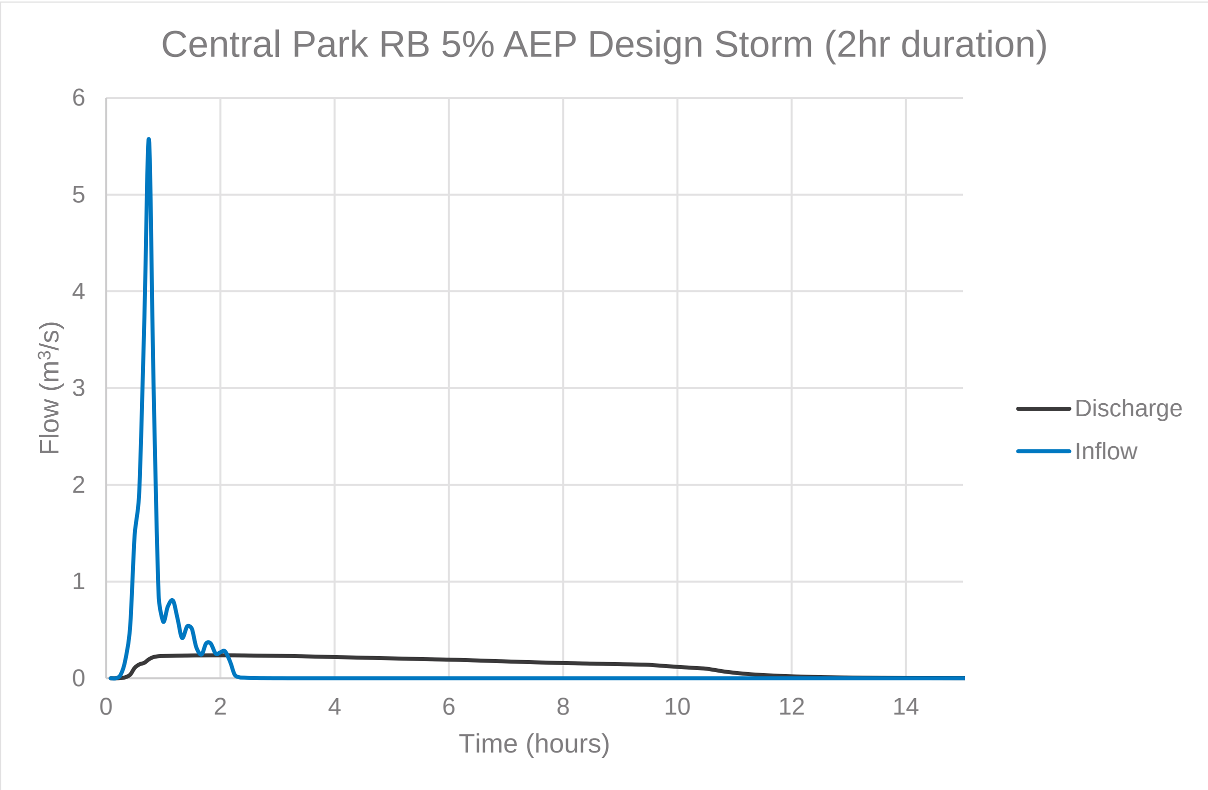
Appendix E – Central Park Retarding Basin Hydrographs

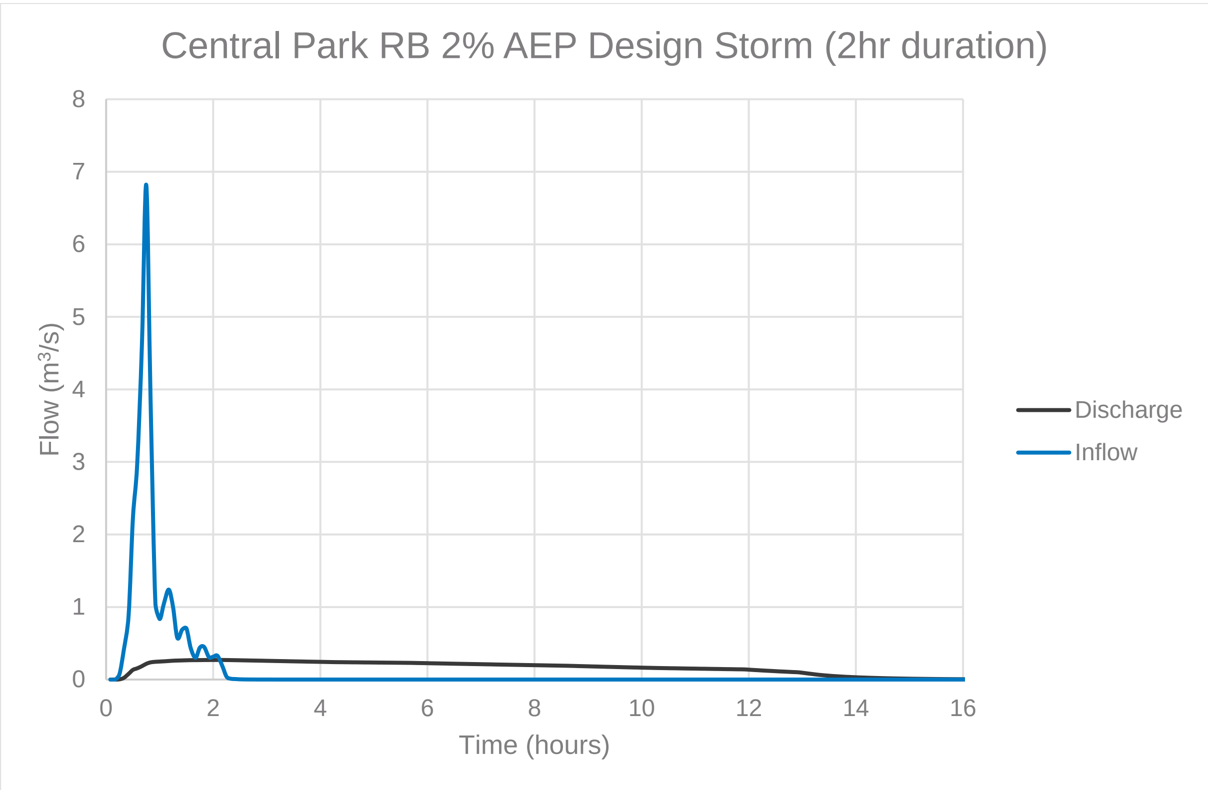


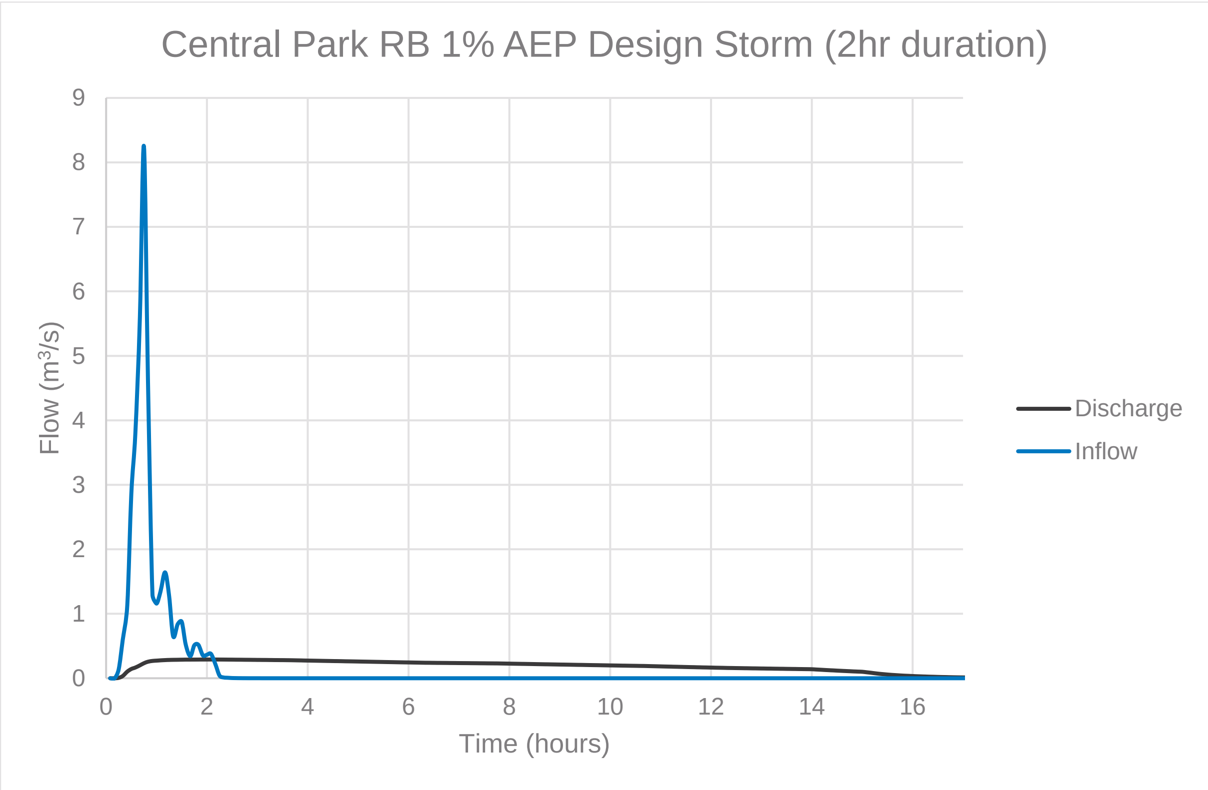



Central Park RB 18% AEP Design Storm (2hr duration)
Flow (m3/s)
3.5
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
10
12
Time (hours)
Discharge
Inflow


Central Park RB 10% AEP Design Storm (2hr duration)
Flow (m3/s)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
10
12
Time (hours)
Discharge
Inflow

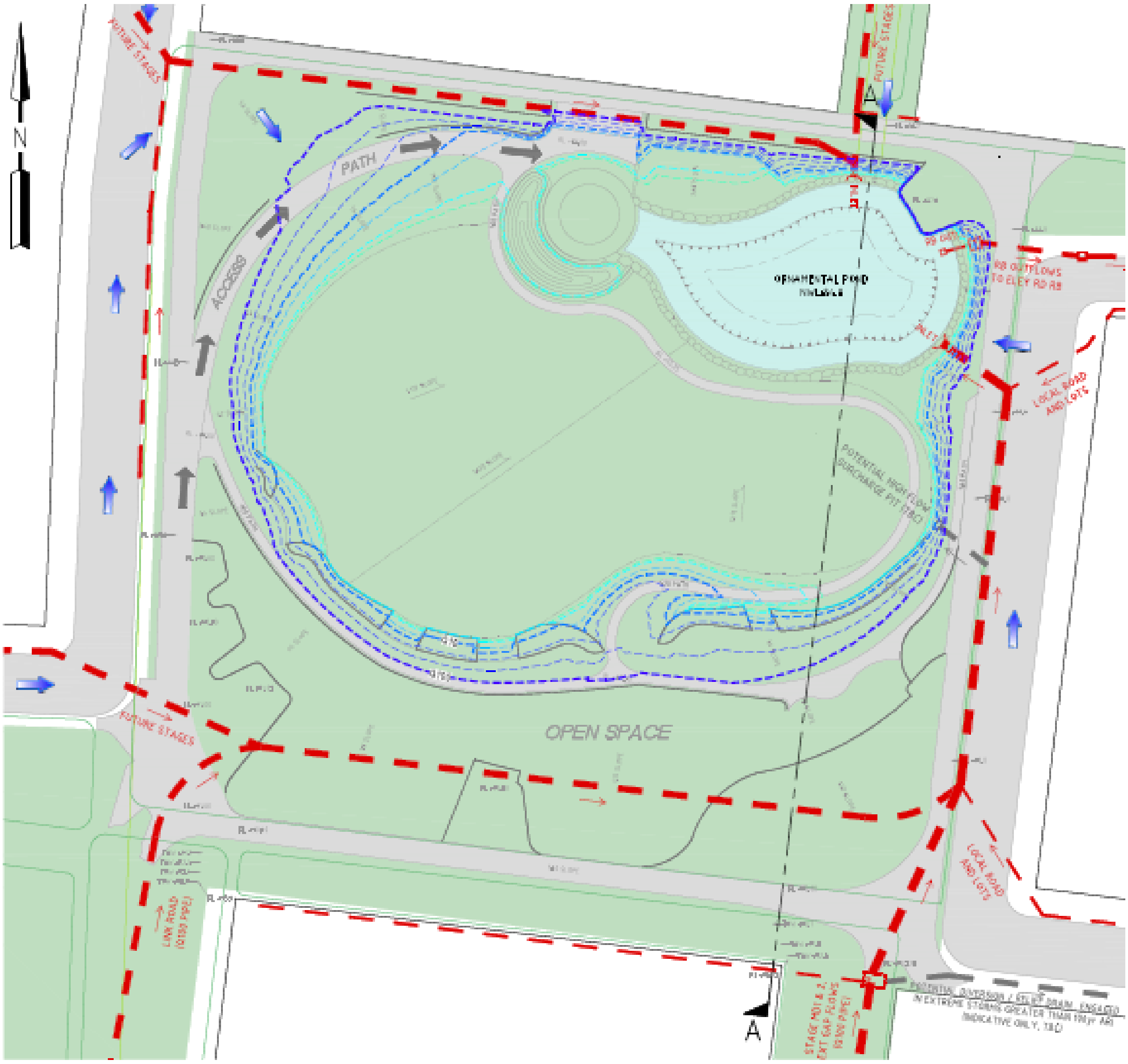

Central Park RB 5% AEP Design Storm (2hr duration)
Flow (m3/s)
0
1
2
3
4
5
6
0
2
4
6
8
10
12
14
Time (hours)
Discharge
Inflow


Central Park RB 2% AEP Design Storm (2hr duration)
Flow (m3/s)
0
1
2
3
4
5
6
7
8
0
2
4
6
8
10
12
14
16
Time (hours)
Discharge
Inflow

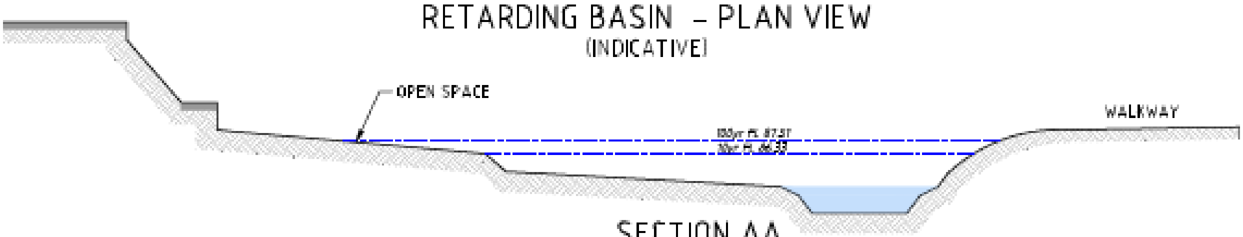


Central Park RB 1% AEP Design Storm (2hr duration)
Flow (m3/s)
9
8
7
6
5
4
3
2
1
0
0
2
4
6
8
10
12
14
16
Time (hours)
Discharge
Inflow

Appendix F – Central Park Retarding Basin Layout and Section



RETARDING BASIN – PLAN VIEW
(INDICATIVE)



SECTION AA
(INDICATIVE, NOT TO SCALE)

CENTRAL RB FLOOD LEVELS
RORB MODEL REVIEW BY INCITUS

ARI	FLOOD LEVEL (m AHD)	FLOOD SURFACE AREA (m^2)	FLOOD STORAGE VOLUME (m^3)
100YR	87.51	5580	10,100
50YR	87.12	5210	7,980
20YR	86.68	4830	5,770
10YR	86.33	4550	4,110
5YR	86.09	4360	3,100
2YR	85.81	3980	1,900
1YR	85.68	3480	1,440

LEGEND

INDICATIVE FINISHED SURFACE LEVELS — FL +90.50

INDICATIVE PIPE ALIGNMENTS (SHOWING DIRECTION OF FLOW)

SITE ACCESS MAINTENANCE

MAJOR STORM OVERLAND FLOW PATH

Appendix G – Melbourne Water Acceptance of Eley Road Modelling

Melbourne Water

18 May 2017

Sasha Jelicic
Drainage Engineer
Reeds Consultant
Level, 6 440 Elizabeth Street
MELBOURNE

Formal Approval Letter for Stormwater Management Strategy at Burwood Brickworks Stage 1 prepared by Reed Consultant.

In line with ongoing discussions on this development, the following attachments were submitted by Reeds Consultants for approval:

- Updated RORB model (plan 22355_RB – RORB_1D)
- Updated Central RB layout (plan 22355_RB – CD1D)
- Summary of RORB flows for internal RB and Eley Road RB (22355 – CENTRAL RB RORB FLOWS REV 3 – SUMMARY 2016 12 09. docx)
- Updated RORB model and critical 100yr output files (15mins, 2 hr, 9hr)

We have undertaken an assessment of this information and are satisfied that there are no adverse impacts on Eley Road RB or downstream flows, and that the Central Park RB will function as intended.

Based on these results, Melbourne Water has ***no objection*** to the updated proposal as per submitted plans and computations.

Yours sincerely,

Keith Boniface

KEITH BONIFACE
TECHNICAL LEAD
SERVICE DELIVERY - WATERWAYS AND LAND

J.P.

JOE PANG
DRAINAGE ENGINEER
SERVICE DELIVERY - WATERWAYS AND LAND

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990 La Trobe Street Docklands VIC 3008
PO Box 4342 Melbourne VIC 3001 Australia
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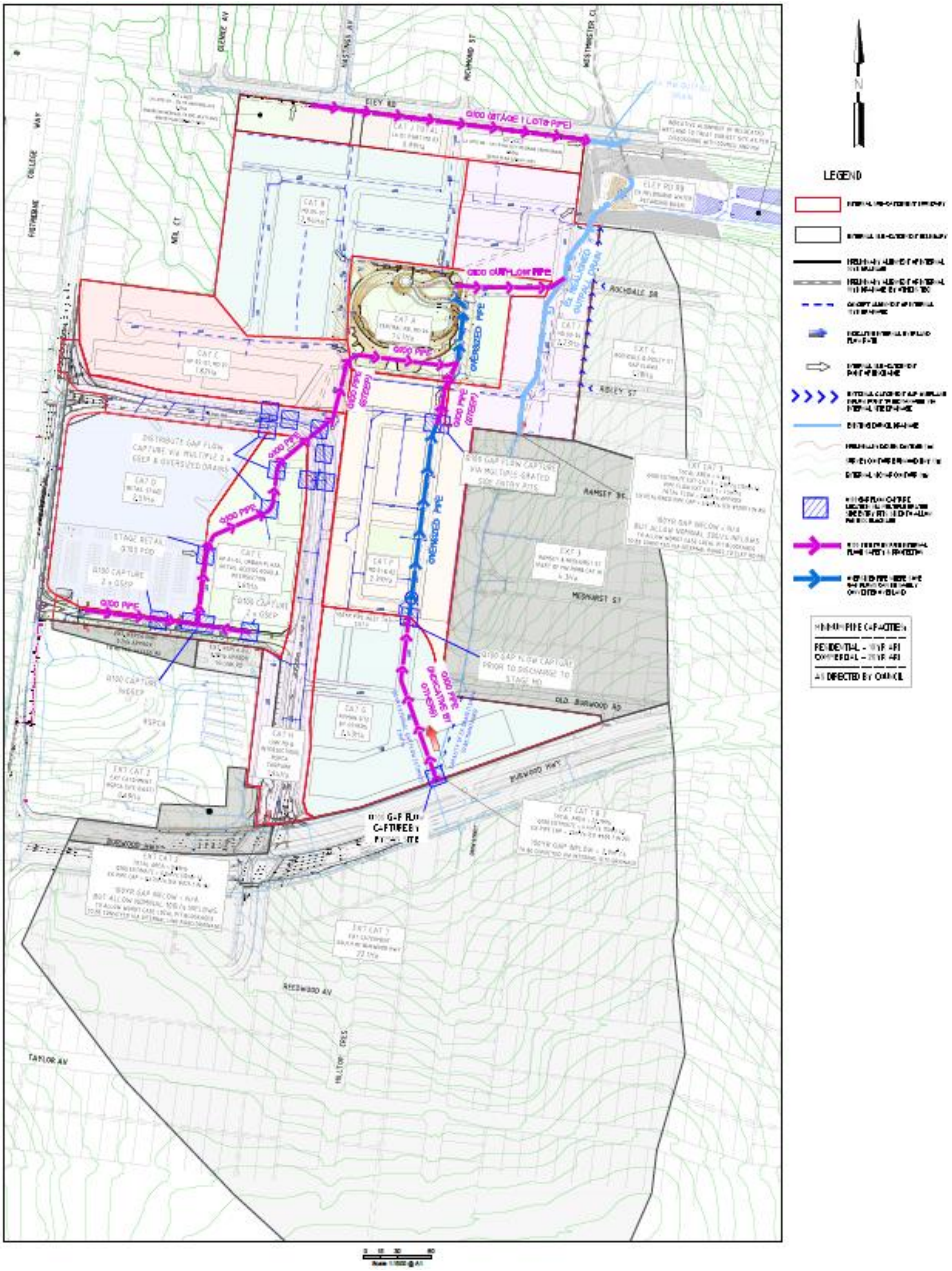
melbournewater.com.au

Appendix H – Pipes Exceeding 10% AEP Capacity


LEGEND
MINIMUM PIPE CAPACITIES
RESIDENTIAL - 5YR ARI
COMMERCIAL - 20YR ARI
AS DIRECTED BY COUNCIL
Q100 (STAGE 1 LOTS PIPE)
Q100 OUTFLOW PIPE
Q100 PIPE
OVERSIZED PIPE
ELGAR RD
HASTINGS AV
RICHMOND ST
WESTMINSTER CL
ROCHDALE DR
ASHLEY ST
RAMSEY ST
MEDHURST ST
OLD BURWOOD RD
BURWOOD HWY
REDWOOD AV
HILLTOP CRES
TAYLOR AV
COLLEGE WAY

Appendix I – Overland Flow Safety Hydraulic Model Output

Link Road Output Based on a 1 in 50 Longitudinal Grade (NB: Only a sample has been included due to the amount of data)

River Station	Q (m^3/s)	Min Ch Elev (m)	W.S. Elev (m)	Vel Chan (m/s)	Flow Area (m^2)	Top Width (m)	D_{av} (m)	$V_{av}.D_{av}$ (m^2/s)	$D_{av} < 0.3$ (m)	$V_{av}.D_{av} < 0.35$ (m^2/s)
170.*	2	103.22	103.42	1.92	1.24	17.95	0.07	0.13	okay	okay
170.*	5	103.22	103.47	2.62	2.4	21.87	0.11	0.29	okay	okay
170.*	6	103.22	103.49	2.79	2.72	22.44	0.12	0.34	okay	okay
170.*	6.5	103.22	103.5	2.87	2.87	22.72	0.13	0.36	okay	fail
160.*	2	103.02	103.22	1.92	1.24	17.95	0.07	0.13	okay	okay
160.*	5	103.02	103.27	2.64	2.39	21.84	0.11	0.29	okay	okay
160.*	6	103.02	103.29	2.8	2.71	22.44	0.12	0.34	okay	okay
160.*	6.5	103.02	103.3	2.88	2.87	22.71	0.13	0.36	okay	fail
150.*	2	102.82	103.02	1.92	1.24	17.95	0.07	0.13	okay	okay
150.*	5	102.82	103.07	2.62	2.4	21.87	0.11	0.29	okay	okay
150.*	6	102.82	103.09	2.8	2.71	22.43	0.12	0.34	okay	okay
150.*	6.5	102.82	103.1	2.88	2.86	22.71	0.13	0.36	okay	fail
140.*	2	102.62	102.82	1.92	1.24	17.95	0.07	0.13	okay	okay
140.*	5	102.62	102.87	2.64	2.38	21.84	0.11	0.29	okay	okay

River Station	Q (m^3/s)	Min Ch Elev (m)	W.S. Elev (m)	Vel Chan (m/s)	Flow Area (m^2)	Top Width (m)	D_{av} (m)	$V_{av}.D_{av}$ (m^2/s)	$D_{av} < 0.3$ (m)	$V_{av}.D_{av} < 0.35$ (m^2/s)
140.*	6	102.62	102.89	2.79	2.72	22.45	0.12	0.34	okay	okay
140.*	6.5	102.62	102.9	2.87	2.87	22.72	0.13	0.36	okay	fail
130.*	2	102.42	102.62	1.92	1.24	17.95	0.07	0.13	okay	okay
130.*	5	102.42	102.67	2.63	2.4	21.87	0.11	0.29	okay	okay
130.*	6	102.42	102.69	2.81	2.7	22.42	0.12	0.34	okay	okay
130.*	6.5	102.42	102.7	2.88	2.86	22.7	0.13	0.36	okay	fail
120.*	2	103.22	103.42	1.92	1.24	17.95	0.07	0.13	okay	okay
120.*	5	103.22	103.47	2.62	2.4	21.87	0.11	0.29	okay	okay
120.*	6	103.22	103.49	2.79	2.72	22.44	0.12	0.34	okay	okay
120.*	6.5	103.22	103.5	2.87	2.87	22.72	0.13	0.36	okay	fail
110.*	2	103.02	103.22	1.92	1.24	17.95	0.07	0.13	okay	okay
110.*	5	103.02	103.27	2.64	2.39	21.84	0.11	0.29	okay	okay
110.*	6	103.02	103.29	2.8	2.71	22.44	0.12	0.34	okay	okay
110.*	6.5	103.02	103.3	2.88	2.87	22.71	0.13	0.36	okay	fail
100.*	2	102.82	103.02	1.92	1.24	17.95	0.07	0.13	okay	okay
100.*	5	102.82	103.07	2.62	2.4	21.87	0.11	0.29	okay	okay
100.*	6	102.82	103.09	2.8	2.71	22.43	0.12	0.34	okay	okay

River Station	Q (m^3/s)	Min Ch Elev (m)	W.S. Elev (m)	Vel Chan (m/s)	Flow Area (m^2)	Top Width (m)	D_{av} (m)	$V_{av}.D_{av}$ (m^2/s)	$D_{av} < 0.3$ (m)	$V_{av}.D_{av} < 0.35$ (m^2/s)
100.*	6.5	102.82	103.1	2.88	2.86	22.71	0.13	0.36	okay	fail
90.*	2	102.62	102.82	1.92	1.24	17.95	0.07	0.13	okay	okay
90.*	5	102.62	102.87	2.64	2.38	21.84	0.11	0.29	okay	okay
90.*	6	102.62	102.89	2.79	2.72	22.45	0.12	0.34	okay	okay
90.*	6.5	102.62	102.9	2.87	2.87	22.72	0.13	0.36	okay	fail
79.9999*	2	101.42	101.62	1.92	1.24	17.95	0.07	0.13	okay	okay
79.9999*	5	101.42	101.67	2.64	2.38	21.84	0.11	0.29	okay	okay
79.9999*	6	101.42	101.69	2.8	2.71	22.43	0.12	0.34	okay	okay
79.9999*	6.5	101.42	101.7	2.88	2.86	22.71	0.13	0.36	okay	fail
70.0000*	2	101.22	101.42	1.92	1.24	17.95	0.07	0.13	okay	okay
70.0000*	5	101.22	101.47	2.64	2.38	21.84	0.11	0.29	okay	okay
70.0000*	6	101.22	101.49	2.8	2.71	22.43	0.12	0.34	okay	okay
70.0000*	6.5	101.22	101.5	2.88	2.86	22.71	0.13	0.36	okay	fail
60.*	2	101.02	101.22	1.92	1.24	17.96	0.07	0.13	okay	okay
60.*	5	101.02	101.27	2.64	2.39	21.85	0.11	0.29	okay	okay
60.*	6	101.02	101.29	2.8	2.71	22.44	0.12	0.34	okay	okay
60.*	6.5	101.02	101.3	2.88	2.87	22.71	0.13	0.36	okay	fail

14 m Access Street Output Based on a 1 in 50 Longitudinal Grade (NB: Only a sample has been included due to the amount of data)

River Station	Q (m^3/s)	Min Ch Elev (m)	W.S. Elev (m)	Vel Chan (m/s)	Flow Area (m^2)	Top Width (m)	D_{av} (m)	$V_{av}.D_{av}$ (m^2/s)	D_{av} < 0.3 (m)	$V_{av}.D_{av}$ < 0.35 (m^2/s)
170.*	2	103.29	103.46	2.23	1.02	12.43	0.08	0.16	okay	okay
170.*	3	103.29	103.49	2.55	1.39	14	0.10	0.21	okay	okay
170.*	4	103.29	103.51	2.79	1.72	14	0.12	0.29	okay	okay
170.*	5	103.29	103.53	2.99	2.01	14	0.14	0.36	okay	fail
160.*	2	103.09	103.26	2.23	1.02	12.42	0.08	0.16	okay	okay
160.*	3	103.09	103.29	2.56	1.39	14	0.10	0.21	okay	okay
160.*	4	103.09	103.31	2.81	1.7	14	0.12	0.29	okay	okay
160.*	5	103.09	103.33	3.03	1.99	14	0.14	0.36	okay	fail
150.*	2	102.89	103.06	2.23	1.02	12.42	0.08	0.16	okay	okay
150.*	3	102.89	103.09	2.56	1.39	14	0.10	0.21	okay	okay
150.*	4	102.89	103.11	2.82	1.7	14	0.12	0.29	okay	okay
150.*	5	102.89	103.13	3.04	1.98	14	0.14	0.36	okay	fail
140.*	2	102.69	102.86	2.22	1.02	12.43	0.08	0.16	okay	okay
140.*	3	102.69	102.89	2.57	1.38	14	0.10	0.21	okay	okay
140.*	4	102.69	102.91	2.83	1.69	14	0.12	0.29	okay	okay
140.*	5	102.69	102.93	3.04	1.98	14	0.14	0.36	okay	fail

River Station	Q (m^3/s)	Min Ch Elev (m)	W.S. Elev (m)	Vel Chan (m/s)	Flow Area (m^2)	Top Width (m)	D_{av} (m)	$V_{av}.D_{av}$ (m^2/s)	$D_{av} < 0.3$ (m)	$V_{av}.D_{av} < 0.35$ (m^2/s)
130.*	2	102.49	102.66	2.23	1.02	12.42	0.08	0.16	okay	okay
130.*	3	102.49	102.69	2.57	1.38	14	0.10	0.21	okay	okay
130.*	4	102.49	102.71	2.83	1.69	14	0.12	0.29	okay	okay
130.*	5	102.49	102.73	3.05	1.97	14	0.14	0.36	okay	fail
120.*	2	102.29	102.46	2.23	1.02	12.43	0.08	0.16	okay	okay
120.*	3	102.29	102.49	2.57	1.38	14	0.10	0.21	okay	okay
120.*	4	102.29	102.51	2.83	1.69	14	0.12	0.29	okay	okay
120.*	5	102.29	102.53	3.05	1.97	14	0.14	0.36	okay	fail
110.*	2	102.09	102.26	2.23	1.02	12.43	0.08	0.16	okay	okay
110.*	3	102.09	102.29	2.57	1.38	14	0.10	0.21	okay	okay
110.*	4	102.09	102.31	2.83	1.69	14	0.12	0.29	okay	okay
110.*	5	102.09	102.33	3.05	1.97	14	0.14	0.36	okay	fail
100.*	2	101.89	102.06	2.23	1.02	12.41	0.08	0.16	okay	okay
100.*	3	101.89	102.09	2.57	1.38	14	0.10	0.21	okay	okay
100.*	4	101.89	102.11	2.83	1.69	14	0.12	0.29	okay	okay
100.*	5	101.89	102.13	3.05	1.97	14	0.14	0.36	okay	fail
90.*	2	101.69	101.86	2.23	1.02	12.41	0.08	0.16	okay	okay

River Station	Q (m^3/s)	Min Ch Elev (m)	W.S. Elev (m)	Vel Chan (m/s)	Flow Area (m^2)	Top Width (m)	D_{av} (m)	$V_{av}.D_{av}$ (m^2/s)	D_{av} < 0.3 (m)	$V_{av}.D_{av}$ < 0.35 (m^2/s)
90.*	3	101.69	101.89	2.57	1.38	14	0.10	0.21	okay	okay
90.*	4	101.69	101.91	2.83	1.69	14	0.12	0.29	okay	okay
90.*	5	101.69	101.93	3.05	1.97	14	0.14	0.36	okay	fail
79.9999*	2	101.49	101.66	2.23	1.02	12.42	0.08	0.16	okay	okay
79.9999*	3	101.49	101.69	2.57	1.38	14	0.10	0.21	okay	okay
79.9999*	4	101.49	101.71	2.83	1.7	14	0.12	0.29	okay	okay
79.9999*	5	101.49	101.73	3.05	1.97	14	0.14	0.36	okay	fail
70.0000*	2	101.29	101.46	2.23	1.02	12.43	0.08	0.16	okay	okay
70.0000*	3	101.29	101.49	2.57	1.38	14	0.10	0.21	okay	okay
70.0000*	4	101.29	101.51	2.83	1.7	14	0.12	0.29	okay	okay
70.0000*	5	101.29	101.53	3.05	1.97	14	0.14	0.36	okay	fail
60.*	2	101.09	101.26	2.23	1.02	12.43	0.08	0.16	okay	okay
60.*	3	101.09	101.29	2.56	1.39	14	0.10	0.21	okay	okay
60.*	4	101.09	101.31	2.83	1.7	14	0.12	0.29	okay	okay
60.*	5	101.09	101.33	3.05	1.97	14	0.14	0.36	okay	fail

Shared Path Output Based on a 1 in 14 Longitudinal Grade prior to transitioning to a required 1 in 50 Longitudinal Grade section

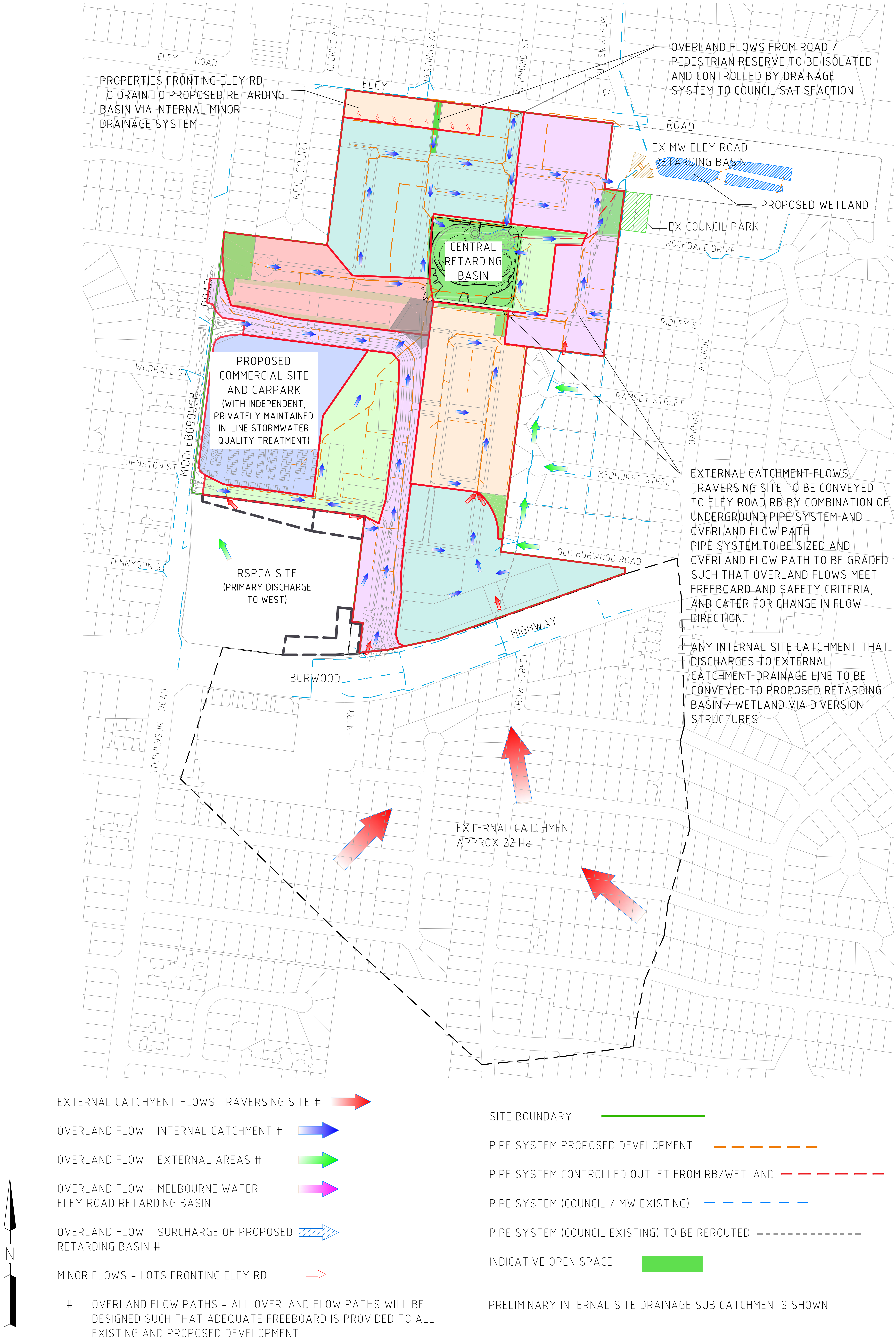
(NB: Only a sample has been included due to the amount of data)

River Station	Q (m^3/s)	Min Ch Elev (m)	W.S. Elev (m)	Vel Chan (m/s)	Flow Area (m^2)	Top Width (m)	D_{av} (m)	$V_{av}.D_{av}$ (m^2/s)	$D_{av} < 0.3$ (m)	$V_{av}.D_{av} < 0.35$ (m^2/s)
4.97777*	1	94.86	95.02	2.89	0.41	3.8	0.11	0.26	okay	okay
4.97777*	1.3	94.86	95.05	3.03	0.53	4.09	0.13	0.32	okay	okay
4.97777*	1.4	94.86	95.05	3.08	0.56	4.18	0.13	0.33	okay	okay
4.97777*	1.5	94.86	95.06	3.12	0.6	4.27	0.14	0.35	okay	fail
4.97777*	1.8	94.86	95.09	3.22	0.72	4.54	0.16	0.40	okay	fail
4.48*	1	94.83	94.98	2.97	0.4	3.77	0.11	0.27	okay	okay
4.48*	1.3	94.83	95.01	3.12	0.51	4.05	0.13	0.32	okay	okay
4.48*	1.4	94.83	95.01	3.16	0.55	4.14	0.13	0.34	okay	okay
4.48*	1.5	94.83	95.02	3.2	0.58	4.23	0.14	0.35	okay	fail
4.48*	1.8	94.83	95.05	3.31	0.7	4.48	0.16	0.40	okay	fail
3.98222*	1	94.79	94.94	3.04	0.39	3.74	0.10	0.27	okay	okay
3.98222*	1.3	94.79	94.97	3.19	0.5	4.01	0.12	0.32	okay	okay
3.98222*	1.4	94.79	94.97	3.24	0.53	4.1	0.13	0.34	okay	okay
3.98222*	1.5	94.79	94.98	3.28	0.57	4.19	0.14	0.36	okay	fail
3.98222*	1.8	94.79	95.01	3.4	0.68	4.44	0.15	0.41	okay	fail

River Station	Q (m^3/s)	Min Ch Elev (m)	W.S. Elev (m)	Vel Chan (m/s)	Flow Area (m^2)	Top Width (m)	D_{av} (m)	$V_{av}.D_{av}$ (m^2/s)	$D_{av} < 0.3$ (m)	$V_{av}.D_{av} < 0.35$ (m^2/s)
3.48444*	1	94.75	94.9	3.1	0.38	3.71	0.10	0.27	okay	okay
3.48444*	1.3	94.75	94.93	3.26	0.48	3.99	0.12	0.33	okay	okay
3.48444*	1.4	94.75	94.94	3.31	0.52	4.07	0.13	0.34	okay	okay
3.48444*	1.5	94.75	94.94	3.35	0.55	4.16	0.13	0.36	okay	fail
3.48444*	1.8	94.75	94.97	3.47	0.66	4.4	0.15	0.41	okay	fail
2.98666*	1	94.72	94.86	3.16	0.37	3.69	0.10	0.27	okay	okay
2.98666*	1.3	94.72	94.89	3.33	0.47	3.96	0.12	0.33	okay	okay
2.98666*	1.4	94.72	94.9	3.38	0.51	4.04	0.13	0.35	okay	okay
2.98666*	1.5	94.72	94.91	3.42	0.54	4.12	0.13	0.36	okay	fail
2.98666*	1.8	94.72	94.93	3.54	0.64	4.37	0.15	0.41	okay	fail
2.48888*	1	94.68	94.83	3.21	0.37	3.68	0.10	0.27	okay	okay
2.48888*	1.3	94.68	94.85	3.39	0.46	3.93	0.12	0.33	okay	okay
2.48888*	1.4	94.68	94.86	3.44	0.5	4.02	0.12	0.35	okay	okay
2.48888*	1.5	94.68	94.87	3.48	0.53	4.1	0.13	0.37	okay	fail
2.48888*	1.8	94.68	94.89	3.61	0.63	4.33	0.15	0.42	okay	fail
1.99111*	1	94.65	94.79	3.26	0.36	3.66	0.10	0.27	okay	okay
1.99111*	1.3	94.65	94.81	3.44	0.46	3.91	0.12	0.33	okay	okay

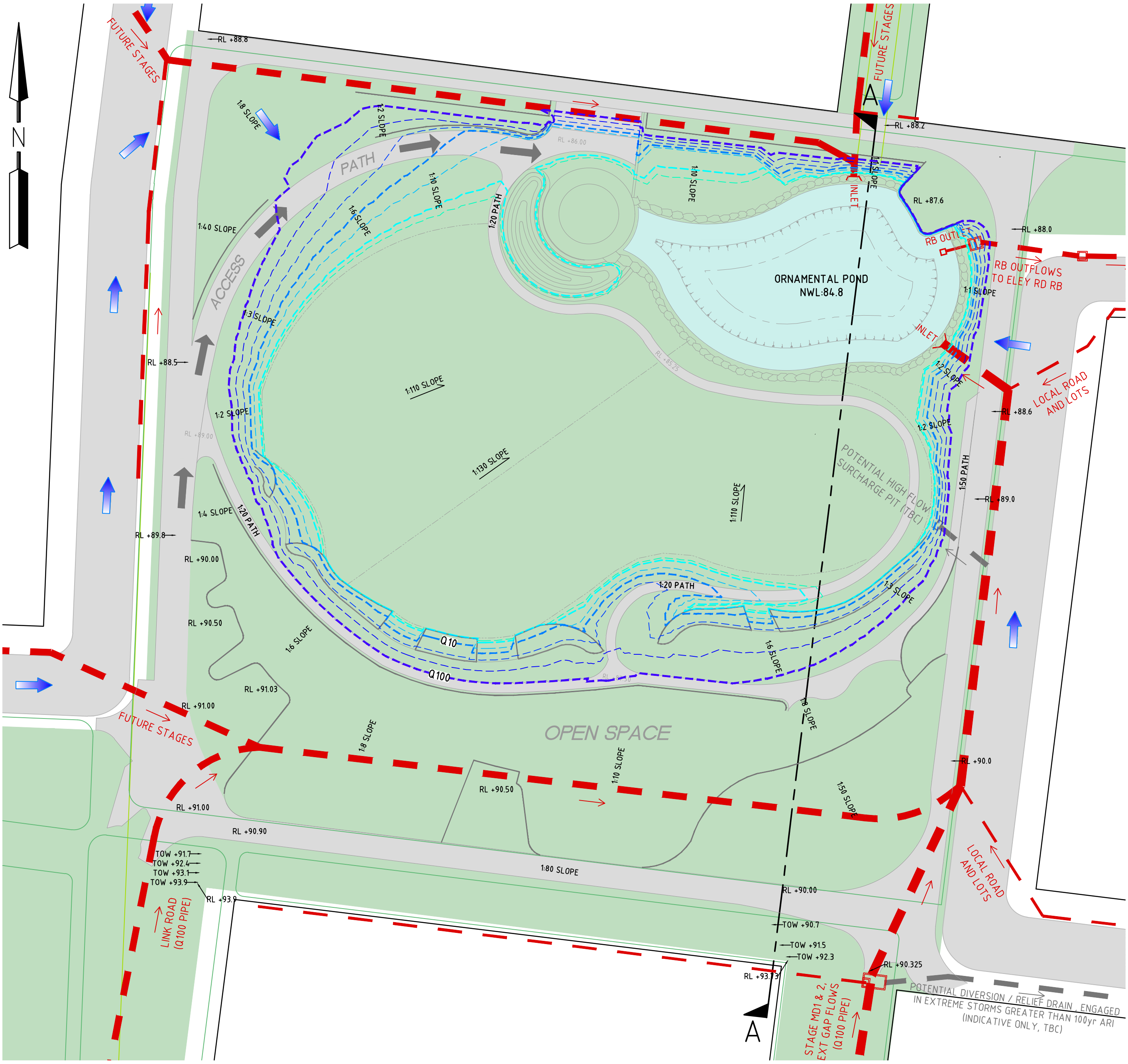
River Station	Q (m^3/s)	Min Ch Elev (m)	W.S. Elev (m)	Vel Chan (m/s)	Flow Area (m^2)	Top Width (m)	D_{av} (m)	$V_{av}.D_{av}$ (m^2/s)	$D_{av} < 0.3$ (m)	$V_{av}.D_{av} < 0.35$ (m^2/s)
1.99111*	1.4	94.65	94.82	3.5	0.49	3.99	0.12	0.35	okay	fail
1.99111*	1.5	94.65	94.83	3.54	0.52	4.07	0.13	0.37	okay	fail
1.99111*	1.8	94.65	94.85	3.67	0.62	4.3	0.14	0.42	okay	fail
1.49333*	1	94.61	94.75	3.3	0.35	3.64	0.10	0.27	okay	okay
1.49333*	1.3	94.61	94.78	3.49	0.45	3.89	0.12	0.33	okay	okay
1.49333*	1.4	94.61	94.78	3.55	0.48	3.97	0.12	0.35	okay	fail
1.49333*	1.5	94.61	94.79	3.6	0.51	4.05	0.13	0.37	okay	fail
1.49333*	1.8	94.61	94.81	3.73	0.61	4.28	0.14	0.42	okay	fail
.995554*	1	94.58	94.71	3.34	0.35	3.63	0.10	0.28	okay	okay
.995554*	1.3	94.58	94.74	3.54	0.44	3.87	0.11	0.34	okay	okay
.995554*	1.4	94.58	94.75	3.6	0.47	3.95	0.12	0.35	okay	fail
.995554*	1.5	94.58	94.75	3.65	0.5	4.03	0.12	0.37	okay	fail
.995554*	1.8	94.58	94.78	3.78	0.6	4.25	0.14	0.42	okay	fail

Appendix J – A3 Plans



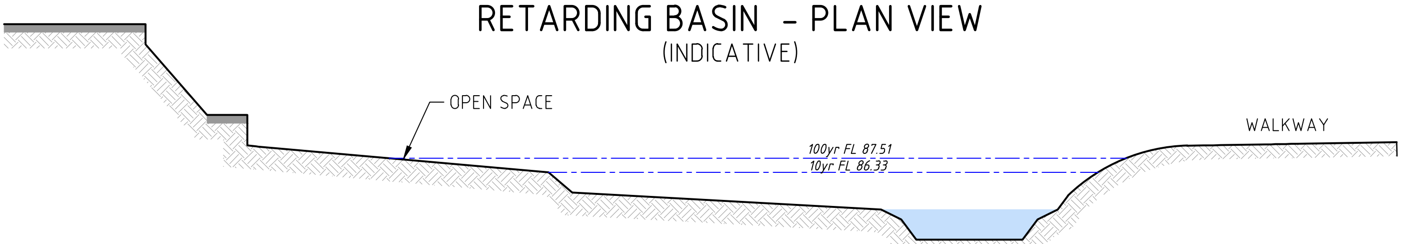
UPDATED 14.12.2017


ELEY RD
GLENICE AV
HASTINGS AV
RICHMOND ST
WESTMINSTER CL
COLLEGE WAY
FIGTREE LANE
NEIL CT
MIDDLEBOROUGH RD
ROCHDALE DR
RIDLEY ST
RAMSEY ST
MEDHURST ST
OLD BURWOOD RD
BURWOOD HWY
REEDWOOD AV
HILLTOP CRES
TAYLOR AV
CROW STREET
LINK RD
RETAIL ACCESS RD
RSPCA
Ex. MW OUTFALL DRAIN
Ex. REALIGNED OUTFALL DRAIN
CAT J WEST
LA LOTS 101 - 104 TO HASTINGS AVE
0.17Ha
ENSURE NO INCREASE TO PRE-DEV FLOWS
(REFER PLAN 22355/1-1C01)
CAT J TOTAL
LA 01, PART MD 03
0.99Ha
CAT J EAST
LA LOTS 105 - 116 TO MW ELEY RD DRAIN (100YR DRAIN)
0.82Ha
(REFER PLAN 22355/1-1C01)
Q100 (STAGE 1 LOTS PIPE)
INDICATIVE ALIGNMENT OF RELOCATED WETLAND TO TREAT SUBJECT SITE AS PER DISCUSSIONS WITH COUNCIL AND MW
ELEY RD RB
EX MELBOURNE WATER RETARDING BASIN
CAT B
MD 05-07
2.94Ha
CAT A
CENTRAL RB, MD 04
1.47Ha
Q100 OUTFLOW PIPE
CAT C
AP 05-07, MD 07
1.82Ha
Q100 PIPE
Q100 PIPE (STEEP)
OVERSIZED PIPE
CAT I
MD 03-04
2.23Ha
EXT 4
ROCHDALE & RIDLEY ST GAP FLOWS
1.78Ha
DISTRIBUTE GAP FLOW CAPTURE Via. MULTIPLE 2 x GSEP & OVERSIZED DRAINS
CAT D
RETAIL STAGE
2.51Ha
STAGE RETAIL
Q100 POD
Q100 CAPTURE
2 x GSEP
CAT E
AP 01-04, URBAN PLAZA, RETAIL ACCESS ROAD & INTERSECTION
1.61Ha
Q100 CAPTURE
2 x GSEP
CAT F
MD 01 & 02
2.39Ha
100YR PIPE INLET TO CAT F
Q100 GAP FLOW CAPTURE VIA MULTIPLE GRATED SIDE ENTRY PITS
EXT CAT 3
TOTAL AREA = 4.3Ha
Q100 ESTIMATE EXT CAT 3 = 1.1m³/s (12min t_c)
PIPE FLOW EXT CAT 1 = 1.5m³/s
TOTAL FLOW = 2.6m³/s APPROX
EX REALIGNED PIPE CAP = 5.5m³/s (EX Ø1200 1 IN 85)
100YR GAP INFLOW = N/A
BUT ALLOW NOMINAL 200l/s INFLOWS
TO ALLOW WORST CASE LOCAL PIT BLOCKAGES
TO BE CONVEYED VIA INTERNAL ROADS TO ELEY RD RB
EXT 3
RAMSEY & MEDHURST ST
(PART OF MW RORB CAT 0)
4.3Ha
Q100 GAP FLOW CAPTURE PRIOR TO DISCHARGE TO STAGE MD
EXT. RSPCA (NW)
0.2Ha APPROX
TO RETAIL ACCESS RD
EXT. RSPCA (NE)
0.15Ha APPROX
TO LINK RD
Q100 CAPTURE
3xGSEP
CAT G
RYMAN SITE
BY OTHERS
2.43Ha
CAT H
LINK RD & INTERSECTIONS, RSPCA CARPARK
1.94Ha
Q100 PIPE (INDICATIVE BY OTHERS)
100YR EXTERNAL GAP FLOW ESTIMATE 2.9m³/s
CAPACITY OF EX DRAIN (1.5m³/s) TO BE MAINTAINED
EXT CAT 2
EXT CATCHMENT
RSPCA SITE (EAST)
0.69Ha
Q100 GAP FLOW CAPTURE BY RYMAN SITE
EXT CAT 1 & 2
TOTAL AREA = 22.79Ha
Q100 ESTIMATE = 4.4m³/s (15min t_c)
EX PIPE CAP = 1.5m³/s (EX Ø600 1 IN 20)
100YR GAP INFLOW = 2.9m³/s
TO BE CONVEYED VIA INTERNAL SITE DRAINAGE
EXT CAT 2
TOTAL AREA = 0.69Ha
Q100 ESTIMATE = 0.2m³/s (10min t_c)
EX PIPE CAP = 0.47m³/s (EX Ø375 1 IN 18)
100YR GAP INFLOW = N/A
BUT ALLOW NOMINAL 100l/s INFLOWS
TO ALLOW WORST CASE LOCAL PIT BLOCKAGES
TO BE CONVEYED VIA INTERNAL LINK ROAD DRAINAGE
EXT CAT 1
EXT CATCHMENT
SOUTH OF BURWOOD HWY
22.1Ha
N
LEGEND
INTERNAL SUB-CATCHMENT BOUNDARY
EXTERNAL SUB-CATCHMENT BOUNDARY
PRELIMINARY ALIGNMENT OF INTERNAL 10YR DRAINAGE
PRELIMINARY ALIGNMENT OF INTERNAL 10YR DRAINAGE (BY OTHERS TBC)
CONCEPT ALIGNMENT OF INTERNAL 10YR DRAINAGE
INDICATIVE INTERNAL OVERLAND FLOW PATH
INTERNAL SUB-CATCHMENT POINT OF DISCHARGE
EXTERNAL CATCHMENT GAP OVERLAND INFLOW POINT TO BE MANAGED VIA INTERNAL SITE DRAINAGE
EXISTING COUNCIL DRAINAGE
PRELIMINARY DESIGN CONTOUR (1m)
SURVEY CONTOUR BURWOOD HWY (1m)
EXTERNAL VICMAP CONTOUR (1m)
Q100 GAP FLOW CAPTURE LOCATION VIA MULTIPLE GRATED SIDE ENTRY PITS SIZED TO ALLOW FOR 50% BLOCKAGE
Q100 PIPE TO ENSURE INTERNAL FLOOD SAFETY & PROTECTION
OVERSIZED PIPE WHERE SOME GAP FLOWS CAN BE SAFELY CONVERTED OVERLAND
MINIMUM PIPE CAPACITIES:
RESIDENTIAL - 10YR ARI
COMMERCIAL - 20YR ARI
AS DIRECTED BY COUNCIL
0 15 30 60
Scale 1:1500 @ A1



RETARDING BASIN – PLAN VIEW

(INDICATIVE)



SECTION AA

(INDICATIVE, NOT TO SCALE)

CENTRAL RB FLOOD LEVELS

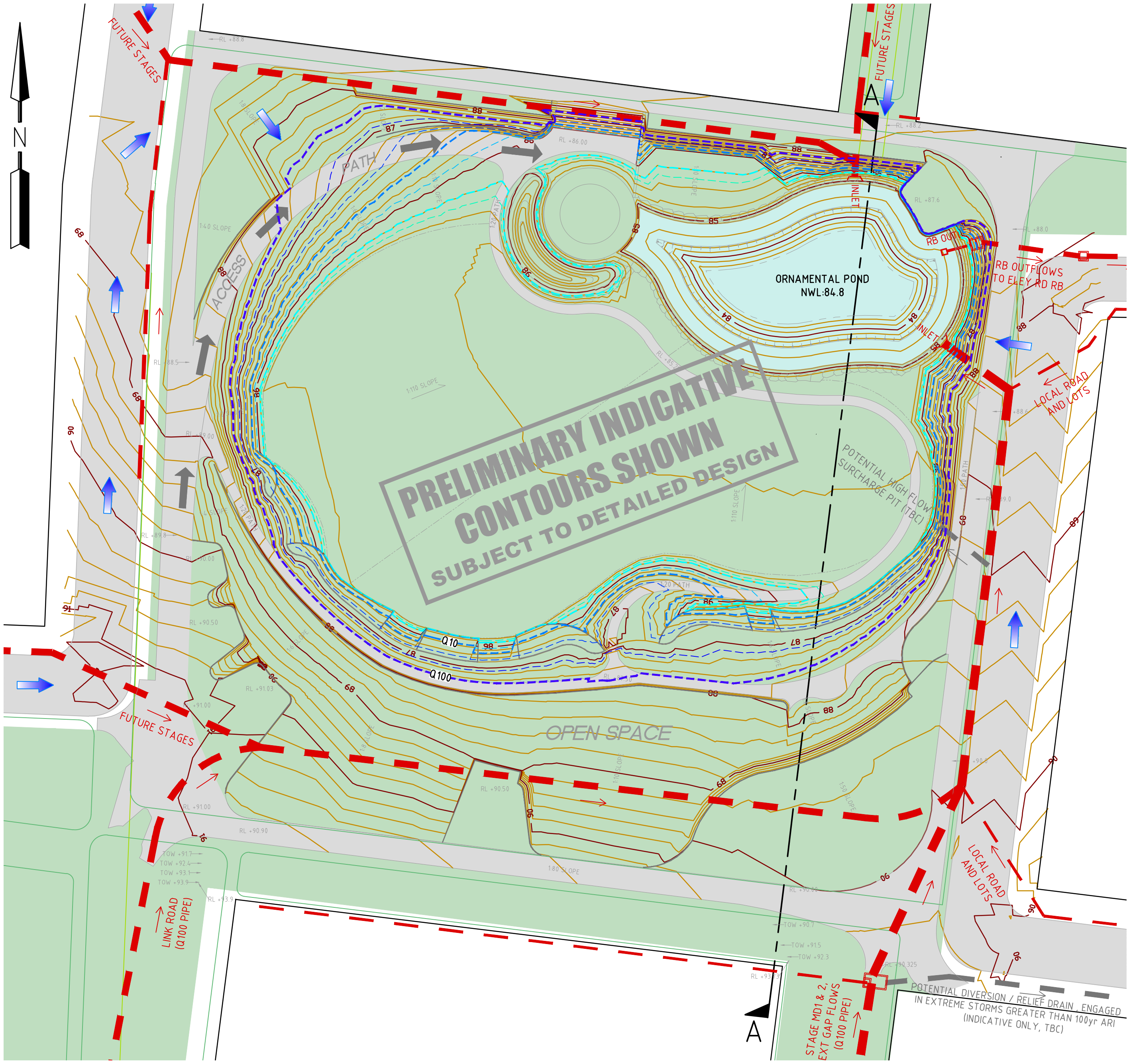
RORB MODEL REVIEW BY INCITUS

ARI	FLOOD LEVEL (m AHD)	FLOOD SURFACE AREA (m^2)	FLOOD STORAGE VOLUME (m^3)
100YR	87.51	5580	10,100
50YR	87.12	5210	7,980
20YR	86.68	4830	5,770
10YR	86.33	4550	4,110
5YR	86.09	4360	3,100
2YR	85.81	3980	1,900
1YR	85.68	3880	1,440

LEGEND

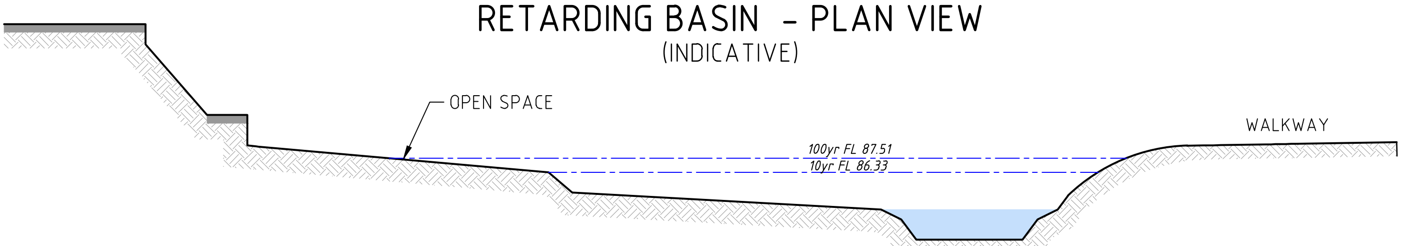
INDICATIVE FINISHED SURFACE LEVELS	RL +90.50
INDICATIVE PIPE ALIGNMENTS (SHOWING DIRECTION OF FLOW)	
SITE ACCESS MAINTENANCE	
MAJOR STORM OVERLAND FLOW PATH	

UPDATED 13.06.2017



RETARDING BASIN - PLAN VIEW

(INDICATIVE)



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(INDICATIVE, NOT TO SCALE)

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LEGEND

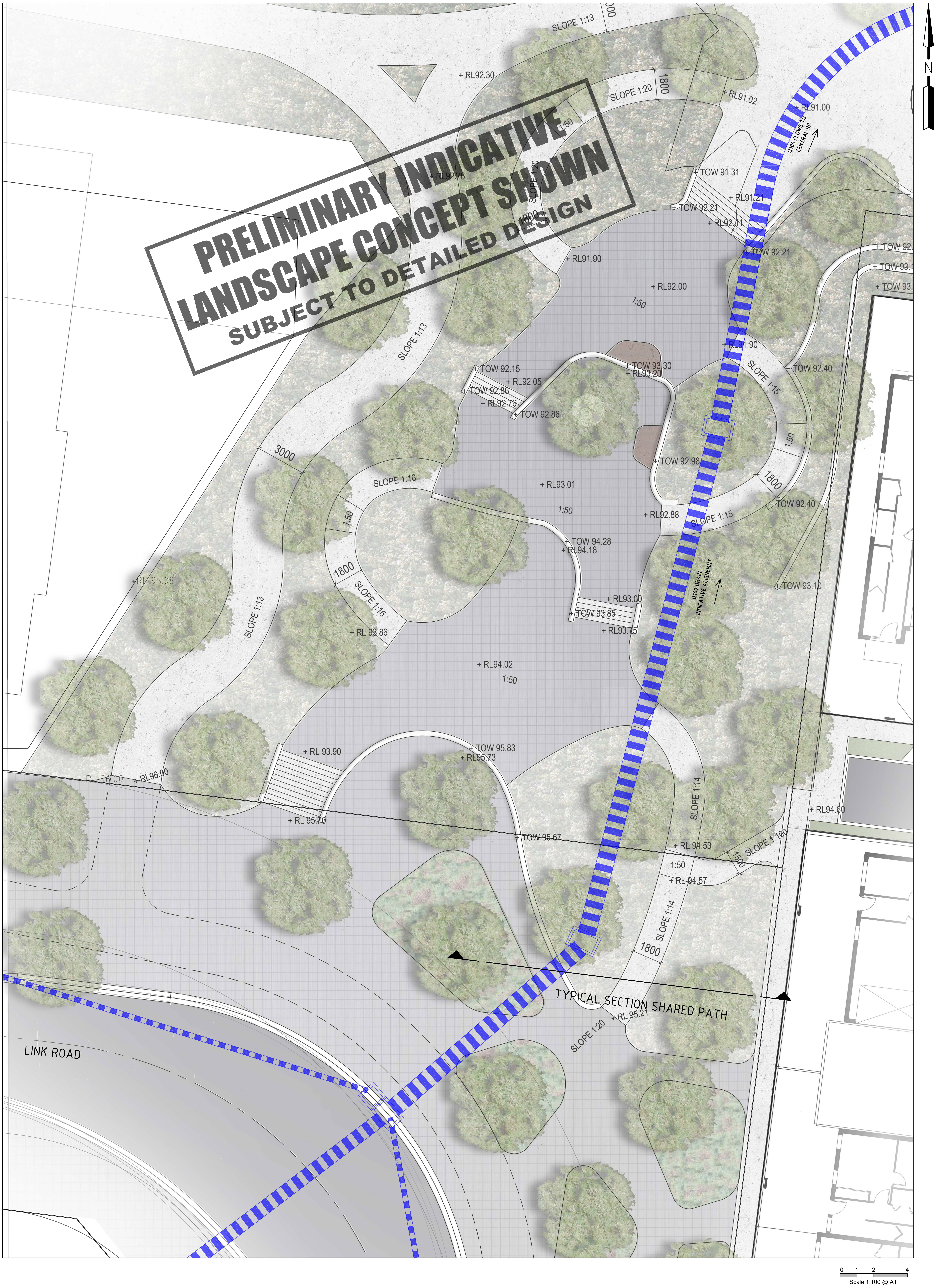
INDICATIVE FINISHED SURFACE LEVELS — RL +90.50

INDICATIVE PIPE ALIGNMENTS (SHOWING DIRECTION OF FLOW)

SITE ACCESS MAINTENANCE

MAJOR STORM OVERLAND FLOW PATH

UPDATED 13.06.2017



PRELIMINARY INDICATIVE
LANDSCAPE CONCEPT SHOWN
SUBJECT TO DETAILED DESIGN
N
SLOPE 1:13
RL92.30
SLOPE 1:20
1800
RL91.02
RL91.00
Q100 FLOWS TO CENTRAL RB
TOW 91.31
RL92.76
SLOPE 1:20
TOW 92.21
RL91.21
RL92.11
TOW 92.21
RL91.90
RL92.00
1:50
RL91.90
TOW 92.15
RL92.05
TOW 93.30
RL93.20
TOW 92.86
RL92.76
TOW 92.86
SLOPE 1:15
TOW 92.40
1:50
3000
SLOPE 1:16
TOW 92.98
1800
RL93.01
1:50
RL92.88
SLOPE 1:15
TOW 92.40
TOW 94.28
RL94.18
1800
SLOPE 1:16
Q100 DRAIN INDICATIVE ALIGNMENT
TOW 93.10
RL 95.08
SLOPE 1:13
RL93.00
TOW 93.85
RL93.75
RL 93.86
RL94.02
1:50
TOW 95.83
RL95.73
RL 93.90
RL 96.00
RL96.00
RL 95.70
SLOPE 1:14
RL94.60
TOW 95.67
RL 94.53
1:50
SLOPE 1:100
150
RL 94.57
SLOPE 1:14
1800
TYPICAL SECTION SHARED PATH
SLOPE 1:20
RL 95.21
LINK ROAD
0 1 2 4
Scale 1:100 @ A1

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