



Drainage report - MUSIC modelling

South Metro Connect (SMC), March 2011. *Roe Highway Extension, Kwinana Freeway to Stock Road: Karel Avenue to Stock Road Concept Drainage Design Report*. Unpublished report prepared for Main Roads, Perth, WA.

Appendix H

Drainage report - MUSIC modelling



Roe Highway Extension

Kwinana Freeway to Stock Road

Karel Avenue to Stock Road

Concept Drainage Design Report

60100953-214J-CI-REP-0001



AECOM

Seeking **collaborative solutions** for extending Roe Highway

Roe Highway Extension

Kwinana Freeway to Stock Road

Karel Avenue to Stock Road
Concept Drainage Design Report

Project Brief

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Prepared by	Luke Cummins
Reviewed by	Ryan Warrington

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Executive Summary

Main Roads Western Australia (MRWA) has engaged AECOM as a lead consultant to prepare a concept design for the Roe Highway Extension (RHE) project. The scope of the project is the extension of Roe Highway (located approximately 17km south of the Perth CBD), west from its current terminus at the Kwinana Freeway in Jandakot to Stock Road in Coolbellup, and any work necessary to provide this extension.

The purpose of this report is to summarise the concept drainage design that has been prepared for RHE. This report aims to provide the background information used for the development of the concept drainage design covering RHE and Murdoch Drive Extension (MDE). This report and accompanying concept design drawings has been prepared for MRWA. The report will also be used to aid in the presentation of information for the Public Environmental Review in 2011.

The design has been conducted based upon the data made available by MRWA from previous works including the Roe 7 Alliance, and also works undertaken by AECOM in areas adjacent to the RHE project area including Kwinana Freeway widening north and south of Roe Highway Interchange.

The detailed design and construction of this project is assumed to be by an Alliance and therefore only indicative pit and pipe infrastructure information has been provided at this stage. The pit and pipe information in this design was determined to confirm that minimum pipe grade, cover and other design requirements could be achieved. Pipe sizes and quantities have not been provided as they were not required at this stage of the project. Stormwater drainage infiltration basin locations and sizes have been designed for the concept drainage design.

Consideration of water quality requirements is an important aspect of this project due to the sensitive wetland areas within the project locale. The requirements of Water Sensitive Urban Design Standards (WSUDS) and the Stormwater Management Manual for WA have been considered throughout the design process and the concept drainage design has been undertaken to reflect the importance of meeting water quality objectives within the project area. Bioretention areas have been sized for basins in the immediate vicinity of the wetland areas. The detailed functioning of these elements will need to be confirmed during future delivery phases.

The permeability factors at each basin location should be critically reviewed against geotechnical field testing, to improve on the values assumed by this study, to assist with optimisation of basin sizes. The existing drainage pit and pipe networks should also be critically reviewed with regard to optimisation for the required levels of service and the functioning of this infrastructure within the overall RHE drainage strategy.

1.0 Glossary

Acronym	Description
AAMGL	Average Annual Maximum Groundwater Level
AHD	Australian Height Datum
ARI	Average Recurrence Interval
DEC	Department of Environment & Conservation
EPA	Environmental Protection Agency
DOE	Department of Environment
DOW	Department of Water
GWL	Groundwater Level
HGL	Hydraulic Grade Line
IL	Invert Level
IPD	Integrated Project Development
ITS	Intelligent Transportation Systems
LWL	Low Water Level
MDE	Murdoch Drive Extension
MRWA	Main Roads WA
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
PER	Public Environmental Review
PSP	Public Shared Path
PTA	Public Transport Authority
RHE	Roe Highway Extension
RL	Reduced Level
SMC	South Metro Connect
SWTC	Scope of Works & Technical Criteria
TN	Total Nitrogen
TP	Total Phosphorous
TSS	Total Suspended Solids
TWL	Top Water Level
WSUDS	Water Sensitive Urban Design Standards

2.0 Introduction

2.1 General

The current State Government has made a commitment to extend Roe Highway westwards from its current termination at the Kwinana Freeway to Stock Road. This extension is expected to largely utilise the existing Metropolitan Region Scheme (MRS) reservation established in the 1960s for that purpose. In order to deliver this commitment Main Roads Western Australia (MRWA) has implemented an Integrated Project Development (IPD) arrangement for the concept design of the extension. The IPD is being managed and resourced by a project team named South Metro Connect (SMC) which is comprised of both MRWA and AECOM staff.

The project development was commenced in late 2009 and is anticipated to finish in late 2011. During that time, various concept road designs were prepared and a preferred option was identified. Environmental approval will be sought from the Environmental Protection Authority (EPA) for the preferred design option, through the Public Environmental Review (PER) process.

In addition to the concept design of the Roe Highway Extension (RHE) MRWA also engaged SMC to undertake the concept design of the following additional projects:

- Kwinana Freeway widening between Leach Highway and Roe Highway.
- Kwinana Freeway widening between Roe Highway and Beeliar Drive.
- The provision of Intelligent Transportation Systems (ITS) on the Kwinana Freeway between Leach Highway and Beeliar Drive.
- Increasing the intersection capacity of Murdoch Drive and South Street.

These additional concept designs are for separate MRWA projects but because of their geographical proximity and operational interdependence they are all being undertaken by the SMC team. This report covers the drainage design associated with the RHE project from Karel Avenue to Stock Road, including Murdoch Drive Extension (MDE).

2.2 Purpose of this Report

This report details a concept design which has been prepared for MRWA to assist with the progression of environmental impact assessments and the seeking of regulatory approvals. The production of this concept design is to form the starting point from which designers may proceed with the development of detailed design.

This does not represent a detailed design and the information contained within this report does not constitute the basis of a detailed design. Whilst general design principles from this concept design can potentially be carried through the design progression, the detailed design must not rely on the assumptions contained within this report. During detailed design it is critical that the designers develop familiarity with the site conditions to ensure the development of a practical and functional detailed design.

This report and accompanying concept road design drawings (relevant drainage drawings are provided in **Appendix F – Concept Design Drawings**) have been prepared for MRWA. This report aims to provide the background information used for the development of the concept drainage design covering RHE, (approximately 7 km of extension), and MDE (approximately 1 km). The report will also be used to support the presentation of information for the Public Environmental Review in 2011.

2.3 Limitations on Use of this Report

This report should be read in conjunction with the Concept Geometric Road Design Report (60100953-215J-CI-REP-0001), in addition to the concept services reports and Kwinana Freeway widening associated reports, including;

- South Metro Connect (2010) *Kwinana Freeway 3rd Lane – Leach Highway to Roe Highway: Drainage Review and Concept Design*. Document Number 60100953-224R-CI-REP-0001.
- South Metro Connect (2011) *Roe Highway Extension: Existing Services Report*. Document Number 60100953-211J-CI-REP-0001.
- South Metro Connect (2011) *Roe Highway Extension: Desktop Study of Gravity Sewer Trunk Main Diversion*. Document Number 60100953-211J-CI-REP-0003.
- South Metro Connect (2011) *Roe Highway Extension: Desktop Study of Water Trunk Main Diversion*. Document Number 60100953-211J-CI-REP-0007.
- South Metro Connect (2011) *Kwinana Freeway Widening – Roe Highway to Beeliar Drive Concept Drainage Design Report*. Document Number: 60100953-224S-CI-REP-0001.

The report should also be read in conjunction with technical reports associated with the RHE Public Environmental Review document, including but not limited to:

- South Metro Connect (2010) *Roe Highway Extension Kwinana Freeway to Stock Road: Vegetation and Flora Assessment* – including targeted declared rare flora surveys. Document Number 60100953-412E-EN-REP-0008.
- South Metro Connect (2011) *Ground Conditions – Acid Sulfate Soil: Preliminary Acid Sulfate Soil Investigation*. Document Number 60100953-412D-EN-REP-0001.

The concept drainage design has been prepared using information provided from a variety of sources. There were some gaps identified in the information available and as such the concept design was based on a number of assumptions (which are subsequently detailed in section 5).

Further investigations maybe required at detailed design to confirm the validity of assumptions associated with the following considerations

- Adopted soil infiltration rates and groundwater elevations.
- The accuracy of the “as built” drainage drawings available has not been verified by survey.
- The feature survey data does not include invert level information for the drainage systems.
- Drainage infrastructure information obtained from relevant City Councils has not been verified and may be incomplete.
- The extent of the “as built” drainage information does not cover other connected drainage systems and therefore the information is incomplete in some instances.
- MRWA standards and DoW principles have been applied throughout the development of the concept drainage design with consideration of the more conservative requirement being adopted.

3.0 Project Description

MRWA is proposing to extend Roe Highway (located approximately 17km south of the Perth CBD), west from its current terminus at the Kwinana Freeway in Jandakot to Stock Road in Coolbellup,. The project area is depicted in **Figure 3-1**. The road alignment was generally required to stay within the existing Metropolitan Region Scheme (MRS) boundaries with the exception that it could extend beyond the MRS boundary between Kwinana Freeway and North Lake Road into adjacent government owned land based on social, environmental and other constraints.

The road alignment between North Lake Road and Stock Road was required to be contained within the existing reserve due to adjacent, constraining land use. A connection to Murdoch Drive is part of the proposed project in order to provide access to the Murdoch Activity Centre, including the Fiona Stanley Hospital.

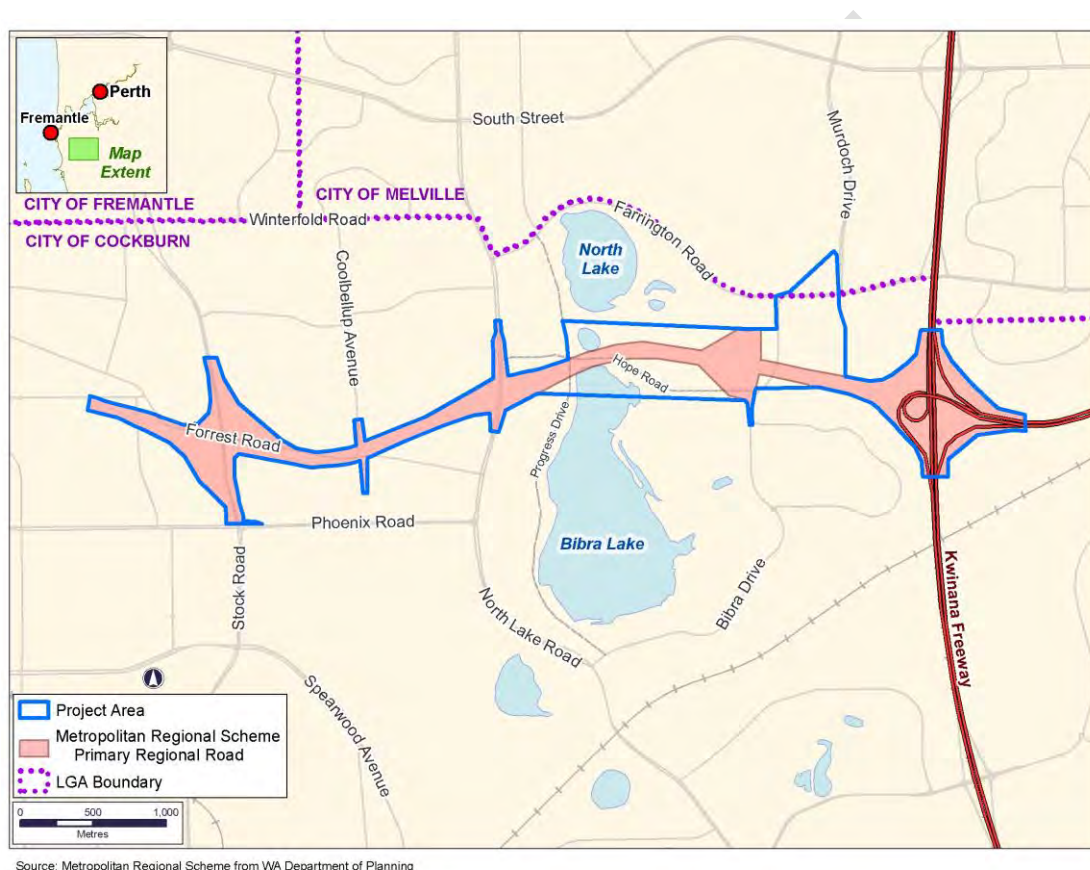


Figure 3-1 Project Area

3.1 Project Objectives

The objectives for the SMC concept design project are set out in **Table 3-1** below.

The overall project outcome required is that the concept design should be the most sustainable solution for meeting the objectives. Sustainability criteria were developed with community input and the assessment of design elements against these criteria was undertaken where appropriate. In some instances over-riding constraints, such as cost and legislative requirements, limited the design options for consideration.

Table 3-1 Concept Design Objectives

Key Result Area	Objectives
Environment	Minimal impact on the environment.
	Net environmental gain
	To be recognized for delivering outstanding solutions to road design in environmentally sensitive areas.
Social	Provide lasting legacies and relationships
	Operational road safety – towards vision zero
	Exceeding community, stakeholder and MRWA client expectations
Economic	Value for Money
	Transport Efficiency
	Meet forecast mobility needs in support of planned regional development
Governance	A safe, positive and fulfilling team experience
	All clearances and approvals in place by mid 2011
	Shared learning's and capability development (between team and stakeholders)
	To be recognised for setting new benchmarks for collaboration, innovation and sustainability in project development.

The objectives of the Concept Drainage Design Project follow standard MRWA guidelines in combination with DoW principles and advice

4.0 Scope of Work

The scope of the concept drainage design was to establish an infrastructure arrangement that would adequately serve the proposed concept design of the road, for a level of service represented by standard MRWA guidelines and DoW principles, including the *Stormwater Management Manual of Western Australia* (DoW 2004-2007) and the *Decision Process for stormwater management in WA* (DoW 2009).

MRWA standard guidelines include:

- *Design Flows*. Document Number: 67-08-73.
- *Piped Systems*. Document Number: 67-08-75.
- *Open Drains for Roads*. Document Number: 67-08-74.
- *Culverts*. Document Number: 67-08-79.
- *Guide to the Design of Drainage Basins*. Document Number: D10#733658

The scope of the work discussed in this report is limited to approximately 7km of Roe Highway and MDE, bounded by the area shown in Figure 3-1 Project Area. Through discussions with MRWA it was determined that the examination of gutter flow widths and optimisation of pipe sizes was not required and indicative pit and pipe locations were satisfactory for the concept design phase. The scope of work also required the sizing of basins and including the basin extents on the drawings, with relevant inverts and dimensions.

5.0 Design Methodology

Drainage design methodology takes into account the standard MRWA guidelines, principles set forth in the *Stormwater Management Manual of Western Australia* (DoW 2004-2007) and the *Decision Process for stormwater management in WA* (DoW 2009).

The project area has been broken into 7 distinct catchment areas to aid in the presentation of information. The catchments are classified as follows:

- Karel Avenue/Roe Highway Interchange.
- Kwinana Freeway/Roe Highway Interchange.
- Murdoch Drive/Roe Highway Interchange.
- Murdoch Drive Extension Area.
- Bibra Drive to Progress Drive.
- North Lake Road/Roe Highway Interchange.
- Stock Road/Roe Highway Interchange.

Catchment plans for these areas are provided in **Appendix C – Design Plans**.

5.1 Pit and Pipe Network Design

The concept pit and pipe network design has been developed using the road design for the preferred option. The network has been designed to accommodate the increased impervious areas associated with the new Roe Highway, MDE and associated upgraded interchanges. The pit and pipe network has been designed for the 5 minute duration, 10 year ARI storm and conforms to MRWA minimum grade, cover and other relevant design requirements.

The concept design did not require gutter flow width calculations or pit and pipe network quantities. As such only indicative pit and pipe locations are shown on the drawings in **Appendix C – Design Plans**.

The adopted contributing catchment area runoff coefficients were;

- Impervious Areas = 0.9.
- Pervious Areas = 0.2.

These are based upon Argue (1986) *Storm drainage design in small urban catchments: a handbook for Australian practice*.

Minimum grades were incorporated in the system check to ensure pipes are self-cleansing. Allowance for the provision of scour protection and access for maintenance have also been also incorporated in design. However neither of these considerations has been analysed in detail as part of this concept design.

5.2 Surface Water Retention System Design

The surface water retention requirements have been based on the assumption that, in addition to all new impervious areas, existing areas of pavement are either removed or are catered for with proposed retention basins. As such, consideration has been given to the location and function existing infrastructure in relation to the proposed road alignment.

Retention basins have generally been sized for the critical 20 year ARI event unless there is an overflow route available, in which case the basins have been sized for the 1 in 5 year storm. This follows the principle of providing infiltration as close as possible to source for more frequent events for water quality purposes.

The retention basins have all been designed as infiltration systems, and permeability values have been selected based upon the concept design geotechnical investigations contained in South Metro Connect – *Preliminary Geotechnical Site Investigation: Factual Report* Document Number: 60100953-213-GT-REP-0002. This information was considered in relation to the data contained within the sources below.

- DoW's *Perth Regional Aquifer Modelling System (PRAMS) Model Development: Hydrogeology and groundwater modelling*. Report No. HG 20.
- *Roe Highway Stage 7 Final Design Report – Roads Lot 13: Drainage* Document Number: REP-13-C-0001-D.
- Literature sources in **Section 10.0**, including Davidson (1983).
- Various site visits undertaken by the SMC Team during 2010.

Permeability testing was undertaken in two locations on the 22nd of October 2010. A site within the location of Basin I yielded results of 16.5m/day, and a site located north of Roe Swamp achieved results of 6.7m/day. These two sites are located in the vicinity of the wetlands and thus are assumed to yield slightly lower results than those typically achieved in Bassendean Sands or Tamala Limestone/Spearwood Sands (eastern project area and western project area, respectively), due to the presence of wetland sediments and differing soil characteristics in these locations. The area north of Roe Swamp is not being considered as a location for a basin due to the proximity to a wetland.

Relevant infiltration rates from the above sources, along with the adopted infiltration rates are summarised in **Table 5-1**. The particle size distribution (PSD) method of assumed permeability values has been given more weight in determining the adopted value as this testing is conducted at discrete locations whereas the many of the literature sources are much broader scale extremes or averages that may not accurately represent the soil properties in the project area.

The permeability values selected for each of the areas agree well with all available information, and it is anticipated that optimisation of the proposed retention system arrangements may be achieved through a detailed review of soil permeability potential during the detailed design stage. Further to this, the effect of ground water levels has been considered insofar as the assumed depth to ground water level for basin design is based upon the data provided within the Department of Environment (DoE) Perth Groundwater Atlas (2004) and the DoW's *Maximum Groundwater Contours* (2001). Assessment of groundwater levels along the project area has resulted in adopted values that can be seen in **Appendix E – Basin Calculations**. These values have been selected conservatively based on the information available and the minimum base level of the retention basins has been set at or above the DoW's historical maximum groundwater contours. The adopted values should be verified during detailed design.

Table 5-1 Summary of permeability values

Reference	Area			
	East of Bibra Drive	Bibra Drive to Progress Drive	Progress Drive	North Lake Road west to Stock Road
Assumed Soil Type from Department of Agriculture Western Australia Regional Soil Mapping	Bassendean Sands	Combination including wetland sediments	Lower permeability sediments	Tamala Limestone/Spearwood Dunes
Preliminary Geotechnical Investigations - PSD to derive permeability	12.5 - 47.5 m/day	8.64 - 86 m/day	Indigenous Heritage – No Testing Permitted	9 - 52 m/day (average 34.5)
Davidson and Xu (2006)	10 - 50 m/day			1 - 1000 m/day (average 50)
Nield (1999)	30 - 60 m/day	30 - 60 m/day	10 - 20 m/day	20 - 900 m/day
Playford <i>et al.</i> (1976)	13 m/day (average)			
Xu <i>et al.</i> (2009)	10 m/day		5 m/day	
Roe 7 Alliance	50 m/day			
Site permeability testing		6.7 - 16.5 m/day	Indigenous Heritage – No Testing Permitted	
Adopted Value	20 m/day	15 m/day	8 m/day	30 m/day

Contributing catchment areas have been determined on a conservative basis. Runoff coefficients are as follows:

- Impervious Areas = 0.9.
- Pervious Areas = 0.3.

The increase in the pervious runoff coefficient from the value used for the pit and pipe network is considered an acceptable conservative increase in runoff to account for the exceedance of depression storage capacity and other related processes.

Vegetation clearing was an important consideration in the design of stormwater basins for RHE. Care has been taken to limit clearing and excavation as much as possible, to preferentially utilise areas of less significant vegetation. Significant trees and other priority vegetation have also been avoided wherever possible.

The retention basins have then been sized using Coffey Geotechnics PC Sump Temporal 2010 version 5. The top water level (TWL) of the basins that abut the road embankment have a minimum 300mm freeboard to the lowest adjacent point in the pavement, to minimise the potential risk of capillary rise. TWL freeboard shown in the PC Sump results is additional to this 300mm. The calculations can be seen in **Appendix E – Basin Calculations**.

Catchments for the individual basins are provided in **Appendix C – Design Plans** and a summary of the basin design can be found in **Appendix A – Summary of Basin Design**. Pervious catchments not contributing to drainage networks or basins have been assumed to infiltrate at source. This assumption will require review during detailed design. Road design plan and profile drawings showing the concept basin designs can be found in **Appendix F – Concept Design Drawings**.

6.0 Drainage Design

The design has been broken into 7 areas, as mentioned previously in the methodology:

- Karel Avenue/Roe Highway Interchange.
- Kwinana Freeway/Roe Highway Interchange.
- Murdoch Drive/Roe Highway Interchange.
- Murdoch Drive Extension Area.
- Bibra Drive to Progress Drive.
- North Lake Road/Roe Highway Interchange.
- Stock Road/Roe Highway Interchange.

Each of these sub-catchment areas are not independent but have been examined in this format so as to aid in the presentation of information. The design can be seen in the following sections.

Approximate locations of each catchment area can be seen in **Figure 6-1**. Detailed catchment plans are available in **Appendix C – Design Plans**.

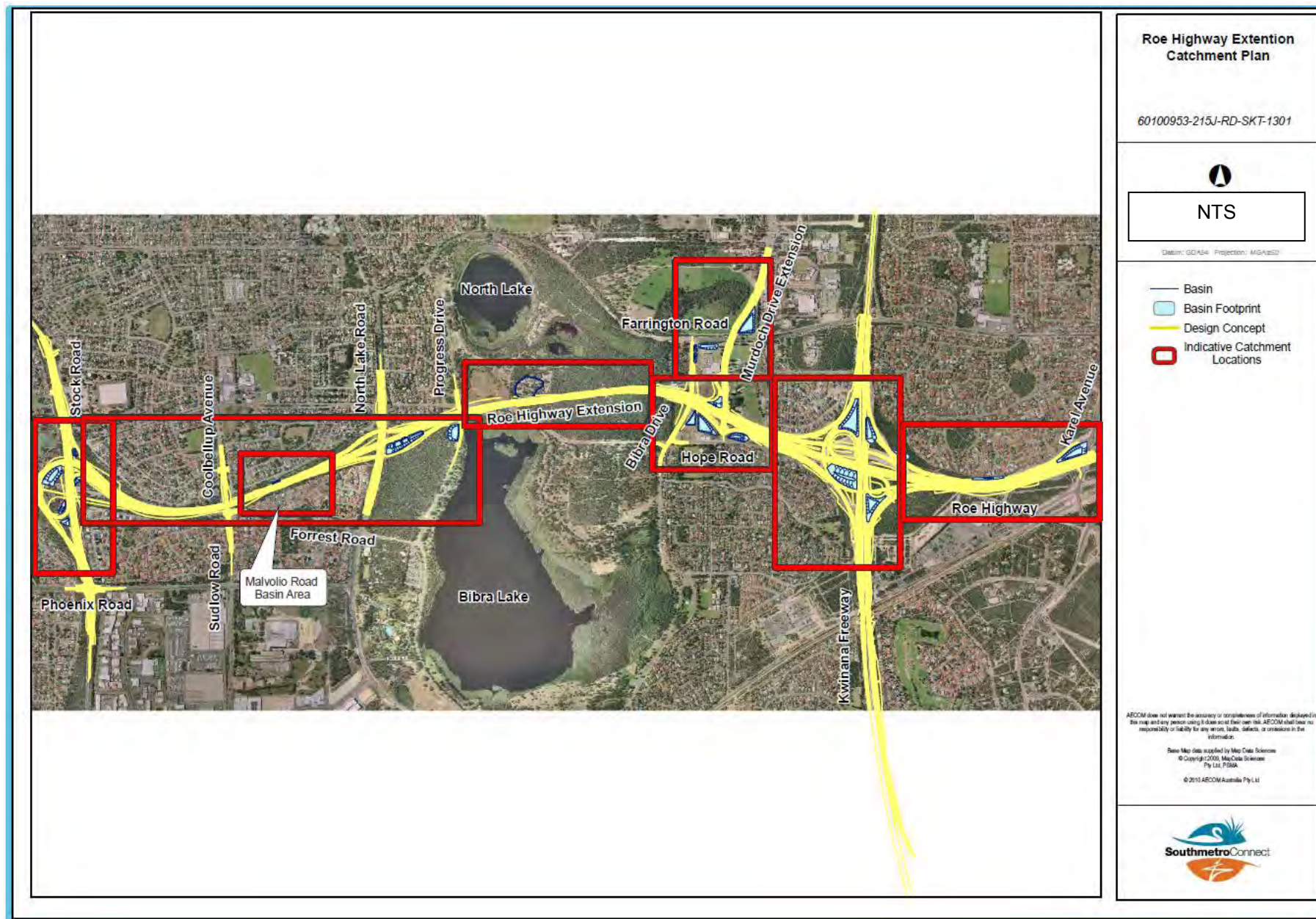


Figure 6-1 Approximate Catchment Locations

6.1 Design Areas

6.1.1 Karel Avenue/Roe Highway Interchange

A catchment plan (60100953-215J-RD-SKT-1302) can be found in **Appendix C – Design Plans**. A summary of the basin design characteristics is presented in **Table 6-1**.

Table 6-1 Karel Avenue/Roe Highway Basin Summary

Basin Reference	Impervious Area	Pervious Area	Storage Required	Base RL (mAHD)	20 Year Water Depth (m)	Calculated Basin Storage Volume (m ³)	Side Slope 1:X	Groundwater Level (mAHD)
Basin M1	33220	19081	2375	31.4	2.4	2525	1:5	24.5
Basin M2	38920	25934	4821	26.4	1.2	4821	1:3	24.5
Basin M3	17456	38294	1734	32	1.22	1743	1:15	24.5

The three basins located in this area are existing basins, designed as part of *Roe Highway Stage 7 Final Design Report – Roads Lot 13*. The capacities of these basins have been assessed using the criteria stated in **Section 4.0** and considered with respect to any increase in contributing area due to the concept road design in this catchment.

Basin M1 is at the natural low point in the topography and is bounded by the road embankment. This is an existing basin (Basin M1) and the design is detailed in *Roe Highway Stage 7 Final Design Report – Roads Lot 13*. The base level of the basin has been set at the existing low in the topography at 31.4 mAHD. If it is determined at the detailed design phase that the 1.2m maximum water depth for accessible basins criterion (as stated in MRWA's *Guide to the Design of Drainage Basins*), needs to be applied, a small amount of fill can be used to achieve this. **Figure 6-2** illustrates this process. Elevation of the base of the basin can accommodate the required volume in this area by an increase in the top water level (TWL).

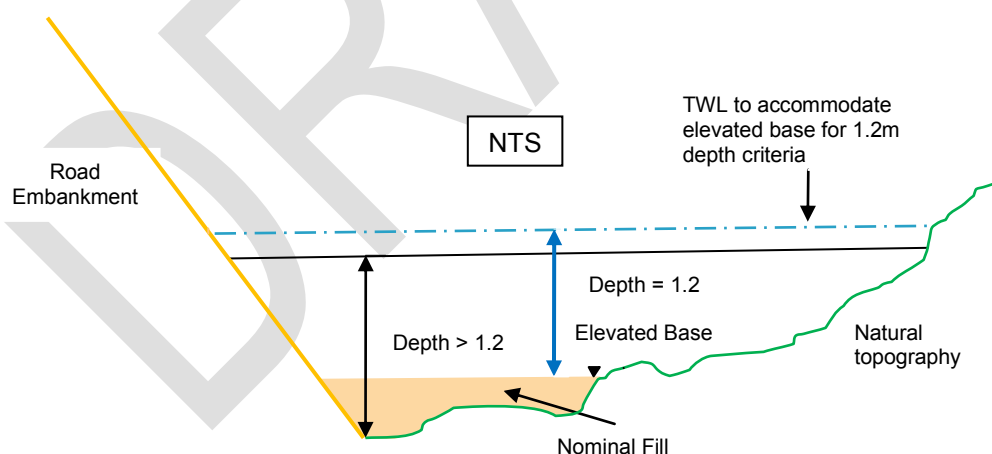


Figure 6-2 Diagram of fill to meet 1.2m depth criterion

Basin M2 is an existing basin from *Roe Highway Stage 7 Final Design Report – Roads Lot 13* (Basin M2), located near the Karel Avenue/Roe Highway interchange. The side slopes of Basin M2 have been cut and steepened from 1:6 to 1:3 to cater for additional contributing area. Basin M3 is also a natural low in the topography and was used for storage in the *Roe Highway Stage 7 Final Design Report – Roads Lot 13*. Again this basin has been assessed using the criteria mentioned in this report, and a small amount of fill may be required if the 1.2m depth criterion is considered critical.

6.1.2 Kwinana Freeway/Roe Highway Interchange

A catchment plan (60100953-215J-RD-SKT-1303) can be found in **Appendix C – Design Plans**. A summary of the basin design characteristics is presented in **Table 6-3**.

Table 6-2 Kwinana Freeway/Roe Highway Basin Summary

Basin Reference	Impervious Area	Pervious Area	Storage Required	Base RL (mAHD)	20 Year Water Depth (m)	Calculated Basin Storage Volume (m ³)	Side Slope 1:X	Groundwater Level (mAHD)
Basin A	17277	37635	2918	24.5	1.2	3025	1:3	23
Basin B	77609	58046	10060	25.4	1.2	10113	1:4	23
Basin C	34865	42575	3410	28.3	1.2	4041	1:4	23
Basin D	30998	43591	3907	26	1.2	3936	1:4	23

This area contains four basins. The drainage design for the Kwinana Freeway, south of the railway bridge towards Berrigan Drive is covered as part of the South Metro Connect (2011) *Kwinana Freeway Widening – Roe Highway to Beeliar Drive Concept Drainage Design Report*. Document Number: 60100953–24S–CI–REP-0001. There is an existing Public Transport Authority (PTA) basin on the west side of Kwinana Freeway northbound and any alterations to the configuration of Farrington Rd and the associated drainage infrastructure in this area must account for the PTA drainage. Drainage to the north of the catchments shown in **Appendix C – Design Plans** is dealt with as part of the South Metro Connect (2010) *Kwinana Freeway 3rd Lane – Leach Highway to Roe Highway: Drainage Review and Concept Design* (Document Number 60100953-224R-CI-REP-0001).

The design has been conducted on the assumption that the alterations to any existing drainage infrastructure, due to the interchange upgrade, will render all existing infrastructure redundant. As such a completely new concept drainage design has been undertaken based on the proposed Kwinana Freeway interchange. Where possible, the drainage has been designed to fit with the to the design proposed in South Metro Connect (2011) *Kwinana Freeway Widening – Roe Highway to Beeliar Drive Concept Drainage Design Report*. Document Number: 60100953–24S–CI–REP-0001 but staging requirements will need to be examined in detailed design.

It may be possible on the northbound Kwinana Freeway to divert the main drainage carrier line to Basin A, before continuing to Basin D, to attenuate flows in smaller events and allow the reduction of pipe sizes further to the north. This was not undertaken at the concept design stage due to the difficulty in draining the trapped low point to the west of Basin B in larger storm events, and pipe sizes were not required at this concept design phase. A conservative approach was taken at this stage to confirm that flows can be accommodated.

Basin D has been located to avoid native vegetation and thus avoid clearing, the result of which is 200m of pipe network to form an extended outlet and pits approximately 5m deep.

6.1.3 Murdoch Drive/Roe Highway Interchange

A catchment plan (60100953-215J-RD-SKT-1304) can be found in **Appendix C – Design Plans**. A summary of the basin design characteristics is presented in **Table 6-3**.

Table 6-3 Murdoch Drive/Roe Highway Basin Summary

Basin Reference	Impervious Area	Pervious Area	Storage Required	Base RL (mAHD)	20 Year Water Depth (m)	Calculated Basin Storage Volume (m ³)	Side Slope 1:X	Groundwater Level (mAHD)
Basin E	11787	20353	1545	20.5	1.2	1854	1:3	18.3
Basin F	57955	23159	6044 (5yr)	17.9	1.2	6118	1:4	17.75
Basin G	18345	7767	1891(5yr)	17.65	0.85	1978	1:4	17.6
Basin H	2467	8464	330 (5yr)	18.7	1.2	379	1:3	17.9

Basin E has been designed to accommodate flows from the proposed Roe Highway Extension off ramp from the Kwinana/Roe interchange. This basin is relatively deep in some sections due to the topography and road design in this area. For the concept design phase this basin has been designed for the 20 year ARI event, without an outflow or weir for the smaller events. In future design phases it may be considered appropriate to analyse the basins in this area as a network, rather than individual sumps, to reduce basin footprints. This level of detail was not required at the concept design stage.

Basin F is a large basin which utilises the degraded land north of the Montessori School. Due to services in this region it was necessary to create two basins, F and G, either side of the sewer main in this area. A minimum offset of 4 metres has been applied between the gravity sewer pipes and the top of batter of Basins F and G. This offset is assumed to be sufficient for any future works required to construct a weir at this location. Basin F and G have both been designed to compensate for the 5 year ARI event from their respective catchments, and in higher ARI events there will be flow from Basin F to Basin G and overflow will be directed to Roe Swamp. The mechanisms to allow the flow to pass between the basins may take the form of a weir over the gravity sewer main or a riser/inverted siphon culvert under the gravity sewer main, however they have not been detailed as part of this concept design.

A WA Gas Networks pipe is likely to be located along the relocated Bibra Drive embankment interface to the natural ground. Preliminary information regarding the gas pipe alignment may place it underneath Basin G. The depth of the basin in this area is less than 1m so this proposed service location was considered acceptable for concept design. If this configuration is considered unacceptable during detailed design, there is available land to the immediate south of the basin between the PSP and the proposed Basin G, to alter the shape of this basin slightly to accommodate the gas pipe. A 10m offset from the bridge abutment of Bibra Drive realignment has also been incorporated to allow for construction of the basin.

Analysing Basin H as part of a network rather than individual sumps may optimise the design in this location. Basin H has capacity to store the 5 year ARI event but then an outlet for larger ARI events will direct water to Basin F. This outlet has not been modelled or designed for the concept design phase.

There are small design alterations to the intersection of Bibra Drive and Hope Road. There is a small area of land located to the west of the Montessori School which may be used to compensate for any additional flows resulting from these intersection improvements. Compensation requirements should be analysed during detailed design, once invert levels and other details of the existing pit and pipe infrastructure are confirmed. It is anticipated at this stage that the size of the existing pit and pipe infrastructure, with some relocation due to the proposed road design, will be sufficient.

6.1.4 Murdoch Drive Extension Area

A catchment plan (60100953-215J-RD-SKT-1305) can be found in **Appendix C – Design Plans**. A summary of the basin design characteristics is presented in **Table 6-4**.

Table 6-4 Murdoch Drive Extension Basin Summary

Basin Reference	Impervious Area	Pervious Area	Storage Required	Base RL (mAHD)	20 Year Water Depth (m)	Calculated Basin Storage Volume (m ³)	Side Slope 1:X	Groundwater Level (mAHD)
Basin L	49785	18169	6883	18.3	1.2	7300	1:6	18.15
Basin N	15417	9531	2036	18	1.2	2096	1:3	17.65
O (combined)	6155	5184	490 (5yr)	18.5	0.7	536	1:3	17.4

Basin N is an existing sump area adjacent to the Spanish Club, with proposed excavation and widening. The alteration to the present basin is required to provide adequate capacity for additional flows from Murdoch Drive Extension. There are several existing services at this location. A minimum offset of 2.5m has been applied to services that are not assumed to require relocation during Stage 1 of the RHE project. This has assumed to be a sufficient easement but this will require confirmation prior to detailed design. Other existing services are assumed to require relocation.

WA Gas Networks has been discussing with the City of Cockburn land issues considering the gas main pipe to supply Fiona Stanley Hospital. Previous discussions between SMC and WA Gas Networks appointed that the gas main will cross below the existing retention basin, Basin N. This basin is proposed to be excavated and widened when Roe Highway is constructed, which will impact the gas main if this alignment is maintained. During the development of the concept drainage design, WA Gas Networks and the City of Cockburn were in discussions regarding the final agreement for the land requirements with regard to the alignment of the gas main. If the pipe is constructed below the existing sump and changes to this basin are required due to MDE, it may be necessary to relocate Basin N slightly to the south. Alternatively alterations to the alignment of the gas pipe may be undertaken.

Basins O1 and O2 are a cascading system of basins located on the east of Bibra Drive. These are assumed to provide compensation and treatment to flows from the proposed realigned Bibra Drive. These basins will store a 5 year ARI storm for water quality and any flows over and above this will be directed into the existing pipe network located at the intersection of Bibra Drive and Farrington Road, which discharges to Murdoch Drain. The minimum 2.5m offset has also been applied to the Water Corporations sewer mains to the east of these basins. A gas main is assumed to require relocation along the Bibra Drive road reserve. The drainage pit and pipe design will need to consider the proposed gas main location when it is determined.

Basin L is located in the triangular piece of land contained within existing Murdoch Drive, Farrington Road and Murdoch Drive Extension. This piece of land is currently a grazing paddock for livestock on Murdoch University land. Murdoch University expressed a desire to continue to use this land as a grazing paddock and a requirement for side slopes to be kept to 1V:6H at the steepest (pers. comm. Kim Thomas January 2011). The City of Melville also expressed a desire to compensate flows from the existing Murdoch Drive within this basin, as the current configuration of table drains is not providing adequate drainage. Farrington Road drainage within the vicinity of this basin is discharging directly into Murdoch Drain. The ability of this basin to provide storage and compensation for part of the existing Farrington Road runoff has been identified. Provision for all of these factors has been built into this basin design but considerations such as access, ownership, maintenance, connection to existing drainage infrastructure and water quality will need to be examined and agreed upon during the detailed design. These will also have to take into account the final arrangement of the intersection of Farrington Road and Murdoch Drive Extension.

6.1.5 Bibra Drive to Progress Drive

A catchment plan (60100953-215J-RD-SKT-1306) can be found in **Appendix C – Design Plans** as well as a basin plan (60100953-215J-RD-SKT-1307). A summary of the basin design characteristics is presented in **Table 6-5**.

Table 6-5 Bibra Drive to Progress Drive Basin Summary

Basin Reference	Impervious Area	Pervious Area	Storage Required	Base RL (mAHD)	5 Year Water Depth (m)	Calculated Basin Storage Volume (m ³)	Side Slope 1:X	Groundwater Level (mAHD)
Basin I	39908	17616	3356 (5yr)	~17 (varies)	~0.225	3387	1:3	15

Basin I is a large basin with a shallow water depth of approximately 210mm in the 5 year ARI event. This basin was considered an ideal location for a large storage area, given the vegetation community and condition in the area. The basin will be created by constructing a small wall or bund, at least 500mm high to a minimum elevation of 17.5 mAHD, around the basin boundary, allowing the required storage volume to be created without the excavation and clearing of the base area. The bund location and height will need to be considered against vegetation priorities in the area during detailed design. An indicative location of the bund wall has been shown in **Appendix C – Design Plans**. This has been based upon aerial photography, which was used to identify and avoid disturbance of vegetation in the area.

Larger ARI storm events will pass via an overflow weir into Horsepaddock Swamp. The design height of this weir is currently set at 17.2 mAHD to allow storms larger than the 5 year ARI event to overtop into Horsepaddock Swamp. This allows for 25mm head to build before weir flow is achieved over the crest. The bunds for this location have the capacity to be raised for a greater volume of storage if required at detailed design.

A concept bioretention area has been designed at this location and details are provided in **Appendix D – Bioretention Drawings**. This basin may also be referred to as the *Dixon Road Bioretention Basin* as this is the name given to a track in the vicinity. An oil separator, gross pollutant trap (GPT) and flow splitter and associated piping will be required although the design of these elements is beyond the scope of concept design.

Treated road runoff is expected to recharge the groundwater, which will contribute to the recharge of Horsepaddock Swamp. This is expected to enhance the ecological values of this swamp. Further enhancement of this area can be achieved through landscape design and planning to realise greater environmental and social benefits during detailed design.

For concept design, pipe sizes have been limited to 525mm diameter pipes to the east and 375mm diameter pipes to the west in order to achieve cover and grade through the structures in these areas. This limitation should be confirmed in detailed design.

There is also a small section of the proposed road in cut in this location. The contributing catchment is approximately 0.8 hectares.. Half will be directed west via cut off drains, towards a natural low in the topography, allowing groundwater recharge through infiltration. The other half will be directed east towards Roe Swamp and will be collected by nominal 450mm diameter culverts conveying flows north. These culverts will also allow connectivity between the two areas, separated by RHE, in large storm events. Optimisation of this culvert arrangement will be confirmed in detailed design.

There is also an existing drain in the area, known as *Murdoch Drain*. A concept realignment design for Murdoch Drain has been developed for the location where the proposed project coincides with the existing alignment of the drain. This can be seen in **Appendix C – Design Plans** (60100953-215J-RD-SKT-1306). The existing open drain does not have a positive grade falling in either direction, and its invert is at approximately 15mAHD, which is at least 1m below the *DoW's Maximum Recorded Groundwater Levels* (which vary between 16mAHD and 17mAHD in this area).

The concept design option is currently shown with 2m wide channel base with a grade of 0.19% from east to west and 1V:6H side slopes. Inverts have been chosen to replicate the existing drain as closely as possible. Detailed design of the drain realignment will need to consider the protection of existing vegetation and other values when developing the alignment and profile. Detailed design will require further investigation of this area to optimise the drain realignment.

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6.1.6 North Lake Road/Roe Highway Interchange

A catchment plan (60100953-215J-RD-SKT-1308) can be found in **Appendix C – Design Plans** along with a basin plan (60100953-215J-RD-SKT-1309). A summary of the basin design characteristics is presented in **Table 6-6**.

Table 6-6 North Lake Road/Roe Highway Basin Summary

Basin Reference	Impervious Area	Pervious Area	Storage Required	Base RL (mAHD)	20 Year Water Depth (m)	Calculated Basin Storage Volume (m ³)	Side Slope 1:X	Groundwater Level (mAHD)
Basin J (combined 1-4)	80185	62510	6030	28 (av)	1.2	5624	1:4 Roe side 1:3 offramp	13 (av.)
Basin K	22903	34451	2832	15.1	1.2	4159	1:03	13.8

The North Lake Road catchment area consists of approximately 2km of Roe Highway, west of North Lake Road. This pipe has been designed to flow against road grade from the low point in the proposed road design. Flows have been directed back east to discharge locations J1 and K, in order to minimise impacts to vegetation between North Lake Road and Stock Road along RHE. The majority of flows are directed to the cascading system of basins J1 through J4. This cascading system consists of four basins in series. The flows first fill up basin J1 then cascade via weir flow to basins J2 through J3 with each of these basins contributing to the storage and retention of the flows. Optimum weir heights to allow for connectivity, while maintaining storage, have not been analysed as they were considered to be beyond the scope of concept design. For the purposes of this design stage the weir heights have been set at the TWL for the respective basins. Finally the flows will enter basin J4 and runoff that is greater than the storage of the combined system will exit via an outlet. The storage within this system has been assessed to be less than that required for the 20 year ARI event and so excess flows are directed by an outlet to Basin K. Basin K holds runoff from a catchment located closer to Progress Drive. The combination of these two systems has the ability to store and infiltrate the 20 year ARI event. Flow that is additional to this can overflow to Bibra Lake. Due to the proximity of these systems to Bibra Lake, bioretention areas have been conceptually sized and a typical system can be seen in **Appendix D – Bioretention Drawings**. Basin K may be designed to hold a 5 year ARI event and allow outflow to Bibra Lake, and the optimal configuration should be confirmed during detailed design.

To allow for potential future design alterations of RHE in the vicinity of Sudlow Road and Coolbellup Avenue a basin, Basin U, has been shown as an excavated area. This basin has not been designed to hold a particular catchment area but rather has been designed to the following criteria for provisional future compensation:

- 1:6 slopes to avoid the need for fencing or barriers to maintain environmental connectivity of the area.
- 20m buffer between the PSP and the basin batter to maintain an environmental corridor along the road alignment.
- A length to width ratio of less than 30.
- Footprint to avoid all significant trees in the area.

Due to the limiting nature of these criteria, this basin is not a functional element in the concept design. This cleared area, however, is located at the low point in the road design and may be used in future design phases to achieve desired outcomes. Future design in this area must also provide protection to the buildings and road infrastructure to the north of this location.

The modifications to runoff due to alterations of Sudlow Road and Forrest Road, south of RHE, are assumed to be compensated within an existing basin to the west of Sudlow and also in areas where existing road is to be made redundant. Currently flows from Coolbellup Avenue

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run off the un-kerbed road into a compensation system to the west or within the road reserve on the east. This existing configuration is assumed to be sufficient for the marginal increase in catchment area of approximately 0.2 ha.

Road runoff from North Lake Road is assumed to be conveyed and compensated adequately by existing infrastructure. Road runoff from Progress Drive at present is running off to either side of the road and in the case of the south-bound lane, directly to the wetland area. These configurations will require review at the detailed design stage.

6.1.7 Stock Road/Roe Highway Interchange Area

A catchment plan (60100953-215J-RD-SKT-1310) can be found in **Appendix C – Design Plans**. A summary of the basin design characteristics is presented in **Table 6-7**.

Table 6-7 Stock Road/Roe Highway Basin Summary

Basin Reference	Impervious Area	Pervious Area	Storage Required	Base RL (mAHD)	20 Year Water Depth (m)	Calculated Basin Storage Volume (m ³)	Side Slope 1:X	Groundwater Level (mAHD)
Basin P	43154	42705	3415	37	1.2	3465	1:3	3.5
Basin Q	2281	7634	254	47.8	1.2	285	1:13	3.5
Basin R	6737	4288	457	47	1.1	522	1:11	3.5
Basin S	16847	12825	1248	46.6	2.4	1371	1:8	3.5
Basin T	8814	2956	577	42.4	1.2	577	1:3	3.5

Basin P has been designed for the ultimate interchange configuration. Final service relocations may not occur until the ultimate interchange construction; therefore this basin has been altered to accommodate existing services that may remain during Stage 1 of the interchange upgrade. The basin design takes into account the provision of expansion for the compensation of the ultimate configuration. Further detail of services can be seen in the reports detailed in:

- South Metro Connect (2011) *Roe Highway Extension: Existing Services Report*. Document Number 60100953-211J-CI-REP-0001.
- South Metro Connect (2011) *Roe Highway Extension: Desktop Study of Gravity Sewer Trunk Main Diversion*. Document Number 60100953-211J-CI-REP-0003.
- South Metro Connect (2011) *Roe Highway Extension: Desktop Study of Water Trunk Main Diversion*. Document Number 60100953-211J-CI-REP-0007.

Basin T has also been designed based on the existing service locations. The basin has been divided to avoid a Water Corporation pipe this area. A significant tree in this area has also been avoided. A minimum of 7 metres has been given between the 2 separate base areas of this basin and the separate bases interface back to natural surface at a minimum slope of 1V:2.5H. Vertical geometry, easement requirements and possible relocation requirements will need to be confirmed during detailed design. The allowance for tree roots and the water service in this area is assumed to adequate at the concept design stage.

Basins Q, R and S all rely on natural topography in addition to the road embankments to form a „natural“ basin that does not require any vegetation clearing or excavation. This was considered preferable at this stage as the ultimate configuration of the interchange will be likely to impinge on any other areas available for basin locations. If the 1.2m water depth criterion for accessible basins needs to be applied, then nominal fill, to increase the base area of these basins and raise the TWL, can be designed to achieve the volume requirements. This design alteration concept can be seen in **Figure 6-2**.

6.2 Subsoil Design

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No consideration of subsoil design requirements have been made as part of this concept design. It is noted however that the existing road drainage arrangements do not require subsoil drainage and as such it is considered unlikely these features will be required for the proposed road arrangement. This will require confirmation during the next phase of works.

6.3 Water Quality

Stormwater quality is an important consideration in the design of stormwater infrastructure. There are varying methods of providing water quality treatment to stormwater runoff within the proposed drainage system. The governing principles of WSUD and the DoW's *Stormwater Management Manual for WA* and the *Decision Process for stormwater management in WA* (2009) have been given high priority during the development of this concept drainage design for the proposed RHE project.

The DoW principle of capturing the 1 year ARI, 1 hour storm event runoff at-source, in order to maintain water quality, has been applied where possible. These more frequent events typically have a higher concentration of pollutants due to the smaller volume of water and these events have "first flush" characteristics. The concept design presented allows for more than enough capacity to satisfy this criterion, with the retention and infiltration of the critical duration 5 year ARI storm event as a minimum.

Opportunities for the utilisation of overland flow paths will be limited in the intersections, and as such attenuation systems which rely on infiltration are likely to provide the greatest opportunity for treatment at source in these areas.

It is assumed that oil separators and gross pollutant traps will be designed in future design phases and will be installed at pipe outlets. Bioretention systems have been conceptually sized within basins immediately adjacent to the wetland area. The incorporation of bioretention features in close proximity to sensitive areas for protection of the natural environment from road runoff pollution has been considered at the concept design phase. There is potential to incorporate bioretention systems in other locations and these additional bioretention areas can be considered in future design phases.

6.3.1 Bioretention Systems

Concept bioretention designs have been developed for basins located in the immediate vicinity of the wetland area. This was undertaken to improve existing runoff quality to the system and also to improve water quality of the proposed systems near existing important wetland areas.

Bioretention systems have been sized using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC). Documents including; Facility for Advancing Water Bioinfiltration's (FAWB) *Adoption Guidelines for Stormwater Bioinfiltration Systems*, Fletcher *et al* (2004), Duncan (1995), Duncan (1999), Water by Design (2009a), Water by Design (2009b), EDAW (2008) and EDAW (2009), have all been used to aid in the design of the bioretention systems. The benefits and design methodology are presented within these sources.

Previous work suggests that MUSIC may not accurately model the nutrient removal ability of Perth's sandy soils, nor the runoff generated by pervious catchment areas. To avoid these inaccuracies only the impervious catchment areas have been used to size the bioretention areas and only imported or amended soil, to act as a filtration media to improve water quality, will be modelled.

The filtration media is very specific in its constituents. Further details are available from the references listed previously and a typical design can be seen in **Appendix D – Bioretention Drawings**.

An important characteristic of the filtration media is the vertical hydraulic conductivity of 180mm/hr. The depth of the filtration media is 600mm and the extended detention depth is 350mm. A lined system has been modelled with an underdrain to ensure that no nutrients are lost from the water budget within the modelling and weir overflow is a nominal 20m, large enough to ensure that there is no choking of the system. Other properties of the media are generally default values but have been

checked against guidelines mentioned previously.

A high-flow bypass has been incorporated into the model that has capacity approximately equivalent to the maximum flow that can enter via the piped network. This is calculated using the rational method for a 10 year ARI 5min storm, which is the design event of the piped network. The capacity of the high flow bypass will require confirmation at the detailed design stage.

An initial value of 1% of the total catchment area was used for the surface area of the bioretention area. This was then altered, as necessary, to achieve nutrient removal rates of 85% of Total Suspended Solids (TSS), 65% of Total Phosphorous (TP) and 45% of Total Nitrogen (TN). The resulting area required has then been shown in plan and approximately represents the treatment of a 3 month event as modelled in MUSIC using 10 years of actual 6 minute rainfall data.

MUSIC water balance outputs can be seen in **Appendix B – MUSIC Nutrient Water Balance** and a typical design of a bioretention area can be seen in **Appendix D – Bioretention Drawings**. The optimisation of this typical design setup, for all areas, is to be confirmed in detailed design.

7.0 Concept Design Issues Requiring Resolution in Detailed Design

At the concept design stage it was determined that quantities of pits and pipes were not required, nor were gutter flow width calculations. An overall system check was undertaken to confirm that the network was feasible but pipe diameters, inverts and other details of the drainage infrastructure are not indicated on the drawings. As such the location and number of drainage structures are indicative only, and length and sizes of pipe must be further refined in the detailed design phase. This will be completed in further design stages of the RHE Project.

Pervious areas contributing to road areas in cut, in areas where catch drains are not indicated, have been included as catchments to the road network. This was undertaken to avoid further impacting significant vegetation in the area, and may require further design works to allow the catchments to reach the pit and pipe road drainage infrastructure in an optimal manner. In future design works it may be considered appropriate to divert these catchments via cut-off or table drains to alternative locations in the catchments. A conservative approach was taken at this stage to confirm that the infrastructure is appropriately sized to cater for any flows that may be directed to the drainage infrastructure. Thus these areas contributing to the piped networks have also been considered when calculating Basin sizes in PC Sump. The calculations can be seen in **Appendix E – Basin Calculations**. Catch drains are assumed to be standard MRWA Type “G” Drains. The optimisation of these drains has not been undertaken as part of concept design.

At the detailed design stage „natural” basins may require a nominal fill amount to maintain the base of the basin at the appropriate RL in order to achieve the maximum 1.2m water depth, for accessible basins, in the 20 year ARI storm event.

Public Shared Path (PSP) drainage has not been considered in this concept design. Much of the proposed PSP is incorporated as part of the existing system or is included as part of contributing catchments to proposed basins. The overall configuration of the PSP drainage should be undertaken as part of the detailed design delivery phase.

Confirmation of existing road drainage infrastructure arrangements, including invert levels, is required prior to detailed design. Optimisation of the concept configurations, utilising existing infrastructure where possible, should be performed during detailed design. Confirmation of proposed structures, such as bridges, and the functioning of these designs in relation to drainage design will also need to be confirmed during detailed design.

The concept design allows flows larger than the 5 minute duration 10 year ARI event to be transported via the road to sags in the proposed road alignment. An overall system check to confirm these sags can be drained will need to be conducted during detailed design. This will need to incorporate criteria such as additional contributing pervious areas in large events, road closure periods, and flooded width and pipe size limitations. Additionally outlets from appropriate basins have not been designed during concept design.

Basins within the Murdoch Drive interchange area and North Lake Road interchange area may also be modelled as a network rather than individual sumps to optimise the arrangements in these locations.

Detailed design will require the review of the alignment, cover and easement requirements for services associated with of Basin G and Basin T. The water pipe at Basin T passes a significant tree within the area. A proposed gas pipeline alignment passes under Basin G, however allowance has been made for appropriate cover. If necessary this basin may re-designed to provide the required storage volume and avoid this service, however the pipe network and outlet to Roe Swamp will also need to be examined. This proposed gas pipe alignment may also pass in the vicinity of Basin N and consideration of this alignment must be given in detailed design.

8.0 Safety in Design

Safety in design has been considered at all stages of the design process. It is assumed that all construction, operations and maintenance of the RHE project will be conducted by a competent and experienced contractor and thus elements which are considered within the capability of these persons are not highlighted in this section.

In future design, basins will likely require fencing and/or barriers to provide appropriate levels of safety for both pedestrians and motorists. The design has used the back of verge to the basin base as the side slope criterion. This design assumption will require confirmation, to ensure that sufficient width is available for provision of required safety barriers and/or fences. The detailed design phase may then use the kerb widths as well as localised steepening of the batter slopes to achieve the required space for these structures. This localised steepening must also be undertaken with safety considered.

MRWA and DoW guidelines have been adopted throughout the concept design. These guidelines provide a framework for safe design of drainage features, such as basin depths and batter slopes. Where applicable, ideal safety criteria have been adopted e.g. batter slopes of 1V:6H and maximum depth of 1.2m of water. Where these criteria have not been adopted this has been identified. Specific locations that may require further consideration are summarised by the table in **Appendix A – Summary of Basin Design**. These safety elements may include, but not be limited to; adequate side-slopes to allow access and provide stability, appropriate water depths during larger storm events, provision of access for maintenance and to allow for operational activities to be undertaken.

There exists the potential for acid sulfate soils to be exposed during excavation for proposed drainage works. Some of the project area is classified within high to moderate risk of potential acid sulfate soils. A preliminary acid sulfate soil investigation has been conducted (document number 60100953-412D-EN-REP-0001) and where possible excavated basins have been designed to avoid higher risk potential acid sulfate soil categories. A more detailed site investigation will need to be conducted, and appropriate management measures developed, during detailed design.

Services clashes and services relocations have been considered through the design process. The interchange upgrades will be likely to require major service relocations, in addition to any mention within the service relocation desktop studies (document numbers 60100953-211J-CI-REP-0003 and 60100953-211J-CI-REP-0007). The proposed basins, that have been designed within the vicinity of services identified within the existing services report (document number 60100953-211J-CI-REP-0001), have been designed to avoid these clashes with the services where possible. Further work at the detailed design phase will be required to confirm the feasibility of basin arrangements, most importantly basins G, N T that have services in their immediate vicinity.

While pit and pipe locations and details are only indicative at the concept design phase, there is potential for several deep manholes to be required within the Kwinana/Roe Highway Interchange. This introduces risks for construction and operations/maintenance. The location of pit and pipe network has also taken into account concept bridge structure locations. The detailed design phase should seek opportunities to remove deep manholes where possible and confirm structure locations.

Clear zone requirements were considered during the concept design. It is a design principle of this project that appropriate barriers are incorporated as part of the road design as a requirement of the implementation of the Vision Zero Logical Framework. This includes all the interchange areas mentioned above. If during detailed design this assumption does not hold, a detailed investigation of basins and clear zone requirements will be undertaken.

Consideration of protection, to both public and private infrastructure, during large infrequent storms, such as the 100 year ARI event, has been incorporated as a safety in design element of this project. These large events will generally be conveyed by the road to sag points in the alignment which will then be outlet to a basin. While the basins have not been designed to provide storage for these large events, consideration has been given and can be seen in **Appendix E – Basin Calculations**. The pit and pipe infrastructure required to drain and convey road runoff has not been designed at the concept stage. Additionally outlets from the basins have not been designed during the concept phase.

9.0 Conclusion

A concept drainage design for the Roe Highway Extension and associated roads has been prepared for MRWA to assist with the progression of environmental impact assessments and the seeking of regulatory approvals.

The objective of the concept drainage design was to establish a drainage infrastructure arrangement that would adequately serve the proposed concept design of the road, for a level of service representative of standard MRWA guidelines and DoW principles. The scope of work required the sizing of basins and the inclusion of basin extents on the drawings, with relevant inverts and dimensions. Through discussions with MRWA it was determined that the examination of gutter flow widths and optimisation of pipe sizes was not required and indicative pit and pipe locations were satisfactory for the concept design phase.

Basin design summaries can be found in **Appendix A – Summary of Basin Design** and catchment and basins plans can be found in **Appendix C – Design Plans**. Basin and bioretention calculations can be found in **Appendix E – Basin Calculations** and **Appendix B – MUSIC Nutrient Water Balance**, respectively. Concept bioretention configuration drawings for Basin I can be seen in **Appendix D – Bioretention Drawings** and this concept may be applied to the other bioretention areas. Relevant concept road design drawings that show basins can be found in **Appendix F – Concept Design Drawings**.

This concept drainage design does not represent a detailed design and the information contained within this report does not constitute the basis of a detailed design. Whilst general design principles from this concept design can potentially be carried through the design progression, the detailed design must not rely on the assumptions contained within this report. During detailed design it is critical that the designers develop familiarity with the site conditions to ensure the development of a practical and functional detailed design.

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Available from <http://www.mainroads.wa.gov.au>

11.0 Appendix A – Summary of Basin Design

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Approximate Chainage	Basin Reference	Impervious Area	Pervious Area	Storage Required 20 yr ARI (m ³) unless states 5yr	Base RL (mAHD)	20 Year Water Depth (m)	Top Water Level (mAHD)	Calculated Basin Storage Volume (m ³)	Side Slope 1:X	Permeability (m/day)	100 year Top Water Level	Comments and Constraints
Kwinana 16200 West	Basin A	17277	37635	2918	24.5	1.2	25.7	3025	1:3	20	26	Designed to cater for the trapped low point to the west. Opportunity to tap water off along northbound trunk line before Basin B to reduce pipe sizes.
Kwinana 15800 West	Basin B	77609	58046	10060	25.4	1.2	26.6	10113	1:4	20	27	As much impervious area as possible was directed to this location. The Roe Hwy bridge over Kwinana is directed down the Roe Hwy East bound on ramp.
Kwinana 16350 East	Basin C	34865	42575	3410	28.3	1.2	29.5	4041	1:4	20	29.7	Opportunity to reduce Basin size if cut-off drain and vegetation impacts are acceptable in order to direct pervious flows to natural low point.
Kwinana 15900 East	Basin D	30998	43591	3907	26	1.2	27.2	3936	1:4	20	27.6	Large pit drops to be examined in detailed design. Foot print reduced and pipes extended to minimise vegetation clearing.
Roe Hwy Extension 9300 South	Basin E	11787	20353	1545	20.5	1.2	21.7	1854	1:3	20	21.82	Possible networking with Basin E & F to reduce footprint in detailed design
Roe Hwy Extension 11300 South	Basin F	57955	23159	6044 (5yr)	17.9	1.2	19.1	6118	1:4	20	19.85	Overflow to Basin G
Roe Hwy Extension 11200 South	Basin G	18345	7767	1891(5yr)	17.65	0.85	18.5	1978	1:4	20	19.02	Outflow to Roe Swamp
Roe Hwy Extension 11300 North	Basin H	2467	8464	330 (5yr)	18.7	1.2	19.9	379	1:3	20	20.3	Overflow to Basin F

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Approximate Chainage	Basin Reference	Impervious Area	Pervious Area	Storage Required 20 yr ARI (m ³) unless states 5yr	Base RL (mAHD)	20 Year Water Depth (m)	Top Water Level (mAHD)	Calculated Basin Storage Volume (m ³)	Side Slope 1:X	Permeability (m/day)	100 year Top Water Level	Comments and Constraints
Roe Hwy Extension 8020 North	Basin I	39908	17616	3356 (5yr)	~17 (varies)	~0.225(5yr)	17.225	3387	1:3	15	17.44	Bunding to create basin. Overflow to Horsepaddock Swamp
Roe Hwy Extension 7200 South	Basin J (combined 1-4)	80185	62510	6030	28 (av)	1.2	29.2 (av)	5624	1:4 Roe side 1:3 offramp	30	29.55	Cascading basins, overflow to Basin K
Roe Hwy Extension 7480 South	Basin K	22903	34451	2832	15.1	1.2	16.3	4159	1:3	8	16.5	Possible 5yr Basin and overflow to Bibra Lake
Murdoch Extension 750 East	Basin L	49785	18169	6883	18.3	1.2	19.5	7300	1:6	20	19.7	Grazing paddock. Tapping existing network on Farrington to store instead of discharge. Receives Road from CoM
Roe Hwy Extension 13050 North	Basin M1	33220	19081	2375	31.4	2.4	33.8	2525	1:5	20	34.1	Existing Basin from Roe 7 (Basin M1). Natural low point in topography.
Roe Hwy Extension 13600 North	Basin M2	38920	25934	4821	26.4	1.2	27.6	4821	1:3	20	28	Existing Basin from Roe 7 (Basin M2) side slopes steepened to from 1:6 to cater for additional flows
Roe Hwy Extension 12500 North	Basin M3	17456	38294	1734	32	1.22	33.22	1743	1:15	20	33.35	Existing Basin from Roe 7 (Basin 02). Natural low point.
Murdoch Extension 580 West	Basin N	15417	9531	2036	18	1.2	19.2	2096	1:3	20	19.55	Widening and deepening of an existing basin to accommodate flows from Murdoch Drive Extension
Bibra Drive 800 East	O (combined)	6155	5184	490 (5yr)	18.5	0.7	19.2	536	1:3	20	19.55	Overflow to existing network or discharge to Frog Swamp. For detailed design.

Approximate Chainage	Basin Reference	Impervious Area	Pervious Area	Storage Required 20 yr ARI (m ³) unless states 5yr	Base RL (mAHD)	20 Year Water Depth (m)	Top Water Level (mAHD)	Calculated Basin Storage Volume (m ³)	Side Slope 1:X	Permeability (m/day)	100 year Top Water Level	Comments and Constraints
Stock 8700 West	Basin P	43154	42705	3415	37	1.2	38.2	3465	1:3	30	38.45	Size has been reduced to allow for services in the area with the option to relocate services and increase basin volume to cater for the ultimate interchange configuration.
Stock 8900 West	Basin Q	2281	7634	254	47.8	1.2	48.4	285	1:13	30	48.45	Natural basin: No clearing or excavation required.
Stock 8750 East	Basin R	6737	4288	457	47	1.1	48.1	522	1:11	30	48.15	Natural basin: No clearing or excavation required
Stock 8990 West	Basin S	16847	12825	1248	46.6	2.4	49	1371	1:8	30	49.11	Natural basin, inaccessible basin, in order for 1.2m depth criteria not to be breached, slight filling of the base to 47.8 may be required. For examination in detailed design.
Stock 8570 East	Basin T	8814	2956	577	42.4	1.2	43.6	577	1:3	30	43.8	Basin base split to avoid service clashes and significant tree in the area.
Roe Hwy Extension 6300 North	Basin U (Malvolio Rd)	TBD	TBD	TBD	30.3	0.38	30.68	101	1:6	30	TBD	Small basin designed based on corridor requirements. Non-functional at concept design phase

Table 11-1 Summary of Basin Design

12.0 Appendix B – MUSIC Nutrient Water Balance

The design criteria of the bioretention areas is to achieve nutrient removal rates of 85% of Total Suspended Solids (TSS), 65% of Total Phosphorous (TP) and 45% of Total Nitrogen (TN). The resulting area required approximately represents the treatment of a 3 month event as modelled in MUSIC using 10 years of actual 6 minute rainfall data.

Roe Hwy to Basins J1-4 (860m ²)					
	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
Flow In	45.67	16403.63	26.18	112.26	1468.07
ET Loss	1.64	0	0	0	0
Infiltration Loss	0	0	0	0	0
Low Flow Bypass Out	0	0	0	0	0
High Flow Bypass Out	0.02	7.48	0.01	0.03	0.22
Orifice / Filter Out	32.3	64.61	4.96	32.81	0
Weir Out	11.68	1676.64	3.49	28.72	0
Transfer Function Out	0	0	0	0	0
Reuse Supplied	0	0	0	0	0
Reuse Requested	0	0	0	0	0
% Reuse Demand Met	0	0	0	0	0
% Load Reduction	3.65	89.34	67.71	45.16	99.98
Roe Hwy to Basin K (240m ²)					
	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
Flow In	13.04	4718.47	7.64	30.81	419.29
ET Loss	0.46	0	0	0	0
Infiltration Loss	0	0	0	0	0
Low Flow Bypass Out	0	0	0	0	0
High Flow Bypass Out	0	0	0	0	0
Orifice / Filter Out	9.08	18.16	1.39	9.22	0
Weir Out	3.5	527.31	1.12	7.56	0
Transfer Function Out	0	0	0	0	0
Reuse Supplied	0	0	0	0	0
Reuse Requested	0	0	0	0	0
% Reuse Demand Met	0	0	0	0	0
% Load Reduction	3.56	88.44	67.06	45.53	100
Roe Hwy to Basin I (500m ²)					
	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
Flow In	22.78	8405.74	12.92	55.11	732.38
ET Loss	0.95	0	0	0	0
Infiltration Loss	0	0	0	0	0
Low Flow Bypass Out	0	0	0	0	0
High Flow Bypass Out	0.01	7.58	0	0.02	0.11
Orifice / Filter Out	16.97	33.94	2.61	17.25	0
Weir Out	4.84	698.35	1.47	11.01	0
Transfer Function Out	0	0	0	0	0
Reuse Supplied	0	0	0	0	0
Reuse Requested	0	0	0	0	0
% Reuse Demand Met	0	0	0	0	0
% Load Reduction	4.2	91.2	68.43	48.68	99.99

Roe Hwy to Basins O1 and O2 (55m ²)					
	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
Flow In	3.49	1274.8	2.05	8.35	112.06
ET Loss	0.12	0	0	0	0
Infiltration Loss	0	0	0	0	0
Low Flow Bypass Out	0	0	0	0	0
High Flow Bypass Out	0	0	0	0	0
Orifice / Filter Out	2.43	4.86	0.37	2.47	0
Weir Out	0.93	127.99	0.29	2.05	0
Transfer Function Out	0	0	0	0	0
Reuse Supplied	0	0	0	0	0
Reuse Requested	0	0	0	0	0
% Reuse Demand Met	0	0	0	0	0
% Load Reduction	3.6	89.58	67.5	45.9	100

Roe Hwy to Basin N (175m ²)					
	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
Flow In	8.78	3382.33	5.32	21.38	282.33
ET Loss	0.33	0	0	0	0
Infiltration Loss	0	0	0	0	0
Low Flow Bypass Out	0	0	0	0	0
High Flow Bypass Out	0	0	0	0	0
Orifice / Filter Out	6.31	12.63	0.97	6.42	0
Weir Out	2.13	325.16	0.68	5.24	0
Transfer Function Out	0	0	0	0	0
Reuse Supplied	0	0	0	0	0
Reuse Requested	0	0	0	0	0
% Reuse Demand Met	0	0	0	0	0
% Load Reduction	3.82	90.01	68.89	45.47	100

Roe Hwy to Basin F (560m ²)					
	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
Flow In	30.22	10343	17.98	71.37	971.51
ET Loss	1.07	0	0	0	0
Infiltration Loss	0	0	0	0	0
Low Flow Bypass Out	0	0	0	0	0
High Flow Bypass Out	0	0	0	0	0
Orifice / Filter Out	21.18	42.37	3.25	21.52	0
Weir Out	7.95	1075.65	2.53	17.29	0
Transfer Function Out	0	0	0	0	0
Reuse Supplied	0	0	0	0	0
Reuse Requested	0	0	0	0	0
% Reuse Demand Met	0	0	0	0	0
% Load Reduction	3.6	89.19	67.83	45.62	100

Roe Hwy to Basin G (200m ²)					
	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
Flow In	10.58	3738.82	6.13	25.31	340.2
ET Loss	0.38	0	0	0	0
Infiltration Loss	0	0	0	0	0
Low Flow Bypass Out	0	0	0	0	0
High Flow Bypass Out	0	0	0	0	0
Orifice / Filter Out	7.44	14.88	1.14	7.56	0
Weir Out	2.75	397.99	0.85	6.37	0
Transfer Function Out	0	0	0	0	0
Reuse Supplied	0	0	0	0	0
Reuse Requested	0	0	0	0	0
% Reuse Demand Met	0	0	0	0	0
% Load Reduction	3.64	88.96	67.5	44.95	100

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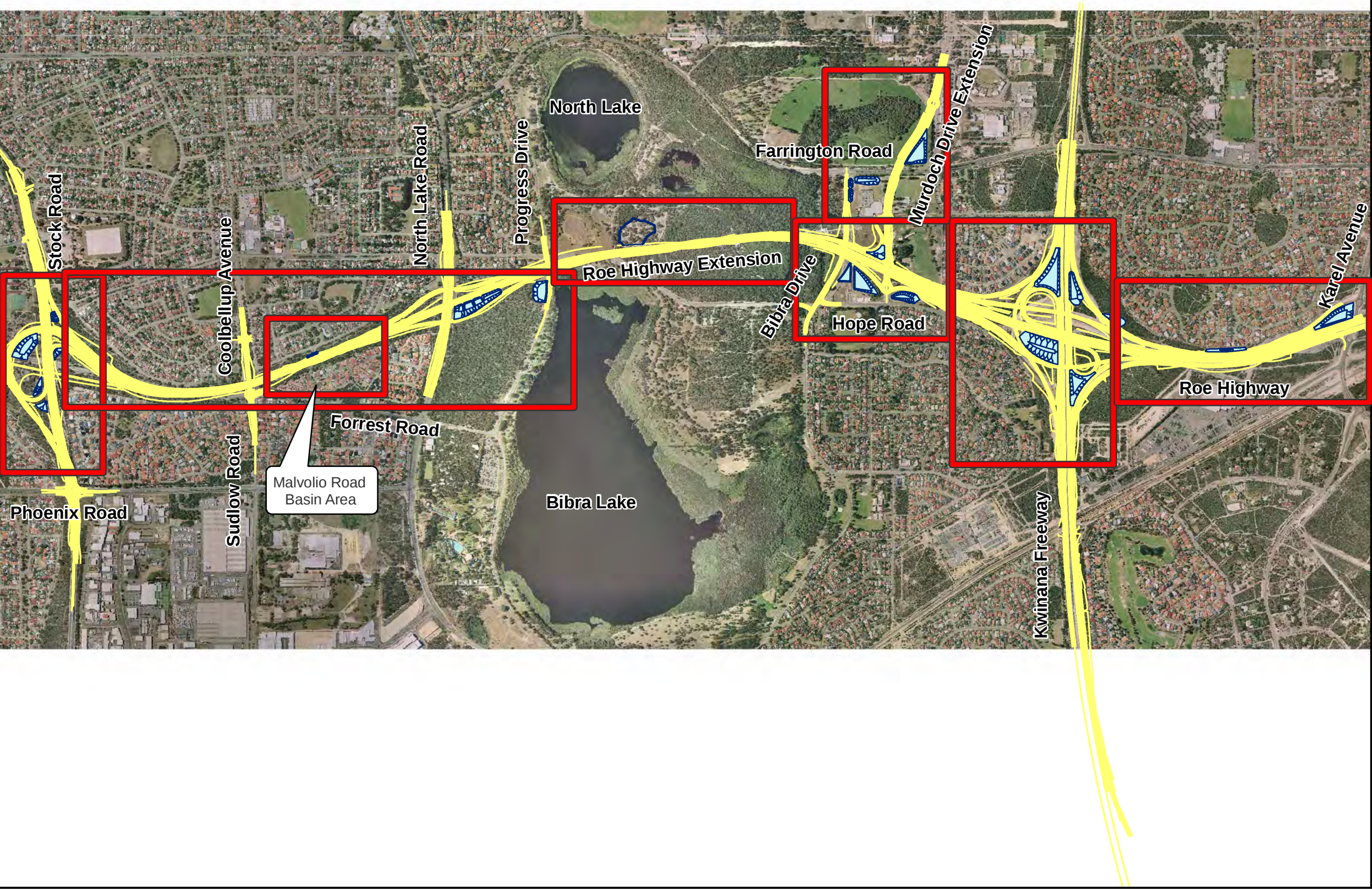
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13.0 Appendix C – Design Plans

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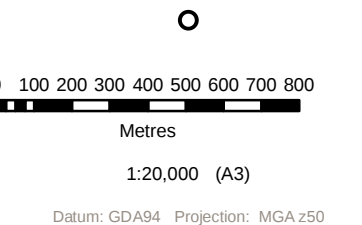
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Roe Highway Extention
Catchment Plan

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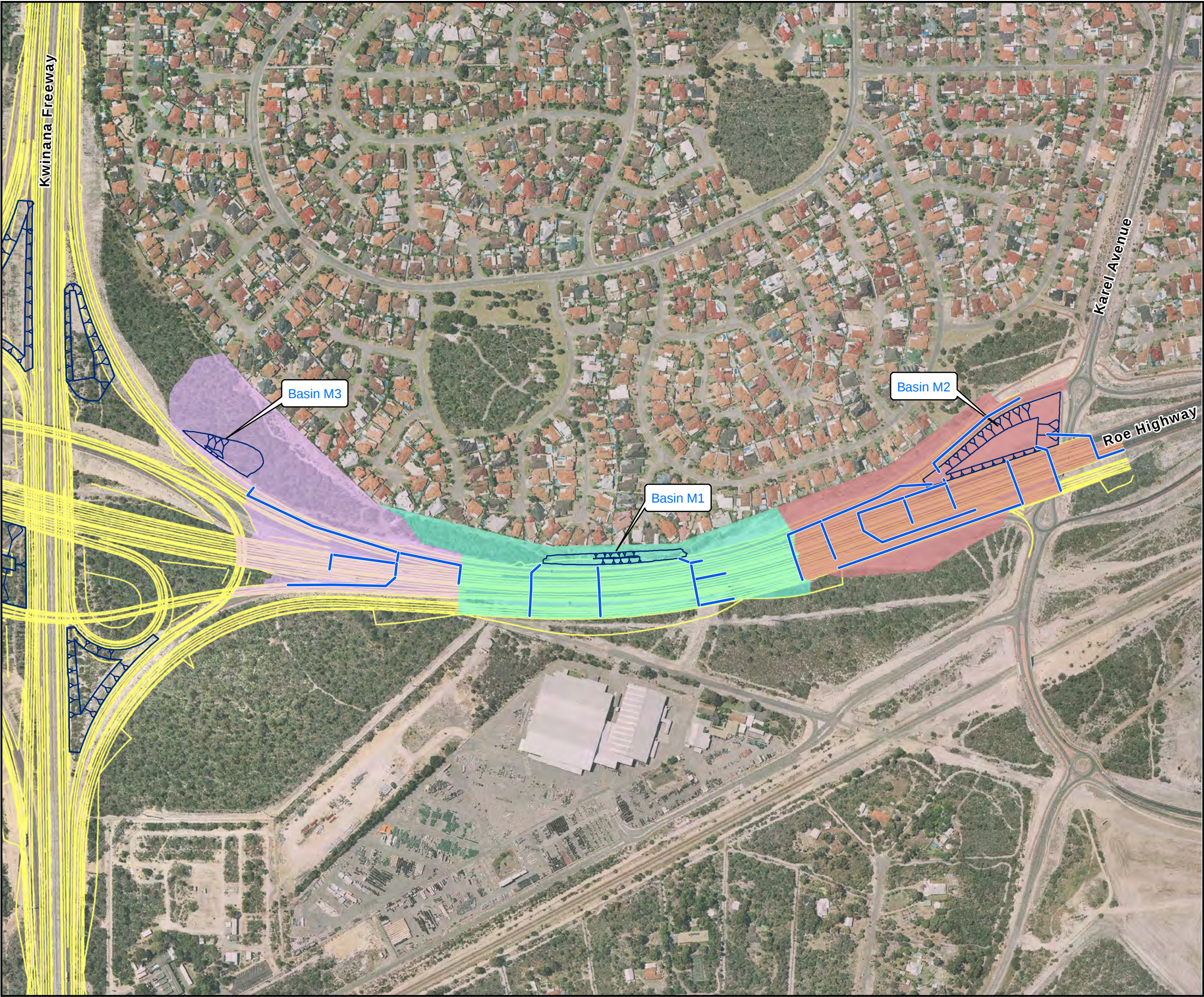
- Basin
- Basin Footprint
- Design Concept
- Indicative Catchment Locations

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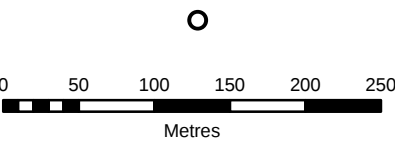
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**Karel Ave/Roe Hwy
Interchange
Catchment Plan**

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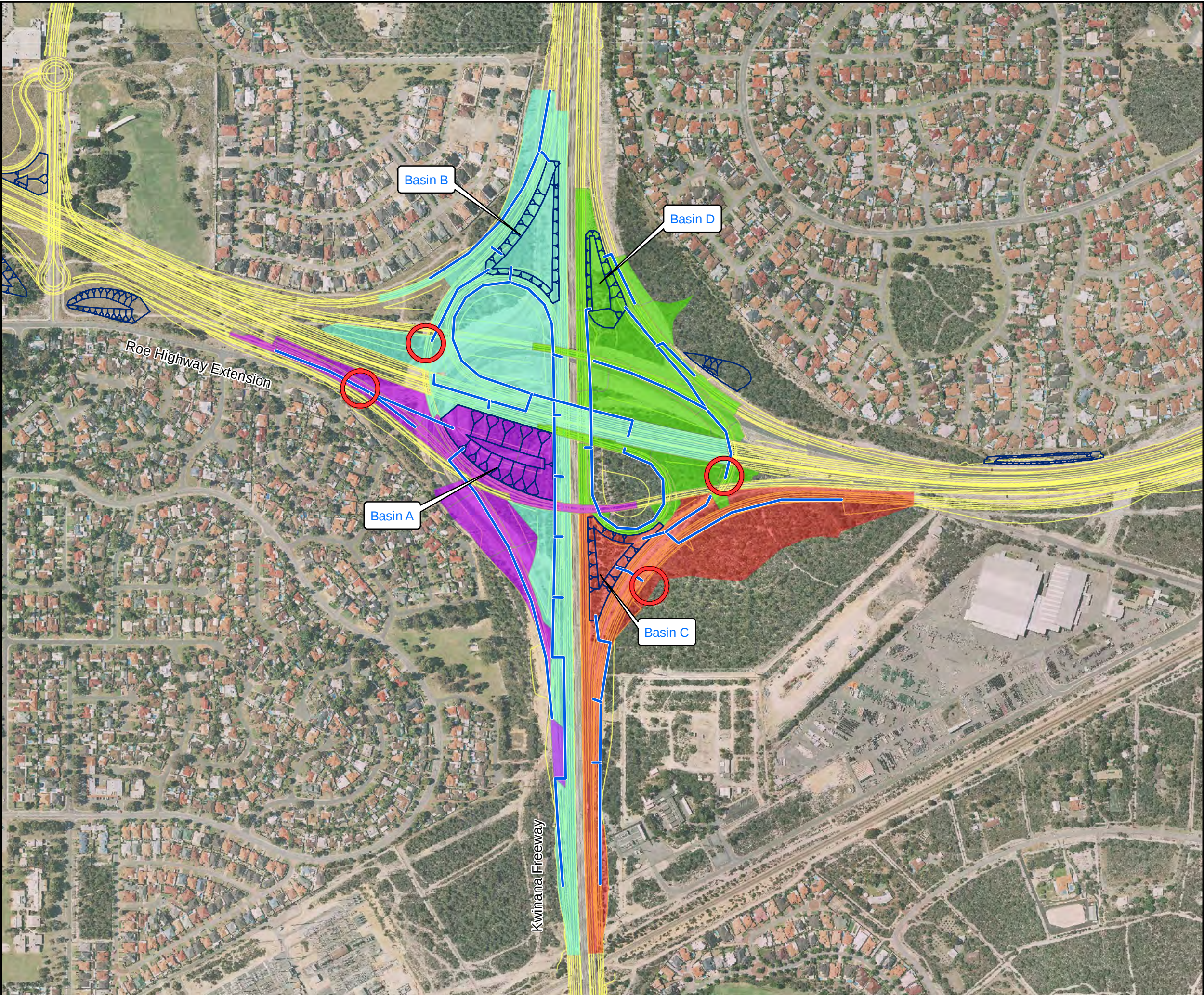
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- Basin M3 Catchment
- Basin M1 Catchment
- Basin M2 Catchment
- Basin
- Indicative Drainage Network
- Design Concept

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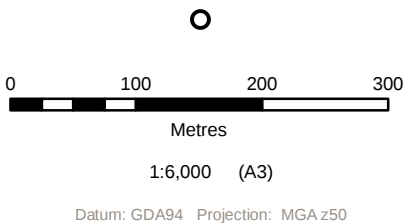
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**Kwinana/Roe Hwy
Interchange
Catchment Plan**

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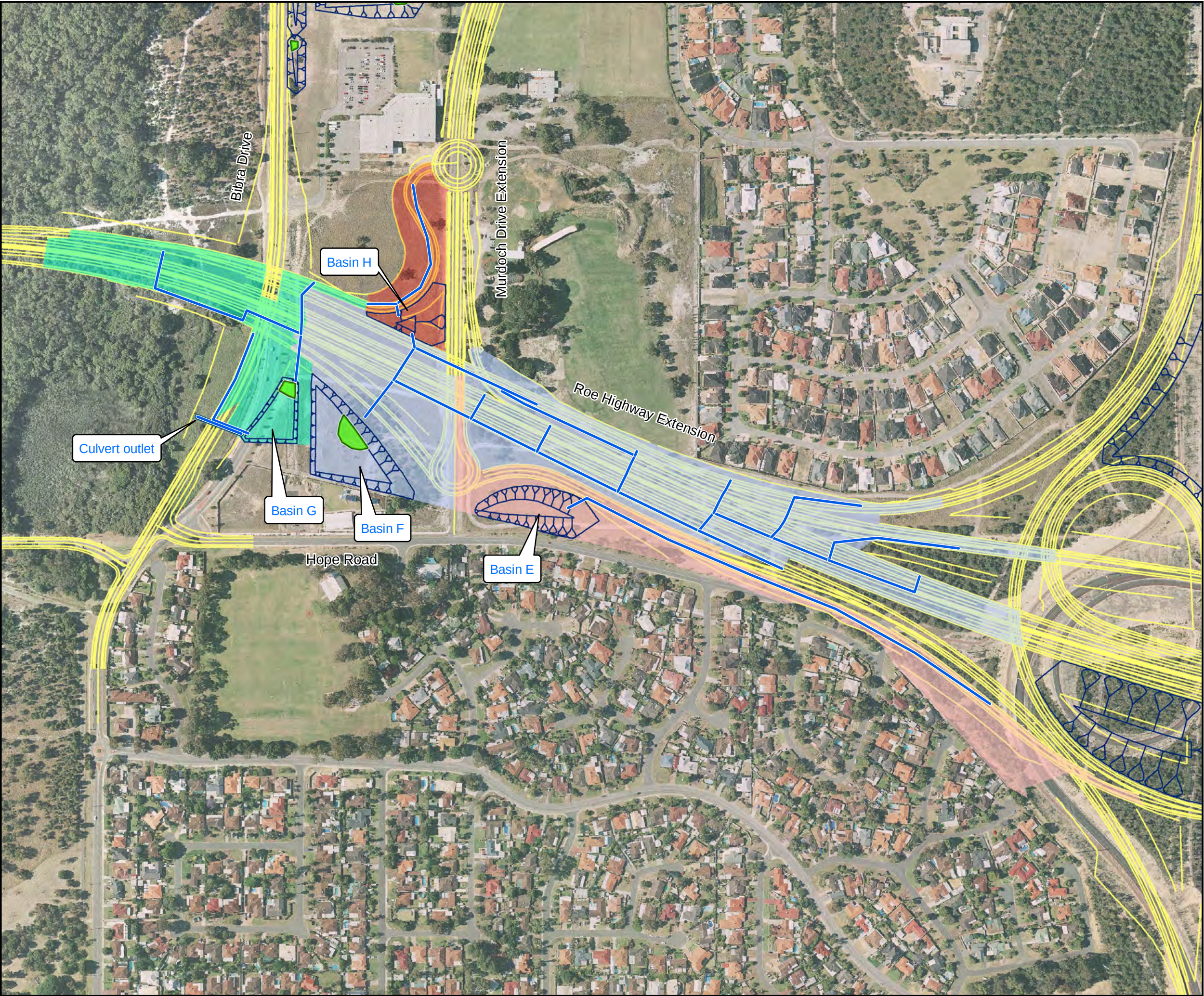


- Basin
- Trapped Low Points
- Basin A Catchment
- Basin B Catchment
- Basin D Catchment
- Basin C Catchment
- Indicative Drainage Network
- Design Concept

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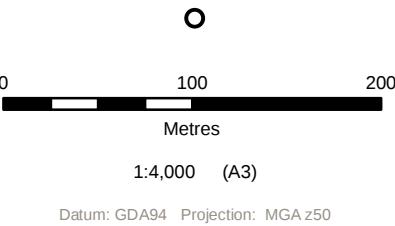
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**Murdoch Dr/Roe Hwy
Interchange
Catchment Plan**

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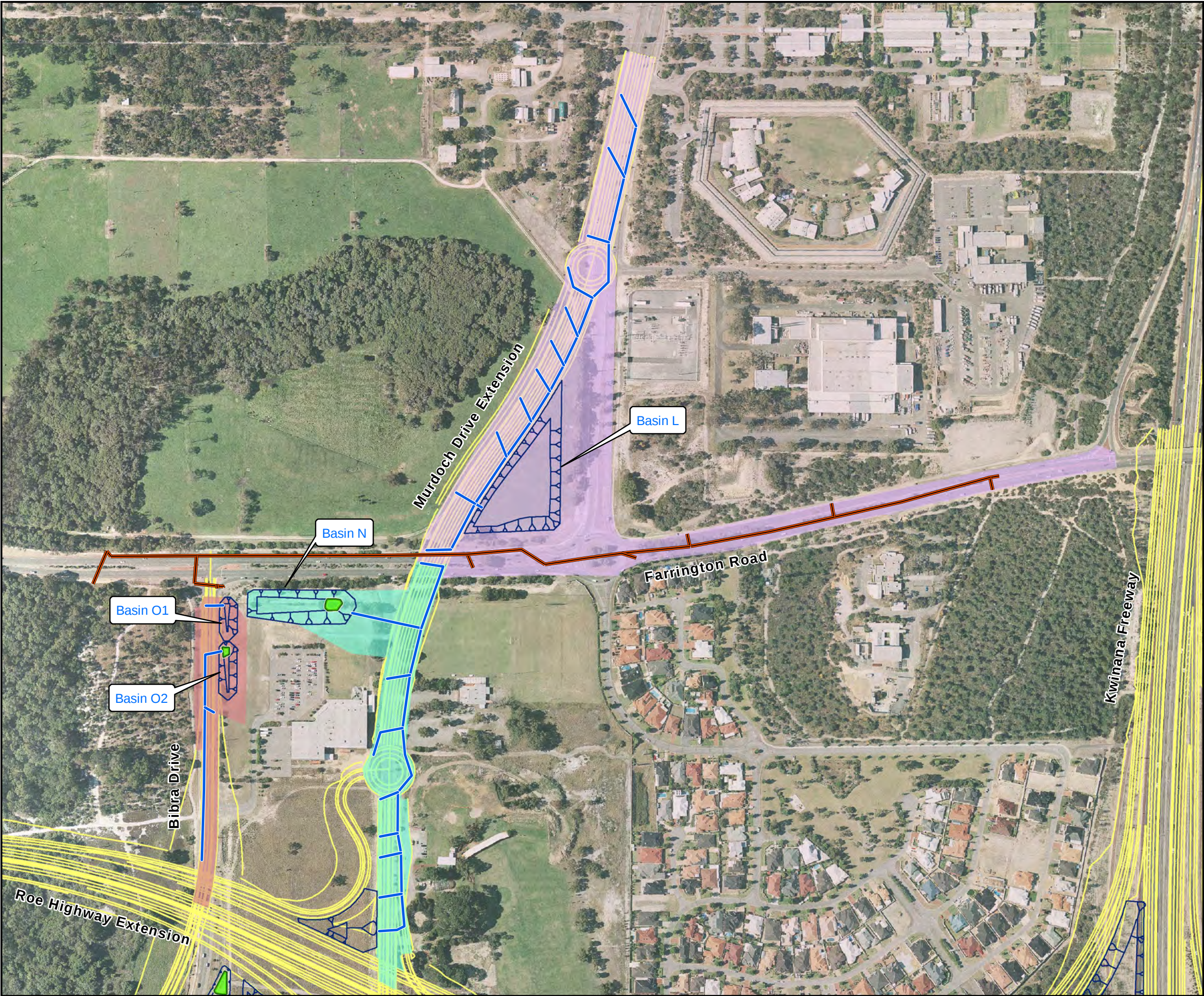


- Basin E Catchment
- Basin F Catchment
- Basin G Catchment
- Basin H Catchment
- Bioretention Area
- Culvert
- Basin
- Indicative Drainage Network
- Design Concept

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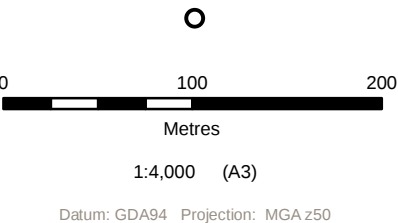
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**Murdoch Drive
Extension
Catchment Plan**

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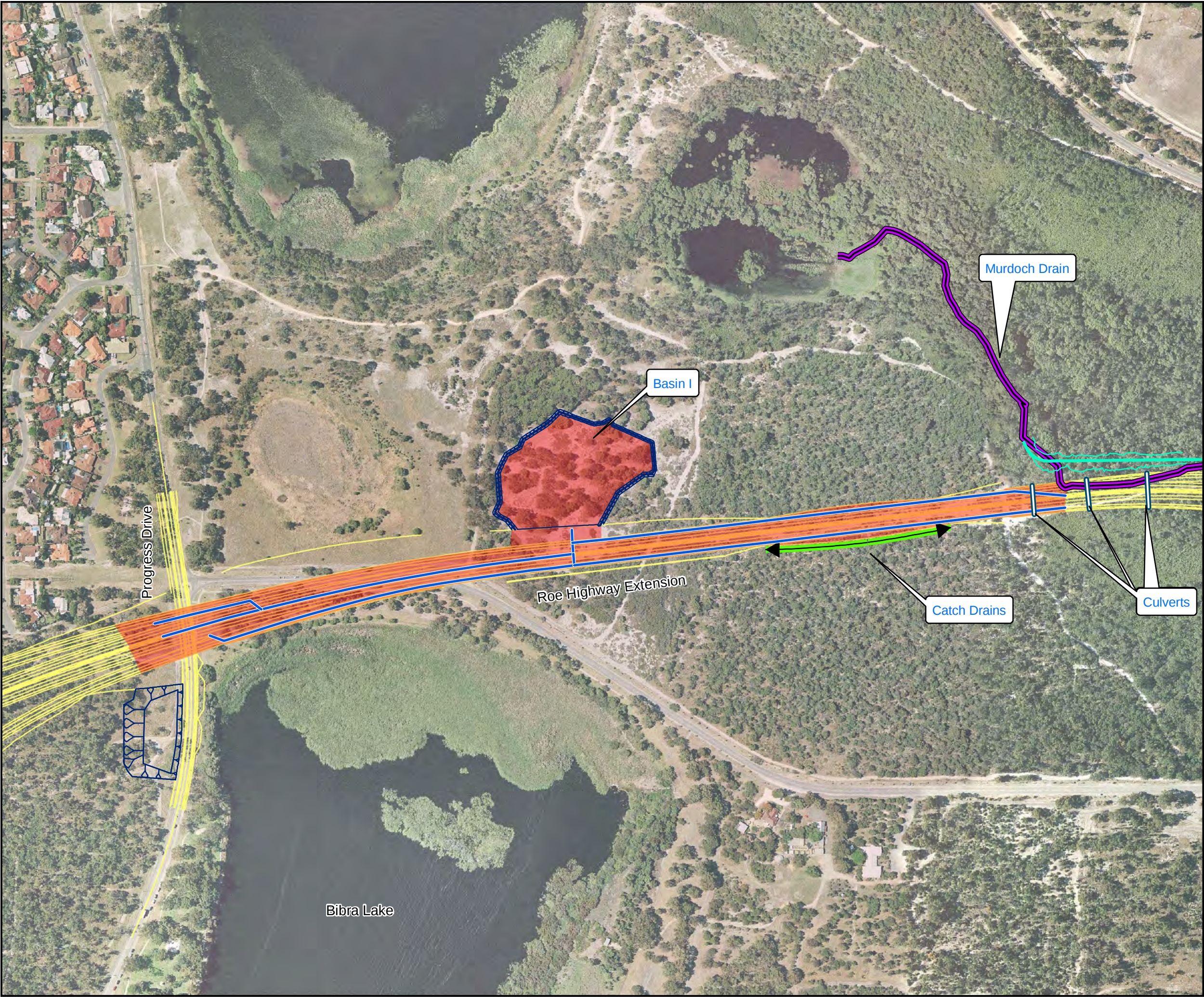


- Basin L Catchment
- Basin N Catchment
- Basin O1 and O2 Catchment
- Bioretention Area
- Indicative Drainage Network
- Design Concept
- Existing Drainage Network

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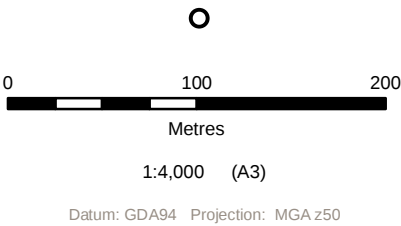
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**Bibra Drive to
Progress Drive
Catchment Plan**

60100953-215J-RD-SKT-1306



- Basin P Catchment
- Basin
- Indicative Drainage Network
- Design Concept
- Catch Drain
- Culverts
- Approximate Murdoch Drain Location
- Murdoch Drain Realignment

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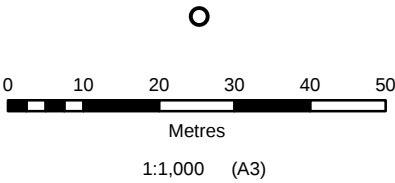
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**Bibra Drive to
Progress Drive
Basin Plan**

60100953-215J-RD-SKT-1307



- Indicative Location of
Oil Interceptor and
Flow Splitter
- Indicative Pipe Location
- Basin
- Indicative Drainage
Network
- Design Concept
- Bioretention Area

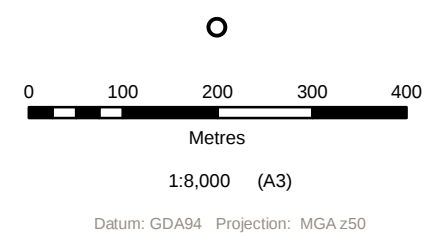
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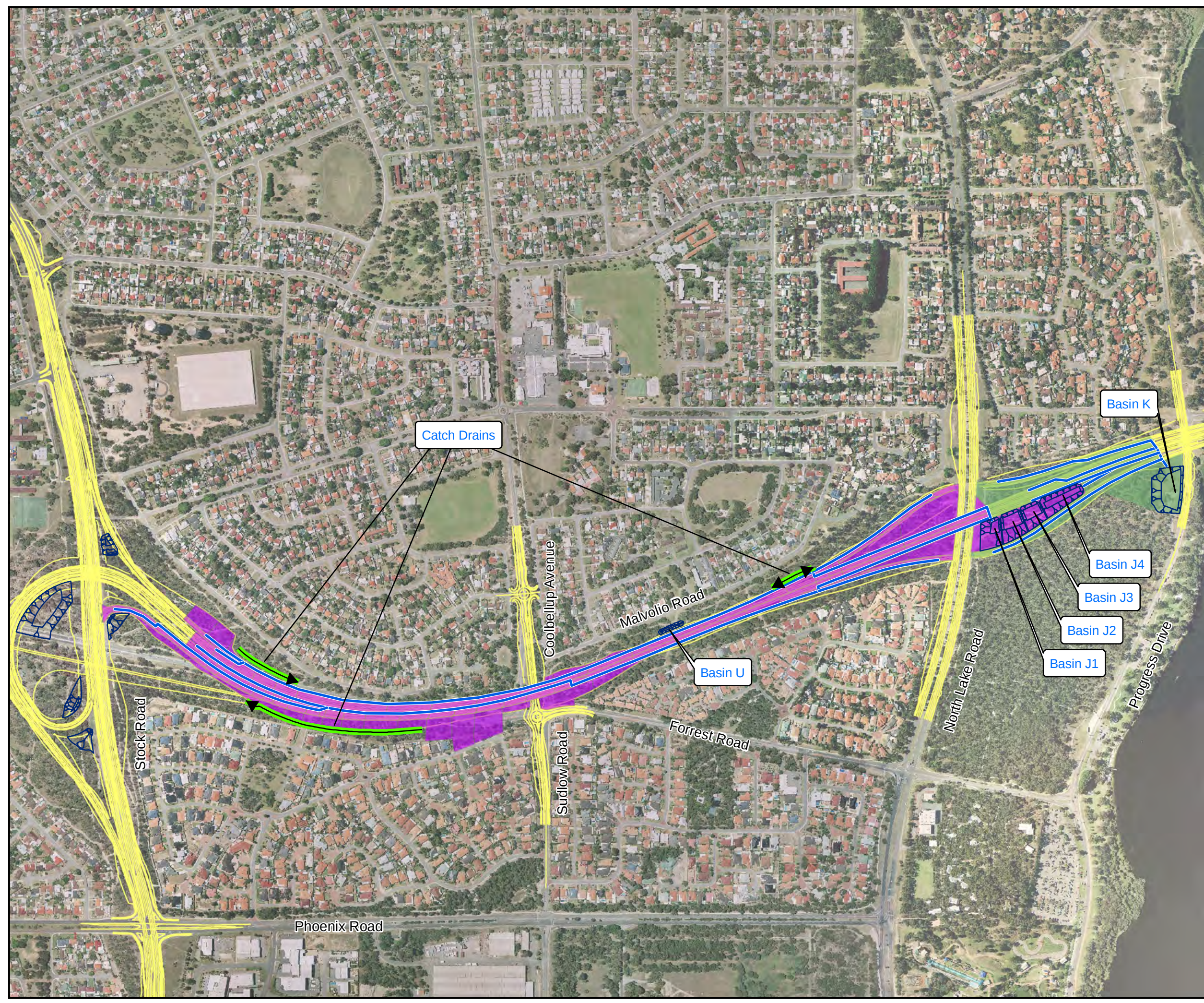


North Lake Rd/Roe Hwy Interchange Catchment Plan

60100953-215J-RD-SKT-1308



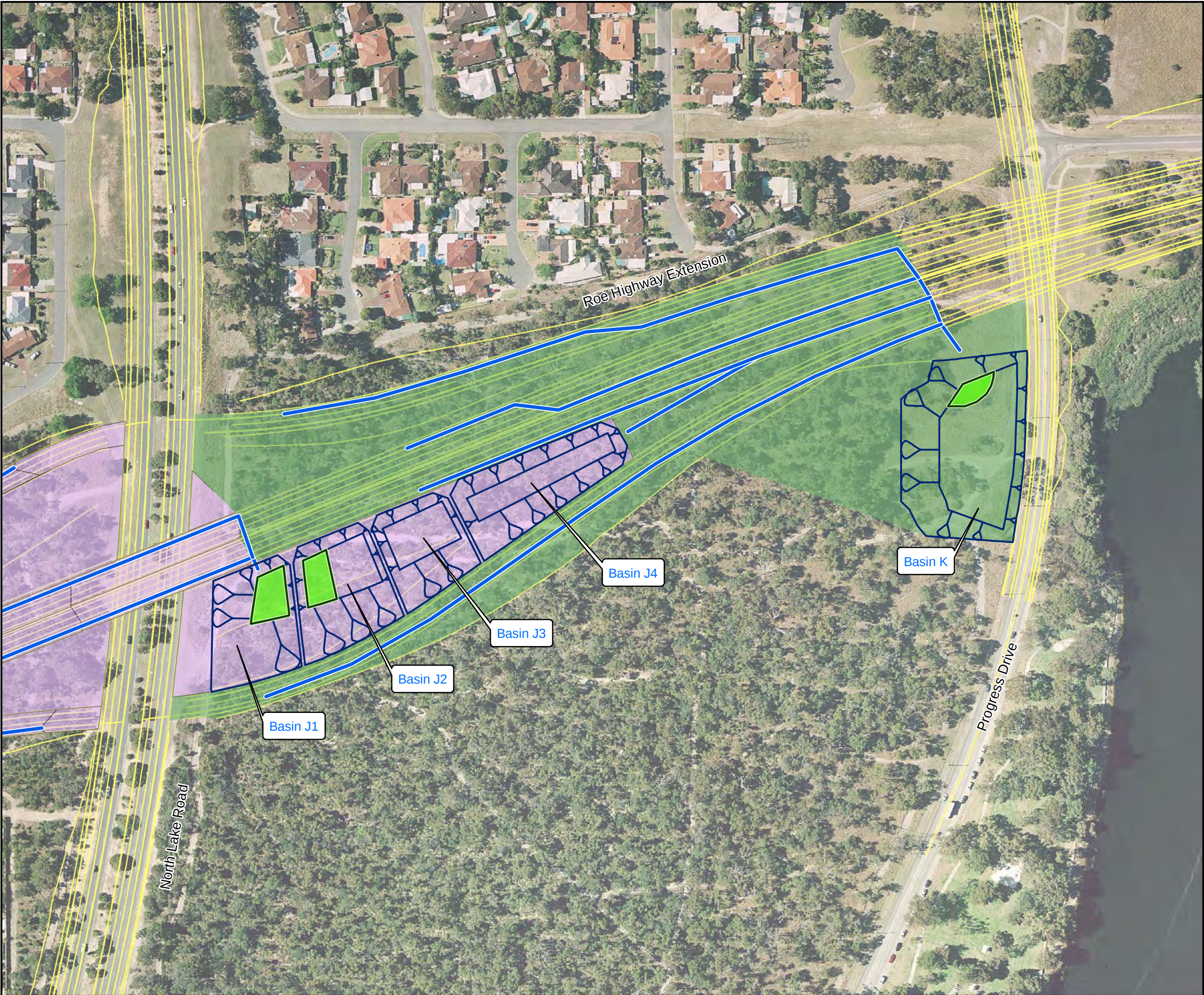
- Basin J1-J4 Catchment
- Basin K Catchment
- Indicative Drainage Network
- Design Concept
- Basin
- Catch Drain



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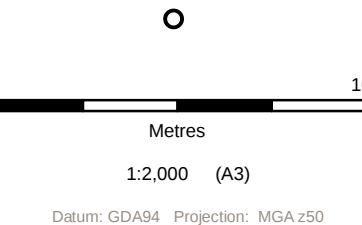
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North Lake Rd/Roe Hwy Interchange Basin Plan

60100953-215J-RD-SKT-1309



- Basin J1-J4 Catchment
- Basin K Catchment
- Bioretention Area
- Basin
- Indicative Drainage Network
- Design Concept

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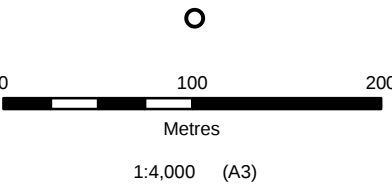
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**Stock Rd/Roe Hwy
Interchange
Catchment Plan**

60100953-215J-RD-SKT-1310



Datum: GDA94 Projection: MGA z50

- Basin P Catchment
- Basin Q Catchment
- Basin R Catchment
- Basin S Catchment
- Basin T Catchment
- Basin
- Indicative Drainage Network
- Design Concept
- Catch Drain

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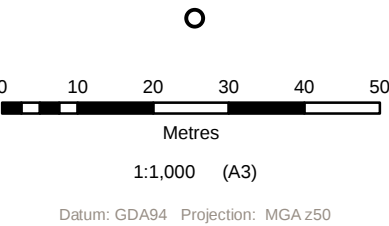
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**Malvolio Rd
Basin Plan**

60100953-215J-RD-SKT-1311



- Basin
- Indicative Drainage Network
- Design Concept

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14.0 Appendix D – Bioretention Drawings

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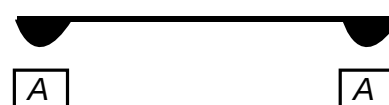
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*Final location of piping subject to existing vegetation and to be confirmed during detail design

**Dixon Road
Bioretention Basin
Concept Plan**
South Metro Connect
Figure 5.6-4

- New bund wall
- Pipe
- Bioretention areas
- Gross Pollutant Trap/oil separator manifold combined with flow splitter and energy dissipation structure
- Proposed road



Cross Section illustrated in
Fig 5.6-5

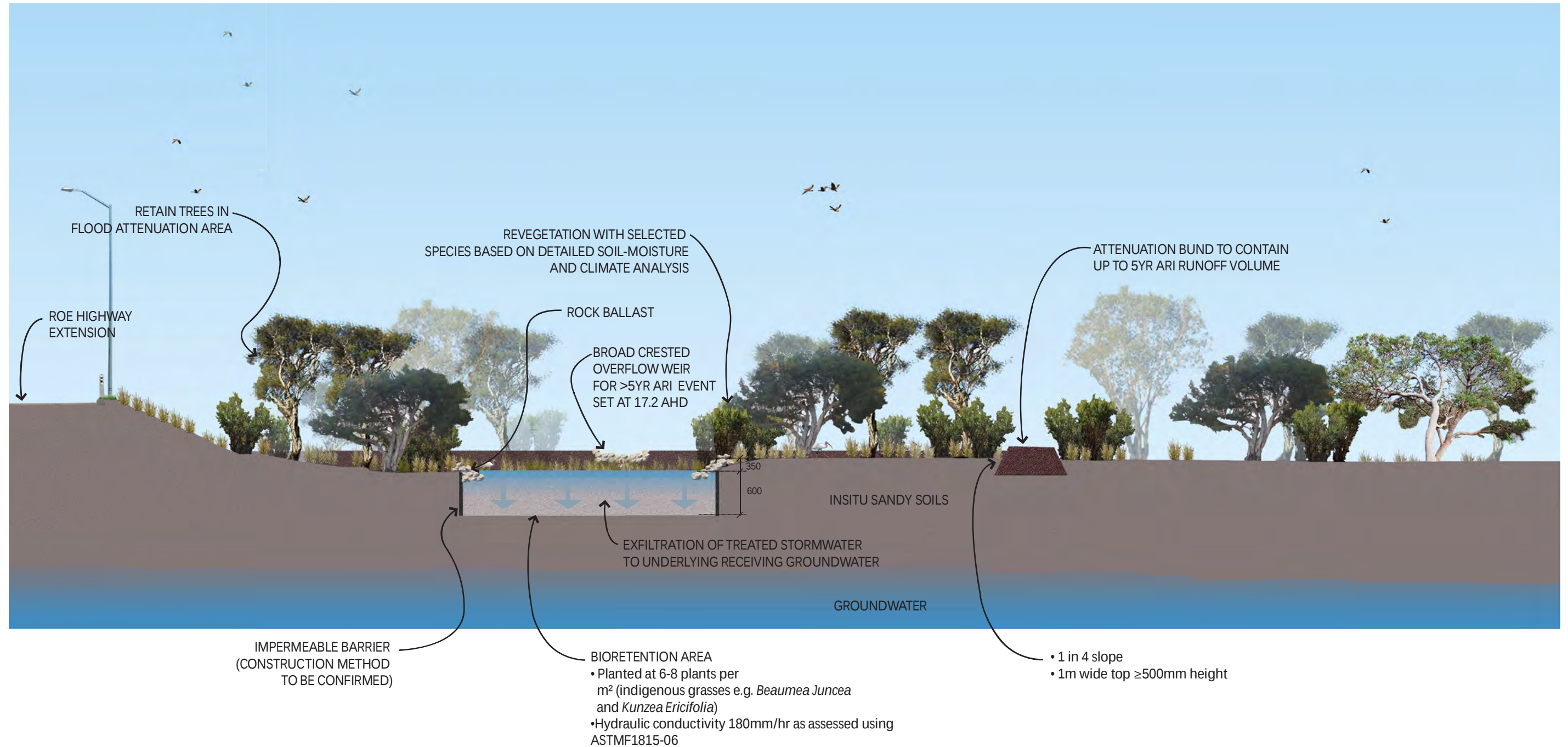


Longitudinal Section illustrated in
Fig 5.6-6

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Bioretention Cross Section

South Metro Connect
Figure 5.6-6



Cross Section illustrated in
Fig 5.6-4

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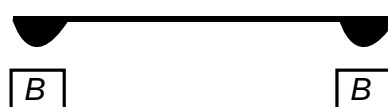
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Bioretention Longitudinal Section

South Metro Connect
Figure 5.6-7



Longitudinal Section illustrated in
Fig 5.6-4

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15.0 Appendix E – Basin Calculations

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Project Details	
Project	Roe Highway Extension - Kwinana/Roe Intersection
Job Number	60100953
Task	Basin A
Designer	LBC

Location	Perth
----------	-------

Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	17277	0.900	15549	
Verge	37635	0.300	11291	
	0	0.700	0	
Total	54912		26840	

Sump Details		
GWL	23.000	m AHD
Depth to GWL from base	1.500	m
Max Allowable TWL	25.700	m AHD
Sump Base Level	24.500	m AHD
Sump Width at base	17	m
Sump Length at base	119	m
Side Slope	3.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	72	4320	44h 00m	2640	2918	1.161	25.700	25.661	0.039	Green & Amp plus Shallow WT models
20	48	2880	40h 00m	2400	2770	1.112	25.700	25.612	0.088	Green & Amp plus Shallow WT models
20	36	2160	36h 00m	2160	2597	1.053	25.700	25.553	0.147	Green & Amp plus Shallow WT models
20	30	1800	28h 00m	1680	2507	1.022	25.700	25.522	0.178	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	2232	0.926	25.700	25.426	0.274	Green & Amp plus Shallow WT models
20	18	1080	18h 00m	1080	2023	0.850	25.700	25.350	0.350	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	1711	0.734	25.700	25.234	0.466	Clogged base model
20	72	4320	16h 00m	960	1702	0.731	25.700	25.231	0.469	Clogged base model
20	30	1800	14h 00m	840	1682	0.723	25.700	25.223	0.477	Clogged base model
20	24	1440	10h 00m	600	1668	0.718	25.700	25.218	0.482	Clogged base model
20	36	2160	12h 00m	720	1665	0.717	25.700	25.217	0.483	Clogged base model
20	12	720	12h 00m	720	1637	0.706	25.700	25.206	0.494	Green & Amp plus Shallow WT models
20	18	1080	11h 00m	660	1582	0.685	25.700	25.185	0.515	Clogged base model
20	9	540	9h 00m	540	1495	0.651	25.700	25.151	0.549	Green & Amp plus Shallow WT models
20	12	720	8h 00m	480	1467	0.640	25.700	25.140	0.560	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	6	360	6h 00m	360	1421	0.622	25.700	25.122	0.578	Green & Amp plus Shallow WT models
20	9	540	8h 00m	480	1401	0.615	25.700	25.115	0.585	Clogged base model
20	6	360	5h 30m	330	1345	0.593	25.700	25.093	0.607	Clogged base model
20	4.5	270	4h 15m	255	1276	0.565	25.700	25.065	0.635	Clogged base model
20	3	180	2h 45m	165	1170	0.522	25.700	25.022	0.678	Clogged base model
20	4.5	270	4h 30m	270	1070	0.481	25.700	24.981	0.719	Green & Amp plus Shallow WT models
20	2	120	2h 00m	120	1062	0.478	25.700	24.978	0.722	Clogged base model
20	1.5	90	1h 30m	90	981	0.444	25.700	24.944	0.756	Clogged base model
20	1	60	1h 00m	60	871	0.398	25.700	24.898	0.802	Clogged base model
20	3	180	3h 00m	180	850	0.389	25.700	24.889	0.811	Green & Amp plus Shallow WT models
20	0.75	45	0h 45m	45	806	0.370	25.700	24.870	0.830	Clogged base model
20	0.5	30	0h 30m	30	711	0.329	25.700	24.829	0.871	Clogged base model
20	0.4167	25	0h 25m	25	671	0.312	25.700	24.812	0.888	Clogged base model
20	2	120	2h 00m	120	662	0.308	25.700	24.808	0.892	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	618	0.288	25.700	24.788	0.912	Clogged base model
20	0.25	15	0h 15m	15	551	0.258	25.700	24.758	0.942	Clogged base model
20	1.5	90	1h 30m	90	515	0.242	25.700	24.742	0.958	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	462	0.218	25.700	24.718	0.982	Clogged base model
20	1	60	1h 00m	60	437	0.207	25.700	24.707	0.993	Green & Amp plus Shallow WT models
20	0.75	45	0h 45m	45	333	0.159	25.700	24.659	1.041	Green & Amp plus Shallow WT models
20	0.4167	25	0h 15m	15	288	0.138	25.700	24.638	1.062	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	283	0.136	25.700	24.636	1.064	Green & Amp plus Shallow WT models
20	0.25	15	0h 10m	10	255	0.122	25.700	24.622	1.078	Green & Amp plus Shallow WT models
20	0.5	30	0h 15m	15	253	0.122	25.700	24.622	1.078	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	250	0.120	25.700	24.620	1.080	Green & Amp plus Shallow WT models
100	72	4320	72h 00m	4320	4172	1.553	25.700	26.053	-0.353	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	3944	1.485	25.700	25.985	-0.285	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	3650	1.395	25.700	25.895	-0.195	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	3484	1.343	25.700	25.843	-0.143	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	3119	1.227	25.700	25.727	-0.027	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	2799	1.121	25.700	25.621	0.079	Green & Amp plus Shallow WT models
100	12	720	12h 00m	720	2278	0.942	25.700	25.442	0.258	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	2163	0.901	25.700	25.401	0.299	Clogged base model
100	24	1440	13h 00m	780	2149	0.896	25.700	25.396	0.304	Clogged base model
100	36	2160	16h 00m	960	2113	0.883	25.700	25.383	0.317	Clogged base model
100	48	2880	16h 00m	960	2097	0.877	25.700	25.377	0.323	Clogged base model
100	72	4320	24h 00m	1440	2094	0.876	25.700	25.376	0.324	Clogged base model
100	9	540	9h 00m	540	2078	0.870	25.700	25.370	0.330	Green & Amp plus Shallow WT models
100	18	1080	12h 00m	720	2076	0.869	25.700	25.369	0.331	Clogged base model
100	12	720	9h 00m	540	1932	0.817	25.700	25.317	0.383	Clogged base model
100	6	360	6h 00m	360	1929	0.816	25.700	25.316	0.384	Green & Amp plus Shallow WT models
100	9	540	8h 30m	510	1910	0.809	25.700	25.309	0.391	Clogged base model
100	6	360	6h 00m	360	1844	0.784	25.700	25.284	0.416	Clogged base model
100	4.5	270	4h 30m	270	1752	0.750	25.700	25.250	0.450	Clogged base model
100	3	180	3h 00m	180	1612	0.697	25.700	25.197	0.503	Clogged base model
100	4.5	270	4h 30m	270	1571	0.681	25.700	25.181	0.519	Green & Amp plus Shallow WT models
100	2	120	2h 00m	120	1461	0.638	25.700	25.138	0.562	Clogged base model
100	1.5	90	1h 30m	90	1353	0.596	25.700	25.096	0.604	Clogged base model
100	3	180	3h 00m	180	1268	0.562	25.700	25.062	0.638	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	1203	0.535	25.700	25.035	0.665	Clogged base model
100	0.75	45	0h 45m	45	1122	0.503	25.700	25.003	0.697	Clogged base model
100	2	120	2h 00m	120	1056	0.475	25.700	24.975	0.725	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	1004	0.454	25.700	24.954	0.746	Clogged base model
100	0.4167	25	0h 25m	25	949	0.431	25.700	24.931	0.769	Clogged base model
100	0.3333	20	0h 20m	20	885	0.404	25.700	24.904	0.796	Clogged base model
100	1.5	90	1h 30m	90	869	0.397	25.700	24.897	0.803	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	792	0.364	25.700	24.864	0.836	Clogged base model
100	1	60	1h 00m	60	726	0.335	25.700	24.835	0.865	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	671	0.312	25.700	24.812	0.888	Clogged base model
100	0.75	45	0h 45m	45	621	0.290	25.700	24.790	0.910	Green & Amp plus Shallow WT models
100	0.3333	20	0h 15m	15	483	0.228	25.700	24.728	0.972	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	468	0.221	25.700	24.721	0.979	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	458	0.217	25.700	24.717	0.983	Green & Amp plus Shallow WT models
100	0.4167	25	0h 15m	15	450	0.213	25.700	24.713	0.987	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	437	0.207	25.700	24.707	0.993	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Kwinana/Roe Intersection
Job Number	60100953
Task	Basin B
Designer	LBC

Location	Perth
----------	-------

Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	77609	0.900	69848	
Verge	58046	0.300	17414	
	0	0.700	0	
Total	135655		87262	

Sump Details		
GWL	23.000	m AHD
Depth to GWL from base	2.400	m
Max Allowable TWL	26.600	m AHD
Sump Base Level	25.400	m AHD
Sump Width at base	41	m
Sump Length at base	180	m
Side Slope	4.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15

200

0.25

30.0%

0.800

0.600

1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	72	4320	72h 00m	4320	10060	1.189	26.600	26.589	0.011	Green & Amp plus Shallow WT models
20	48	2880	48h 00m	2880	9357	1.115	26.600	26.515	0.085	Green & Amp plus Shallow WT models
20	36	2160	36h 00m	2160	8637	1.038	26.600	26.438	0.162	Green & Amp plus Shallow WT models
20	30	1800	30h 00m	1800	8334	1.005	26.600	26.405	0.195	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	7140	0.874	26.600	26.274	0.326	Green & Amp plus Shallow WT models
20	18	1080	18h 00m	1080	6376	0.788	26.600	26.188	0.412	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	5558	0.694	26.600	26.094	0.506	Clogged base model
20	72	4320	16h 00m	960	5532	0.691	26.600	26.091	0.509	Clogged base model
20	30	1800	14h 00m	840	5461	0.683	26.600	26.083	0.517	Clogged base model
20	24	1440	10h 00m	600	5418	0.678	26.600	26.078	0.522	Clogged base model
20	36	2160	12h 00m	720	5404	0.676	26.600	26.076	0.524	Clogged base model
20	18	1080	11h 00m	660	5139	0.645	26.600	26.045	0.555	Clogged base model
20	12	720	8h 00m	480	4763	0.601	26.600	26.001	0.599	Clogged base model
20	9	540	9h 00m	540	4574	0.579	26.600	25.979	0.621	Green & Amp plus Shallow WT models
20	9	540	8h 00m	480	4548	0.576	26.600	25.976	0.624	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	6	360	5h 30m	330	4363	0.554	26.600	25.954	0.646	Clogged base model
20	12	720	12h 00m	720	4269	0.542	26.600	25.942	0.658	Green & Amp plus Shallow WT models
20	4.5	270	4h 15m	255	4142	0.527	26.600	25.927	0.673	Clogged base model
20	6	360	6h 00m	360	4032	0.514	26.600	25.914	0.686	Green & Amp plus Shallow WT models
20	3	180	2h 45m	165	3800	0.486	26.600	25.886	0.714	Clogged base model
20	2	120	2h 00m	120	3449	0.443	26.600	25.843	0.757	Clogged base model
20	1.5	90	1h 30m	90	3184	0.411	26.600	25.811	0.789	Clogged base model
20	1	60	1h 00m	60	2829	0.367	26.600	25.767	0.833	Clogged base model
20	4.5	270	4h 30m	270	2647	0.344	26.600	25.744	0.856	Green & Amp plus Shallow WT models
20	0.75	45	0h 45m	45	2618	0.340	26.600	25.740	0.860	Clogged base model
20	0.5	30	0h 30m	30	2310	0.302	26.600	25.702	0.898	Clogged base model
20	0.4167	25	0h 25m	25	2181	0.286	26.600	25.686	0.914	Clogged base model
20	0.3333	20	0h 20m	20	2008	0.263	26.600	25.663	0.937	Clogged base model
20	0.25	15	0h 15m	15	1791	0.236	26.600	25.636	0.964	Clogged base model
20	3	180	3h 00m	180	1585	0.209	26.600	25.609	0.991	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	1500	0.199	26.600	25.599	1.001	Clogged base model
20	2	120	2h 00m	120	1109	0.147	26.600	25.547	1.053	Green & Amp plus Shallow WT models
20	0.4167	25	0h 15m	15	855	0.114	26.600	25.514	1.086	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	841	0.112	26.600	25.512	1.088	Green & Amp plus Shallow WT models
20	0.25	15	0h 10m	10	772	0.103	26.600	25.503	1.097	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	757	0.101	26.600	25.501	1.099	Green & Amp plus Shallow WT models
20	0.5	30	0h 15m	15	742	0.099	26.600	25.499	1.101	Green & Amp plus Shallow WT models
20	1.5	90	1h 30m	90	634	0.085	26.600	25.485	1.115	Green & Amp plus Shallow WT models
20	1	60	0h 25m	25	563	0.075	26.600	25.475	1.125	Green & Amp plus Shallow WT models
20	0.75	45	0h 20m	20	562	0.075	26.600	25.475	1.125	Green & Amp plus Shallow WT models
100	72	4320	72h 00m	4320	14523	1.635	26.600	27.035	-0.435	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	13434	1.530	26.600	26.930	-0.330	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	12244	1.412	26.600	26.812	-0.212	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	11548	1.342	26.600	26.742	-0.142	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	10132	1.196	26.600	26.596	0.004	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	8985	1.075	26.600	26.475	0.125	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	7041	0.863	26.600	26.263	0.337	Clogged base model
100	24	1440	13h 00m	780	6994	0.857	26.600	26.257	0.343	Clogged base model
100	36	2160	16h 00m	960	6876	0.844	26.600	26.244	0.356	Clogged base model
100	72	4320	24h 00m	1440	6828	0.839	26.600	26.239	0.361	Clogged base model
100	48	2880	16h 00m	960	6827	0.839	26.600	26.239	0.361	Clogged base model
100	18	1080	12h 00m	720	6755	0.831	26.600	26.231	0.369	Clogged base model
100	12	720	12h 00m	720	6430	0.794	26.600	26.194	0.406	Green & Amp plus Shallow WT models
100	9	540	9h 00m	540	6409	0.792	26.600	26.192	0.408	Green & Amp plus Shallow WT models
100	12	720	9h 00m	540	6283	0.777	26.600	26.177	0.423	Clogged base model
100	9	540	8h 30m	510	6210	0.769	26.600	26.169	0.431	Clogged base model
100	6	360	6h 00m	360	5993	0.744	26.600	26.144	0.456	Clogged base model
100	4.5	270	4h 30m	270	5694	0.710	26.600	26.110	0.490	Clogged base model
100	6	360	6h 00m	360	5573	0.696	26.600	26.096	0.504	Green & Amp plus Shallow WT models
100	3	180	3h 00m	180	5239	0.657	26.600	26.057	0.543	Clogged base model
100	2	120	2h 00m	120	4747	0.600	26.600	26.000	0.600	Clogged base model
100	1.5	90	1h 30m	90	4396	0.558	26.600	25.958	0.642	Clogged base model
100	4.5	270	4h 30m	270	4028	0.514	26.600	25.914	0.686	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	3908	0.499	26.600	25.899	0.701	Clogged base model
100	0.75	45	0h 45m	45	3644	0.467	26.600	25.867	0.733	Clogged base model
100	0.5	30	0h 30m	30	3262	0.420	26.600	25.820	0.780	Clogged base model
100	0.4167	25	0h 25m	25	3084	0.399	26.600	25.799	0.801	Clogged base model
100	0.3333	20	0h 20m	20	2876	0.373	26.600	25.773	0.827	Clogged base model
100	3	180	3h 00m	180	2840	0.368	26.600	25.768	0.832	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	2573	0.335	26.600	25.735	0.865	Clogged base model
100	0.1667	10	0h 10m	10	2182	0.286	26.600	25.686	0.914	Clogged base model
100	2	120	2h 00m	120	2099	0.275	26.600	25.675	0.925	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	1512	0.200	26.600	25.600	1.000	Green & Amp plus Shallow WT models
100	0.3333	20	0h 15m	15	1496	0.198	26.600	25.598	1.002	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	1416	0.188	26.600	25.588	1.012	Green & Amp plus Shallow WT models
100	0.4167	25	0h 15m	15	1384	0.183	26.600	25.583	1.017	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	1367	0.181	26.600	25.581	1.019	Green & Amp plus Shallow WT models
100	0.5	30	0h 15m	15	1248	0.166	26.600	25.566	1.034	Green & Amp plus Shallow WT models
100	0.75	45	0h 30m	30	1121	0.149	26.600	25.549	1.051	Green & Amp plus Shallow WT models
100	1	60	0h 35m	35	1067	0.142	26.600	25.542	1.058	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Kwinana/Roe Intersection
Job Number	60100953
Task	Basin C
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	34865	0.900	31379	
Verge	42575	0.300	12773	
	0	0.700	0	
Total	77440		44151	

Sump Details		
GWL	23.000	m AHD
Depth to GWL from base	5.300	m
Max Allowable TWL	29.500	m AHD
Sump Base Level	28.300	m AHD
Sump Width at base	35	m
Sump Length at base	77	m
Side Slope	4.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

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SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	72	4320	32h 00m	1920	3410	1.066	29.500	29.366	0.134	Green & Amp plus Shallow WT models
20	30	1800	28h 00m	1680	3190	1.007	29.500	29.307	0.193	Green & Amp plus Shallow WT models
20	48	2880	40h 00m	2400	3187	1.006	29.500	29.306	0.194	Green & Amp plus Shallow WT models
20	36	2160	28h 00m	1680	3135	0.992	29.500	29.292	0.208	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	2871	0.919	29.500	29.219	0.281	Clogged base model
20	72	4320	16h 00m	960	2864	0.917	29.500	29.217	0.283	Clogged base model
20	30	1800	14h 00m	840	2822	0.905	29.500	29.205	0.295	Clogged base model
20	36	2160	16h 00m	960	2790	0.896	29.500	29.196	0.304	Clogged base model
20	24	1440	11h 00m	660	2790	0.896	29.500	29.196	0.304	Clogged base model
20	18	1080	11h 00m	660	2649	0.856	29.500	29.156	0.344	Clogged base model
20	12	720	8h 00m	480	2448	0.798	29.500	29.098	0.402	Clogged base model
20	9	540	8h 00m	480	2339	0.766	29.500	29.066	0.434	Clogged base model
20	6	360	5h 30m	330	2236	0.736	29.500	29.036	0.464	Clogged base model
20	4.5	270	4h 15m	255	2118	0.701	29.500	29.001	0.499	Clogged base model
20	24	1440	17h 00m	1020	2056	0.683	29.500	28.983	0.517	Green & Amp plus Shallow WT models

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	3	180	3h 00m	180	1939	0.647	29.500	28.947	0.553	Clogged base model
20	18	1080	15h 00m	900	1842	0.618	29.500	28.918	0.582	Green & Amp plus Shallow WT models
20	2	120	2h 00m	120	1756	0.592	29.500	28.892	0.608	Clogged base model
20	1.5	90	1h 30m	90	1620	0.549	29.500	28.849	0.651	Clogged base model
20	1	60	1h 00m	60	1437	0.492	29.500	28.792	0.708	Clogged base model
20	0.75	45	0h 45m	45	1329	0.457	29.500	28.757	0.743	Clogged base model
20	12	720	11h 30m	690	1243	0.429	29.500	28.729	0.771	Green & Amp plus Shallow WT models
20	6	360	6h 00m	360	1216	0.421	29.500	28.721	0.779	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	1172	0.407	29.500	28.707	0.793	Clogged base model
20	0.4167	25	0h 25m	25	1106	0.385	29.500	28.685	0.815	Clogged base model
20	9	540	9h 00m	540	1081	0.377	29.500	28.677	0.823	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	1018	0.356	29.500	28.656	0.844	Clogged base model
20	0.25	15	0h 15m	15	908	0.319	29.500	28.619	0.881	Clogged base model
20	0.1667	10	0h 10m	10	760	0.269	29.500	28.569	0.931	Clogged base model
20	4.5	270	4h 30m	270	615	0.220	29.500	28.520	0.980	Green & Amp plus Shallow WT models
20	0.4167	25	0h 15m	15	544	0.195	29.500	28.495	1.005	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	537	0.193	29.500	28.493	1.007	Green & Amp plus Shallow WT models
20	0.5	30	0h 15m	15	487	0.175	29.500	28.475	1.025	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	486	0.175	29.500	28.475	1.025	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	462	0.166	29.500	28.466	1.034	Green & Amp plus Shallow WT models
20	1	60	0h 35m	35	425	0.153	29.500	28.453	1.047	Green & Amp plus Shallow WT models
20	0.75	45	0h 30m	30	424	0.153	29.500	28.453	1.047	Green & Amp plus Shallow WT models
20	1.5	90	0h 35m	35	360	0.130	29.500	28.430	1.070	Green & Amp plus Shallow WT models
20	2	120	0h 35m	35	357	0.129	29.500	28.429	1.071	Green & Amp plus Shallow WT models
20	3	180	0h 45m	45	286	0.104	29.500	28.404	1.096	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	4833	1.430	29.500	29.730	-0.230	Green & Amp plus Shallow WT models
100	72	4320	44h 00m	2640	4770	1.415	29.500	29.715	-0.215	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	4650	1.385	29.500	29.685	-0.185	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	4632	1.381	29.500	29.681	-0.181	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	3624	1.123	29.500	29.423	0.077	Clogged base model
100	24	1440	13h 00m	780	3591	1.115	29.500	29.415	0.085	Clogged base model
100	36	2160	16h 00m	960	3541	1.102	29.500	29.402	0.098	Clogged base model
100	72	4320	24h 00m	1440	3534	1.100	29.500	29.400	0.100	Clogged base model
100	48	2880	16h 00m	960	3516	1.095	29.500	29.395	0.105	Clogged base model
100	18	1080	12h 00m	720	3467	1.082	29.500	29.382	0.118	Clogged base model
100	24	1440	24h 00m	1440	3306	1.038	29.500	29.338	0.162	Green & Amp plus Shallow WT models
100	12	720	10h 30m	630	3219	1.015	29.500	29.315	0.185	Clogged base model
100	9	540	8h 30m	510	3180	1.004	29.500	29.304	0.196	Clogged base model
100	6	360	6h 00m	360	3061	0.971	29.500	29.271	0.229	Clogged base model
100	18	1080	18h 00m	1080	2950	0.941	29.500	29.241	0.259	Green & Amp plus Shallow WT models
100	4.5	270	4h 30m	270	2903	0.927	29.500	29.227	0.273	Clogged base model
100	3	180	3h 00m	180	2666	0.861	29.500	29.161	0.339	Clogged base model
100	2	120	2h 00m	120	2413	0.788	29.500	29.088	0.412	Clogged base model
100	1.5	90	1h 30m	90	2233	0.735	29.500	29.035	0.465	Clogged base model
100	12	720	12h 00m	720	2165	0.715	29.500	29.015	0.485	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	1983	0.661	29.500	28.961	0.539	Clogged base model
100	6	360	6h 00m	360	1878	0.629	29.500	28.929	0.571	Green & Amp plus Shallow WT models
100	9	540	9h 00m	540	1866	0.625	29.500	28.925	0.575	Green & Amp plus Shallow WT models
100	0.75	45	0h 45m	45	1848	0.620	29.500	28.920	0.580	Clogged base model
100	0.5	30	0h 30m	30	1653	0.560	29.500	28.860	0.640	Clogged base model
100	0.4167	25	0h 25m	25	1563	0.531	29.500	28.831	0.669	Clogged base model
100	0.3333	20	0h 20m	20	1457	0.498	29.500	28.798	0.702	Clogged base model
100	0.25	15	0h 15m	15	1303	0.449	29.500	28.749	0.751	Clogged base model
100	0.1667	10	0h 10m	10	1105	0.385	29.500	28.685	0.815	Clogged base model
100	4.5	270	4h 30m	270	1096	0.382	29.500	28.682	0.818	Green & Amp plus Shallow WT models
100	0.3333	20	0h 15m	15	870	0.307	29.500	28.607	0.893	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	837	0.296	29.500	28.596	0.904	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	832	0.294	29.500	28.594	0.906	Green & Amp plus Shallow WT models
100	0.5	30	0h 25m	25	810	0.287	29.500	28.587	0.913	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	772	0.274	29.500	28.574	0.926	Green & Amp plus Shallow WT models
100	0.75	45	0h 35m	35	760	0.269	29.500	28.569	0.931	Green & Amp plus Shallow WT models
100	1	60	0h 35m	35	754	0.267	29.500	28.567	0.933	Green & Amp plus Shallow WT models
100	1.5	90	0h 35m	35	558	0.200	29.500	28.500	1.000	Green & Amp plus Shallow WT models
100	2	120	0h 35m	35	492	0.177	29.500	28.477	1.023	Green & Amp plus Shallow WT models
100	3	180	3h 00m	180	462	0.166	29.500	28.466	1.034	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Kwinana/Roe Intersection
Job Number	60100953
Task	Basin D
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	30998	0.900	27898	
Verge	43591	0.300	13077	
	0	0.700	0	
Total	74589		40976	

Sump Details		
GWL	23.000	m AHD
Depth to GWL from base	3.000	m
Max Allowable TWL	27.200	m AHD
Sump Base Level	26.000	m AHD
Sump Width at base	22	m
Sump Length at base	118	m
Side Slope	4.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	48	2880	40h 00m	2400	3807	1.162	27.200	27.162	0.038	Green & Amp plus Shallow WT models
20	36	2160	34h 00m	2040	3582	1.105	27.200	27.105	0.095	Green & Amp plus Shallow WT models
20	30	1800	28h 00m	1680	3539	1.094	27.200	27.094	0.106	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	2992	0.950	27.200	26.950	0.250	Green & Amp plus Shallow WT models
20	18	1080	17h 00m	1020	2716	0.875	27.200	26.875	0.325	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	2646	0.856	27.200	26.856	0.344	Clogged base model
20	30	1800	14h 00m	840	2601	0.843	27.200	26.843	0.357	Clogged base model
20	24	1440	11h 00m	660	2574	0.836	27.200	26.836	0.364	Clogged base model
20	36	2160	12h 00m	720	2572	0.835	27.200	26.835	0.365	Clogged base model
20	18	1080	11h 00m	660	2444	0.799	27.200	26.799	0.401	Clogged base model
20	12	720	8h 00m	480	2261	0.747	27.200	26.747	0.453	Clogged base model
20	9	540	8h 00m	480	2160	0.718	27.200	26.718	0.482	Clogged base model
20	6	360	5h 30m	330	2068	0.691	27.200	26.691	0.509	Clogged base model
20	4.5	270	4h 15m	255	1960	0.659	27.200	26.659	0.541	Clogged base model
20	9	540	9h 00m	540	1939	0.652	27.200	26.652	0.548	Green & Amp plus Shallow WT models

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	3	180	3h 00m	180	1795	0.609	27.200	26.609	0.591	Clogged base model
20	12	720	12h 00m	720	1735	0.591	27.200	26.591	0.609	Green & Amp plus Shallow WT models
20	6	360	6h 00m	360	1690	0.577	27.200	26.577	0.623	Green & Amp plus Shallow WT models
20	2	120	2h 00m	120	1628	0.558	27.200	26.558	0.642	Clogged base model
20	1.5	90	1h 30m	90	1501	0.519	27.200	26.519	0.681	Clogged base model
20	1	60	1h 00m	60	1333	0.465	27.200	26.465	0.735	Clogged base model
20	0.75	45	0h 45m	45	1233	0.433	27.200	26.433	0.767	Clogged base model
20	0.5	30	0h 30m	30	1087	0.386	27.200	26.386	0.814	Clogged base model
20	4.5	270	4h 30m	270	1060	0.377	27.200	26.377	0.823	Green & Amp plus Shallow WT models
20	0.4167	25	0h 25m	25	1026	0.366	27.200	26.366	0.834	Clogged base model
20	0.3333	20	0h 20m	20	945	0.338	27.200	26.338	0.862	Clogged base model
20	0.25	15	0h 15m	15	842	0.304	27.200	26.304	0.896	Clogged base model
20	0.1667	10	0h 10m	10	705	0.257	27.200	26.257	0.943	Clogged base model
20	3	180	3h 00m	180	650	0.238	27.200	26.238	0.962	Green & Amp plus Shallow WT models
20	0.4167	25	0h 15m	15	492	0.182	27.200	26.182	1.018	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	486	0.180	27.200	26.180	1.020	Green & Amp plus Shallow WT models
20	0.5	30	0h 15m	15	440	0.163	27.200	26.163	1.037	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	437	0.162	27.200	26.162	1.038	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	419	0.156	27.200	26.156	1.044	Green & Amp plus Shallow WT models
20	2	120	2h 00m	120	415	0.154	27.200	26.154	1.046	Green & Amp plus Shallow WT models
20	1	60	0h 30m	30	374	0.139	27.200	26.139	1.061	Green & Amp plus Shallow WT models
20	0.75	45	0h 30m	30	372	0.139	27.200	26.139	1.061	Green & Amp plus Shallow WT models
20	1.5	90	0h 20m	20	315	0.118	27.200	26.118	1.082	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	5523	1.566	27.200	27.566	-0.366	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	5149	1.482	27.200	27.482	-0.282	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	4988	1.445	27.200	27.445	-0.245	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	4309	1.286	27.200	27.286	-0.086	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	3856	1.174	27.200	27.174	0.026	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	3341	1.042	27.200	27.042	0.158	Clogged base model
100	24	1440	13h 00m	780	3313	1.035	27.200	27.035	0.165	Clogged base model
100	36	2160	16h 00m	960	3264	1.023	27.200	27.023	0.177	Clogged base model
100	48	2880	16h 00m	960	3240	1.016	27.200	27.016	0.184	Clogged base model
100	18	1080	12h 00m	720	3200	1.006	27.200	27.006	0.194	Clogged base model
100	12	720	9h 00m	540	2974	0.945	27.200	26.945	0.255	Clogged base model
100	9	540	8h 30m	510	2938	0.936	27.200	26.936	0.264	Clogged base model
100	6	360	6h 00m	360	2832	0.907	27.200	26.907	0.293	Clogged base model
100	9	540	9h 00m	540	2778	0.892	27.200	26.892	0.308	Green & Amp plus Shallow WT models
100	12	720	12h 00m	720	2749	0.884	27.200	26.884	0.316	Green & Amp plus Shallow WT models
100	4.5	270	4h 30m	270	2688	0.867	27.200	26.867	0.333	Clogged base model
100	3	180	3h 00m	180	2470	0.807	27.200	26.807	0.393	Clogged base model
100	6	360	6h 00m	360	2378	0.780	27.200	26.780	0.420	Green & Amp plus Shallow WT models
100	2	120	2h 00m	120	2237	0.740	27.200	26.740	0.460	Clogged base model
100	1.5	90	1h 30m	90	2070	0.691	27.200	26.691	0.509	Clogged base model
100	1	60	1h 00m	60	1839	0.623	27.200	26.623	0.577	Clogged base model
100	4.5	270	4h 30m	270	1734	0.591	27.200	26.591	0.609	Green & Amp plus Shallow WT models
100	0.75	45	0h 45m	45	1714	0.585	27.200	26.585	0.615	Clogged base model
100	0.5	30	0h 30m	30	1534	0.529	27.200	26.529	0.671	Clogged base model
100	0.4167	25	0h 25m	25	1450	0.503	27.200	26.503	0.697	Clogged base model
100	0.3333	20	0h 20m	20	1352	0.472	27.200	26.472	0.728	Clogged base model
100	3	180	3h 00m	180	1268	0.445	27.200	26.445	0.755	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	1209	0.426	27.200	26.426	0.774	Clogged base model
100	0.1667	10	0h 10m	10	1025	0.365	27.200	26.365	0.835	Clogged base model
100	2	120	2h 00m	120	990	0.353	27.200	26.353	0.847	Green & Amp plus Shallow WT models
100	0.3333	20	0h 15m	15	792	0.287	27.200	26.287	0.913	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	755	0.274	27.200	26.274	0.926	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	749	0.272	27.200	26.272	0.928	Green & Amp plus Shallow WT models
100	0.5	30	0h 25m	25	726	0.264	27.200	26.264	0.936	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	718	0.261	27.200	26.261	0.939	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	705	0.257	27.200	26.257	0.943	Green & Amp plus Shallow WT models
100	0.75	45	0h 35m	35	674	0.246	27.200	26.246	0.954	Green & Amp plus Shallow WT models
100	1	60	0h 35m	35	671	0.245	27.200	26.245	0.955	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Murdoch/Roe Interchange
Job Number	60100953
Task	Basin E
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	11787	0.900	10608	
Verge	20353	0.300	6106	
	0	0.700	0	
Total	32140		16714	

Sump Details		
GWL	18.300	m AHD
Depth to GWL from base	2.200	m
Max Allowable TWL	21.700	m AHD
Sump Base Level	20.500	m AHD
Sump Width at base	13	m
Sump Length at base	90	m
Side Slope	3.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	72	4320	32h 00m	1920	1545	1.029	21.700	21.529	0.171	Green & Amp plus Shallow WT models
20	48	2880	40h 00m	2400	1453	0.979	21.700	21.479	0.221	Green & Amp plus Shallow WT models
20	36	2160	28h 00m	1680	1407	0.953	21.700	21.453	0.247	Green & Amp plus Shallow WT models
20	30	1800	28h 00m	1680	1375	0.935	21.700	21.435	0.265	Green & Amp plus Shallow WT models
20	24	1440	17h 00m	1020	1212	0.842	21.700	21.342	0.358	Green & Amp plus Shallow WT models
20	18	1080	15h 00m	900	1111	0.783	21.700	21.283	0.417	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	1065	0.755	21.700	21.255	0.445	Clogged base model
20	72	4320	16h 00m	960	1060	0.751	21.700	21.251	0.449	Clogged base model
20	30	1800	14h 00m	840	1047	0.744	21.700	21.244	0.456	Clogged base model
20	24	1440	10h 00m	600	1039	0.739	21.700	21.239	0.461	Clogged base model
20	36	2160	12h 00m	720	1037	0.738	21.700	21.238	0.462	Clogged base model
20	18	1080	11h 00m	660	985	0.707	21.700	21.207	0.493	Clogged base model
20	12	720	8h 00m	480	914	0.662	21.700	21.162	0.538	Clogged base model
20	9	540	8h 00m	480	873	0.636	21.700	21.136	0.564	Clogged base model
20	6	360	5h 30m	330	838	0.614	21.700	21.114	0.586	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	9	540	9h 00m	540	837	0.614	21.700	21.114	0.586	Green & Amp plus Shallow WT models
20	12	720	12h 00m	720	822	0.604	21.700	21.104	0.596	Green & Amp plus Shallow WT models
20	4.5	270	4h 15m	255	795	0.586	21.700	21.086	0.614	Clogged base model
20	6	360	6h 00m	360	772	0.571	21.700	21.071	0.629	Green & Amp plus Shallow WT models
20	3	180	2h 45m	165	729	0.543	21.700	21.043	0.657	Clogged base model
20	2	120	2h 00m	120	662	0.499	21.700	20.999	0.701	Clogged base model
20	1.5	90	1h 30m	90	611	0.464	21.700	20.964	0.736	Clogged base model
20	1	60	1h 00m	60	543	0.417	21.700	20.917	0.783	Clogged base model
20	4.5	270	4h 30m	270	519	0.400	21.700	20.900	0.800	Green & Amp plus Shallow WT models
20	0.75	45	0h 45m	45	502	0.388	21.700	20.888	0.812	Clogged base model
20	0.5	30	0h 30m	30	443	0.346	21.700	20.846	0.854	Clogged base model
20	0.4167	25	0h 25m	25	418	0.328	21.700	20.828	0.872	Clogged base model
20	0.3333	20	0h 20m	20	385	0.304	21.700	20.804	0.896	Clogged base model
20	3	180	3h 00m	180	383	0.302	21.700	20.802	0.898	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	343	0.273	21.700	20.773	0.927	Clogged base model
20	0.1667	10	0h 10m	10	288	0.231	21.700	20.731	0.969	Clogged base model
20	2	120	2h 00m	120	274	0.221	21.700	20.721	0.979	Green & Amp plus Shallow WT models
20	1.5	90	1h 30m	90	190	0.156	21.700	20.656	1.044	Green & Amp plus Shallow WT models
20	0.4167	25	0h 15m	15	188	0.154	21.700	20.654	1.046	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	185	0.151	21.700	20.651	1.049	Green & Amp plus Shallow WT models
20	0.5	30	0h 15m	15	167	0.137	21.700	20.637	1.063	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	165	0.135	21.700	20.635	1.065	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	162	0.133	21.700	20.633	1.067	Green & Amp plus Shallow WT models
20	1	60	0h 30m	30	135	0.112	21.700	20.612	1.088	Green & Amp plus Shallow WT models
20	0.75	45	0h 20m	20	133	0.110	21.700	20.610	1.090	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	2102	1.316	21.700	21.816	-0.116	Green & Amp plus Shallow WT models
100	72	4320	44h 00m	2640	2094	1.312	21.700	21.812	-0.112	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	2006	1.268	21.700	21.768	-0.068	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	1952	1.241	21.700	21.741	-0.041	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	1727	1.126	21.700	21.626	0.074	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	1571	1.043	21.700	21.543	0.157	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	1345	0.919	21.700	21.419	0.281	Clogged base model
100	24	1440	13h 00m	780	1336	0.914	21.700	21.414	0.286	Clogged base model
100	36	2160	16h 00m	960	1314	0.901	21.700	21.401	0.299	Clogged base model
100	48	2880	16h 00m	960	1304	0.895	21.700	21.395	0.305	Clogged base model
100	72	4320	24h 00m	1440	1300	0.893	21.700	21.393	0.307	Clogged base model
100	18	1080	12h 00m	720	1292	0.888	21.700	21.388	0.312	Clogged base model
100	12	720	12h 00m	720	1216	0.844	21.700	21.344	0.356	Green & Amp plus Shallow WT models
100	12	720	9h 00m	540	1203	0.836	21.700	21.336	0.364	Clogged base model
100	9	540	8h 30m	510	1189	0.828	21.700	21.328	0.372	Clogged base model
100	9	540	9h 00m	540	1188	0.828	21.700	21.328	0.372	Green & Amp plus Shallow WT models
100	6	360	6h 00m	360	1149	0.805	21.700	21.305	0.395	Clogged base model
100	4.5	270	4h 30m	270	1091	0.771	21.700	21.271	0.429	Clogged base model
100	6	360	6h 00m	360	1072	0.759	21.700	21.259	0.441	Green & Amp plus Shallow WT models
100	3	180	3h 00m	180	1004	0.718	21.700	21.218	0.482	Clogged base model
100	2	120	2h 00m	120	910	0.659	21.700	21.159	0.541	Clogged base model
100	1.5	90	1h 30m	90	843	0.617	21.700	21.117	0.583	Clogged base model
100	4.5	270	4h 30m	270	815	0.600	21.700	21.100	0.600	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	749	0.556	21.700	21.056	0.644	Clogged base model
100	0.75	45	0h 45m	45	699	0.523	21.700	21.023	0.677	Clogged base model
100	3	180	3h 00m	180	637	0.482	21.700	20.982	0.718	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	625	0.473	21.700	20.973	0.727	Clogged base model
100	0.4167	25	0h 25m	25	591	0.450	21.700	20.950	0.750	Clogged base model
100	0.3333	20	0h 20m	20	551	0.423	21.700	20.923	0.777	Clogged base model
100	2	120	2h 00m	120	517	0.399	21.700	20.899	0.801	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	493	0.382	21.700	20.882	0.818	Clogged base model
100	0.1667	10	0h 10m	10	418	0.328	21.700	20.828	0.872	Clogged base model
100	1.5	90	1h 30m	90	402	0.316	21.700	20.816	0.884	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	310	0.248	21.700	20.748	0.952	Green & Amp plus Shallow WT models
100	0.3333	20	0h 15m	15	309	0.247	21.700	20.747	0.953	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	293	0.235	21.700	20.735	0.965	Green & Amp plus Shallow WT models
100	0.4167	25	0h 15m	15	288	0.231	21.700	20.731	0.969	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	277	0.223	21.700	20.723	0.977	Green & Amp plus Shallow WT models
100	0.5	30	0h 25m	25	273	0.220	21.700	20.720	0.980	Green & Amp plus Shallow WT models
100	0.75	45	0h 30m	30	251	0.203	21.700	20.703	0.997	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Murdoch/Roe Interchange
Job Number	60100953
Task	Basin F
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	57955	0.900	52160	
Verge	23159	0.300	6948	
	0	0.700	0	
Total	81114		59107	

Sump Details		
GWL	17.750	m AHD
Depth to GWL from base	0.150	m
Max Allowable TWL	19.100	m AHD
Sump Base Level	17.900	m AHD
Sump Width at base	44	m
Sump Length at base	103	m
Side Slope	4.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	72	4320	72h 00m	4320	6044	1.153	19.100	19.053	0.047	Green & Amp plus Shallow WT models
5	48	2880	48h 00m	2880	5502	1.062	19.100	18.962	0.138	Green & Amp plus Shallow WT models
5	36	2160	36h 00m	2160	5056	0.985	19.100	18.885	0.215	Green & Amp plus Shallow WT models
5	30	1800	30h 00m	1800	4768	0.935	19.100	18.835	0.265	Green & Amp plus Shallow WT models
5	24	1440	24h 00m	1440	4427	0.874	19.100	18.774	0.326	Green & Amp plus Shallow WT models
5	18	1080	18h 00m	1080	3986	0.795	19.100	18.695	0.405	Green & Amp plus Shallow WT models
5	12	720	12h 00m	720	3403	0.688	19.100	18.588	0.512	Green & Amp plus Shallow WT models
5	9	540	9h 00m	540	3095	0.630	19.100	18.530	0.570	Green & Amp plus Shallow WT models
5	48	2880	14h 00m	840	2797	0.573	19.100	18.473	0.627	Clogged base model
5	24	1440	10h 00m	600	2792	0.572	19.100	18.472	0.628	Clogged base model
5	30	1800	14h 00m	840	2779	0.570	19.100	18.470	0.630	Clogged base model
5	36	2160	12h 00m	720	2741	0.563	19.100	18.463	0.637	Clogged base model
5	72	4320	16h 00m	960	2741	0.562	19.100	18.462	0.638	Clogged base model
5	6	360	6h 00m	360	2722	0.559	19.100	18.459	0.641	Green & Amp plus Shallow WT models
5	18	1080	11h 00m	660	2651	0.545	19.100	18.445	0.655	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	12	720	8h 00m	480	2490	0.514	19.100	18.414	0.686	Clogged base model
5	4.5	270	4h 30m	270	2458	0.508	19.100	18.408	0.692	Green & Amp plus Shallow WT models
5	9	540	6h 30m	390	2367	0.490	19.100	18.390	0.710	Clogged base model
5	6	360	5h 30m	330	2269	0.471	19.100	18.371	0.729	Clogged base model
5	4.5	270	4h 15m	255	2142	0.446	19.100	18.346	0.754	Clogged base model
5	3	180	3h 00m	180	2121	0.442	19.100	18.342	0.758	Green & Amp plus Shallow WT models
5	3	180	2h 45m	165	1954	0.409	19.100	18.309	0.791	Clogged base model
5	2	120	2h 00m	120	1899	0.398	19.100	18.298	0.802	Green & Amp plus Shallow WT models
5	2	120	2h 00m	120	1776	0.373	19.100	18.273	0.827	Clogged base model
5	1.5	90	1h 30m	90	1670	0.352	19.100	18.252	0.848	Green & Amp plus Shallow WT models
5	1.5	90	1h 30m	90	1630	0.344	19.100	18.244	0.856	Clogged base model
5	1	60	1h 00m	60	1465	0.311	19.100	18.211	0.889	Green & Amp plus Shallow WT models
5	1	60	1h 00m	60	1444	0.306	19.100	18.206	0.894	Clogged base model
5	0.75	45	0h 45m	45	1330	0.283	19.100	18.183	0.917	Green & Amp plus Shallow WT models
5	0.75	45	0h 45m	45	1329	0.283	19.100	18.183	0.917	Clogged base model
5	0.5	30	0h 30m	30	1159	0.247	19.100	18.147	0.953	Clogged base model
5	0.4167	25	0h 25m	25	1085	0.232	19.100	18.132	0.968	Clogged base model
5	0.5	30	0h 30m	30	1071	0.229	19.100	18.129	0.971	Green & Amp plus Shallow WT models
5	0.4167	25	0h 25m	25	993	0.213	19.100	18.113	0.987	Green & Amp plus Shallow WT models
5	0.3333	20	0h 20m	20	989	0.212	19.100	18.112	0.988	Clogged base model
5	0.25	15	0h 15m	15	890	0.192	19.100	18.092	1.008	Clogged base model
5	0.3333	20	0h 20m	20	890	0.192	19.100	18.092	1.008	Green & Amp plus Shallow WT models
5	0.25	15	0h 15m	15	798	0.172	19.100	18.072	1.028	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	732	0.158	19.100	18.058	1.042	Clogged base model
5	0.1667	10	0h 10m	10	628	0.136	19.100	18.036	1.064	Green & Amp plus Shallow WT models
20	72	4320	72h 00m	4320	8066	1.480	19.100	19.380	-0.280	Green & Amp plus Shallow WT models
20	48	2880	48h 00m	2880	7260	1.353	19.100	19.253	-0.153	Green & Amp plus Shallow WT models
20	36	2160	36h 00m	2160	6636	1.251	19.100	19.151	-0.051	Green & Amp plus Shallow WT models
20	30	1800	30h 00m	1800	6230	1.185	19.100	19.085	0.015	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	5739	1.102	19.100	19.002	0.098	Green & Amp plus Shallow WT models
20	18	1080	18h 00m	1080	5154	1.002	19.100	18.902	0.198	Green & Amp plus Shallow WT models
20	12	720	12h 00m	720	4358	0.862	19.100	18.762	0.338	Green & Amp plus Shallow WT models
20	9	540	9h 00m	540	3981	0.794	19.100	18.694	0.406	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	3793	0.760	19.100	18.660	0.440	Clogged base model
20	72	4320	16h 00m	960	3779	0.757	19.100	18.657	0.443	Clogged base model
20	30	1800	14h 00m	840	3728	0.748	19.100	18.648	0.452	Clogged base model
20	24	1440	11h 00m	660	3693	0.741	19.100	18.641	0.459	Clogged base model
20	36	2160	12h 00m	720	3686	0.740	19.100	18.640	0.460	Clogged base model
20	6	360	6h 00m	360	3513	0.708	19.100	18.608	0.492	Green & Amp plus Shallow WT models
20	18	1080	11h 00m	660	3504	0.707	19.100	18.607	0.493	Clogged base model
20	12	720	8h 00m	480	3245	0.658	19.100	18.558	0.542	Clogged base model
20	4.5	270	4h 30m	270	3193	0.648	19.100	18.548	0.552	Green & Amp plus Shallow WT models
20	9	540	8h 00m	480	3099	0.631	19.100	18.531	0.569	Clogged base model
20	6	360	5h 30m	330	2969	0.606	19.100	18.506	0.594	Clogged base model
20	4.5	270	4h 15m	255	2816	0.577	19.100	18.477	0.623	Clogged base model
20	3	180	3h 00m	180	2777	0.569	19.100	18.469	0.631	Green & Amp plus Shallow WT models
20	3	180	3h 00m	180	2581	0.532	19.100	18.432	0.668	Clogged base model
20	2	120	2h 00m	120	2485	0.513	19.100	18.413	0.687	Green & Amp plus Shallow WT models
20	2	120	2h 00m	120	2341	0.485	19.100	18.385	0.715	Clogged base model
20	1.5	90	1h 30m	90	2201	0.458	19.100	18.358	0.742	Green & Amp plus Shallow WT models
20	1.5	90	1h 30m	90	2161	0.450	19.100	18.350	0.750	Clogged base model
20	1	60	1h 00m	60	1938	0.406	19.100	18.306	0.794	Green & Amp plus Shallow WT models
20	1	60	1h 00m	60	1919	0.402	19.100	18.302	0.798	Clogged base model
20	0.75	45	0h 45m	45	1775	0.373	19.100	18.273	0.827	Clogged base model
20	0.75	45	0h 45m	45	1769	0.372	19.100	18.272	0.828	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	1566	0.331	19.100	18.231	0.869	Clogged base model
20	0.5	30	0h 30m	30	1494	0.316	19.100	18.216	0.884	Green & Amp plus Shallow WT models
20	0.4167	25	0h 25m	25	1479	0.313	19.100	18.213	0.887	Clogged base model
20	0.4167	25	0h 25m	25	1400	0.297	19.100	18.197	0.903	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	1361	0.289	19.100	18.189	0.911	Clogged base model
20	0.3333	20	0h 20m	20	1277	0.272	19.100	18.172	0.928	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	1214	0.259	19.100	18.159	0.941	Clogged base model
20	0.25	15	0h 15m	15	1117	0.239	19.100	18.139	0.961	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	1017	0.218	19.100	18.118	0.982	Clogged base model
20	0.1667	10	0h 10m	10	905	0.195	19.100	18.095	1.005	Green & Amp plus Shallow WT models
100	72	4320	72h 00m	4320	11173	1.941	19.100	19.841	-0.741	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	10001	1.773	19.100	19.673	-0.573	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	9060	1.633	19.100	19.533	-0.433	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	8483	1.545	19.100	19.445	-0.345	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	7785	1.436	19.100	19.336	-0.236	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	6947	1.302	19.100	19.202	-0.102	Green & Amp plus Shallow WT models
100	12	720	12h 00m	720	5843	1.120	19.100	19.020	0.080	Green & Amp plus Shallow WT models
100	9	540	9h 00m	540	5353	1.036	19.100	18.936	0.164	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	4799	0.940	19.100	18.840	0.260	Clogged base model
100	24	1440	13h 00m	780	4763	0.934	19.100	18.834	0.266	Clogged base model
100	6	360	6h 00m	360	4743	0.930	19.100	18.830	0.270	Green & Amp plus Shallow WT models
100	36	2160	16h 00m	960	4688	0.921	19.100	18.821	0.279	Clogged base model
100	72	4320	24h 00m	1440	4664	0.916	19.100	18.816	0.284	Clogged base model
100	48	2880	16h 00m	960	4654	0.915	19.100	18.815	0.285	Clogged base model
100	18	1080	12h 00m	720	4600	0.905	19.100	18.805	0.295	Clogged base model
100	4.5	270	4h 30m	270	4322	0.855	19.100	18.755	0.345	Green & Amp plus Shallow WT models
100	12	720	9h 00m	540	4275	0.847	19.100	18.747	0.353	Clogged base model
100	9	540	8h 30m	510	4225	0.838	19.100	18.738	0.362	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
100	6	360	6h 00m	360	4073	0.811	19.100	18.711	0.389	Clogged base model
100	4.5	270	4h 30m	270	3867	0.773	19.100	18.673	0.427	Clogged base model
100	3	180	3h 00m	180	3784	0.758	19.100	18.658	0.442	Green & Amp plus Shallow WT models
100	3	180	3h 00m	180	3556	0.716	19.100	18.616	0.484	Clogged base model
100	2	120	2h 00m	120	3370	0.682	19.100	18.582	0.518	Green & Amp plus Shallow WT models
100	2	120	2h 00m	120	3221	0.654	19.100	18.554	0.546	Clogged base model
100	1.5	90	1h 30m	90	3010	0.614	19.100	18.514	0.586	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	2982	0.609	19.100	18.509	0.591	Clogged base model
100	1	60	1h 00m	60	2659	0.547	19.100	18.447	0.653	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	2650	0.545	19.100	18.445	0.655	Clogged base model
100	0.75	45	0h 45m	45	2470	0.511	19.100	18.411	0.689	Clogged base model
100	0.75	45	0h 45m	45	2446	0.506	19.100	18.406	0.694	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	2211	0.460	19.100	18.360	0.740	Clogged base model
100	0.5	30	0h 30m	30	2138	0.445	19.100	18.345	0.755	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	2090	0.436	19.100	18.336	0.764	Clogged base model
100	0.4167	25	0h 25m	25	2009	0.420	19.100	18.320	0.780	Green & Amp plus Shallow WT models
100	0.3333	20	0h 20m	20	1949	0.408	19.100	18.308	0.792	Clogged base model
100	0.3333	20	0h 20m	20	1860	0.390	19.100	18.290	0.810	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	1744	0.367	19.100	18.267	0.833	Clogged base model
100	0.25	15	0h 15m	15	1639	0.346	19.100	18.246	0.854	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	1479	0.313	19.100	18.213	0.887	Clogged base model
100	0.1667	10	0h 10m	10	1383	0.294	19.100	18.194	0.906	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Murdoch/Roe Interchange
Job Number	60100953
Task	Basin G
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	18345	0.900	16511	
Verge	7767	0.300	2330	
	0	0.700	0	
Total	26112		18841	

Sump Details		
GWL	17.600	m AHD
Depth to GWL from base	0.050	m
Max Allowable TWL	18.500	m AHD
Sump Base Level	17.650	m AHD
Sump Width at base	30	m
Sump Length at base	66	m
Side Slope	4.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	72	4320	72h 00m	4320	1891	0.819	18.500	18.469	0.031	Green & Amp plus Shallow WT models
5	48	2880	48h 00m	2880	1733	0.759	18.500	18.409	0.091	Green & Amp plus Shallow WT models
5	36	2160	36h 00m	2160	1598	0.707	18.500	18.357	0.143	Green & Amp plus Shallow WT models
5	30	1800	30h 00m	1800	1510	0.671	18.500	18.321	0.179	Green & Amp plus Shallow WT models
5	24	1440	24h 00m	1440	1403	0.629	18.500	18.279	0.221	Green & Amp plus Shallow WT models
5	18	1080	18h 00m	1080	1266	0.573	18.500	18.223	0.277	Green & Amp plus Shallow WT models
5	12	720	12h 00m	720	1092	0.501	18.500	18.151	0.349	Green & Amp plus Shallow WT models
5	9	540	9h 00m	540	995	0.460	18.500	18.110	0.390	Green & Amp plus Shallow WT models
5	6	360	6h 00m	360	872	0.407	18.500	18.057	0.443	Green & Amp plus Shallow WT models
5	24	1440	10h 00m	600	857	0.401	18.500	18.051	0.449	Clogged base model
5	48	2880	14h 00m	840	848	0.397	18.500	18.047	0.453	Clogged base model
5	30	1800	14h 00m	840	842	0.394	18.500	18.044	0.456	Clogged base model
5	36	2160	12h 00m	720	836	0.392	18.500	18.042	0.458	Clogged base model
5	72	4320	12h 00m	720	829	0.389	18.500	18.039	0.461	Clogged base model
5	18	1080	11h 00m	660	809	0.380	18.500	18.030	0.470	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	4.5	270	4h 30m	270	790	0.371	18.500	18.021	0.479	Green & Amp plus Shallow WT models
5	12	720	8h 00m	480	767	0.361	18.500	18.011	0.489	Clogged base model
5	9	540	6h 30m	390	732	0.346	18.500	17.996	0.504	Clogged base model
5	6	360	5h 00m	300	706	0.334	18.500	17.984	0.516	Clogged base model
5	3	180	3h 00m	180	688	0.326	18.500	17.976	0.524	Green & Amp plus Shallow WT models
5	4.5	270	4h 15m	255	668	0.317	18.500	17.967	0.533	Clogged base model
5	3	180	2h 45m	165	613	0.293	18.500	17.943	0.557	Clogged base model
5	2	120	2h 00m	120	608	0.290	18.500	17.940	0.560	Green & Amp plus Shallow WT models
5	2	120	1h 55m	115	559	0.268	18.500	17.918	0.582	Clogged base model
5	1.5	90	1h 30m	90	544	0.261	18.500	17.911	0.589	Green & Amp plus Shallow WT models
5	1.5	90	1h 30m	90	514	0.247	18.500	17.897	0.603	Clogged base model
5	1	60	1h 00m	60	474	0.229	18.500	17.879	0.621	Green & Amp plus Shallow WT models
5	1	60	1h 00m	60	457	0.221	18.500	17.871	0.629	Clogged base model
5	0.75	45	0h 45m	45	432	0.210	18.500	17.860	0.640	Green & Amp plus Shallow WT models
5	0.75	45	0h 45m	45	421	0.204	18.500	17.854	0.646	Clogged base model
5	0.5	30	0h 30m	30	368	0.179	18.500	17.829	0.671	Clogged base model
5	0.5	30	0h 30m	30	366	0.178	18.500	17.828	0.672	Green & Amp plus Shallow WT models
5	0.4167	25	0h 25m	25	345	0.168	18.500	17.818	0.682	Clogged base model
5	0.4167	25	0h 25m	25	340	0.166	18.500	17.816	0.684	Green & Amp plus Shallow WT models
5	0.3333	20	0h 20m	20	314	0.154	18.500	17.804	0.696	Clogged base model
5	0.3333	20	0h 20m	20	308	0.151	18.500	17.801	0.699	Green & Amp plus Shallow WT models
5	0.25	15	0h 15m	15	283	0.139	18.500	17.789	0.711	Clogged base model
5	0.25	15	0h 15m	15	270	0.132	18.500	17.782	0.718	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	233	0.115	18.500	17.765	0.735	Clogged base model
5	0.1667	10	0h 10m	10	226	0.112	18.500	17.762	0.738	Green & Amp plus Shallow WT models
20	72	4320	72h 00m	4320	2519	1.047	18.500	18.697	-0.197	Green & Amp plus Shallow WT models
20	48	2880	48h 00m	2880	2285	0.964	18.500	18.614	-0.114	Green & Amp plus Shallow WT models
20	36	2160	36h 00m	2160	2096	0.895	18.500	18.545	-0.045	Green & Amp plus Shallow WT models
20	30	1800	30h 00m	1800	1971	0.849	18.500	18.499	0.001	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	1818	0.791	18.500	18.441	0.059	Green & Amp plus Shallow WT models
20	18	1080	18h 00m	1080	1636	0.721	18.500	18.371	0.129	Green & Amp plus Shallow WT models
20	12	720	12h 00m	720	1398	0.627	18.500	18.277	0.223	Green & Amp plus Shallow WT models
20	9	540	9h 00m	540	1279	0.579	18.500	18.229	0.271	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	1163	0.531	18.500	18.181	0.319	Clogged base model
20	72	4320	16h 00m	960	1154	0.527	18.500	18.177	0.323	Clogged base model
20	30	1800	14h 00m	840	1143	0.522	18.500	18.172	0.328	Clogged base model
20	24	1440	10h 00m	600	1142	0.522	18.500	18.172	0.328	Clogged base model
20	36	2160	12h 00m	720	1135	0.519	18.500	18.169	0.331	Clogged base model
20	6	360	6h 00m	360	1125	0.515	18.500	18.165	0.335	Green & Amp plus Shallow WT models
20	18	1080	11h 00m	660	1080	0.496	18.500	18.146	0.354	Clogged base model
20	4.5	270	4h 30m	270	1026	0.473	18.500	18.123	0.377	Green & Amp plus Shallow WT models
20	12	720	8h 00m	480	1006	0.465	18.500	18.115	0.385	Clogged base model
20	9	540	6h 30m	390	962	0.446	18.500	18.096	0.404	Clogged base model
20	6	360	5h 00m	300	927	0.431	18.500	18.081	0.419	Clogged base model
20	3	180	3h 00m	180	900	0.419	18.500	18.069	0.431	Green & Amp plus Shallow WT models
20	4.5	270	4h 15m	255	882	0.412	18.500	18.062	0.438	Clogged base model
20	3	180	2h 45m	165	813	0.381	18.500	18.031	0.469	Clogged base model
20	2	120	2h 00m	120	796	0.374	18.500	18.024	0.476	Green & Amp plus Shallow WT models
20	2	120	2h 00m	120	739	0.349	18.500	17.999	0.501	Clogged base model
20	1.5	90	1h 30m	90	717	0.339	18.500	17.989	0.511	Green & Amp plus Shallow WT models
20	1.5	90	1h 30m	90	683	0.324	18.500	17.974	0.526	Clogged base model
20	1	60	1h 00m	60	628	0.299	18.500	17.949	0.551	Green & Amp plus Shallow WT models
20	1	60	1h 00m	60	608	0.290	18.500	17.940	0.560	Clogged base model
20	0.75	45	0h 45m	45	575	0.275	18.500	17.925	0.575	Green & Amp plus Shallow WT models
20	0.75	45	0h 45m	45	563	0.270	18.500	17.920	0.580	Clogged base model
20	0.5	30	0h 30m	30	497	0.239	18.500	17.889	0.611	Clogged base model
20	0.5	30	0h 30m	30	492	0.237	18.500	17.887	0.613	Green & Amp plus Shallow WT models
20	0.4167	25	0h 25m	25	470	0.227	18.500	17.877	0.623	Clogged base model
20	0.4167	25	0h 25m	25	462	0.223	18.500	17.873	0.627	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	433	0.210	18.500	17.860	0.640	Clogged base model
20	0.3333	20	0h 20m	20	423	0.205	18.500	17.855	0.645	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	386	0.188	18.500	17.838	0.662	Clogged base model
20	0.25	15	0h 15m	15	382	0.186	18.500	17.836	0.664	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	324	0.158	18.500	17.808	0.692	Clogged base model
20	0.1667	10	0h 10m	10	317	0.155	18.500	17.805	0.695	Green & Amp plus Shallow WT models
100	72	4320	72h 00m	4320	3490	1.370	18.500	19.020	-0.520	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	3148	1.260	18.500	18.910	-0.410	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	2862	1.165	18.500	18.815	-0.315	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	2684	1.104	18.500	18.754	-0.254	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	2466	1.028	18.500	18.678	-0.178	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	2205	0.935	18.500	18.585	-0.085	Green & Amp plus Shallow WT models
100	12	720	12h 00m	720	1871	0.811	18.500	18.461	0.039	Green & Amp plus Shallow WT models
100	9	540	9h 00m	540	1717	0.752	18.500	18.402	0.098	Green & Amp plus Shallow WT models
100	6	360	6h 00m	360	1519	0.675	18.500	18.325	0.175	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	1477	0.658	18.500	18.308	0.192	Clogged base model
100	24	1440	13h 00m	780	1473	0.657	18.500	18.307	0.193	Clogged base model
100	36	2160	16h 00m	960	1442	0.644	18.500	18.294	0.206	Clogged base model
100	48	2880	16h 00m	960	1431	0.640	18.500	18.290	0.210	Clogged base model
100	18	1080	12h 00m	720	1425	0.637	18.500	18.287	0.213	Clogged base model
100	72	4320	24h 00m	1440	1415	0.634	18.500	18.284	0.216	Clogged base model
100	4.5	270	4h 30m	270	1388	0.623	18.500	18.273	0.227	Green & Amp plus Shallow WT models
100	12	720	9h 00m	540	1330	0.600	18.500	18.250	0.250	Clogged base model
100	9	540	8h 00m	480	1317	0.594	18.500	18.244	0.256	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
100	6	360	6h 00m	360	1276	0.578	18.500	18.228	0.272	Clogged base model
100	3	180	3h 00m	180	1225	0.556	18.500	18.206	0.294	Green & Amp plus Shallow WT models
100	4.5	270	4h 30m	270	1216	0.553	18.500	18.203	0.297	Clogged base model
100	3	180	3h 00m	180	1122	0.514	18.500	18.164	0.336	Clogged base model
100	2	120	2h 00m	120	1083	0.498	18.500	18.148	0.352	Green & Amp plus Shallow WT models
100	2	120	2h 00m	120	1019	0.470	18.500	18.120	0.380	Clogged base model
100	1.5	90	1h 30m	90	982	0.454	18.500	18.104	0.396	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	945	0.438	18.500	18.088	0.412	Clogged base model
100	1	60	1h 00m	60	862	0.403	18.500	18.053	0.447	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	841	0.394	18.500	18.044	0.456	Clogged base model
100	0.75	45	0h 45m	45	797	0.374	18.500	18.024	0.476	Green & Amp plus Shallow WT models
100	0.75	45	0h 45m	45	785	0.369	18.500	18.019	0.481	Clogged base model
100	0.5	30	0h 30m	30	706	0.334	18.500	17.984	0.516	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	703	0.333	18.500	17.983	0.517	Clogged base model
100	0.4167	25	0h 25m	25	666	0.316	18.500	17.966	0.534	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	665	0.316	18.500	17.966	0.534	Clogged base model
100	0.3333	20	0h 20m	20	620	0.296	18.500	17.946	0.554	Clogged base model
100	0.3333	20	0h 20m	20	619	0.295	18.500	17.945	0.555	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	555	0.266	18.500	17.916	0.584	Clogged base model
100	0.25	15	0h 15m	15	551	0.264	18.500	17.914	0.586	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	471	0.227	18.500	17.877	0.623	Clogged base model
100	0.1667	10	0h 10m	10	464	0.224	18.500	17.874	0.626	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Murdoch/Roe Interchange
Job Number	60100953
Task	Basin H
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	2467	0.900	2220	
Verge	8464	0.300	2539	
	0	0.700	0	
Total	10931		4760	

Sump Details		
GWL	17.900	m AHD
Depth to GWL from base	0.800	m
Max Allowable TWL	19.900	m AHD
Sump Base Level	18.700	m AHD
Sump Width at base	9	m
Sump Length at base	21	m
Side Slope	3.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	72	4320	32h 00m	1920	330	1.093	19.900	19.793	0.107	Green & Amp plus Shallow WT models
5	36	2160	28h 00m	1680	307	1.038	19.900	19.738	0.162	Green & Amp plus Shallow WT models
5	48	2880	32h 00m	1920	306	1.037	19.900	19.737	0.163	Green & Amp plus Shallow WT models
5	30	1800	16h 00m	960	298	1.016	19.900	19.716	0.184	Green & Amp plus Shallow WT models
5	24	1440	17h 00m	1020	283	0.980	19.900	19.680	0.220	Green & Amp plus Shallow WT models
5	18	1080	15h 00m	900	264	0.931	19.900	19.631	0.269	Green & Amp plus Shallow WT models
5	48	2880	14h 00m	840	229	0.839	19.900	19.539	0.361	Clogged base model
5	30	1800	14h 00m	840	228	0.836	19.900	19.536	0.364	Clogged base model
5	24	1440	10h 00m	600	228	0.836	19.900	19.536	0.364	Clogged base model
5	12	720	11h 30m	690	227	0.833	19.900	19.533	0.367	Green & Amp plus Shallow WT models
5	72	4320	16h 00m	960	225	0.828	19.900	19.528	0.372	Clogged base model
5	36	2160	12h 00m	720	225	0.828	19.900	19.528	0.372	Clogged base model
5	18	1080	11h 00m	660	217	0.806	19.900	19.506	0.394	Clogged base model
5	9	540	9h 00m	540	212	0.791	19.900	19.491	0.409	Green & Amp plus Shallow WT models
5	12	720	8h 00m	480	204	0.767	19.900	19.467	0.433	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	6	360	6h 00m	360	198	0.750	19.900	19.450	0.450	Green & Amp plus Shallow WT models
5	9	540	8h 00m	480	194	0.738	19.900	19.438	0.462	Clogged base model
5	6	360	5h 30m	330	186	0.715	19.900	19.415	0.485	Clogged base model
5	4.5	270	4h 30m	270	177	0.689	19.900	19.389	0.511	Green & Amp plus Shallow WT models
5	4.5	270	4h 15m	255	175	0.682	19.900	19.382	0.518	Clogged base model
5	3	180	2h 45m	165	159	0.633	19.900	19.333	0.567	Clogged base model
5	3	180	3h 00m	180	146	0.593	19.900	19.293	0.607	Green & Amp plus Shallow WT models
5	2	120	2h 00m	120	144	0.586	19.900	19.286	0.614	Clogged base model
5	1.5	90	1h 30m	90	132	0.546	19.900	19.246	0.654	Clogged base model
5	2	120	2h 00m	120	130	0.538	19.900	19.238	0.662	Green & Amp plus Shallow WT models
5	1	60	1h 00m	60	117	0.495	19.900	19.195	0.705	Clogged base model
5	1.5	90	1h 30m	90	110	0.470	19.900	19.170	0.730	Green & Amp plus Shallow WT models
5	0.75	45	0h 45m	45	108	0.461	19.900	19.161	0.739	Clogged base model
5	1	60	1h 00m	60	97	0.421	19.900	19.121	0.779	Green & Amp plus Shallow WT models
5	0.5	30	0h 30m	30	94	0.411	19.900	19.111	0.789	Clogged base model
5	0.4167	25	0h 25m	25	88	0.388	19.900	19.088	0.812	Clogged base model
5	0.75	45	0h 45m	45	85	0.378	19.900	19.078	0.822	Green & Amp plus Shallow WT models
5	0.3333	20	0h 20m	20	80	0.358	19.900	19.058	0.842	Clogged base model
5	0.25	15	0h 15m	15	72	0.327	19.900	19.027	0.873	Clogged base model
5	0.5	30	0h 30m	30	67	0.309	19.900	19.009	0.891	Green & Amp plus Shallow WT models
5	0.4167	25	0h 25m	25	61	0.282	19.900	18.982	0.918	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	59	0.275	19.900	18.975	0.925	Clogged base model
5	0.3333	20	0h 20m	20	52	0.244	19.900	18.944	0.956	Green & Amp plus Shallow WT models
5	0.25	15	0h 15m	15	44	0.210	19.900	18.910	0.990	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	36	0.176	19.900	18.876	1.024	Green & Amp plus Shallow WT models
20	72	4320	32h 00m	1920	451	1.353	19.900	20.053	-0.153	Green & Amp plus Shallow WT models
20	48	2880	40h 00m	2400	414	1.278	19.900	19.978	-0.078	Green & Amp plus Shallow WT models
20	36	2160	28h 00m	1680	411	1.272	19.900	19.972	-0.072	Green & Amp plus Shallow WT models
20	30	1800	28h 00m	1680	395	1.238	19.900	19.938	-0.038	Green & Amp plus Shallow WT models
20	24	1440	17h 00m	1020	372	1.188	19.900	19.888	0.012	Green & Amp plus Shallow WT models
20	18	1080	15h 00m	900	345	1.129	19.900	19.829	0.071	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	307	1.039	19.900	19.739	0.161	Clogged base model
20	72	4320	16h 00m	960	306	1.036	19.900	19.736	0.164	Clogged base model
20	30	1800	14h 00m	840	303	1.028	19.900	19.728	0.172	Clogged base model
20	36	2160	12h 00m	720	300	1.021	19.900	19.721	0.179	Clogged base model
20	24	1440	11h 00m	660	299	1.019	19.900	19.719	0.181	Clogged base model
20	12	720	11h 30m	690	294	1.008	19.900	19.708	0.192	Green & Amp plus Shallow WT models
20	18	1080	11h 00m	660	284	0.983	19.900	19.683	0.217	Clogged base model
20	9	540	9h 00m	540	275	0.958	19.900	19.658	0.242	Green & Amp plus Shallow WT models
20	12	720	8h 00m	480	263	0.929	19.900	19.629	0.271	Clogged base model
20	6	360	6h 00m	360	257	0.913	19.900	19.613	0.287	Green & Amp plus Shallow WT models
20	9	540	8h 00m	480	252	0.900	19.900	19.600	0.300	Clogged base model
20	6	360	5h 30m	330	241	0.871	19.900	19.571	0.329	Clogged base model
20	4.5	270	4h 30m	270	232	0.846	19.900	19.546	0.354	Green & Amp plus Shallow WT models
20	4.5	270	4h 15m	255	228	0.837	19.900	19.537	0.363	Clogged base model
20	3	180	3h 00m	180	209	0.783	19.900	19.483	0.417	Clogged base model
20	3	180	3h 00m	180	197	0.747	19.900	19.447	0.453	Green & Amp plus Shallow WT models
20	2	120	2h 00m	120	190	0.726	19.900	19.426	0.474	Clogged base model
20	2	120	2h 00m	120	176	0.685	19.900	19.385	0.515	Green & Amp plus Shallow WT models
20	1.5	90	1h 30m	90	175	0.682	19.900	19.382	0.518	Clogged base model
20	1	60	1h 00m	60	155	0.621	19.900	19.321	0.579	Clogged base model
20	1.5	90	1h 30m	90	152	0.613	19.900	19.313	0.587	Green & Amp plus Shallow WT models
20	0.75	45	0h 45m	45	143	0.584	19.900	19.284	0.616	Clogged base model
20	1	60	1h 00m	60	133	0.548	19.900	19.248	0.652	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	127	0.527	19.900	19.227	0.673	Clogged base model
20	0.75	45	0h 45m	45	119	0.503	19.900	19.203	0.697	Green & Amp plus Shallow WT models
20	0.4167	25	0h 25m	25	119	0.503	19.900	19.203	0.697	Clogged base model
20	0.3333	20	0h 20m	20	110	0.469	19.900	19.169	0.731	Clogged base model
20	0.5	30	0h 30m	30	99	0.429	19.900	19.129	0.771	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	98	0.426	19.900	19.126	0.774	Clogged base model
20	0.4167	25	0h 25m	25	91	0.401	19.900	19.101	0.799	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	82	0.366	19.900	19.066	0.834	Clogged base model
20	0.3333	20	0h 20m	20	81	0.362	19.900	19.062	0.838	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	69	0.316	19.900	19.016	0.884	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	56	0.262	19.900	18.962	0.938	Green & Amp plus Shallow WT models
100	72	4320	32h 00m	1920	585	1.606	19.900	20.306	-0.406	Green & Amp plus Shallow WT models
100	48	2880	40h 00m	2400	580	1.596	19.900	20.296	-0.396	Green & Amp plus Shallow WT models
100	36	2160	34h 00m	2040	565	1.570	19.900	20.270	-0.370	Green & Amp plus Shallow WT models
100	30	1800	28h 00m	1680	550	1.543	19.900	20.243	-0.343	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	509	1.467	19.900	20.167	-0.267	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	473	1.399	19.900	20.099	-0.199	Green & Amp plus Shallow WT models
100	12	720	12h 00m	720	407	1.264	19.900	19.964	-0.064	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	386	1.220	19.900	19.920	-0.020	Clogged base model
100	24	1440	13h 00m	780	383	1.213	19.900	19.913	-0.013	Clogged base model
100	9	540	9h 00m	540	380	1.207	19.900	19.907	-0.007	Green & Amp plus Shallow WT models
100	36	2160	16h 00m	960	378	1.202	19.900	19.902	-0.002	Clogged base model
100	48	2880	16h 00m	960	375	1.194	19.900	19.894	0.006	Clogged base model
100	72	4320	24h 00m	1440	374	1.192	19.900	19.892	0.008	Clogged base model
100	18	1080	12h 00m	720	371	1.186	19.900	19.886	0.014	Clogged base model
100	6	360	6h 00m	360	349	1.137	19.900	19.837	0.063	Green & Amp plus Shallow WT models
100	12	720	9h 00m	540	345	1.127	19.900	19.827	0.073	Clogged base model
100	9	540	8h 30m	510	341	1.118	19.900	19.818	0.082	Clogged base model
100	6	360	6h 00m	360	329	1.092	19.900	19.792	0.108	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
100	4.5	270	4h 30m	270	317	1.062	19.900	19.762	0.138	Green & Amp plus Shallow WT models
100	4.5	270	4h 30m	270	312	1.051	19.900	19.751	0.149	Clogged base model
100	3	180	3h 00m	180	287	0.990	19.900	19.690	0.210	Clogged base model
100	3	180	3h 00m	180	279	0.969	19.900	19.669	0.231	Green & Amp plus Shallow WT models
100	2	120	2h 00m	120	260	0.921	19.900	19.621	0.279	Clogged base model
100	2	120	2h 00m	120	245	0.881	19.900	19.581	0.319	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	241	0.870	19.900	19.570	0.330	Clogged base model
100	1.5	90	1h 30m	90	219	0.811	19.900	19.511	0.389	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	214	0.797	19.900	19.497	0.403	Clogged base model
100	0.75	45	0h 45m	45	199	0.755	19.900	19.455	0.445	Clogged base model
100	1	60	1h 00m	60	191	0.731	19.900	19.431	0.469	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	178	0.693	19.900	19.393	0.507	Clogged base model
100	0.75	45	0h 45m	45	174	0.679	19.900	19.379	0.521	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	169	0.663	19.900	19.363	0.537	Clogged base model
100	0.3333	20	0h 20m	20	157	0.627	19.900	19.327	0.573	Clogged base model
100	0.5	30	0h 30m	30	150	0.605	19.900	19.305	0.595	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	141	0.574	19.900	19.274	0.626	Clogged base model
100	0.4167	25	0h 25m	25	139	0.570	19.900	19.270	0.630	Green & Amp plus Shallow WT models
100	0.3333	20	0h 20m	20	127	0.529	19.900	19.229	0.671	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	119	0.502	19.900	19.202	0.698	Clogged base model
100	0.25	15	0h 15m	15	110	0.470	19.900	19.170	0.730	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	89	0.393	19.900	19.093	0.807	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Horsepaddock
Job Number	60100953
Task	Basin I
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	39908	0.900	35917	
Verge	17616	0.300	5285	
	0	0.700	0	
Total	57524		41202	

Sump Details		
GWL	15.000	m AHD
Depth to GWL from base	2.000	m
Max Allowable TWL	17.215	m AHD
Sump Base Level	17.000	m AHD
Sump Width at base	107	m
Sump Length at base	144	m
Side Slope	3.0	1 in --

Permeability		
Soil Permeability, K	15.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	72	4320	68h 00m	4080	3356	0.215	17.215	17.215	0.000	Green & Amp plus Shallow WT models
5	48	2880	48h 00m	2880	3202	0.206	17.215	17.206	0.009	Green & Amp plus Shallow WT models
5	36	2160	36h 00m	2160	2992	0.192	17.215	17.192	0.023	Green & Amp plus Shallow WT models
5	30	1800	30h 00m	1800	2917	0.188	17.215	17.188	0.027	Green & Amp plus Shallow WT models
5	24	1440	24h 00m	1440	2486	0.160	17.215	17.160	0.055	Green & Amp plus Shallow WT models
5	18	1080	18h 00m	1080	2232	0.144	17.215	17.144	0.071	Green & Amp plus Shallow WT models
5	9	540	9h 00m	540	1621	0.105	17.215	17.105	0.110	Green & Amp plus Shallow WT models
5	12	720	12h 00m	720	1444	0.093	17.215	17.093	0.122	Green & Amp plus Shallow WT models
5	6	360	6h 00m	360	1408	0.091	17.215	17.091	0.124	Green & Amp plus Shallow WT models
5	24	1440	8h 00m	480	1371	0.089	17.215	17.089	0.126	Clogged base model
5	12	720	4h 30m	270	1322	0.085	17.215	17.085	0.130	Clogged base model
5	48	2880	6h 00m	360	1295	0.084	17.215	17.084	0.131	Clogged base model
5	36	2160	6h 00m	360	1293	0.084	17.215	17.084	0.131	Clogged base model
5	30	1800	6h 00m	360	1290	0.083	17.215	17.083	0.132	Clogged base model
5	9	540	4h 30m	270	1287	0.083	17.215	17.083	0.132	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	18	1080	8h 00m	480	1276	0.082	17.215	17.082	0.133	Clogged base model
5	6	360	4h 00m	240	1261	0.081	17.215	17.081	0.134	Clogged base model
5	72	4320	8h 00m	480	1219	0.079	17.215	17.079	0.136	Clogged base model
5	4.5	270	4h 00m	240	1201	0.078	17.215	17.078	0.137	Clogged base model
5	3	180	2h 30m	150	1171	0.076	17.215	17.076	0.139	Clogged base model
5	2	120	1h 45m	105	1100	0.071	17.215	17.071	0.144	Clogged base model
5	1.5	90	1h 25m	85	1026	0.066	17.215	17.066	0.149	Clogged base model
5	1	60	1h 00m	60	932	0.060	17.215	17.060	0.155	Clogged base model
5	4.5	270	4h 30m	270	896	0.058	17.215	17.058	0.157	Green & Amp plus Shallow WT models
5	0.75	45	0h 45m	45	870	0.056	17.215	17.056	0.159	Clogged base model
5	0.5	30	0h 30m	30	771	0.050	17.215	17.050	0.165	Clogged base model
5	0.4167	25	0h 25m	25	725	0.047	17.215	17.047	0.168	Clogged base model
5	0.3333	20	0h 20m	20	664	0.043	17.215	17.043	0.172	Clogged base model
5	0.25	15	0h 15m	15	602	0.039	17.215	17.039	0.176	Clogged base model
5	3	180	3h 00m	180	533	0.034	17.215	17.034	0.181	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	498	0.032	17.215	17.032	0.183	Clogged base model
5	2	120	2h 00m	120	343	0.022	17.215	17.022	0.193	Green & Amp plus Shallow WT models
5	1.5	90	1h 30m	90	169	0.011	17.215	17.011	0.204	Green & Amp plus Shallow WT models
5	1	60	1h 00m	60	17	0.001	17.215	17.001	0.214	Green & Amp plus Shallow WT models
5	0.75	45	0h 00m	0	0	0.000	17.215	17.000	0.215	Green & Amp plus Shallow WT models
5	0.5	30	0h 00m	0	0	0.000	17.215	17.000	0.215	Green & Amp plus Shallow WT models
5	0.4167	25	0h 00m	0	0	0.000	17.215	17.000	0.215	Green & Amp plus Shallow WT models
5	0.3333	20	0h 00m	0	0	0.000	17.215	17.000	0.215	Green & Amp plus Shallow WT models
5	0.25	15	0h 00m	0	0	0.000	17.215	17.000	0.215	Green & Amp plus Shallow WT models
5	0.1667	10	0h 00m	0	0	0.000	17.215	17.000	0.215	Green & Amp plus Shallow WT models
10	72	4320	68h 00m	4080	3922	0.251	17.215	17.251	-0.036	Green & Amp plus Shallow WT models
10	48	2880	48h 00m	2880	3697	0.237	17.215	17.237	-0.022	Green & Amp plus Shallow WT models
10	36	2160	36h 00m	2160	3418	0.219	17.215	17.219	-0.004	Green & Amp plus Shallow WT models
10	30	1800	30h 00m	1800	3326	0.214	17.215	17.214	0.001	Green & Amp plus Shallow WT models
10	24	1440	24h 00m	1440	2812	0.181	17.215	17.181	0.034	Green & Amp plus Shallow WT models
10	18	1080	18h 00m	1080	2517	0.162	17.215	17.162	0.053	Green & Amp plus Shallow WT models
10	9	540	9h 00m	540	1820	0.117	17.215	17.117	0.098	Green & Amp plus Shallow WT models
10	12	720	12h 00m	720	1619	0.104	17.215	17.104	0.111	Green & Amp plus Shallow WT models
10	24	1440	8h 00m	480	1617	0.104	17.215	17.104	0.111	Clogged base model
10	6	360	6h 00m	360	1582	0.102	17.215	17.102	0.113	Green & Amp plus Shallow WT models
10	30	1800	8h 00m	480	1541	0.100	17.215	17.100	0.115	Clogged base model
10	48	2880	6h 00m	360	1541	0.100	17.215	17.100	0.115	Clogged base model
10	36	2160	8h 00m	480	1535	0.099	17.215	17.099	0.116	Clogged base model
10	12	720	4h 30m	270	1517	0.098	17.215	17.098	0.117	Clogged base model
10	18	1080	8h 00m	480	1509	0.097	17.215	17.097	0.118	Clogged base model
10	72	4320	8h 00m	480	1487	0.096	17.215	17.096	0.119	Clogged base model
10	9	540	4h 30m	270	1484	0.096	17.215	17.096	0.119	Clogged base model
10	6	360	4h 00m	240	1454	0.094	17.215	17.094	0.121	Clogged base model
10	4.5	270	4h 00m	240	1385	0.089	17.215	17.089	0.126	Clogged base model
10	3	180	2h 30m	150	1353	0.087	17.215	17.087	0.128	Clogged base model
10	2	120	1h 50m	110	1257	0.081	17.215	17.081	0.134	Clogged base model
10	1.5	90	1h 25m	85	1181	0.076	17.215	17.076	0.139	Clogged base model
10	1	60	1h 00m	60	1069	0.069	17.215	17.069	0.146	Clogged base model
10	4.5	270	4h 30m	270	1006	0.065	17.215	17.065	0.150	Green & Amp plus Shallow WT models
10	0.75	45	0h 45m	45	998	0.064	17.215	17.064	0.151	Clogged base model
10	0.5	30	0h 30m	30	891	0.058	17.215	17.058	0.157	Clogged base model
10	0.4167	25	0h 25m	25	846	0.055	17.215	17.055	0.160	Clogged base model
10	0.3333	20	0h 20m	20	774	0.050	17.215	17.050	0.165	Clogged base model
10	0.25	15	0h 15m	15	694	0.045	17.215	17.045	0.170	Clogged base model
10	3	180	3h 00m	180	605	0.039	17.215	17.039	0.176	Green & Amp plus Shallow WT models
10	0.1667	10	0h 10m	10	580	0.037	17.215	17.037	0.178	Clogged base model
10	2	120	2h 00m	120	387	0.025	17.215	17.025	0.190	Green & Amp plus Shallow WT models
10	1.5	90	1h 30m	90	193	0.012	17.215	17.012	0.203	Green & Amp plus Shallow WT models
10	1	60	1h 00m	60	20	0.001	17.215	17.001	0.214	Green & Amp plus Shallow WT models
10	0.75	45					17.215	17.000	0.215	Green & Amp plus Shallow WT models
10	0.5	30					17.215	17.000	0.215	Green & Amp plus Shallow WT models
10	0.4167	25					17.215	17.000	0.215	Green & Amp plus Shallow WT models
10	0.3333	20					17.215	17.000	0.215	Green & Amp plus Shallow WT models
10	0.25	15					17.215	17.000	0.215	Green & Amp plus Shallow WT models
10	0.1667	10					17.215	17.000	0.215	Green & Amp plus Shallow WT models
20	72	4320	72h 00m	4320	4708	0.301	17.215	17.301	-0.086	Green & Amp plus Shallow WT models
20	48	2880	48h 00m	2880	4375	0.280	17.215	17.280	-0.065	Green & Amp plus Shallow WT models
20	36	2160	36h 00m	2160	4036	0.259	17.215	17.259	-0.044	Green & Amp plus Shallow WT models
20	30	1800	30h 00m	1800	3899	0.250	17.215	17.250	-0.035	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	3291	0.211	17.215	17.211	0.004	Green & Amp plus Shallow WT models
20	18	1080	18h 00m	1080	2935	0.189	17.215	17.189	0.026	Green & Amp plus Shallow WT models
20	9	540	9h 00m	540	2108	0.136	17.215	17.136	0.079	Green & Amp plus Shallow WT models
20	24	1440	8h 00m	480	1980	0.128	17.215	17.128	0.087	Clogged base model
20	36	2160	8h 00m	480	1899	0.122	17.215	17.122	0.093	Clogged base model
20	48	2880	10h 00m	600	1898	0.122	17.215	17.122	0.093	Clogged base model
20	30	1800	8h 00m	480	1893	0.122	17.215	17.122	0.093	Clogged base model
20	12	720	12h 00m	720	1880	0.121	17.215	17.121	0.094	Green & Amp plus Shallow WT models
20	72	4320	8h 00m	480	1857	0.120	17.215	17.120	0.095	Clogged base model
20	18	1080	8h 00m	480	1850	0.119	17.215	17.119	0.096	Clogged base model
20	6	360	6h 00m	360	1832	0.118	17.215	17.118	0.097	Green & Amp plus Shallow WT models
20	12	720	4h 30m	270	1807	0.117	17.215	17.117	0.098	Clogged base model
20	9	540	4h 30m	270	1770	0.114	17.215	17.114	0.101	Clogged base model
20	6	360	4h 30m	270	1738	0.112	17.215	17.112	0.103	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	4.5	270	4h 00m	240	1668	0.108	17.215	17.108	0.107	Clogged base model
20	3	180	2h 30m	150	1604	0.104	17.215	17.104	0.111	Clogged base model
20	2	120	1h 50m	110	1493	0.096	17.215	17.096	0.119	Clogged base model
20	1.5	90	1h 30m	90	1396	0.090	17.215	17.090	0.125	Clogged base model
20	1	60	1h 00m	60	1263	0.082	17.215	17.082	0.133	Clogged base model
20	0.75	45	0h 45m	45	1181	0.076	17.215	17.076	0.139	Clogged base model
20	4.5	270	4h 30m	270	1174	0.076	17.215	17.076	0.139	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	1054	0.068	17.215	17.068	0.147	Clogged base model
20	0.4167	25	0h 25m	25	999	0.065	17.215	17.065	0.150	Clogged base model
20	0.3333	20	0h 20m	20	924	0.060	17.215	17.060	0.155	Clogged base model
20	0.25	15	0h 15m	15	827	0.053	17.215	17.053	0.162	Clogged base model
20	3	180	3h 00m	180	704	0.045	17.215	17.045	0.170	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	696	0.045	17.215	17.045	0.170	Clogged base model
20	2	120	2h 00m	120	453	0.029	17.215	17.029	0.186	Green & Amp plus Shallow WT models
20	1.5	90	1h 30m	90	225	0.015	17.215	17.015	0.200	Green & Amp plus Shallow WT models
20	1	60	1h 00m	60	23	0.001	17.215	17.001	0.214	Green & Amp plus Shallow WT models
20	0.75	45					17.215	17.000	0.215	Green & Amp plus Shallow WT models
20	0.5	30					17.215	17.000	0.215	Green & Amp plus Shallow WT models
20	0.4167	25					17.215	17.000	0.215	Green & Amp plus Shallow WT models
20	0.3333	20					17.215	17.000	0.215	Green & Amp plus Shallow WT models
20	0.25	15					17.215	17.000	0.215	Green & Amp plus Shallow WT models
20	0.1667	10					17.215	17.000	0.215	Green & Amp plus Shallow WT models
100	72	4320	72h 00m	4320	6875	0.437	17.215	17.437	-0.222	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	6268	0.399	17.215	17.399	-0.184	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	5695	0.363	17.215	17.363	-0.148	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	5433	0.347	17.215	17.347	-0.132	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	4659	0.298	17.215	17.298	-0.083	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	4116	0.264	17.215	17.264	-0.049	Green & Amp plus Shallow WT models
100	9	540	9h 00m	540	2970	0.191	17.215	17.191	0.024	Green & Amp plus Shallow WT models
100	12	720	12h 00m	720	2829	0.182	17.215	17.182	0.033	Green & Amp plus Shallow WT models
100	24	1440	11h 00m	660	2586	0.166	17.215	17.166	0.049	Clogged base model
100	6	360	6h 00m	360	2550	0.164	17.215	17.164	0.051	Green & Amp plus Shallow WT models
100	18	1080	11h 00m	660	2501	0.161	17.215	17.161	0.054	Clogged base model
100	30	1800	14h 00m	840	2484	0.160	17.215	17.160	0.055	Clogged base model
100	6	360	5h 30m	330	2433	0.157	17.215	17.157	0.058	Clogged base model
100	12	720	8h 00m	480	2428	0.156	17.215	17.156	0.059	Clogged base model
100	9	540	8h 00m	480	2418	0.156	17.215	17.156	0.059	Clogged base model
100	4.5	270	4h 15m	255	2389	0.154	17.215	17.154	0.061	Clogged base model
100	36	2160	12h 00m	720	2386	0.154	17.215	17.154	0.061	Clogged base model
100	48	2880	14h 00m	840	2379	0.153	17.215	17.153	0.062	Clogged base model
100	72	4320	12h 00m	720	2335	0.150	17.215	17.150	0.065	Clogged base model
100	3	180	3h 00m	180	2265	0.146	17.215	17.146	0.069	Clogged base model
100	2	120	1h 55m	115	2104	0.136	17.215	17.136	0.079	Clogged base model
100	1.5	90	1h 30m	90	1968	0.127	17.215	17.127	0.088	Clogged base model
100	4.5	270	4h 30m	270	1793	0.116	17.215	17.116	0.099	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	1773	0.114	17.215	17.114	0.101	Clogged base model
100	0.75	45	0h 45m	45	1666	0.108	17.215	17.108	0.107	Clogged base model
100	0.5	30	0h 30m	30	1504	0.097	17.215	17.097	0.118	Clogged base model
100	0.4167	25	0h 25m	25	1426	0.092	17.215	17.092	0.123	Clogged base model
100	0.3333	20	0h 20m	20	1333	0.086	17.215	17.086	0.129	Clogged base model
100	0.25	15	0h 15m	15	1196	0.077	17.215	17.077	0.138	Clogged base model
100	3	180	3h 00m	180	1166	0.075	17.215	17.075	0.140	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	1018	0.066	17.215	17.066	0.149	Clogged base model
100	2	120	2h 00m	120	786	0.051	17.215	17.051	0.164	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	426	0.028	17.215	17.028	0.187	Green & Amp plus Shallow WT models
100	0.25	15	0h 10m	10	87	0.006	17.215	17.006	0.209	Green & Amp plus Shallow WT models
100	0.3333	20	0h 10m	10	62	0.004	17.215	17.004	0.211	Green & Amp plus Shallow WT models
100	0.1667	10	0h 05m	5	58	0.004	17.215	17.004	0.211	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	39	0.002	17.215	17.002	0.213	Green & Amp plus Shallow WT models
100	0.4167	25	0h 15m	15	32	0.002	17.215	17.002	0.213	Green & Amp plus Shallow WT models
100	0.75	45	0h 15m	15	0	0.000	17.215	17.000	0.215	Green & Amp plus Shallow WT models
100	0.5	30	0h 15m	15	0	0.000	17.215	17.000	0.215	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - North Lake Road
Job Number	60100953
Task	Basin J
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	80185	0.900	72167	
Verge	62510	0.300	18753	
	0	0.700	0	
Total	142695		90920	

Sump Details		
GWL	13.000	m AHD
Depth to GWL from base	15.000	m
Max Allowable TWL	29.200	m AHD
Sump Base Level	28.000	m AHD
Sump Width at base	25	m
Sump Length at base	156	m
Side Slope	3.5	1 in --

Permeability		
Soil Permeability, K	30.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15

200

0.25

30.0%

0.800

0.600

1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	48	2880	14h 00m	840	4502	0.991	29.200	28.991	0.209	Clogged base model
5	30	1800	14h 00m	840	4474	0.985	29.200	28.985	0.215	Clogged base model
5	24	1440	11h 00m	660	4454	0.981	29.200	28.981	0.219	Clogged base model
5	72	4320	16h 00m	960	4437	0.978	29.200	28.978	0.222	Clogged base model
5	36	2160	16h 00m	960	4403	0.972	29.200	28.972	0.228	Clogged base model
5	18	1080	11h 00m	660	4243	0.940	29.200	28.940	0.260	Clogged base model
5	12	720	8h 00m	480	3956	0.884	29.200	28.884	0.316	Clogged base model
5	9	540	8h 00m	480	3765	0.846	29.200	28.846	0.354	Clogged base model
5	6	360	5h 30m	330	3581	0.809	29.200	28.809	0.391	Clogged base model
5	4.5	270	4h 15m	255	3366	0.766	29.200	28.766	0.434	Clogged base model
5	3	180	3h 00m	180	3056	0.702	29.200	28.702	0.498	Clogged base model
5	2	120	2h 00m	120	2768	0.641	29.200	28.641	0.559	Clogged base model
5	1.5	90	1h 30m	90	2534	0.592	29.200	28.592	0.608	Clogged base model
5	1	60	1h 00m	60	2239	0.528	29.200	28.528	0.672	Clogged base model
5	0.75	45	0h 45m	45	2059	0.488	29.200	28.488	0.712	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	36	2160	8h 00m	480	1864	0.445	29.200	28.445	0.755	Green & Amp plus Shallow WT models
5	0.5	30	0h 30m	30	1793	0.429	29.200	28.429	0.771	Clogged base model
5	0.4167	25	0h 25m	25	1677	0.403	29.200	28.403	0.797	Clogged base model
5	0.3333	20	0h 20m	20	1528	0.369	29.200	28.369	0.831	Clogged base model
5	0.25	15	0h 15m	15	1374	0.334	29.200	28.334	0.866	Clogged base model
5	30	1800	8h 00m	480	1350	0.328	29.200	28.328	0.872	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	1129	0.277	29.200	28.277	0.923	Clogged base model
5	72	4320	8h 00m	480	935	0.231	29.200	28.231	0.969	Green & Amp plus Shallow WT models
5	48	2880	6h 00m	360	838	0.208	29.200	28.208	0.992	Green & Amp plus Shallow WT models
5	0.4167	25	0h 15m	15	628	0.157	29.200	28.157	1.043	Green & Amp plus Shallow WT models
5	0.3333	20	0h 15m	15	603	0.151	29.200	28.151	1.049	Green & Amp plus Shallow WT models
5	0.25	15	0h 10m	10	572	0.143	29.200	28.143	1.057	Green & Amp plus Shallow WT models
5	0.5	30	0h 15m	15	553	0.138	29.200	28.138	1.062	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	539	0.135	29.200	28.135	1.065	Green & Amp plus Shallow WT models
5	24	1440	8h 00m	480	493	0.124	29.200	28.124	1.076	Green & Amp plus Shallow WT models
5	1	60	0h 25m	25	433	0.109	29.200	28.109	1.091	Green & Amp plus Shallow WT models
5	18	1080	8h 00m	480	426	0.107	29.200	28.107	1.093	Green & Amp plus Shallow WT models
5	0.75	45	0h 20m	20	426	0.107	29.200	28.107	1.093	Green & Amp plus Shallow WT models
5	1.5	90	0h 20m	20	361	0.091	29.200	28.091	1.109	Green & Amp plus Shallow WT models
5	2	120	0h 15m	15	336	0.085	29.200	28.085	1.115	Green & Amp plus Shallow WT models
5	3	180	0h 30m	30	225	0.057	29.200	28.057	1.143	Green & Amp plus Shallow WT models
5	12	720	4h 30m	270	195	0.050	29.200	28.050	1.150	Green & Amp plus Shallow WT models
5	9	540	4h 30m	270	135	0.034	29.200	28.034	1.166	Green & Amp plus Shallow WT models
5	4.5	270	4h 00m	240	131	0.033	29.200	28.033	1.167	Green & Amp plus Shallow WT models
5	6	360	4h 30m	270	98	0.025	29.200	28.025	1.175	Green & Amp plus Shallow WT models
10	48	2880	14h 00m	840	5147	1.113	29.200	29.113	0.087	Clogged base model
10	72	4320	16h 00m	960	5105	1.105	29.200	29.105	0.095	Clogged base model
10	30	1800	14h 00m	840	5081	1.101	29.200	29.101	0.099	Clogged base model
10	24	1440	11h 00m	660	5015	1.088	29.200	29.088	0.112	Clogged base model
10	36	2160	16h 00m	960	5004	1.086	29.200	29.086	0.114	Clogged base model
10	18	1080	11h 00m	660	4774	1.042	29.200	29.042	0.158	Clogged base model
10	12	720	8h 00m	480	4421	0.975	29.200	28.975	0.225	Clogged base model
10	9	540	8h 00m	480	4225	0.937	29.200	28.937	0.263	Clogged base model
10	6	360	5h 30m	330	4021	0.897	29.200	28.897	0.303	Clogged base model
10	4.5	270	4h 15m	255	3776	0.848	29.200	28.848	0.352	Clogged base model
10	3	180	3h 00m	180	3463	0.785	29.200	28.785	0.415	Clogged base model
10	2	120	2h 00m	120	3115	0.714	29.200	28.714	0.486	Clogged base model
10	1.5	90	1h 30m	90	2876	0.664	29.200	28.664	0.536	Clogged base model
10	1	60	1h 00m	60	2542	0.594	29.200	28.594	0.606	Clogged base model
10	0.75	45	0h 45m	45	2341	0.550	29.200	28.550	0.650	Clogged base model
10	36	2160	8h 00m	480	2259	0.532	29.200	28.532	0.668	Green & Amp plus Shallow WT models
10	0.5	30	0h 30m	30	2058	0.488	29.200	28.488	0.712	Clogged base model
10	0.4167	25	0h 25m	25	1944	0.463	29.200	28.463	0.737	Clogged base model
10	0.3333	20	0h 20m	20	1769	0.424	29.200	28.424	0.776	Clogged base model
10	30	1800	10h 00m	600	1686	0.405	29.200	28.405	0.795	Green & Amp plus Shallow WT models
10	0.25	15	0h 15m	15	1578	0.381	29.200	28.381	0.819	Clogged base model
10	0.1667	10	0h 10m	10	1310	0.319	29.200	28.319	0.881	Clogged base model
10	72	4320	12h 00m	720	1293	0.315	29.200	28.315	0.885	Green & Amp plus Shallow WT models
10	48	2880	10h 00m	600	1164	0.285	29.200	28.285	0.915	Green & Amp plus Shallow WT models
10	0.4167	25	0h 15m	15	827	0.205	29.200	28.205	0.995	Green & Amp plus Shallow WT models
10	0.3333	20	0h 15m	15	797	0.198	29.200	28.198	1.002	Green & Amp plus Shallow WT models
10	0.5	30	0h 15m	15	727	0.181	29.200	28.181	1.019	Green & Amp plus Shallow WT models
10	0.25	15	0h 10m	10	720	0.179	29.200	28.179	1.021	Green & Amp plus Shallow WT models
10	0.1667	10	0h 10m	10	696	0.173	29.200	28.173	1.027	Green & Amp plus Shallow WT models
10	24	1440	8h 00m	480	696	0.173	29.200	28.173	1.027	Green & Amp plus Shallow WT models
10	18	1080	8h 00m	480	602	0.150	29.200	28.150	1.050	Green & Amp plus Shallow WT models
10	1	60	0h 25m	25	581	0.145	29.200	28.145	1.055	Green & Amp plus Shallow WT models
10	0.75	45	0h 20m	20	573	0.143	29.200	28.143	1.057	Green & Amp plus Shallow WT models
10	1.5	90	0h 20m	20	497	0.125	29.200	28.125	1.075	Green & Amp plus Shallow WT models
10	2	120	0h 15m	15	432	0.109	29.200	28.109	1.091	Green & Amp plus Shallow WT models
10	3	180	0h 30m	30	342	0.086	29.200	28.086	1.114	Green & Amp plus Shallow WT models
10	12	720	4h 30m	270	248	0.063	29.200	28.063	1.137	Green & Amp plus Shallow WT models
10	4.5	270	0h 30m	30	221	0.056	29.200	28.056	1.144	Green & Amp plus Shallow WT models
10	9	540	4h 30m	270	183	0.047	29.200	28.047	1.153	Green & Amp plus Shallow WT models
10	6	360	4h 30m	270	143	0.036	29.200	28.036	1.164	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	6030	1.274	29.200	29.274	-0.074	Clogged base model
20	72	4320	16h 00m	960	6029	1.273	29.200	29.273	-0.073	Clogged base model
20	30	1800	14h 00m	840	5930	1.256	29.200	29.256	-0.056	Clogged base model
20	36	2160	16h 00m	960	5876	1.246	29.200	29.246	-0.046	Clogged base model
20	24	1440	11h 00m	660	5842	1.240	29.200	29.240	-0.040	Clogged base model
20	18	1080	11h 00m	660	5552	1.187	29.200	29.187	0.013	Clogged base model
20	12	720	8h 00m	480	5115	1.107	29.200	29.107	0.093	Clogged base model
20	9	540	8h 00m	480	4891	1.065	29.200	29.065	0.135	Clogged base model
20	6	360	5h 30m	330	4657	1.020	29.200	29.020	0.180	Clogged base model
20	4.5	270	4h 15m	255	4403	0.971	29.200	28.971	0.229	Clogged base model
20	3	180	3h 00m	180	4022	0.897	29.200	28.897	0.303	Clogged base model
20	2	120	2h 00m	120	3637	0.821	29.200	28.821	0.379	Clogged base model
20	1.5	90	1h 30m	90	3350	0.762	29.200	28.762	0.438	Clogged base model
20	1	60	1h 00m	60	2970	0.684	29.200	28.684	0.516	Clogged base model
20	36	2160	10h 00m	600	2883	0.666	29.200	28.666	0.534	Green & Amp plus Shallow WT models
20	0.75	45	0h 45m	45	2744	0.636	29.200	28.636	0.564	Clogged base model
20	0.5	30	0h 30m	30	2418	0.567	29.200	28.567	0.633	Clogged base model
20	0.4167	25	0h 25m	25	2282	0.537	29.200	28.537	0.663	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	30	1800	10h 00m	600	2230	0.526	29.200	28.526	0.674	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	2100	0.498	29.200	28.498	0.702	Clogged base model
20	72	4320	12h 00m	720	1900	0.453	29.200	28.453	0.747	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	1872	0.447	29.200	28.447	0.753	Clogged base model
20	48	2880	12h 00m	720	1681	0.404	29.200	28.404	0.796	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	1567	0.378	29.200	28.378	0.822	Clogged base model
20	0.4167	25	0h 15m	15	1080	0.265	29.200	28.265	0.935	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	1064	0.261	29.200	28.261	0.939	Green & Amp plus Shallow WT models
20	24	1440	10h 00m	600	1042	0.256	29.200	28.256	0.944	Green & Amp plus Shallow WT models
20	0.5	30	0h 15m	15	963	0.237	29.200	28.237	0.963	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	955	0.235	29.200	28.235	0.965	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	920	0.227	29.200	28.227	0.973	Green & Amp plus Shallow WT models
20	18	1080	8h 00m	480	880	0.218	29.200	28.218	0.982	Green & Amp plus Shallow WT models
20	1	60	0h 30m	30	812	0.202	29.200	28.202	0.998	Green & Amp plus Shallow WT models
20	0.75	45	0h 30m	30	802	0.199	29.200	28.199	1.001	Green & Amp plus Shallow WT models
20	1.5	90	0h 20m	20	685	0.171	29.200	28.171	1.029	Green & Amp plus Shallow WT models
20	2	120	0h 35m	35	652	0.163	29.200	28.163	1.037	Green & Amp plus Shallow WT models
20	3	180	0h 45m	45	508	0.127	29.200	28.127	1.073	Green & Amp plus Shallow WT models
20	12	720	8h 00m	480	395	0.100	29.200	28.100	1.100	Green & Amp plus Shallow WT models
20	4.5	270	0h 30m	30	366	0.092	29.200	28.092	1.108	Green & Amp plus Shallow WT models
20	9	540	1h 30m	90	319	0.081	29.200	28.081	1.119	Green & Amp plus Shallow WT models
20	6	360	4h 30m	270	207	0.053	29.200	28.053	1.147	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	7595	1.544	29.200	29.544	-0.344	Clogged base model
100	24	1440	14h 00m	840	7511	1.530	29.200	29.530	-0.330	Clogged base model
100	72	4320	24h 00m	1440	7454	1.521	29.200	29.521	-0.321	Clogged base model
100	36	2160	16h 00m	960	7424	1.516	29.200	29.516	-0.316	Clogged base model
100	48	2880	16h 00m	960	7372	1.507	29.200	29.507	-0.307	Clogged base model
100	18	1080	12h 00m	720	7245	1.485	29.200	29.485	-0.285	Clogged base model
100	12	720	10h 30m	630	6723	1.396	29.200	29.396	-0.196	Clogged base model
100	9	540	9h 00m	540	6629	1.379	29.200	29.379	-0.179	Clogged base model
100	6	360	6h 00m	360	6361	1.332	29.200	29.332	-0.132	Clogged base model
100	4.5	270	4h 30m	270	6022	1.272	29.200	29.272	-0.072	Clogged base model
100	3	180	3h 00m	180	5520	1.182	29.200	29.182	0.018	Clogged base model
100	2	120	2h 00m	120	4989	1.083	29.200	29.083	0.117	Clogged base model
100	1.5	90	1h 30m	90	4613	1.012	29.200	29.012	0.188	Clogged base model
100	36	2160	16h 00m	960	4134	0.919	29.200	28.919	0.281	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	4094	0.911	29.200	28.911	0.289	Clogged base model
100	0.75	45	0h 45m	45	3814	0.856	29.200	28.856	0.344	Clogged base model
100	30	1800	16h 00m	960	3644	0.822	29.200	28.822	0.378	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	3410	0.775	29.200	28.775	0.425	Clogged base model
100	0.4167	25	0h 25m	25	3223	0.736	29.200	28.736	0.464	Clogged base model
100	0.3333	20	0h 20m	20	3004	0.691	29.200	28.691	0.509	Clogged base model
100	72	4320	16h 00m	960	2909	0.671	29.200	28.671	0.529	Green & Amp plus Shallow WT models
100	48	2880	16h 00m	960	2789	0.646	29.200	28.646	0.554	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	2687	0.624	29.200	28.624	0.576	Clogged base model
100	24	1440	13h 00m	780	2337	0.549	29.200	28.549	0.651	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	2277	0.536	29.200	28.536	0.664	Clogged base model
100	18	1080	12h 00m	720	2173	0.514	29.200	28.514	0.686	Green & Amp plus Shallow WT models
100	0.3333	20	0h 15m	15	1742	0.418	29.200	28.418	0.782	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	1658	0.399	29.200	28.399	0.801	Green & Amp plus Shallow WT models
100	0.4167	25	0h 20m	20	1640	0.395	29.200	28.395	0.805	Green & Amp plus Shallow WT models
100	0.5	30	0h 25m	25	1583	0.382	29.200	28.382	0.818	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	1553	0.375	29.200	28.375	0.825	Green & Amp plus Shallow WT models
100	0.75	45	0h 30m	30	1466	0.355	29.200	28.355	0.845	Green & Amp plus Shallow WT models
100	1	60	0h 35m	35	1459	0.353	29.200	28.353	0.847	Green & Amp plus Shallow WT models
100	12	720	9h 00m	540	1411	0.342	29.200	28.342	0.858	Green & Amp plus Shallow WT models
100	9	540	8h 00m	480	1221	0.298	29.200	28.298	0.902	Green & Amp plus Shallow WT models
100	1.5	90	0h 35m	35	1049	0.258	29.200	28.258	0.942	Green & Amp plus Shallow WT models
100	2	120	0h 35m	35	924	0.228	29.200	28.228	0.972	Green & Amp plus Shallow WT models
100	6	360	6h 00m	360	801	0.199	29.200	28.199	1.001	Green & Amp plus Shallow WT models
100	3	180	0h 45m	45	789	0.196	29.200	28.196	1.004	Green & Amp plus Shallow WT models
100	4.5	270	4h 30m	270	554	0.139	29.200	28.139	1.061	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Progress Drive
Job Number	60100953
Task	Basin K
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	22903	0.900	20613	
Verge	34451	0.300	10335	
	0	0.700	0	
Total	57354		30948	

Sump Details		
GWL	13.800	m AHD
Depth to GWL from base	1.300	m
Max Allowable TWL	16.300	m AHD
Sump Base Level	15.100	m AHD
Sump Width at base	38	m
Sump Length at base	80	m
Side Slope	3.0	1 in --

Permeability		
Soil Permeability, K	8.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	72	4320	72h 00m	4320	2759	0.826	16.300	15.926	0.374	Green & Amp plus Shallow WT models
5	48	2880	48h 00m	2880	2581	0.777	16.300	15.877	0.423	Green & Amp plus Shallow WT models
5	36	2160	36h 00m	2160	2374	0.719	16.300	15.819	0.481	Green & Amp plus Shallow WT models
5	30	1800	30h 00m	1800	2302	0.699	16.300	15.799	0.501	Green & Amp plus Shallow WT models
5	24	1440	24h 00m	1440	1898	0.584	16.300	15.684	0.616	Green & Amp plus Shallow WT models
5	18	1080	18h 00m	1080	1682	0.521	16.300	15.621	0.679	Green & Amp plus Shallow WT models
5	24	1440	10h 00m	600	1427	0.446	16.300	15.546	0.754	Clogged base model
5	48	2880	14h 00m	840	1419	0.443	16.300	15.543	0.757	Clogged base model
5	30	1800	14h 00m	840	1409	0.440	16.300	15.540	0.760	Clogged base model
5	36	2160	12h 00m	720	1395	0.436	16.300	15.536	0.764	Clogged base model
5	72	4320	16h 00m	960	1384	0.433	16.300	15.533	0.767	Clogged base model
5	18	1080	11h 00m	660	1351	0.423	16.300	15.523	0.777	Clogged base model
5	12	720	8h 00m	480	1275	0.400	16.300	15.500	0.800	Clogged base model
5	9	540	6h 30m	390	1215	0.382	16.300	15.482	0.818	Clogged base model
5	6	360	5h 00m	300	1169	0.368	16.300	15.468	0.832	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	9	540	9h 00m	540	1167	0.368	16.300	15.468	0.832	Green & Amp plus Shallow WT models
5	12	720	12h 00m	720	1150	0.362	16.300	15.462	0.838	Green & Amp plus Shallow WT models
5	4.5	270	4h 15m	255	1105	0.349	16.300	15.449	0.851	Clogged base model
5	6	360	6h 00m	360	1019	0.323	16.300	15.423	0.877	Green & Amp plus Shallow WT models
5	3	180	2h 45m	165	1012	0.321	16.300	15.421	0.879	Clogged base model
5	2	120	1h 55m	115	922	0.293	16.300	15.393	0.907	Clogged base model
5	1.5	90	1h 30m	90	847	0.270	16.300	15.370	0.930	Clogged base model
5	1	60	1h 00m	60	752	0.240	16.300	15.340	0.960	Clogged base model
5	0.75	45	0h 45m	45	693	0.222	16.300	15.322	0.978	Clogged base model
5	4.5	270	4h 30m	270	679	0.218	16.300	15.318	0.982	Green & Amp plus Shallow WT models
5	0.5	30	0h 30m	30	605	0.195	16.300	15.295	1.005	Clogged base model
5	0.4167	25	0h 25m	25	567	0.182	16.300	15.282	1.018	Clogged base model
5	0.3333	20	0h 20m	20	517	0.166	16.300	15.266	1.034	Clogged base model
5	0.25	15	0h 15m	15	465	0.150	16.300	15.250	1.050	Clogged base model
5	3	180	3h 00m	180	457	0.148	16.300	15.248	1.052	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	383	0.124	16.300	15.224	1.076	Clogged base model
5	2	120	2h 00m	120	342	0.111	16.300	15.211	1.089	Green & Amp plus Shallow WT models
5	0.4167	25	0h 15m	15	304	0.099	16.300	15.199	1.101	Green & Amp plus Shallow WT models
5	0.3333	20	0h 15m	15	297	0.096	16.300	15.196	1.104	Green & Amp plus Shallow WT models
5	0.5	30	0h 15m	15	278	0.090	16.300	15.190	1.110	Green & Amp plus Shallow WT models
5	1	60	0h 35m	35	276	0.090	16.300	15.190	1.110	Green & Amp plus Shallow WT models
5	0.25	15	0h 15m	15	275	0.089	16.300	15.189	1.111	Green & Amp plus Shallow WT models
5	0.75	45	0h 30m	30	270	0.088	16.300	15.188	1.112	Green & Amp plus Shallow WT models
5	1.5	90	0h 35m	35	250	0.081	16.300	15.181	1.119	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	248	0.081	16.300	15.181	1.119	Green & Amp plus Shallow WT models
20	72	4320	72h 00m	4320	3735	1.086	16.300	16.186	0.114	Green & Amp plus Shallow WT models
20	48	2880	48h 00m	2880	3439	1.009	16.300	16.109	0.191	Green & Amp plus Shallow WT models
20	36	2160	36h 00m	2160	3140	0.929	16.300	16.029	0.271	Green & Amp plus Shallow WT models
20	30	1800	30h 00m	1800	3026	0.899	16.300	15.999	0.301	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	2490	0.751	16.300	15.851	0.449	Green & Amp plus Shallow WT models
20	18	1080	18h 00m	1080	2198	0.669	16.300	15.769	0.531	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	1941	0.596	16.300	15.696	0.604	Clogged base model
20	72	4320	16h 00m	960	1928	0.592	16.300	15.692	0.608	Clogged base model
20	30	1800	14h 00m	840	1906	0.586	16.300	15.686	0.614	Clogged base model
20	24	1440	10h 00m	600	1898	0.584	16.300	15.684	0.616	Clogged base model
20	36	2160	12h 00m	720	1890	0.581	16.300	15.681	0.619	Clogged base model
20	18	1080	11h 00m	660	1797	0.554	16.300	15.654	0.646	Clogged base model
20	12	720	8h 00m	480	1670	0.518	16.300	15.618	0.682	Clogged base model
20	12	720	12h 00m	720	1605	0.498	16.300	15.598	0.702	Green & Amp plus Shallow WT models
20	9	540	6h 30m	390	1595	0.495	16.300	15.595	0.705	Clogged base model
20	6	360	5h 30m	330	1534	0.477	16.300	15.577	0.723	Clogged base model
20	9	540	9h 00m	540	1523	0.474	16.300	15.574	0.726	Green & Amp plus Shallow WT models
20	4.5	270	4h 15m	255	1458	0.455	16.300	15.555	0.745	Clogged base model
20	3	180	2h 45m	165	1341	0.420	16.300	15.520	0.780	Clogged base model
20	6	360	6h 00m	360	1318	0.413	16.300	15.513	0.787	Green & Amp plus Shallow WT models
20	2	120	2h 00m	120	1218	0.383	16.300	15.483	0.817	Clogged base model
20	1.5	90	1h 30m	90	1125	0.355	16.300	15.455	0.845	Clogged base model
20	4.5	270	4h 30m	270	1031	0.327	16.300	15.427	0.873	Green & Amp plus Shallow WT models
20	1	60	1h 00m	60	1001	0.317	16.300	15.417	0.883	Clogged base model
20	0.75	45	0h 45m	45	926	0.294	16.300	15.394	0.906	Clogged base model
20	0.5	30	0h 30m	30	818	0.261	16.300	15.361	0.939	Clogged base model
20	3	180	3h 00m	180	785	0.251	16.300	15.351	0.949	Green & Amp plus Shallow WT models
20	0.4167	25	0h 25m	25	773	0.247	16.300	15.347	0.953	Clogged base model
20	0.3333	20	0h 20m	20	711	0.228	16.300	15.328	0.972	Clogged base model
20	2	120	2h 00m	120	640	0.206	16.300	15.306	0.994	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	635	0.204	16.300	15.304	0.996	Clogged base model
20	0.1667	10	0h 10m	10	532	0.171	16.300	15.271	1.029	Clogged base model
20	1.5	90	1h 30m	90	485	0.157	16.300	15.257	1.043	Green & Amp plus Shallow WT models
20	0.4167	25	0h 20m	20	463	0.149	16.300	15.249	1.051	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	460	0.148	16.300	15.248	1.052	Green & Amp plus Shallow WT models
20	0.5	30	0h 25m	25	454	0.147	16.300	15.247	1.053	Green & Amp plus Shallow WT models
20	1	60	0h 35m	35	454	0.146	16.300	15.246	1.054	Green & Amp plus Shallow WT models
20	0.75	45	0h 35m	35	444	0.143	16.300	15.243	1.057	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	427	0.138	16.300	15.238	1.062	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	383	0.124	16.300	15.224	1.076	Green & Amp plus Shallow WT models
100	72	4320	72h 00m	4320	5324	1.482	16.300	16.582	-0.282	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	4840	1.365	16.300	16.465	-0.165	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	4369	1.248	16.300	16.348	-0.048	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	4164	1.196	16.300	16.296	0.004	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	3508	1.027	16.300	16.127	0.173	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	3077	0.912	16.300	16.012	0.288	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	2463	0.744	16.300	15.844	0.456	Clogged base model
100	24	1440	13h 00m	780	2451	0.741	16.300	15.841	0.459	Clogged base model
100	36	2160	16h 00m	960	2404	0.728	16.300	15.828	0.472	Clogged base model
100	48	2880	16h 00m	960	2387	0.723	16.300	15.823	0.477	Clogged base model
100	72	4320	24h 00m	1440	2375	0.719	16.300	15.819	0.481	Clogged base model
100	12	720	12h 00m	720	2372	0.719	16.300	15.819	0.481	Green & Amp plus Shallow WT models
100	18	1080	12h 00m	720	2368	0.717	16.300	15.817	0.483	Clogged base model
100	12	720	9h 00m	540	2207	0.672	16.300	15.772	0.528	Clogged base model
100	9	540	8h 30m	510	2182	0.665	16.300	15.765	0.535	Clogged base model
100	9	540	9h 00m	540	2161	0.659	16.300	15.759	0.541	Green & Amp plus Shallow WT models
100	6	360	6h 00m	360	2111	0.645	16.300	15.745	0.555	Clogged base model
100	4.5	270	4h 30m	270	2008	0.615	16.300	15.715	0.585	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
100	6	360	6h 00m	360	1889	0.581	16.300	15.681	0.619	Green & Amp plus Shallow WT models
100	3	180	3h 00m	180	1850	0.570	16.300	15.670	0.630	Clogged base model
100	2	120	2h 00m	120	1679	0.520	16.300	15.620	0.680	Clogged base model
100	4.5	270	4h 30m	270	1594	0.495	16.300	15.595	0.705	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	1555	0.484	16.300	15.584	0.716	Clogged base model
100	1	60	1h 00m	60	1383	0.433	16.300	15.533	0.767	Clogged base model
100	3	180	3h 00m	180	1327	0.416	16.300	15.516	0.784	Green & Amp plus Shallow WT models
100	0.75	45	0h 45m	45	1290	0.405	16.300	15.505	0.795	Clogged base model
100	0.5	30	0h 30m	30	1155	0.364	16.300	15.464	0.836	Clogged base model
100	0.4167	25	0h 25m	25	1093	0.345	16.300	15.445	0.855	Clogged base model
100	2	120	2h 00m	120	1090	0.344	16.300	15.444	0.856	Green & Amp plus Shallow WT models
100	0.3333	20	0h 20m	20	1019	0.323	16.300	15.423	0.877	Clogged base model
100	1.5	90	1h 30m	90	923	0.293	16.300	15.393	0.907	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	912	0.290	16.300	15.390	0.910	Clogged base model
100	0.1667	10	0h 10m	10	773	0.247	16.300	15.347	0.953	Clogged base model
100	0.75	45	0h 40m	40	741	0.237	16.300	15.337	0.963	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	741	0.237	16.300	15.337	0.963	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	739	0.236	16.300	15.336	0.964	Green & Amp plus Shallow WT models
100	1	60	0h 45m	45	732	0.234	16.300	15.334	0.966	Green & Amp plus Shallow WT models
100	0.3333	20	0h 20m	20	725	0.232	16.300	15.332	0.968	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	678	0.217	16.300	15.317	0.983	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	606	0.195	16.300	15.295	1.005	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Murdoch Drive Extension
Job Number	60100953
Task	Basin L
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	49785	0.900	44807	
Verge	18169	0.300	5451	
	0	0.700	0	
Total	67954		50257	

Sump Details		
GWL	18.150	m AHD
Depth to GWL from base	0.150	m
Max Allowable TWL	19.500	m AHD
Sump Base Level	18.300	m AHD
Sump Width at base	44	m
Sump Length at base	111	m
Side Slope	6.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

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SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	72	4320	72h 00m	4320	6883	1.145	19.500	19.445	0.055	Green & Amp plus Shallow WT models
20	48	2880	48h 00m	2880	6186	1.046	19.500	19.346	0.154	Green & Amp plus Shallow WT models
20	36	2160	36h 00m	2160	5650	0.969	19.500	19.269	0.231	Green & Amp plus Shallow WT models
20	30	1800	30h 00m	1800	5302	0.917	19.500	19.217	0.283	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	4884	0.854	19.500	19.154	0.346	Green & Amp plus Shallow WT models
20	18	1080	18h 00m	1080	4384	0.778	19.500	19.078	0.422	Green & Amp plus Shallow WT models
20	12	720	12h 00m	720	3707	0.670	19.500	18.970	0.530	Green & Amp plus Shallow WT models
20	9	540	9h 00m	540	3385	0.618	19.500	18.918	0.582	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	3135	0.576	19.500	18.876	0.624	Clogged base model
20	72	4320	16h 00m	960	3112	0.573	19.500	18.873	0.627	Clogged base model
20	30	1800	14h 00m	840	3080	0.567	19.500	18.867	0.633	Clogged base model
20	24	1440	10h 00m	600	3071	0.566	19.500	18.866	0.634	Clogged base model
20	36	2160	12h 00m	720	3056	0.563	19.500	18.863	0.637	Clogged base model
20	6	360	6h 00m	360	2987	0.551	19.500	18.851	0.649	Green & Amp plus Shallow WT models
20	18	1080	11h 00m	660	2906	0.538	19.500	18.838	0.662	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	4.5	270	4h 30m	270	2715	0.506	19.500	18.806	0.694	Green & Amp plus Shallow WT models
20	12	720	8h 00m	480	2703	0.504	19.500	18.804	0.696	Clogged base model
20	9	540	6h 30m	390	2583	0.483	19.500	18.783	0.717	Clogged base model
20	6	360	5h 30m	330	2486	0.466	19.500	18.766	0.734	Clogged base model
20	4.5	270	4h 15m	255	2364	0.445	19.500	18.745	0.755	Clogged base model
20	3	180	3h 00m	180	2361	0.444	19.500	18.744	0.756	Green & Amp plus Shallow WT models
20	3	180	2h 45m	165	2175	0.412	19.500	18.712	0.788	Clogged base model
20	2	120	2h 00m	120	2113	0.401	19.500	18.701	0.799	Green & Amp plus Shallow WT models
20	2	120	2h 00m	120	1977	0.377	19.500	18.677	0.823	Clogged base model
20	1.5	90	1h 30m	90	1872	0.358	19.500	18.658	0.842	Green & Amp plus Shallow WT models
20	1.5	90	1h 30m	90	1827	0.350	19.500	18.650	0.850	Clogged base model
20	1	60	1h 00m	60	1648	0.318	19.500	18.618	0.882	Green & Amp plus Shallow WT models
20	1	60	1h 00m	60	1625	0.313	19.500	18.613	0.887	Clogged base model
20	0.75	45	0h 45m	45	1504	0.291	19.500	18.591	0.909	Clogged base model
20	0.75	45	0h 45m	45	1504	0.291	19.500	18.591	0.909	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	1328	0.259	19.500	18.559	0.941	Clogged base model
20	0.4167	25	0h 25m	25	1254	0.245	19.500	18.545	0.955	Clogged base model
20	0.5	30	0h 30m	30	1230	0.240	19.500	18.540	0.960	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	1155	0.226	19.500	18.526	0.974	Clogged base model
20	0.4167	25	0h 25m	25	1151	0.225	19.500	18.525	0.975	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	1045	0.206	19.500	18.506	0.994	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	1030	0.203	19.500	18.503	0.997	Clogged base model
20	0.25	15	0h 15m	15	930	0.184	19.500	18.484	1.016	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	863	0.171	19.500	18.471	1.029	Clogged base model
20	0.1667	10	0h 10m	10	749	0.149	19.500	18.449	1.051	Green & Amp plus Shallow WT models
100	72	4320	72h 00m	4320	9541	1.495	19.500	19.795	-0.295	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	8524	1.365	19.500	19.665	-0.165	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	7716	1.258	19.500	19.558	-0.058	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	7222	1.192	19.500	19.492	0.008	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	6626	1.109	19.500	19.409	0.091	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	5911	1.007	19.500	19.307	0.193	Green & Amp plus Shallow WT models
100	12	720	12h 00m	720	4969	0.867	19.500	19.167	0.333	Green & Amp plus Shallow WT models
100	9	540	9h 00m	540	4552	0.804	19.500	19.104	0.396	Green & Amp plus Shallow WT models
100	6	360	6h 00m	360	4033	0.722	19.500	19.022	0.478	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	3977	0.713	19.500	19.013	0.487	Clogged base model
100	24	1440	13h 00m	780	3961	0.711	19.500	19.011	0.489	Clogged base model
100	36	2160	16h 00m	960	3883	0.699	19.500	18.999	0.501	Clogged base model
100	48	2880	16h 00m	960	3853	0.694	19.500	18.994	0.506	Clogged base model
100	18	1080	12h 00m	720	3829	0.690	19.500	18.990	0.510	Clogged base model
100	72	4320	24h 00m	1440	3824	0.689	19.500	18.989	0.511	Clogged base model
100	4.5	270	4h 30m	270	3675	0.665	19.500	18.965	0.535	Green & Amp plus Shallow WT models
100	12	720	9h 00m	540	3571	0.648	19.500	18.948	0.552	Clogged base model
100	9	540	8h 00m	480	3532	0.642	19.500	18.942	0.558	Clogged base model
100	6	360	6h 00m	360	3420	0.624	19.500	18.924	0.576	Clogged base model
100	4.5	270	4h 30m	270	3255	0.597	19.500	18.897	0.603	Clogged base model
100	3	180	3h 00m	180	3218	0.590	19.500	18.890	0.610	Green & Amp plus Shallow WT models
100	3	180	3h 00m	180	3001	0.554	19.500	18.854	0.646	Clogged base model
100	2	120	2h 00m	120	2865	0.531	19.500	18.831	0.669	Green & Amp plus Shallow WT models
100	2	120	2h 00m	120	2724	0.507	19.500	18.807	0.693	Clogged base model
100	1.5	90	1h 30m	90	2559	0.479	19.500	18.779	0.721	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	2524	0.473	19.500	18.773	0.727	Clogged base model
100	1	60	1h 00m	60	2261	0.427	19.500	18.727	0.773	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	2246	0.424	19.500	18.724	0.776	Clogged base model
100	0.75	45	0h 45m	45	2095	0.398	19.500	18.698	0.802	Clogged base model
100	0.75	45	0h 45m	45	2079	0.395	19.500	18.695	0.805	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	1876	0.359	19.500	18.659	0.841	Clogged base model
100	0.5	30	0h 30m	30	1798	0.345	19.500	18.645	0.855	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	1774	0.340	19.500	18.640	0.860	Clogged base model
100	0.4167	25	0h 25m	25	1688	0.325	19.500	18.625	0.875	Green & Amp plus Shallow WT models
100	0.3333	20	0h 20m	20	1655	0.319	19.500	18.619	0.881	Clogged base model
100	0.3333	20	0h 20m	20	1562	0.302	19.500	18.602	0.898	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	1481	0.287	19.500	18.587	0.913	Clogged base model
100	0.25	15	0h 15m	15	1373	0.267	19.500	18.567	0.933	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	1256	0.245	19.500	18.545	0.955	Clogged base model
100	0.1667	10	0h 10m	10	1133	0.222	19.500	18.522	0.978	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Karel to Kwinana
Job Number	60100953
Task	Basin M1
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	33220	0.900	29898	
Verge	19081	0.300	5724	
	0	0.700	0	
Total	52301		35622	

Sump Details		
GWL	24.500	m AHD
Depth to GWL from base	6.900	m
Max Allowable TWL	33.800	m AHD
Sump Base Level	31.400	m AHD
Sump Width at base	2	m
Sump Length at base	60	m
Side Slope	5.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	48	2880	14h 00m	840	2375	2.325	33.800	33.725	0.075	Clogged base model
20	72	4320	16h 00m	960	2373	2.324	33.800	33.724	0.076	Clogged base model
20	30	1800	14h 00m	840	2338	2.308	33.800	33.708	0.092	Clogged base model
20	36	2160	16h 00m	960	2316	2.297	33.800	33.697	0.103	Clogged base model
20	24	1440	11h 00m	660	2299	2.289	33.800	33.689	0.111	Clogged base model
20	18	1080	11h 00m	660	2187	2.234	33.800	33.634	0.166	Clogged base model
20	30	1800	16h 00m	960	2103	2.191	33.800	33.591	0.209	Green & Amp plus Shallow WT models
20	48	2880	16h 00m	960	2084	2.182	33.800	33.582	0.218	Green & Amp plus Shallow WT models
20	72	4320	24h 00m	1440	2066	2.172	33.800	33.572	0.228	Green & Amp plus Shallow WT models
20	36	2160	16h 00m	960	2017	2.146	33.800	33.546	0.254	Green & Amp plus Shallow WT models
20	12	720	8h 00m	480	2015	2.145	33.800	33.545	0.255	Clogged base model
20	9	540	8h 00m	480	1928	2.100	33.800	33.500	0.300	Clogged base model
20	6	360	5h 30m	330	1837	2.050	33.800	33.450	0.350	Clogged base model
20	24	1440	13h 00m	780	1758	2.006	33.800	33.406	0.394	Green & Amp plus Shallow WT models
20	4.5	270	4h 15m	255	1735	1.993	33.800	33.393	0.407	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	18	1080	11h 00m	660	1622	1.927	33.800	33.327	0.473	Green & Amp plus Shallow WT models
20	3	180	3h 00m	180	1583	1.904	33.800	33.304	0.496	Clogged base model
20	2	120	2h 00m	120	1431	1.810	33.800	33.210	0.590	Clogged base model
20	1.5	90	1h 30m	90	1318	1.736	33.800	33.136	0.664	Clogged base model
20	12	720	8h 30m	510	1232	1.678	33.800	33.078	0.722	Green & Amp plus Shallow WT models
20	6	360	5h 30m	330	1228	1.675	33.800	33.075	0.725	Green & Amp plus Shallow WT models
20	9	540	8h 00m	480	1223	1.671	33.800	33.071	0.729	Green & Amp plus Shallow WT models
20	1	60	1h 00m	60	1168	1.632	33.800	33.032	0.768	Clogged base model
20	0.75	45	0h 45m	45	1079	1.567	33.800	32.967	0.833	Clogged base model
20	0.5	30	0h 30m	30	950	1.467	33.800	32.867	0.933	Clogged base model
20	0.4167	25	0h 25m	25	896	1.424	33.800	32.824	0.976	Clogged base model
20	4.5	270	4h 15m	255	891	1.419	33.800	32.819	0.981	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	825	1.363	33.800	32.763	1.037	Clogged base model
20	0.25	15	0h 15m	15	735	1.283	33.800	32.683	1.117	Clogged base model
20	1	60	0h 40m	40	689	1.239	33.800	32.639	1.161	Green & Amp plus Shallow WT models
20	3	180	3h 00m	180	680	1.230	33.800	32.630	1.170	Green & Amp plus Shallow WT models
20	0.75	45	0h 40m	40	667	1.218	33.800	32.618	1.182	Green & Amp plus Shallow WT models
20	1.5	90	0h 35m	35	645	1.197	33.800	32.597	1.203	Green & Amp plus Shallow WT models
20	0.5	30	0h 25m	25	636	1.188	33.800	32.588	1.212	Green & Amp plus Shallow WT models
20	0.4167	25	0h 20m	20	632	1.183	33.800	32.583	1.217	Green & Amp plus Shallow WT models
20	2	120	0h 40m	40	630	1.182	33.800	32.582	1.218	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	615	1.166	33.800	32.566	1.234	Clogged base model
20	0.3333	20	0h 15m	15	613	1.164	33.800	32.564	1.236	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	571	1.120	33.800	32.520	1.280	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	503	1.045	33.800	32.445	1.355	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	2979	2.594	33.800	33.994	-0.194	Clogged base model
100	24	1440	14h 00m	840	2943	2.579	33.800	33.979	-0.179	Clogged base model
100	72	4320	24h 00m	1440	2915	2.567	33.800	33.967	-0.167	Clogged base model
100	36	2160	16h 00m	960	2914	2.566	33.800	33.966	-0.166	Clogged base model
100	30	1800	16h 00m	960	2893	2.557	33.800	33.957	-0.157	Green & Amp plus Shallow WT models
100	48	2880	16h 00m	960	2891	2.556	33.800	33.956	-0.156	Clogged base model
100	72	4320	24h 00m	1440	2853	2.540	33.800	33.940	-0.140	Green & Amp plus Shallow WT models
100	36	2160	28h 00m	1680	2849	2.538	33.800	33.938	-0.138	Green & Amp plus Shallow WT models
100	18	1080	12h 00m	720	2843	2.536	33.800	33.936	-0.136	Clogged base model
100	48	2880	16h 00m	960	2702	2.475	33.800	33.875	-0.075	Green & Amp plus Shallow WT models
100	12	720	10h 30m	630	2638	2.446	33.800	33.846	-0.046	Clogged base model
100	9	540	9h 00m	540	2602	2.430	33.800	33.830	-0.030	Clogged base model
100	24	1440	17h 00m	1020	2574	2.418	33.800	33.818	-0.018	Green & Amp plus Shallow WT models
100	6	360	6h 00m	360	2500	2.384	33.800	33.784	0.016	Clogged base model
100	18	1080	15h 00m	900	2416	2.345	33.800	33.744	0.055	Green & Amp plus Shallow WT models
100	4.5	270	4h 30m	270	2366	2.321	33.800	33.721	0.079	Clogged base model
100	3	180	3h 00m	180	2168	2.224	33.800	33.624	0.176	Clogged base model
100	12	720	11h 30m	690	1964	2.119	33.800	33.519	0.281	Green & Amp plus Shallow WT models
100	2	120	2h 00m	120	1959	2.116	33.800	33.516	0.284	Clogged base model
100	9	540	9h 00m	540	1938	2.105	33.800	33.505	0.295	Green & Amp plus Shallow WT models
100	6	360	6h 00m	360	1866	2.066	33.800	33.466	0.334	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	1811	2.036	33.800	33.436	0.364	Clogged base model
100	1	60	1h 00m	60	1608	1.919	33.800	33.319	0.481	Clogged base model
100	0.75	45	0h 45m	45	1497	1.851	33.800	33.251	0.549	Clogged base model
100	4.5	270	4h 30m	270	1467	1.832	33.800	33.232	0.568	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	1338	1.749	33.800	33.149	0.651	Clogged base model
100	0.4167	25	0h 25m	25	1264	1.700	33.800	33.100	0.700	Clogged base model
100	0.3333	20	0h 20m	20	1179	1.640	33.800	33.040	0.760	Clogged base model
100	3	180	3h 00m	180	1155	1.623	33.800	33.023	0.777	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	1054	1.548	33.800	32.948	0.852	Clogged base model
100	1	60	0h 45m	45	976	1.488	33.800	32.888	0.912	Green & Amp plus Shallow WT models
100	0.75	45	0h 40m	40	966	1.481	33.800	32.881	0.919	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	937	1.457	33.800	32.857	0.943	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	927	1.449	33.800	32.849	0.951	Green & Amp plus Shallow WT models
100	0.3333	20	0h 20m	20	903	1.429	33.800	32.829	0.971	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	893	1.421	33.800	32.821	0.979	Clogged base model
100	2	120	2h 00m	120	886	1.415	33.800	32.815	0.985	Green & Amp plus Shallow WT models
100	1.5	90	1h 05m	65	885	1.414	33.800	32.814	0.986	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	841	1.377	33.800	32.777	1.023	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	749	1.296	33.800	32.696	1.104	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extention - Karel to Kwinana
Job Number	60100953
Task	Basin M2
Designer	JL

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	38920	0.900	35028	
Verge	25934	0.300	7780	
	0	0.700	0	
Total	64854		42808	

Sump Details		
GWL	24.500	m AHD
Depth to GWL from base	1.900	m
Max Allowable TWL	27.600	m AHD
Sump Base Level	26.400	m AHD
Sump Width at base	30	m
Sump Length at base	116	m
Side Slope	3.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

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SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	72	4320	68h 00m	4080	4821	1.199	27.600	27.599	0.001	Green & Amp plus Shallow WT models
20	48	2880	48h 00m	2880	4561	1.141	27.600	27.541	0.059	Green & Amp plus Shallow WT models
20	36	2160	36h 00m	2160	4252	1.073	27.600	27.473	0.127	Green & Amp plus Shallow WT models
20	30	1800	30h 00m	1800	4083	1.035	27.600	27.435	0.165	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	3582	0.920	27.600	27.320	0.280	Green & Amp plus Shallow WT models
20	18	1080	18h 00m	1080	3227	0.837	27.600	27.237	0.363	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	2733	0.719	27.600	27.119	0.481	Clogged base model
20	72	4320	16h 00m	960	2720	0.716	27.600	27.116	0.484	Clogged base model
20	30	1800	14h 00m	840	2685	0.707	27.600	27.107	0.493	Clogged base model
20	24	1440	11h 00m	660	2663	0.702	27.600	27.102	0.498	Clogged base model
20	36	2160	12h 00m	720	2657	0.700	27.600	27.100	0.500	Clogged base model
20	18	1080	11h 00m	660	2526	0.668	27.600	27.068	0.532	Clogged base model
20	12	720	12h 00m	720	2412	0.640	27.600	27.040	0.560	Green & Amp plus Shallow WT models
20	12	720	8h 00m	480	2341	0.623	27.600	27.023	0.577	Clogged base model
20	9	540	9h 00m	540	2333	0.621	27.600	27.021	0.579	Green & Amp plus Shallow WT models

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	9	540	8h 00m	480	2235	0.597	27.600	26.997	0.603	Clogged base model
20	6	360	6h 00m	360	2154	0.576	27.600	26.976	0.624	Green & Amp plus Shallow WT models
20	6	360	5h 30m	330	2144	0.574	27.600	26.974	0.626	Clogged base model
20	4.5	270	4h 15m	255	2034	0.546	27.600	26.946	0.654	Clogged base model
20	3	180	2h 45m	165	1866	0.504	27.600	26.904	0.696	Clogged base model
20	2	120	2h 00m	120	1693	0.459	27.600	26.859	0.741	Clogged base model
20	1.5	90	1h 30m	90	1563	0.426	27.600	26.826	0.774	Clogged base model
20	4.5	270	4h 30m	270	1466	0.401	27.600	26.801	0.799	Green & Amp plus Shallow WT models
20	1	60	1h 00m	60	1389	0.380	27.600	26.780	0.820	Clogged base model
20	0.75	45	0h 45m	45	1285	0.353	27.600	26.753	0.847	Clogged base model
20	0.5	30	0h 30m	30	1134	0.313	27.600	26.713	0.887	Clogged base model
20	0.4167	25	0h 25m	25	1070	0.296	27.600	26.696	0.904	Clogged base model
20	3	180	3h 00m	180	1063	0.295	27.600	26.695	0.905	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	986	0.273	27.600	26.673	0.927	Clogged base model
20	0.25	15	0h 15m	15	879	0.245	27.600	26.645	0.955	Clogged base model
20	2	120	2h 00m	120	763	0.213	27.600	26.613	0.987	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	736	0.206	27.600	26.606	0.994	Clogged base model
20	1.5	90	1h 30m	90	543	0.153	27.600	26.553	1.047	Green & Amp plus Shallow WT models
20	0.4167	25	0h 15m	15	434	0.123	27.600	26.523	1.077	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	428	0.121	27.600	26.521	1.079	Green & Amp plus Shallow WT models
20	1	60	1h 00m	60	404	0.114	27.600	26.514	1.086	Green & Amp plus Shallow WT models
20	0.25	15	0h 10m	10	389	0.110	27.600	26.510	1.090	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	382	0.108	27.600	26.508	1.092	Green & Amp plus Shallow WT models
20	0.5	30	0h 15m	15	379	0.107	27.600	26.507	1.093	Green & Amp plus Shallow WT models
20	0.75	45	0h 20m	20	291	0.083	27.600	26.483	1.117	Green & Amp plus Shallow WT models
100	72	4320	72h 00m	4320	6957	1.643	27.600	28.043	-0.443	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	6478	1.547	27.600	27.947	-0.347	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	5951	1.439	27.600	27.839	-0.239	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	5663	1.379	27.600	27.779	-0.179	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	5003	1.238	27.600	27.638	-0.038	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	4466	1.120	27.600	27.520	0.080	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	3459	0.891	27.600	27.291	0.309	Clogged base model
100	12	720	12h 00m	720	3436	0.886	27.600	27.286	0.314	Green & Amp plus Shallow WT models
100	24	1440	13h 00m	780	3435	0.886	27.600	27.286	0.314	Clogged base model
100	36	2160	16h 00m	960	3379	0.873	27.600	27.273	0.327	Clogged base model
100	72	4320	24h 00m	1440	3356	0.867	27.600	27.267	0.333	Clogged base model
100	48	2880	16h 00m	960	3354	0.867	27.600	27.267	0.333	Clogged base model
100	18	1080	12h 00m	720	3318	0.858	27.600	27.258	0.342	Clogged base model
100	9	540	9h 00m	540	3252	0.843	27.600	27.243	0.357	Green & Amp plus Shallow WT models
100	12	720	9h 00m	540	3086	0.804	27.600	27.204	0.396	Clogged base model
100	9	540	8h 30m	510	3050	0.795	27.600	27.195	0.405	Clogged base model
100	6	360	6h 00m	360	2944	0.769	27.600	27.169	0.431	Green & Amp plus Shallow WT models
100	6	360	6h 00m	360	2943	0.769	27.600	27.169	0.431	Clogged base model
100	4.5	270	4h 30m	270	2795	0.734	27.600	27.134	0.466	Clogged base model
100	3	180	3h 00m	180	2572	0.680	27.600	27.080	0.520	Clogged base model
100	2	120	2h 00m	120	2330	0.620	27.600	27.020	0.580	Clogged base model
100	4.5	270	4h 30m	270	2221	0.593	27.600	26.993	0.607	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	2158	0.577	27.600	26.977	0.623	Clogged base model
100	1	60	1h 00m	60	1918	0.517	27.600	26.917	0.683	Clogged base model
100	0.75	45	0h 45m	45	1788	0.484	27.600	26.884	0.716	Clogged base model
100	3	180	3h 00m	180	1756	0.476	27.600	26.876	0.724	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	1600	0.435	27.600	26.835	0.765	Clogged base model
100	0.4167	25	0h 25m	25	1513	0.413	27.600	26.813	0.787	Clogged base model
100	0.3333	20	0h 20m	20	1411	0.386	27.600	26.786	0.814	Clogged base model
100	2	120	2h 00m	120	1387	0.380	27.600	26.780	0.820	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	1262	0.347	27.600	26.747	0.853	Clogged base model
100	1.5	90	1h 30m	90	1101	0.305	27.600	26.705	0.895	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	1071	0.296	27.600	26.696	0.904	Clogged base model
100	1	60	1h 00m	60	860	0.239	27.600	26.639	0.961	Green & Amp plus Shallow WT models
100	0.3333	20	0h 15m	15	749	0.210	27.600	26.610	0.990	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	710	0.199	27.600	26.599	1.001	Green & Amp plus Shallow WT models
100	0.75	45	0h 45m	45	694	0.195	27.600	26.595	1.005	Green & Amp plus Shallow WT models
100	0.4167	25	0h 15m	15	694	0.195	27.600	26.595	1.005	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	681	0.191	27.600	26.591	1.009	Green & Amp plus Shallow WT models
100	0.5	30	0h 25m	25	633	0.178	27.600	26.578	1.022	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Karel to Kwinana
Job Number	60100953
Task	Basin M3
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	17456	0.900	15710	
Verge	38294	0.300	11488	
	0	0.700	0	
Total	55750		27199	

Sump Details		
GWL	24.500	m AHD
Depth to GWL from base	7.500	m
Max Allowable TWL	33.220	m AHD
Sump Base Level	32.000	m AHD
Sump Width at base	6	m
Sump Length at base	36	m
Side Slope	15.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15

200

0.25

30.0%

0.800

0.600

1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

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SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	48	2880	14h 00m	840	1734	1.215	33.220	33.215	0.005	Clogged base model
20	72	4320	16h 00m	960	1723	1.212	33.220	33.212	0.008	Clogged base model
20	30	1800	14h 00m	840	1709	1.208	33.220	33.208	0.012	Clogged base model
20	36	2160	12h 00m	720	1698	1.204	33.220	33.204	0.016	Clogged base model
20	24	1440	10h 00m	600	1693	1.203	33.220	33.203	0.017	Clogged base model
20	18	1080	11h 00m	660	1608	1.173	33.220	33.173	0.047	Clogged base model
20	12	720	8h 00m	480	1492	1.133	33.220	33.133	0.087	Clogged base model
20	9	540	8h 00m	480	1427	1.110	33.220	33.110	0.110	Clogged base model
20	6	360	5h 30m	330	1374	1.090	33.220	33.090	0.130	Clogged base model
20	30	1800	14h 00m	840	1336	1.075	33.220	33.075	0.145	Green & Amp plus Shallow WT models
20	4.5	270	4h 15m	255	1302	1.062	33.220	33.062	0.158	Clogged base model
20	48	2880	14h 00m	840	1289	1.057	33.220	33.057	0.163	Green & Amp plus Shallow WT models
20	36	2160	16h 00m	960	1240	1.037	33.220	33.037	0.183	Green & Amp plus Shallow WT models
20	72	4320	16h 00m	960	1196	1.020	33.220	33.020	0.200	Green & Amp plus Shallow WT models
20	3	180	2h 45m	165	1194	1.019	33.220	33.019	0.201	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	2	120	2h 00m	120	1083	0.972	33.220	32.972	0.248	Clogged base model
20	1.5	90	1h 30m	90	999	0.934	33.220	32.934	0.286	Clogged base model
20	1	60	1h 00m	60	888	0.882	33.220	32.882	0.338	Clogged base model
20	24	1440	12h 00m	720	878	0.877	33.220	32.877	0.343	Green & Amp plus Shallow WT models
20	0.75	45	0h 45m	45	821	0.847	33.220	32.847	0.373	Clogged base model
20	18	1080	11h 00m	660	798	0.835	33.220	32.835	0.385	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	724	0.796	33.220	32.796	0.424	Clogged base model
20	0.4167	25	0h 25m	25	683	0.772	33.220	32.772	0.448	Clogged base model
20	0.3333	20	0h 20m	20	629	0.739	33.220	32.739	0.481	Clogged base model
20	0.25	15	0h 15m	15	560	0.698	33.220	32.698	0.522	Clogged base model
20	12	720	8h 00m	480	544	0.686	33.220	32.686	0.534	Green & Amp plus Shallow WT models
20	6	360	5h 30m	330	531	0.677	33.220	32.677	0.543	Green & Amp plus Shallow WT models
20	9	540	8h 00m	480	512	0.666	33.220	32.666	0.554	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	469	0.636	33.220	32.636	0.584	Clogged base model
20	0.4167	25	0h 15m	15	429	0.605	33.220	32.605	0.615	Green & Amp plus Shallow WT models
20	1	60	0h 35m	35	423	0.601	33.220	32.601	0.619	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	419	0.598	33.220	32.598	0.622	Green & Amp plus Shallow WT models
20	0.75	45	0h 30m	30	399	0.581	33.220	32.581	0.639	Green & Amp plus Shallow WT models
20	0.5	30	0h 25m	25	398	0.580	33.220	32.580	0.640	Green & Amp plus Shallow WT models
20	3	180	0h 45m	45	389	0.574	33.220	32.574	0.646	Green & Amp plus Shallow WT models
20	1.5	90	0h 35m	35	383	0.570	33.220	32.570	0.650	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	381	0.568	33.220	32.568	0.652	Green & Amp plus Shallow WT models
20	2	120	0h 35m	35	369	0.558	33.220	32.558	0.662	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	347	0.539	33.220	32.539	0.681	Green & Amp plus Shallow WT models
20	4.5	270	1h 15m	75	329	0.523	33.220	32.523	0.697	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	2176	1.348	33.220	33.348	-0.128	Clogged base model
100	24	1440	13h 00m	780	2161	1.344	33.220	33.344	-0.124	Clogged base model
100	36	2160	16h 00m	960	2129	1.335	33.220	33.335	-0.115	Clogged base model
100	48	2880	16h 00m	960	2108	1.329	33.220	33.329	-0.109	Clogged base model
100	18	1080	12h 00m	720	2093	1.325	33.220	33.325	-0.105	Clogged base model
100	72	4320	24h 00m	1440	2086	1.323	33.220	33.323	-0.103	Clogged base model
100	12	720	9h 00m	540	1953	1.284	33.220	33.284	-0.064	Clogged base model
100	9	540	8h 00m	480	1932	1.277	33.220	33.277	-0.057	Clogged base model
100	30	1800	16h 00m	960	1873	1.259	33.220	33.259	-0.039	Green & Amp plus Shallow WT models
100	6	360	6h 00m	360	1872	1.259	33.220	33.259	-0.039	Clogged base model
100	4.5	270	4h 30m	270	1779	1.229	33.220	33.229	-0.009	Clogged base model
100	36	2160	16h 00m	960	1752	1.221	33.220	33.221	-0.001	Green & Amp plus Shallow WT models
100	72	4320	24h 00m	1440	1751	1.221	33.220	33.221	-0.001	Green & Amp plus Shallow WT models
100	48	2880	16h 00m	960	1727	1.213	33.220	33.213	0.007	Green & Amp plus Shallow WT models
100	3	180	3h 00m	180	1638	1.183	33.220	33.183	0.037	Clogged base model
100	2	120	2h 00m	120	1485	1.130	33.220	33.130	0.090	Clogged base model
100	24	1440	16h 00m	960	1425	1.109	33.220	33.109	0.111	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	1375	1.090	33.220	33.090	0.130	Clogged base model
100	18	1080	14h 00m	840	1328	1.072	33.220	33.072	0.148	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	1223	1.030	33.220	33.030	0.190	Clogged base model
100	0.75	45	0h 45m	45	1140	0.997	33.220	32.997	0.223	Clogged base model
100	0.5	30	0h 30m	30	1020	0.943	33.220	32.943	0.277	Clogged base model
100	12	720	11h 30m	690	1019	0.943	33.220	32.943	0.277	Green & Amp plus Shallow WT models
100	9	540	9h 00m	540	984	0.927	33.220	32.927	0.293	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	964	0.918	33.220	32.918	0.302	Clogged base model
100	6	360	6h 00m	360	944	0.909	33.220	32.909	0.311	Green & Amp plus Shallow WT models
100	0.3333	20	0h 20m	20	899	0.887	33.220	32.887	0.333	Clogged base model
100	0.25	15	0h 15m	15	804	0.838	33.220	32.838	0.382	Clogged base model
100	0.1667	10	0h 10m	10	681	0.771	33.220	32.771	0.449	Clogged base model
100	4.5	270	4h 30m	270	633	0.744	33.220	32.744	0.476	Green & Amp plus Shallow WT models
100	0.3333	20	0h 15m	15	602	0.724	33.220	32.724	0.496	Green & Amp plus Shallow WT models
100	1	60	0h 35m	35	596	0.720	33.220	32.720	0.500	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	590	0.716	33.220	32.716	0.504	Green & Amp plus Shallow WT models
100	0.5	30	0h 25m	25	581	0.711	33.220	32.711	0.509	Green & Amp plus Shallow WT models
100	0.75	45	0h 35m	35	580	0.710	33.220	32.710	0.510	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	569	0.703	33.220	32.703	0.517	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	523	0.672	33.220	32.672	0.548	Green & Amp plus Shallow WT models
100	1.5	90	0h 35m	35	487	0.648	33.220	32.648	0.572	Green & Amp plus Shallow WT models
100	3	180	0h 45m	45	474	0.639	33.220	32.639	0.581	Green & Amp plus Shallow WT models
100	2	120	0h 40m	40	451	0.621	33.220	32.621	0.599	Green & Amp plus Shallow WT models

Project Details

Project	Roe Highway Extension - Murdoch Drive Extension
Job Number	60100953
Task	Basin N
Designer	LBC

Location

Perth

Catchment Area Details

Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	15417	0.900	13875	
Verge	9531	0.300	2859	
	0	0.700	0	
Total	24948		16735	

Sump Details

GWL	17.650	m AHD
Depth to GWL from base	0.350	m
Max Allowable TWL	19.200	m AHD
Sump Base Level	18.000	m AHD
Sump Width at base	12.5	m
Sump Length at base	105	m
Side Slope	3.0	1 in --

Permeability

Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmp	0.600	
Reduction Factor - Clogged	1.000	

0.15

200

0.25

30.0%

0.800

0.600

1.000

Outlet Pipe Details (free outfall)

Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall

Entrance Type 2 - Socket (Grove) end with headwall

Entrance Type 3 - Socket (Grove) end projecting

Weir Details

Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	72	4320	68h 00m	4080	1533	0.928	19.200	18.928	0.272	Green & Amp plus Shallow WT models
5	48	2880	48h 00m	2880	1447	0.885	19.200	18.885	0.315	Green & Amp plus Shallow WT models
5	36	2160	36h 00m	2160	1354	0.837	19.200	18.837	0.363	Green & Amp plus Shallow WT models
5	30	1800	30h 00m	1800	1288	0.803	19.200	18.803	0.397	Green & Amp plus Shallow WT models
5	24	1440	24h 00m	1440	1190	0.751	19.200	18.751	0.449	Green & Amp plus Shallow WT models
5	18	1080	18h 00m	1080	1081	0.692	19.200	18.692	0.508	Green & Amp plus Shallow WT models
5	12	720	12h 00m	720	925	0.605	19.200	18.605	0.595	Green & Amp plus Shallow WT models
5	9	540	9h 00m	540	845	0.558	19.200	18.558	0.642	Green & Amp plus Shallow WT models
5	24	1440	10h 00m	600	780	0.520	19.200	18.520	0.680	Clogged base model
5	48	2880	14h 00m	840	778	0.519	19.200	18.519	0.681	Clogged base model
5	30	1800	14h 00m	840	773	0.516	19.200	18.516	0.684	Clogged base model
5	36	2160	12h 00m	720	765	0.511	19.200	18.511	0.689	Clogged base model
5	72	4320	16h 00m	960	760	0.508	19.200	18.508	0.692	Clogged base model
5	6	360	6h 00m	360	753	0.504	19.200	18.504	0.696	Green & Amp plus Shallow WT models
5	18	1080	11h 00m	660	739	0.496	19.200	18.496	0.704	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	12	720	8h 00m	480	697	0.470	19.200	18.470	0.730	Clogged base model
5	4.5	270	4h 30m	270	677	0.458	19.200	18.458	0.742	Green & Amp plus Shallow WT models
5	9	540	6h 30m	390	664	0.450	19.200	18.450	0.750	Clogged base model
5	6	360	5h 00m	300	638	0.434	19.200	18.434	0.766	Clogged base model
5	4.5	270	4h 15m	255	602	0.412	19.200	18.412	0.788	Clogged base model
5	3	180	3h 00m	180	576	0.396	19.200	18.396	0.804	Green & Amp plus Shallow WT models
5	3	180	2h 45m	165	551	0.380	19.200	18.380	0.820	Clogged base model
5	2	120	2h 00m	120	510	0.354	19.200	18.354	0.846	Green & Amp plus Shallow WT models
5	2	120	2h 00m	120	501	0.348	19.200	18.348	0.852	Clogged base model
5	1.5	90	1h 30m	90	460	0.322	19.200	18.322	0.878	Clogged base model
5	1.5	90	1h 30m	90	438	0.308	19.200	18.308	0.892	Green & Amp plus Shallow WT models
5	1	60	1h 00m	60	408	0.288	19.200	18.288	0.912	Clogged base model
5	1	60	1h 00m	60	395	0.280	19.200	18.280	0.920	Green & Amp plus Shallow WT models
5	0.75	45	0h 45m	45	376	0.267	19.200	18.267	0.933	Clogged base model
5	0.75	45	0h 45m	45	346	0.247	19.200	18.247	0.953	Green & Amp plus Shallow WT models
5	0.5	30	0h 30m	30	328	0.234	19.200	18.234	0.966	Clogged base model
5	0.4167	25	0h 25m	25	307	0.220	19.200	18.220	0.980	Clogged base model
5	0.3333	20	0h 20m	20	280	0.202	19.200	18.202	0.998	Clogged base model
5	0.5	30	0h 30m	30	259	0.188	19.200	18.188	1.012	Green & Amp plus Shallow WT models
5	0.25	15	0h 15m	15	252	0.183	19.200	18.183	1.017	Clogged base model
5	0.4167	25	0h 25m	25	237	0.172	19.200	18.172	1.028	Green & Amp plus Shallow WT models
5	0.3333	20	0h 20m	20	207	0.151	19.200	18.151	1.049	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	207	0.151	19.200	18.151	1.049	Clogged base model
5	0.25	15	0h 15m	15	177	0.130	19.200	18.130	1.070	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	132	0.098	19.200	18.098	1.102	Green & Amp plus Shallow WT models
20	72	4320	72h 00m	4320	2061	1.181	19.200	19.181	0.019	Green & Amp plus Shallow WT models
20	48	2880	48h 00m	2880	1920	1.115	19.200	19.115	0.085	Green & Amp plus Shallow WT models
20	36	2160	36h 00m	2160	1785	1.052	19.200	19.052	0.148	Green & Amp plus Shallow WT models
20	30	1800	30h 00m	1800	1689	1.006	19.200	19.006	0.194	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	1548	0.936	19.200	18.936	0.264	Green & Amp plus Shallow WT models
20	18	1080	18h 00m	1080	1401	0.861	19.200	18.861	0.339	Green & Amp plus Shallow WT models
20	12	720	12h 00m	720	1187	0.749	19.200	18.749	0.451	Green & Amp plus Shallow WT models
20	9	540	9h 00m	540	1088	0.696	19.200	18.696	0.504	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	1056	0.678	19.200	18.678	0.522	Clogged base model
20	72	4320	16h 00m	960	1050	0.674	19.200	18.674	0.526	Clogged base model
20	30	1800	14h 00m	840	1038	0.668	19.200	18.668	0.532	Clogged base model
20	24	1440	10h 00m	600	1032	0.664	19.200	18.664	0.536	Clogged base model
20	36	2160	12h 00m	720	1030	0.663	19.200	18.663	0.537	Clogged base model
20	18	1080	11h 00m	660	978	0.634	19.200	18.634	0.566	Clogged base model
20	6	360	6h 00m	360	973	0.631	19.200	18.631	0.569	Green & Amp plus Shallow WT models
20	12	720	8h 00m	480	909	0.595	19.200	18.595	0.605	Clogged base model
20	4.5	270	4h 30m	270	881	0.579	19.200	18.579	0.621	Green & Amp plus Shallow WT models
20	9	540	8h 00m	480	868	0.571	19.200	18.571	0.629	Clogged base model
20	6	360	5h 30m	330	835	0.552	19.200	18.552	0.648	Clogged base model
20	4.5	270	4h 15m	255	793	0.527	19.200	18.527	0.673	Clogged base model
20	3	180	3h 00m	180	754	0.505	19.200	18.505	0.695	Green & Amp plus Shallow WT models
20	3	180	2h 45m	165	728	0.489	19.200	18.489	0.711	Clogged base model
20	2	120	2h 00m	120	675	0.457	19.200	18.457	0.743	Green & Amp plus Shallow WT models
20	2	120	2h 00m	120	661	0.448	19.200	18.448	0.752	Clogged base model
20	1.5	90	1h 30m	90	610	0.417	19.200	18.417	0.783	Clogged base model
20	1.5	90	1h 30m	90	584	0.401	19.200	18.401	0.799	Green & Amp plus Shallow WT models
20	1	60	1h 00m	60	543	0.375	19.200	18.375	0.825	Clogged base model
20	1	60	1h 00m	60	523	0.362	19.200	18.362	0.838	Green & Amp plus Shallow WT models
20	0.75	45	0h 45m	45	502	0.349	19.200	18.349	0.851	Clogged base model
20	0.75	45	0h 45m	45	468	0.327	19.200	18.327	0.873	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	443	0.311	19.200	18.311	0.889	Clogged base model
20	0.4167	25	0h 25m	25	418	0.295	19.200	18.295	0.905	Clogged base model
20	0.3333	20	0h 20m	20	385	0.273	19.200	18.273	0.927	Clogged base model
20	0.5	30	0h 30m	30	375	0.266	19.200	18.266	0.934	Green & Amp plus Shallow WT models
20	0.4167	25	0h 25m	25	349	0.249	19.200	18.249	0.951	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	344	0.245	19.200	18.245	0.955	Clogged base model
20	0.3333	20	0h 20m	20	314	0.225	19.200	18.225	0.975	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	288	0.207	19.200	18.207	0.993	Clogged base model
20	0.25	15	0h 15m	15	271	0.196	19.200	18.196	1.004	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	213	0.155	19.200	18.155	1.045	Green & Amp plus Shallow WT models
100	72	4320	72h 00m	4320	2893	1.536	19.200	19.536	-0.336	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	2668	1.444	19.200	19.444	-0.244	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	2453	1.353	19.200	19.353	-0.153	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	2312	1.293	19.200	19.293	-0.093	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	2114	1.205	19.200	19.205	-0.005	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	1899	1.106	19.200	19.106	0.094	Green & Amp plus Shallow WT models
100	12	720	12h 00m	720	1601	0.962	19.200	18.962	0.238	Green & Amp plus Shallow WT models
100	9	540	9h 00m	540	1471	0.898	19.200	18.898	0.302	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	1335	0.828	19.200	18.828	0.372	Clogged base model
100	24	1440	13h 00m	780	1328	0.824	19.200	18.824	0.376	Clogged base model
100	6	360	6h 00m	360	1315	0.817	19.200	18.817	0.383	Green & Amp plus Shallow WT models
100	36	2160	16h 00m	960	1305	0.812	19.200	18.812	0.388	Clogged base model
100	48	2880	16h 00m	960	1294	0.806	19.200	18.806	0.394	Clogged base model
100	72	4320	24h 00m	1440	1287	0.802	19.200	18.802	0.398	Clogged base model
100	18	1080	12h 00m	720	1284	0.801	19.200	18.801	0.399	Clogged base model
100	12	720	9h 00m	540	1197	0.754	19.200	18.754	0.446	Clogged base model
100	4.5	270	4h 30m	270	1194	0.753	19.200	18.753	0.447	Green & Amp plus Shallow WT models
100	9	540	8h 30m	510	1183	0.747	19.200	18.747	0.453	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
100	6	360	6h 00m	360	1145	0.727	19.200	18.727	0.473	Clogged base model
100	4.5	270	4h 30m	270	1089	0.696	19.200	18.696	0.504	Clogged base model
100	3	180	3h 00m	180	1032	0.664	19.200	18.664	0.536	Green & Amp plus Shallow WT models
100	3	180	3h 00m	180	1003	0.648	19.200	18.648	0.552	Clogged base model
100	2	120	2h 00m	120	920	0.602	19.200	18.602	0.598	Green & Amp plus Shallow WT models
100	2	120	2h 00m	120	910	0.596	19.200	18.596	0.604	Clogged base model
100	1.5	90	1h 30m	90	843	0.556	19.200	18.556	0.644	Clogged base model
100	1.5	90	1h 30m	90	807	0.536	19.200	18.536	0.664	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	749	0.502	19.200	18.502	0.698	Clogged base model
100	1	60	1h 00m	60	716	0.482	19.200	18.482	0.718	Green & Amp plus Shallow WT models
100	0.75	45	0h 45m	45	699	0.471	19.200	18.471	0.729	Clogged base model
100	0.75	45	0h 45m	45	654	0.444	19.200	18.444	0.756	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	625	0.426	19.200	18.426	0.774	Clogged base model
100	0.4167	25	0h 25m	25	591	0.406	19.200	18.406	0.794	Clogged base model
100	0.5	30	0h 30m	30	554	0.382	19.200	18.382	0.818	Green & Amp plus Shallow WT models
100	0.3333	20	0h 20m	20	552	0.380	19.200	18.380	0.820	Clogged base model
100	0.4167	25	0h 25m	25	517	0.358	19.200	18.358	0.842	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	493	0.343	19.200	18.343	0.857	Clogged base model
100	0.3333	20	0h 20m	20	481	0.335	19.200	18.335	0.865	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	421	0.297	19.200	18.297	0.903	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	419	0.295	19.200	18.295	0.905	Clogged base model
100	0.1667	10	0h 10m	10	337	0.240	19.200	18.240	0.960	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Murdoch Drive Extension
Job Number	60100953
Task	Basin O
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	6115	0.900	5504	
Verge	5184	0.300	1555	
	0	0.700	0	
Total	11299		7059	

Sump Details		
GWL	17.400	m AHD
Depth to GWL from base	1.100	m
Max Allowable TWL	19.200	m AHD
Sump Base Level	18.500	m AHD
Sump Width at base	6.5	m
Sump Length at base	87	m
Side Slope	3.0	1 in --

Permeability		
Soil Permeability, K	20.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	72	4320	32h 00m	1920	490	0.650	19.200	19.150	0.050	Green & Amp plus Shallow WT models
5	48	2880	32h 00m	1920	448	0.606	19.200	19.106	0.094	Green & Amp plus Shallow WT models
5	36	2160	28h 00m	1680	446	0.604	19.200	19.104	0.096	Green & Amp plus Shallow WT models
5	30	1800	28h 00m	1680	434	0.590	19.200	19.090	0.110	Green & Amp plus Shallow WT models
5	24	1440	17h 00m	1020	412	0.565	19.200	19.065	0.135	Green & Amp plus Shallow WT models
5	18	1080	15h 00m	900	382	0.531	19.200	19.031	0.169	Green & Amp plus Shallow WT models
5	24	1440	10h 00m	600	323	0.462	19.200	18.962	0.238	Clogged base model
5	12	720	11h 30m	690	322	0.461	19.200	18.961	0.239	Green & Amp plus Shallow WT models
5	48	2880	14h 00m	840	320	0.459	19.200	18.959	0.241	Clogged base model
5	30	1800	14h 00m	840	319	0.457	19.200	18.957	0.243	Clogged base model
5	36	2160	12h 00m	720	317	0.454	19.200	18.954	0.246	Clogged base model
5	72	4320	12h 00m	720	314	0.451	19.200	18.951	0.249	Clogged base model
5	18	1080	11h 00m	660	306	0.441	19.200	18.941	0.259	Clogged base model
5	9	540	9h 00m	540	299	0.433	19.200	18.933	0.267	Green & Amp plus Shallow WT models
5	12	720	8h 00m	480	289	0.421	19.200	18.921	0.279	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	6	360	6h 00m	360	284	0.415	19.200	18.915	0.285	Green & Amp plus Shallow WT models
5	9	540	6h 30m	390	276	0.406	19.200	18.906	0.294	Clogged base model
5	6	360	5h 00m	300	267	0.393	19.200	18.893	0.307	Clogged base model
5	4.5	270	4h 15m	255	252	0.374	19.200	18.874	0.326	Clogged base model
5	4.5	270	4h 30m	270	231	0.347	19.200	18.847	0.353	Green & Amp plus Shallow WT models
5	3	180	2h 45m	165	231	0.347	19.200	18.847	0.353	Clogged base model
5	2	120	1h 55m	115	211	0.320	19.200	18.820	0.380	Clogged base model
5	1.5	90	1h 30m	90	194	0.298	19.200	18.798	0.402	Clogged base model
5	3	180	3h 00m	180	184	0.285	19.200	18.785	0.415	Green & Amp plus Shallow WT models
5	1	60	1h 00m	60	172	0.267	19.200	18.767	0.433	Clogged base model
5	0.75	45	0h 45m	45	158	0.248	19.200	18.748	0.452	Clogged base model
5	0.5	30	0h 30m	30	138	0.219	19.200	18.719	0.481	Clogged base model
5	2	120	2h 00m	120	136	0.216	19.200	18.716	0.484	Green & Amp plus Shallow WT models
5	0.4167	25	0h 25m	25	129	0.207	19.200	18.707	0.493	Clogged base model
5	0.3333	20	0h 20m	20	118	0.190	19.200	18.690	0.510	Clogged base model
5	1.5	90	1h 30m	90	106	0.173	19.200	18.673	0.527	Green & Amp plus Shallow WT models
5	0.25	15	0h 15m	15	106	0.173	19.200	18.673	0.527	Clogged base model
5	1	60	1h 00m	60	97	0.160	19.200	18.660	0.540	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	87	0.144	19.200	18.644	0.556	Clogged base model
5	0.75	45	0h 45m	45	69	0.115	19.200	18.615	0.585	Green & Amp plus Shallow WT models
5	0.4167	25	0h 15m	15	37	0.064	19.200	18.564	0.636	Green & Amp plus Shallow WT models
5	0.25	15	0h 10m	10	36	0.061	19.200	18.561	0.639	Green & Amp plus Shallow WT models
5	0.3333	20	0h 15m	15	35	0.060	19.200	18.560	0.640	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	33	0.056	19.200	18.556	0.644	Green & Amp plus Shallow WT models
5	0.5	30	0h 30m	30	32	0.055	19.200	18.555	0.645	Green & Amp plus Shallow WT models
20	72	4320	32h 00m	1920	684	0.843	19.200	19.343	-0.143	Green & Amp plus Shallow WT models
20	48	2880	40h 00m	2400	626	0.788	19.200	19.288	-0.088	Green & Amp plus Shallow WT models
20	36	2160	28h 00m	1680	610	0.772	19.200	19.272	-0.072	Green & Amp plus Shallow WT models
20	30	1800	28h 00m	1680	590	0.752	19.200	19.252	-0.052	Green & Amp plus Shallow WT models
20	24	1440	17h 00m	1020	548	0.710	19.200	19.210	-0.010	Green & Amp plus Shallow WT models
20	18	1080	15h 00m	900	506	0.667	19.200	19.167	0.033	Green & Amp plus Shallow WT models
20	48	2880	14h 00m	840	436	0.592	19.200	19.092	0.108	Clogged base model
20	72	4320	16h 00m	960	432	0.587	19.200	19.087	0.113	Clogged base model
20	30	1800	14h 00m	840	429	0.584	19.200	19.084	0.116	Clogged base model
20	24	1440	10h 00m	600	428	0.583	19.200	19.083	0.117	Clogged base model
20	36	2160	12h 00m	720	427	0.582	19.200	19.082	0.118	Clogged base model
20	12	720	12h 00m	720	421	0.575	19.200	19.075	0.125	Green & Amp plus Shallow WT models
20	18	1080	11h 00m	660	405	0.557	19.200	19.057	0.143	Clogged base model
20	9	540	9h 00m	540	392	0.542	19.200	19.042	0.158	Green & Amp plus Shallow WT models
20	12	720	8h 00m	480	378	0.526	19.200	19.026	0.174	Clogged base model
20	6	360	6h 00m	360	371	0.519	19.200	19.019	0.181	Green & Amp plus Shallow WT models
20	9	540	6h 30m	390	362	0.508	19.200	19.008	0.192	Clogged base model
20	6	360	5h 00m	300	349	0.493	19.200	18.993	0.207	Clogged base model
20	4.5	270	4h 15m	255	332	0.472	19.200	18.972	0.228	Clogged base model
20	4.5	270	4h 30m	270	311	0.448	19.200	18.948	0.252	Green & Amp plus Shallow WT models
20	3	180	2h 45m	165	305	0.441	19.200	18.941	0.259	Clogged base model
20	2	120	2h 00m	120	278	0.407	19.200	18.907	0.293	Clogged base model
20	1.5	90	1h 30m	90	257	0.380	19.200	18.880	0.320	Clogged base model
20	3	180	3h 00m	180	253	0.375	19.200	18.875	0.325	Green & Amp plus Shallow WT models
20	1	60	1h 00m	60	228	0.343	19.200	18.843	0.357	Clogged base model
20	0.75	45	0h 45m	45	211	0.321	19.200	18.821	0.379	Clogged base model
20	2	120	2h 00m	120	203	0.310	19.200	18.810	0.390	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	187	0.288	19.200	18.788	0.412	Clogged base model
20	0.4167	25	0h 25m	25	176	0.273	19.200	18.773	0.427	Clogged base model
20	1.5	90	1h 30m	90	166	0.258	19.200	18.758	0.442	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	162	0.254	19.200	18.754	0.446	Clogged base model
20	1	60	1h 00m	60	147	0.231	19.200	18.731	0.469	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	145	0.229	19.200	18.729	0.471	Clogged base model
20	0.1667	10	0h 10m	10	121	0.195	19.200	18.695	0.505	Clogged base model
20	0.75	45	0h 45m	45	117	0.189	19.200	18.689	0.511	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	76	0.127	19.200	18.627	0.573	Green & Amp plus Shallow WT models
20	0.4167	25	0h 15m	15	70	0.117	19.200	18.617	0.583	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	69	0.115	19.200	18.615	0.585	Green & Amp plus Shallow WT models
20	0.25	15	0h 10m	10	63	0.106	19.200	18.606	0.594	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	61	0.103	19.200	18.603	0.597	Green & Amp plus Shallow WT models
100	72	4320	44h 00m	2640	911	1.044	19.200	19.544	-0.344	Green & Amp plus Shallow WT models
100	48	2880	48h 00m	2880	894	1.030	19.200	19.530	-0.330	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	859	1.001	19.200	19.501	-0.301	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	832	0.977	19.200	19.477	-0.277	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	765	0.918	19.200	19.418	-0.218	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	703	0.860	19.200	19.360	-0.160	Green & Amp plus Shallow WT models
100	12	720	12h 00m	720	589	0.751	19.200	19.251	-0.051	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	551	0.713	19.200	19.213	-0.013	Clogged base model
100	24	1440	13h 00m	780	549	0.712	19.200	19.212	-0.012	Clogged base model
100	9	540	9h 00m	540	546	0.708	19.200	19.208	-0.008	Green & Amp plus Shallow WT models
100	36	2160	16h 00m	960	538	0.701	19.200	19.201	-0.001	Clogged base model
100	48	2880	16h 00m	960	533	0.696	19.200	19.196	0.004	Clogged base model
100	18	1080	12h 00m	720	532	0.694	19.200	19.194	0.006	Clogged base model
100	72	4320	16h 00m	960	525	0.687	19.200	19.187	0.013	Clogged base model
100	6	360	6h 00m	360	507	0.668	19.200	19.168	0.032	Green & Amp plus Shallow WT models
100	12	720	9h 00m	540	498	0.658	19.200	19.158	0.042	Clogged base model
100	9	540	8h 00m	480	493	0.653	19.200	19.153	0.047	Clogged base model
100	6	360	6h 00m	360	478	0.638	19.200	19.138	0.062	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
100	4.5	270	4h 30m	270	456	0.614	19.200	19.114	0.086	Clogged base model
100	4.5	270	4h 30m	270	438	0.595	19.200	19.095	0.105	Green & Amp plus Shallow WT models
100	3	180	3h 00m	180	421	0.575	19.200	19.075	0.125	Clogged base model
100	2	120	2h 00m	120	382	0.532	19.200	19.032	0.168	Clogged base model
100	3	180	3h 00m	180	363	0.510	19.200	19.010	0.190	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	354	0.500	19.200	19.000	0.200	Clogged base model
100	1	60	1h 00m	60	316	0.453	19.200	18.953	0.247	Clogged base model
100	2	120	2h 00m	120	304	0.439	19.200	18.939	0.261	Green & Amp plus Shallow WT models
100	0.75	45	0h 45m	45	294	0.427	19.200	18.927	0.273	Clogged base model
100	0.5	30	0h 30m	30	264	0.389	19.200	18.889	0.311	Clogged base model
100	1.5	90	1h 30m	90	257	0.381	19.200	18.881	0.319	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	249	0.371	19.200	18.871	0.329	Clogged base model
100	0.3333	20	0h 20m	20	233	0.349	19.200	18.849	0.351	Clogged base model
100	1	60	1h 00m	60	223	0.336	19.200	18.836	0.364	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	208	0.317	19.200	18.817	0.383	Clogged base model
100	0.75	45	0h 45m	45	195	0.300	19.200	18.800	0.400	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	176	0.274	19.200	18.774	0.426	Clogged base model
100	0.5	30	0h 30m	30	149	0.234	19.200	18.734	0.466	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	135	0.214	19.200	18.714	0.486	Green & Amp plus Shallow WT models
100	0.3333	20	0h 15m	15	119	0.192	19.200	18.692	0.508	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	112	0.181	19.200	18.681	0.519	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	109	0.177	19.200	18.677	0.523	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Stock Road Interchange
Job Number	60100953
Task	Basin P
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	43154	0.900	38839	
Verge	42750	0.300	12825	
	0	0.700	0	
Total	85904		51664	

Sump Details		
GWL	3.500	m AHD
Depth to GWL from base	33.500	m
Max Allowable TWL	38.200	m AHD
Sump Base Level	37.000	m AHD
Sump Width at base	30	m
Sump Length at base	82	m
Side Slope	3.0	1 in --

Permeability		
Soil Permeability, K	30.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15

200

0.25

30.0%

0.800

0.600

1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	48	2880	14h 00m	840	3415	1.187	38.200	38.187	0.013	Clogged base model
20	72	4320	16h 00m	960	3413	1.187	38.200	38.187	0.013	Clogged base model
20	30	1800	14h 00m	840	3358	1.170	38.200	38.170	0.030	Clogged base model
20	36	2160	16h 00m	960	3326	1.160	38.200	38.160	0.040	Clogged base model
20	24	1440	11h 00m	660	3310	1.155	38.200	38.155	0.045	Clogged base model
20	18	1080	11h 00m	660	3145	1.105	38.200	38.105	0.095	Clogged base model
20	12	720	8h 00m	480	2899	1.028	38.200	38.028	0.172	Clogged base model
20	9	540	8h 00m	480	2772	0.988	38.200	37.988	0.212	Clogged base model
20	6	360	5h 30m	330	2640	0.946	38.200	37.946	0.254	Clogged base model
20	4.5	270	4h 15m	255	2497	0.901	38.200	37.901	0.299	Clogged base model
20	3	180	3h 00m	180	2282	0.830	38.200	37.830	0.370	Clogged base model
20	2	120	2h 00m	120	2064	0.758	38.200	37.758	0.442	Clogged base model
20	1.5	90	1h 30m	90	1902	0.704	38.200	37.704	0.496	Clogged base model
20	1	60	1h 00m	60	1687	0.630	38.200	37.630	0.570	Clogged base model
20	0.75	45	0h 45m	45	1558	0.586	38.200	37.586	0.614	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	0.5	30	0h 30m	30	1374	0.520	38.200	37.520	0.680	Clogged base model
20	0.4167	25	0h 25m	25	1296	0.493	38.200	37.493	0.707	Clogged base model
20	0.3333	20	0h 20m	20	1193	0.456	38.200	37.456	0.744	Clogged base model
20	0.25	15	0h 15m	15	1063	0.409	38.200	37.409	0.791	Clogged base model
20	0.1667	10	0h 10m	10	890	0.345	38.200	37.345	0.855	Clogged base model
20	0.4167	25	0h 15m	15	576	0.227	38.200	37.227	0.973	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	567	0.223	38.200	37.223	0.977	Green & Amp plus Shallow WT models
20	0.5	30	0h 15m	15	509	0.201	38.200	37.201	0.999	Green & Amp plus Shallow WT models
20	0.25	15	0h 10m	10	505	0.200	38.200	37.200	1.000	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	496	0.196	38.200	37.196	1.004	Green & Amp plus Shallow WT models
20	1	60	0h 30m	30	410	0.163	38.200	37.163	1.037	Green & Amp plus Shallow WT models
20	0.75	45	0h 20m	20	406	0.161	38.200	37.161	1.039	Green & Amp plus Shallow WT models
20	1.5	90	0h 20m	20	350	0.139	38.200	37.139	1.061	Green & Amp plus Shallow WT models
20	2	120	0h 20m	20	307	0.122	38.200	37.122	1.078	Green & Amp plus Shallow WT models
20	3	180	0h 30m	30	245	0.098	38.200	37.098	1.102	Green & Amp plus Shallow WT models
20	4.5	270	0h 30m	30	167	0.067	38.200	37.067	1.133	Green & Amp plus Shallow WT models
20	12	720	1h 00m	60	106	0.043	38.200	37.043	1.157	Green & Amp plus Shallow WT models
20	9	540	1h 30m	90	99	0.040	38.200	37.040	1.160	Green & Amp plus Shallow WT models
20	6	360	2h 00m	120	20	0.008	38.200	37.008	1.192	Green & Amp plus Shallow WT models
20	72	4320	7h 30m	450	0	0.000	38.200	37.000	1.200	Green & Amp plus Shallow WT models
20	48	2880	5h 00m	300	0	0.000	38.200	37.000	1.200	Green & Amp plus Shallow WT models
20	36	2160	5h 00m	300	0	0.000	38.200	37.000	1.200	Green & Amp plus Shallow WT models
20	30	1800	5h 00m	300	0	0.000	38.200	37.000	1.200	Green & Amp plus Shallow WT models
20	24	1440	2h 30m	150	0	0.000	38.200	37.000	1.200	Green & Amp plus Shallow WT models
20	18	1080	2h 30m	150	0	0.000	38.200	37.000	1.200	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	4303	1.448	38.200	38.448	-0.248	Clogged base model
100	24	1440	14h 00m	840	4257	1.435	38.200	38.435	-0.235	Clogged base model
100	72	4320	24h 00m	1440	4220	1.424	38.200	38.424	-0.224	Clogged base model
100	36	2160	16h 00m	960	4206	1.420	38.200	38.420	-0.220	Clogged base model
100	48	2880	16h 00m	960	4176	1.412	38.200	38.412	-0.212	Clogged base model
100	18	1080	12h 00m	720	4107	1.392	38.200	38.392	-0.192	Clogged base model
100	12	720	10h 30m	630	3811	1.306	38.200	38.306	-0.106	Clogged base model
100	9	540	9h 00m	540	3759	1.290	38.200	38.290	-0.090	Clogged base model
100	6	360	6h 00m	360	3609	1.245	38.200	38.245	-0.045	Clogged base model
100	4.5	270	4h 30m	270	3417	1.188	38.200	38.188	0.012	Clogged base model
100	3	180	3h 00m	180	3134	1.102	38.200	38.102	0.098	Clogged base model
100	2	120	2h 00m	120	2833	1.008	38.200	38.008	0.192	Clogged base model
100	1.5	90	1h 30m	90	2620	0.940	38.200	37.940	0.260	Clogged base model
100	1	60	1h 00m	60	2325	0.844	38.200	37.844	0.356	Clogged base model
100	0.75	45	0h 45m	45	2166	0.792	38.200	37.792	0.408	Clogged base model
100	0.5	30	0h 30m	30	1937	0.715	38.200	37.715	0.485	Clogged base model
100	0.4167	25	0h 25m	25	1831	0.679	38.200	37.679	0.521	Clogged base model
100	0.3333	20	0h 20m	20	1707	0.637	38.200	37.637	0.563	Clogged base model
100	0.25	15	0h 15m	15	1526	0.574	38.200	37.574	0.626	Clogged base model
100	0.1667	10	0h 10m	10	1294	0.492	38.200	37.492	0.708	Clogged base model
100	0.3333	20	0h 15m	15	953	0.368	38.200	37.368	0.832	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	905	0.351	38.200	37.351	0.849	Green & Amp plus Shallow WT models
100	0.4167	25	0h 15m	15	888	0.344	38.200	37.344	0.856	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	856	0.333	38.200	37.333	0.867	Green & Amp plus Shallow WT models
100	0.5	30	0h 25m	25	841	0.327	38.200	37.327	0.873	Green & Amp plus Shallow WT models
100	0.75	45	0h 30m	30	773	0.302	38.200	37.302	0.898	Green & Amp plus Shallow WT models
100	1	60	0h 35m	35	758	0.296	38.200	37.296	0.904	Green & Amp plus Shallow WT models
100	1.5	90	0h 35m	35	515	0.204	38.200	37.204	0.996	Green & Amp plus Shallow WT models
100	2	120	0h 35m	35	452	0.179	38.200	37.179	1.021	Green & Amp plus Shallow WT models
100	3	180	0h 45m	45	373	0.148	38.200	37.148	1.052	Green & Amp plus Shallow WT models
100	4.5	270	0h 30m	30	221	0.088	38.200	37.088	1.112	Green & Amp plus Shallow WT models
100	9	540	1h 30m	90	181	0.072	38.200	37.072	1.128	Green & Amp plus Shallow WT models
100	12	720	1h 00m	60	172	0.069	38.200	37.069	1.131	Green & Amp plus Shallow WT models
100	6	360	2h 00m	120	122	0.049	38.200	37.049	1.151	Green & Amp plus Shallow WT models
100	72	4320	7h 30m	450	0	0.000	38.200	37.000	1.200	Green & Amp plus Shallow WT models
100	48	2880	5h 00m	300	0	0.000	38.200	37.000	1.200	Green & Amp plus Shallow WT models
100	36	2160	5h 00m	300	0	0.000	38.200	37.000	1.200	Green & Amp plus Shallow WT models
100	30	1800	5h 00m	300	0	0.000	38.200	37.000	1.200	Green & Amp plus Shallow WT models
100	24	1440	2h 30m	150	0	0.000	38.200	37.000	1.200	Green & Amp plus Shallow WT models
100	18	1080	2h 30m	150	0	0.000	38.200	37.000	1.200	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Stock Road Interchange
Job Number	60100953
Task	Basin Q
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	2281	0.900	2053	
Verge	7634	0.300	2290	
	0	0.700	0	
Total	9915		4343	

Sump Details		
GWL	3.500	m AHD
Depth to GWL from base	44.300	m
Max Allowable TWL	48.400	m AHD
Sump Base Level	47.800	m AHD
Sump Width at base	3.6	m
Sump Length at base	32	m
Side Slope	13.0	1 in --

Permeability		
Soil Permeability, K	30.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

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SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	48	2880	12h 00m	720	254	0.565	48.400	48.365	0.035	Clogged base model
20	72	4320	12h 00m	720	253	0.565	48.400	48.365	0.035	Clogged base model
20	24	1440	10h 00m	600	253	0.564	48.400	48.364	0.036	Clogged base model
20	36	2160	12h 00m	720	252	0.563	48.400	48.363	0.037	Clogged base model
20	30	1800	10h 00m	600	251	0.562	48.400	48.362	0.038	Clogged base model
20	18	1080	11h 00m	660	238	0.546	48.400	48.346	0.054	Clogged base model
20	12	720	8h 00m	480	224	0.529	48.400	48.329	0.071	Clogged base model
20	9	540	6h 30m	390	217	0.520	48.400	48.320	0.080	Clogged base model
20	6	360	5h 00m	300	211	0.512	48.400	48.312	0.088	Clogged base model
20	4.5	270	4h 15m	255	201	0.499	48.400	48.299	0.101	Clogged base model
20	3	180	2h 45m	165	186	0.479	48.400	48.279	0.121	Clogged base model
20	2	120	1h 55m	115	170	0.456	48.400	48.256	0.144	Clogged base model
20	1.5	90	1h 30m	90	157	0.436	48.400	48.236	0.164	Clogged base model
20	1	60	1h 00m	60	140	0.409	48.400	48.209	0.191	Clogged base model
20	0.75	45	0h 45m	45	130	0.392	48.400	48.192	0.208	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	0.5	30	0h 30m	30	115	0.365	48.400	48.165	0.235	Clogged base model
20	0.4167	25	0h 25m	25	109	0.353	48.400	48.153	0.247	Clogged base model
20	0.3333	20	0h 20m	20	100	0.337	48.400	48.137	0.263	Clogged base model
20	0.25	15	0h 15m	15	89	0.315	48.400	48.115	0.285	Clogged base model
20	0.1667	10	0h 10m	10	75	0.283	48.400	48.083	0.317	Clogged base model
20	0.4167	25	0h 15m	15	45	0.203	48.400	48.003	0.397	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	41	0.194	48.400	47.994	0.406	Green & Amp plus Shallow WT models
20	0.5	30	0h 15m	15	40	0.190	48.400	47.990	0.410	Green & Amp plus Shallow WT models
20	0.25	15	0h 10m	10	40	0.189	48.400	47.989	0.411	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	36	0.178	48.400	47.978	0.422	Green & Amp plus Shallow WT models
20	1	60	0h 25m	25	34	0.169	48.400	47.969	0.431	Green & Amp plus Shallow WT models
20	0.75	45	0h 20m	20	32	0.161	48.400	47.961	0.439	Green & Amp plus Shallow WT models
20	1.5	90	0h 20m	20	26	0.139	48.400	47.939	0.461	Green & Amp plus Shallow WT models
20	2	120	0h 15m	15	24	0.134	48.400	47.934	0.466	Green & Amp plus Shallow WT models
20	3	180	0h 30m	30	22	0.126	48.400	47.926	0.474	Green & Amp plus Shallow WT models
20	4.5	270	0h 30m	30	17	0.104	48.400	47.904	0.496	Green & Amp plus Shallow WT models
20	12	720	1h 00m	60	14	0.091	48.400	47.891	0.509	Green & Amp plus Shallow WT models
20	9	540	1h 30m	90	14	0.091	48.400	47.891	0.509	Green & Amp plus Shallow WT models
20	6	360	2h 00m	120	12	0.076	48.400	47.876	0.524	Green & Amp plus Shallow WT models
20	24	1440	2h 00m	120	1	0.005	48.400	47.805	0.595	Green & Amp plus Shallow WT models
20	72	4320	6h 00m	360	0	0.000	48.400	47.800	0.600	Green & Amp plus Shallow WT models
20	48	2880	4h 00m	240	0	0.000	48.400	47.800	0.600	Green & Amp plus Shallow WT models
20	36	2160	4h 00m	240	0	0.000	48.400	47.800	0.600	Green & Amp plus Shallow WT models
20	30	1800	4h 00m	240	0	0.000	48.400	47.800	0.600	Green & Amp plus Shallow WT models
20	18	1080	2h 30m	150	0	0.000	48.400	47.800	0.600	Green & Amp plus Shallow WT models
100	30	1800	14h 00m	840	321	0.639	48.400	48.439	-0.039	Clogged base model
100	24	1440	12h 00m	720	321	0.639	48.400	48.439	-0.039	Clogged base model
100	18	1080	11h 00m	660	312	0.630	48.400	48.430	-0.030	Clogged base model
100	36	2160	16h 00m	960	312	0.629	48.400	48.429	-0.029	Clogged base model
100	48	2880	14h 00m	840	310	0.627	48.400	48.427	-0.027	Clogged base model
100	72	4320	16h 00m	960	303	0.619	48.400	48.419	-0.019	Clogged base model
100	12	720	8h 30m	510	295	0.610	48.400	48.410	-0.010	Clogged base model
100	9	540	8h 00m	480	293	0.609	48.400	48.409	-0.009	Clogged base model
100	6	360	6h 00m	360	288	0.603	48.400	48.403	-0.003	Clogged base model
100	4.5	270	4h 30m	270	275	0.589	48.400	48.389	0.011	Clogged base model
100	3	180	3h 00m	180	256	0.568	48.400	48.368	0.032	Clogged base model
100	2	120	1h 55m	115	234	0.541	48.400	48.341	0.059	Clogged base model
100	1.5	90	1h 30m	90	217	0.520	48.400	48.320	0.080	Clogged base model
100	1	60	1h 00m	60	194	0.488	48.400	48.288	0.112	Clogged base model
100	0.75	45	0h 45m	45	181	0.472	48.400	48.272	0.128	Clogged base model
100	0.5	30	0h 30m	30	162	0.444	48.400	48.244	0.156	Clogged base model
100	0.4167	25	0h 25m	25	153	0.430	48.400	48.230	0.170	Clogged base model
100	0.3333	20	0h 20m	20	143	0.414	48.400	48.214	0.186	Clogged base model
100	0.25	15	0h 15m	15	128	0.389	48.400	48.189	0.211	Clogged base model
100	0.1667	10	0h 10m	10	109	0.354	48.400	48.154	0.246	Clogged base model
100	0.3333	20	0h 15m	15	65	0.259	48.400	48.059	0.341	Green & Amp plus Shallow WT models
100	0.4167	25	0h 15m	15	63	0.255	48.400	48.055	0.345	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	60	0.246	48.400	48.046	0.354	Green & Amp plus Shallow WT models
100	0.25	15	0h 10m	10	60	0.246	48.400	48.046	0.354	Green & Amp plus Shallow WT models
100	0.5	30	0h 15m	15	58	0.241	48.400	48.041	0.359	Green & Amp plus Shallow WT models
100	1	60	0h 25m	25	50	0.220	48.400	48.020	0.380	Green & Amp plus Shallow WT models
100	0.75	45	0h 20m	20	48	0.214	48.400	48.014	0.386	Green & Amp plus Shallow WT models
100	1.5	90	0h 20m	20	32	0.164	48.400	47.964	0.436	Green & Amp plus Shallow WT models
100	3	180	0h 30m	30	28	0.149	48.400	47.949	0.451	Green & Amp plus Shallow WT models
100	2	120	0h 15m	15	27	0.144	48.400	47.944	0.456	Green & Amp plus Shallow WT models
100	4.5	270	0h 30m	30	20	0.118	48.400	47.918	0.482	Green & Amp plus Shallow WT models
100	9	540	1h 30m	90	18	0.105	48.400	47.905	0.495	Green & Amp plus Shallow WT models
100	12	720	1h 00m	60	17	0.103	48.400	47.903	0.497	Green & Amp plus Shallow WT models
100	6	360	2h 00m	120	15	0.095	48.400	47.895	0.505	Green & Amp plus Shallow WT models
100	24	1440	2h 00m	120	2	0.019	48.400	47.819	0.581	Green & Amp plus Shallow WT models
100	18	1080	2h 00m	120	1	0.011	48.400	47.811	0.589	Green & Amp plus Shallow WT models
100	72	4320	6h 00m	360	0	0.000	48.400	47.800	0.600	Green & Amp plus Shallow WT models
100	48	2880	4h 00m	240	0	0.000	48.400	47.800	0.600	Green & Amp plus Shallow WT models
100	36	2160	4h 00m	240	0	0.000	48.400	47.800	0.600	Green & Amp plus Shallow WT models
100	30	1800	4h 00m	240	0	0.000	48.400	47.800	0.600	Green & Amp plus Shallow WT models

Project Details	
Project	Roe Highway Extension - Stock Road Interchange
Job Number	60100953
Task	Basin S
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	16847	0.900	15162	
Verge	12825	0.300	3848	
	0	0.700	0	
Total	29672		19010	

Sump Details		
GWL	3.500	m AHD
Depth to GWL from base	43.100	m
Max Allowable TWL	49.000	m AHD
Sump Base Level	46.600	m AHD
Sump Width at base	1.5	m
Sump Length at base	2.5	m
Side Slope	8.0	1 in --

Permeability		
Soil Permeability, K	30.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%
0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	48	2880	14h 00m	840	1248	2.320	49.000	48.920	0.080	Clogged base model
20	72	4320	16h 00m	960	1245	2.318	49.000	48.918	0.082	Clogged base model
20	30	1800	14h 00m	840	1230	2.309	49.000	48.909	0.091	Clogged base model
20	36	2160	12h 00m	720	1216	2.300	49.000	48.900	0.100	Clogged base model
20	24	1440	11h 00m	660	1212	2.297	49.000	48.897	0.103	Clogged base model
20	18	1080	11h 00m	660	1153	2.256	49.000	48.856	0.144	Clogged base model
20	12	720	8h 00m	480	1065	2.195	49.000	48.795	0.205	Clogged base model
20	9	540	8h 00m	480	1019	2.160	49.000	48.760	0.240	Clogged base model
20	6	360	5h 30m	330	974	2.126	49.000	48.726	0.274	Clogged base model
20	4.5	270	4h 15m	255	921	2.085	49.000	48.685	0.315	Clogged base model
20	3	180	3h 00m	180	842	2.020	49.000	48.620	0.380	Clogged base model
20	2	120	2h 00m	120	762	1.949	49.000	48.549	0.451	Clogged base model
20	1.5	90	1h 30m	90	702	1.894	49.000	48.494	0.506	Clogged base model
20	1	60	1h 00m	60	623	1.815	49.000	48.415	0.585	Clogged base model
20	0.75	45	0h 45m	45	575	1.763	49.000	48.363	0.637	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	0.5	30	0h 30m	30	507	1.686	49.000	48.286	0.714	Clogged base model
20	0.4167	25	0h 25m	25	478	1.650	49.000	48.250	0.750	Clogged base model
20	0.3333	20	0h 20m	20	440	1.603	49.000	48.203	0.797	Clogged base model
20	0.25	15	0h 15m	15	392	1.537	49.000	48.137	0.863	Clogged base model
20	0.1667	10	0h 10m	10	328	1.441	49.000	48.041	0.959	Clogged base model
20	0.4167	25	0h 15m	15	300	1.396	49.000	47.996	1.004	Green & Amp plus Shallow WT models
20	1	60	0h 35m	35	295	1.387	49.000	47.987	1.013	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	292	1.381	49.000	47.981	1.019	Green & Amp plus Shallow WT models
20	0.75	45	0h 30m	30	278	1.356	49.000	47.956	1.044	Green & Amp plus Shallow WT models
20	0.5	30	0h 15m	15	277	1.355	49.000	47.955	1.045	Green & Amp plus Shallow WT models
20	9	540	1h 30m	90	275	1.352	49.000	47.952	1.048	Green & Amp plus Shallow WT models
20	3	180	0h 45m	45	272	1.346	49.000	47.946	1.054	Green & Amp plus Shallow WT models
20	12	720	1h 00m	60	270	1.342	49.000	47.942	1.058	Green & Amp plus Shallow WT models
20	1.5	90	0h 35m	35	265	1.334	49.000	47.934	1.066	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	264	1.331	49.000	47.931	1.069	Green & Amp plus Shallow WT models
20	2	120	0h 35m	35	257	1.320	49.000	47.920	1.080	Green & Amp plus Shallow WT models
20	6	360	2h 00m	120	243	1.293	49.000	47.893	1.107	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	242	1.291	49.000	47.891	1.109	Green & Amp plus Shallow WT models
20	4.5	270	1h 15m	75	234	1.274	49.000	47.874	1.126	Green & Amp plus Shallow WT models
20	24	1440	2h 00m	120	219	1.244	49.000	47.844	1.156	Green & Amp plus Shallow WT models
20	18	1080	2h 00m	120	206	1.217	49.000	47.817	1.183	Green & Amp plus Shallow WT models
20	48	2880	4h 00m	240	152	1.086	49.000	47.686	1.314	Green & Amp plus Shallow WT models
20	36	2160	6h 00m	360	138	1.051	49.000	47.651	1.349	Green & Amp plus Shallow WT models
20	30	1800	4h 00m	240	133	1.037	49.000	47.637	1.363	Green & Amp plus Shallow WT models
20	72	4320	4h 00m	240	75	0.833	49.000	47.433	1.567	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	1565	2.512	49.000	49.112	-0.112	Clogged base model
100	24	1440	13h 00m	780	1549	2.503	49.000	49.103	-0.103	Clogged base model
100	36	2160	16h 00m	960	1531	2.493	49.000	49.093	-0.093	Clogged base model
100	72	4320	24h 00m	1440	1519	2.486	49.000	49.086	-0.086	Clogged base model
100	48	2880	16h 00m	960	1518	2.485	49.000	49.085	-0.085	Clogged base model
100	18	1080	12h 00m	720	1498	2.474	49.000	49.074	-0.074	Clogged base model
100	12	720	9h 00m	540	1391	2.411	49.000	49.011	-0.011	Clogged base model
100	9	540	8h 30m	510	1375	2.401	49.000	49.001	-0.001	Clogged base model
100	6	360	6h 00m	360	1326	2.370	49.000	48.970	0.030	Clogged base model
100	4.5	270	4h 30m	270	1256	2.325	49.000	48.925	0.075	Clogged base model
100	3	180	3h 00m	180	1153	2.256	49.000	48.856	0.144	Clogged base model
100	2	120	2h 00m	120	1043	2.179	49.000	48.779	0.221	Clogged base model
100	1.5	90	1h 30m	90	965	2.119	49.000	48.719	0.281	Clogged base model
100	1	60	1h 00m	60	857	2.032	49.000	48.632	0.368	Clogged base model
100	0.75	45	0h 45m	45	798	1.982	49.000	48.582	0.418	Clogged base model
100	0.5	30	0h 30m	30	714	1.905	49.000	48.505	0.495	Clogged base model
100	0.4167	25	0h 25m	25	674	1.866	49.000	48.466	0.534	Clogged base model
100	0.3333	20	0h 20m	20	629	1.821	49.000	48.421	0.579	Clogged base model
100	0.25	15	0h 15m	15	562	1.749	49.000	48.349	0.651	Clogged base model
100	0.1667	10	0h 10m	10	477	1.649	49.000	48.249	0.751	Clogged base model
100	0.3333	20	0h 15m	15	417	1.571	49.000	48.171	0.829	Green & Amp plus Shallow WT models
100	1	60	0h 35m	35	411	1.563	49.000	48.163	0.837	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	403	1.552	49.000	48.152	0.848	Green & Amp plus Shallow WT models
100	0.5	30	0h 25m	25	397	1.544	49.000	48.144	0.856	Green & Amp plus Shallow WT models
100	0.75	45	0h 35m	35	397	1.543	49.000	48.143	0.857	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	392	1.536	49.000	48.136	0.864	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	363	1.496	49.000	48.096	0.904	Green & Amp plus Shallow WT models
100	1.5	90	0h 35m	35	335	1.451	49.000	48.051	0.949	Green & Amp plus Shallow WT models
100	3	180	0h 45m	45	328	1.441	49.000	48.041	0.959	Green & Amp plus Shallow WT models
100	2	120	0h 40m	40	311	1.414	49.000	48.014	0.986	Green & Amp plus Shallow WT models
100	9	540	1h 30m	90	309	1.412	49.000	48.012	0.988	Green & Amp plus Shallow WT models
100	12	720	1h 00m	60	294	1.386	49.000	47.986	1.014	Green & Amp plus Shallow WT models
100	6	360	2h 00m	120	292	1.381	49.000	47.981	1.019	Green & Amp plus Shallow WT models
100	4.5	270	1h 15m	75	283	1.366	49.000	47.966	1.034	Green & Amp plus Shallow WT models
100	24	1440	2h 00m	120	246	1.299	49.000	47.899	1.101	Green & Amp plus Shallow WT models
100	18	1080	2h 00m	120	233	1.273	49.000	47.873	1.127	Green & Amp plus Shallow WT models
100	48	2880	4h 00m	240	176	1.146	49.000	47.746	1.254	Green & Amp plus Shallow WT models
100	36	2160	6h 00m	360	160	1.110	49.000	47.710	1.290	Green & Amp plus Shallow WT models
100	30	1800	4h 00m	240	155	1.097	49.000	47.697	1.303	Green & Amp plus Shallow WT models
100	72	4320	4h 00m	240	90	0.895	49.000	47.495	1.505	Green & Amp plus Shallow WT models

Project Details	
Project	Roe Highway Extension - Stock Road Interchange
Job Number	60100953
Task	Basin T
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	8814	0.900	7933	
Verge	2956	0.300	887	
	0	0.700	0	
Total	11770		8819	

Sump Details		
GWL	3.500	m AHD
Depth to GWL from base	38.900	m
Max Allowable TWL	43.600	m AHD
Sump Base Level	42.400	m AHD
Sump Width at base	11	m
Sump Length at base	29	m
Side Slope	3.0	1 in --

Permeability		
Soil Permeability, K	30.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmp	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%
0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

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SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	48	2880	14h 00m	840	577	1.201	43.600	43.601	-0.001	Clogged base model
20	72	4320	16h 00m	960	575	1.198	43.600	43.598	0.002	Clogged base model
20	30	1800	14h 00m	840	568	1.186	43.600	43.586	0.014	Clogged base model
20	36	2160	16h 00m	960	561	1.176	43.600	43.576	0.024	Clogged base model
20	24	1440	11h 00m	660	560	1.175	43.600	43.575	0.025	Clogged base model
20	18	1080	11h 00m	660	532	1.132	43.600	43.532	0.068	Clogged base model
20	12	720	8h 00m	480	492	1.067	43.600	43.467	0.133	Clogged base model
20	9	540	8h 00m	480	470	1.032	43.600	43.432	0.168	Clogged base model
20	6	360	5h 30m	330	450	0.998	43.600	43.398	0.202	Clogged base model
20	4.5	270	4h 15m	255	425	0.956	43.600	43.356	0.244	Clogged base model
20	3	180	3h 00m	180	389	0.893	43.600	43.293	0.307	Clogged base model
20	2	120	2h 00m	120	352	0.826	43.600	43.226	0.374	Clogged base model
20	1.5	90	1h 30m	90	325	0.774	43.600	43.174	0.426	Clogged base model
20	1	60	1h 00m	60	288	0.704	43.600	43.104	0.496	Clogged base model
20	0.75	45	0h 45m	45	266	0.659	43.600	43.059	0.541	Clogged base model

ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
20	0.5	30	0h 30m	30	235	0.594	43.600	42.994	0.606	Clogged base model
20	0.4167	25	0h 25m	25	221	0.566	43.600	42.966	0.634	Clogged base model
20	0.3333	20	0h 20m	20	204	0.528	43.600	42.928	0.672	Clogged base model
20	0.25	15	0h 15m	15	182	0.478	43.600	42.878	0.722	Clogged base model
20	0.1667	10	0h 10m	10	152	0.410	43.600	42.810	0.790	Clogged base model
20	0.4167	25	0h 15m	15	111	0.311	43.600	42.711	0.889	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	109	0.305	43.600	42.705	0.895	Green & Amp plus Shallow WT models
20	0.5	30	0h 15m	15	100	0.282	43.600	42.682	0.918	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	98	0.277	43.600	42.677	0.923	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	93	0.264	43.600	42.664	0.936	Green & Amp plus Shallow WT models
20	1	60	0h 35m	35	88	0.250	43.600	42.650	0.950	Green & Amp plus Shallow WT models
20	0.75	45	0h 30m	30	87	0.248	43.600	42.648	0.952	Green & Amp plus Shallow WT models
20	2	120	0h 35m	35	74	0.215	43.600	42.615	0.985	Green & Amp plus Shallow WT models
20	1.5	90	0h 35m	35	74	0.215	43.600	42.615	0.985	Green & Amp plus Shallow WT models
20	3	180	0h 45m	45	62	0.182	43.600	42.582	1.018	Green & Amp plus Shallow WT models
20	12	720	1h 00m	60	48	0.142	43.600	42.542	1.058	Green & Amp plus Shallow WT models
20	9	540	1h 30m	90	47	0.140	43.600	42.540	1.060	Green & Amp plus Shallow WT models
20	4.5	270	0h 30m	30	44	0.131	43.600	42.531	1.069	Green & Amp plus Shallow WT models
20	6	360	2h 00m	120	35	0.105	43.600	42.505	1.095	Green & Amp plus Shallow WT models
20	72	4320	7h 30m	450	0	0.000	43.600	42.400	1.200	Green & Amp plus Shallow WT models
20	48	2880	5h 00m	300	0	0.000	43.600	42.400	1.200	Green & Amp plus Shallow WT models
20	36	2160	5h 00m	300	0	0.000	43.600	42.400	1.200	Green & Amp plus Shallow WT models
20	30	1800	5h 00m	300	0	0.000	43.600	42.400	1.200	Green & Amp plus Shallow WT models
20	24	1440	2h 30m	150	0	0.000	43.600	42.400	1.200	Green & Amp plus Shallow WT models
20	18	1080	2h 30m	150	0	0.000	43.600	42.400	1.200	Green & Amp plus Shallow WT models
100	30	1800	16h 00m	960	725	1.414	43.600	43.814	-0.214	Clogged base model
100	24	1440	13h 00m	780	718	1.404	43.600	43.804	-0.204	Clogged base model
100	36	2160	16h 00m	960	709	1.392	43.600	43.792	-0.192	Clogged base model
100	72	4320	24h 00m	1440	705	1.387	43.600	43.787	-0.187	Clogged base model
100	48	2880	16h 00m	960	703	1.384	43.600	43.784	-0.184	Clogged base model
100	18	1080	12h 00m	720	694	1.371	43.600	43.771	-0.171	Clogged base model
100	12	720	9h 00m	540	645	1.301	43.600	43.701	-0.101	Clogged base model
100	9	540	8h 30m	510	637	1.290	43.600	43.690	-0.090	Clogged base model
100	6	360	6h 00m	360	613	1.255	43.600	43.655	-0.055	Clogged base model
100	4.5	270	4h 30m	270	582	1.208	43.600	43.608	-0.008	Clogged base model
100	3	180	3h 00m	180	534	1.134	43.600	43.534	0.066	Clogged base model
100	2	120	2h 00m	120	483	1.053	43.600	43.453	0.147	Clogged base model
100	1.5	90	1h 30m	90	447	0.993	43.600	43.393	0.207	Clogged base model
100	1	60	1h 00m	60	397	0.907	43.600	43.307	0.293	Clogged base model
100	0.75	45	0h 45m	45	370	0.858	43.600	43.258	0.342	Clogged base model
100	0.5	30	0h 30m	30	331	0.786	43.600	43.186	0.414	Clogged base model
100	0.4167	25	0h 25m	25	313	0.751	43.600	43.151	0.449	Clogged base model
100	0.3333	20	0h 20m	20	291	0.710	43.600	43.110	0.490	Clogged base model
100	0.25	15	0h 15m	15	261	0.648	43.600	43.048	0.552	Clogged base model
100	0.1667	10	0h 10m	10	221	0.565	43.600	42.965	0.635	Clogged base model
100	0.3333	20	0h 15m	15	173	0.458	43.600	42.858	0.742	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	163	0.437	43.600	42.837	0.763	Green & Amp plus Shallow WT models
100	0.4167	25	0h 20m	20	163	0.435	43.600	42.835	0.765	Green & Amp plus Shallow WT models
100	0.5	30	0h 25m	25	158	0.423	43.600	42.823	0.777	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	153	0.413	43.600	42.813	0.787	Green & Amp plus Shallow WT models
100	1	60	0h 35m	35	149	0.403	43.600	42.803	0.797	Green & Amp plus Shallow WT models
100	0.75	45	0h 30m	30	147	0.399	43.600	42.799	0.801	Green & Amp plus Shallow WT models
100	1.5	90	0h 35m	35	112	0.312	43.600	42.712	0.888	Green & Amp plus Shallow WT models
100	2	120	0h 35m	35	99	0.280	43.600	42.680	0.920	Green & Amp plus Shallow WT models
100	3	180	0h 45m	45	92	0.260	43.600	42.660	0.940	Green & Amp plus Shallow WT models
100	9	540	1h 30m	90	60	0.175	43.600	42.575	1.025	Green & Amp plus Shallow WT models
100	12	720	1h 00m	60	58	0.170	43.600	42.570	1.030	Green & Amp plus Shallow WT models
100	4.5	270	0h 30m	30	53	0.156	43.600	42.556	1.044	Green & Amp plus Shallow WT models
100	6	360	2h 00m	120	51	0.151	43.600	42.551	1.049	Green & Amp plus Shallow WT models
100	24	1440	2h 00m	120	3	0.009	43.600	42.409	1.191	Green & Amp plus Shallow WT models
100	72	4320	6h 00m	360	0	0.000	43.600	42.400	1.200	Green & Amp plus Shallow WT models
100	48	2880	4h 00m	240	0	0.000	43.600	42.400	1.200	Green & Amp plus Shallow WT models
100	36	2160	4h 00m	240	0	0.000	43.600	42.400	1.200	Green & Amp plus Shallow WT models
100	30	1800	4h 00m	240	0	0.000	43.600	42.400	1.200	Green & Amp plus Shallow WT models
100	18	1080	2h 30m	150	0	0.000	43.600	42.400	1.200	Green & Amp plus Shallow WT models

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Project Details	
Project	Roe Highway Extension - Malvolio Road
Job Number	60100953
Task	Basin U
Designer	LBC

Location	Perth
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Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Road pavement	2250	0.900	2025	
Verge	921	0.300	276	
	0	0.700	0	
Total	3171		2301	

Sump Details		
GWL	7.000	m AHD
Depth to GWL from base	23.300	m
Max Allowable TWL	30.680	m AHD
Sump Base Level	30.300	m AHD
Sump Width at base	2.65	m
Sump Length at base	51	m
Side Slope	6.0	1 in --

Permeability		
Soil Permeability, K	30.0	m/d
Permeability Clogged Layer	0.15	m/d
Thickness of Clogged Layer	200	mm
Porosity	0.25	
Initial Degree of Saturation	30.0%	
Effective Porosity, n	17.5%	
Reduction Factor - Shallow	0.800	
Reduction Factor - GreenAmpt	0.600	
Reduction Factor - Clogged	1.000	

0.15
200
0.25
30.0%

0.800
0.600
1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details		
Weir Coefficient, Cd		
Weir Length		m
Weir Level		m AHD

1.7

SUMMARY OUTPUT										
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	24	1440	10h 00m	600	100	0.379	30.680	30.679	0.001	Clogged base model
5	30	1800	10h 00m	600	98	0.374	30.680	30.674	0.006	Clogged base model
5	48	2880	12h 00m	720	98	0.373	30.680	30.673	0.007	Clogged base model
5	36	2160	10h 00m	600	98	0.373	30.680	30.673	0.007	Clogged base model
5	72	4320	12h 00m	720	96	0.370	30.680	30.670	0.010	Clogged base model
5	18	1080	8h 00m	480	95	0.365	30.680	30.665	0.015	Clogged base model
5	12	720	8h 00m	480	90	0.353	30.680	30.653	0.027	Clogged base model
5	9	540	6h 30m	390	87	0.345	30.680	30.645	0.035	Clogged base model
5	6	360	4h 30m	270	85	0.340	30.680	30.640	0.040	Clogged base model
5	4.5	270	4h 15m	255	80	0.327	30.680	30.627	0.053	Clogged base model
5	3	180	2h 45m	165	74	0.309	30.680	30.609	0.071	Clogged base model
5	2	120	1h 55m	115	68	0.291	30.680	30.591	0.089	Clogged base model
5	1.5	90	1h 30m	90	63	0.275	30.680	30.575	0.105	Clogged base model
5	1	60	1h 00m	60	56	0.254	30.680	30.554	0.126	Clogged base model
5	0.75	45	0h 45m	45	52	0.239	30.680	30.539	0.141	Clogged base model

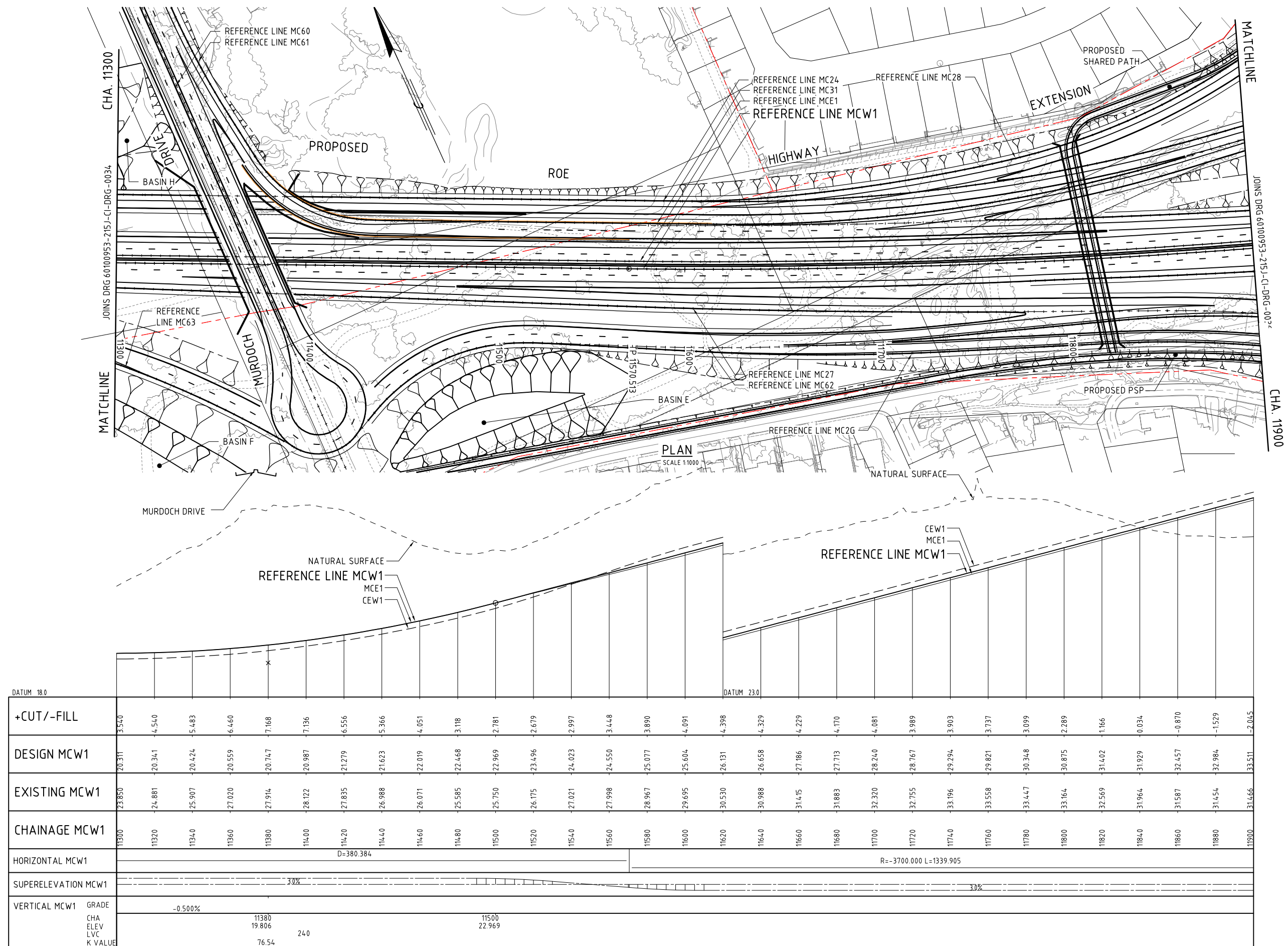
ARI (years)	Storm Duration		Critical Time		Storage Required (m3)	Water Depth, H (m)	Allowable TWL (m AHD)	TWL (m AHD)	Freeboard (m)	Critical Model
	(hours)	(min)	(h:m)	(min)						
5	0.5	30	0h 30m	30	45	0.217	30.680	30.517	0.163	Clogged base model
5	0.4167	25	0h 25m	25	42	0.206	30.680	30.506	0.174	Clogged base model
5	0.3333	20	0h 20m	20	38	0.193	30.680	30.493	0.187	Clogged base model
5	0.25	15	0h 15m	15	35	0.178	30.680	30.478	0.202	Clogged base model
5	0.1667	10	0h 10m	10	28	0.153	30.680	30.453	0.227	Clogged base model
5	0.4167	25	0h 15m	15	9	0.058	30.680	30.358	0.322	Green & Amp plus Shallow WT models
5	0.25	15	0h 10m	10	9	0.056	30.680	30.356	0.324	Green & Amp plus Shallow WT models
5	0.3333	20	0h 15m	15	7	0.049	30.680	30.349	0.331	Green & Amp plus Shallow WT models
5	0.5	30	0h 15m	15	7	0.048	30.680	30.348	0.332	Green & Amp plus Shallow WT models
5	0.1667	10	0h 10m	10	7	0.047	30.680	30.347	0.333	Green & Amp plus Shallow WT models
5	1	60	0h 25m	25	4	0.029	30.680	30.329	0.351	Green & Amp plus Shallow WT models
5	0.75	45	0h 15m	15	4	0.027	30.680	30.327	0.353	Green & Amp plus Shallow WT models
5	2	120	0h 10m	10	3	0.023	30.680	30.323	0.357	Green & Amp plus Shallow WT models
5	1.5	90	0h 10m	10	3	0.023	30.680	30.323	0.357	Green & Amp plus Shallow WT models
5	72	4320	5h 00m	300	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
5	48	2880	3h 20m	200	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
5	36	2160	3h 20m	200	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
5	30	1800	3h 20m	200	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
5	24	1440	1h 40m	100	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
5	18	1080	1h 40m	100	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
5	12	720	0h 40m	40	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
5	9	540	0h 40m	40	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
5	6	360	0h 40m	40	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
5	4.5	270	0h 20m	20	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
5	3	180	0h 20m	20	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
20	48	2880	12h 00m	720	133	0.456	30.680	30.756	-0.076	Clogged base model
20	72	4320	12h 00m	720	133	0.455	30.680	30.755	-0.075	Clogged base model
20	24	1440	10h 00m	600	133	0.455	30.680	30.755	-0.075	Clogged base model
20	36	2160	12h 00m	720	132	0.453	30.680	30.753	-0.073	Clogged base model
20	30	1800	10h 00m	600	131	0.452	30.680	30.752	-0.072	Clogged base model
20	18	1080	11h 00m	660	125	0.438	30.680	30.738	-0.058	Clogged base model
20	12	720	8h 00m	480	118	0.422	30.680	30.722	-0.042	Clogged base model
20	9	540	6h 30m	390	114	0.411	30.680	30.711	-0.031	Clogged base model
20	6	360	5h 00m	300	111	0.405	30.680	30.705	-0.025	Clogged base model
20	4.5	270	4h 15m	255	106	0.392	30.680	30.692	-0.012	Clogged base model
20	3	180	2h 45m	165	98	0.374	30.680	30.674	0.006	Clogged base model
20	2	120	1h 55m	115	90	0.352	30.680	30.652	0.028	Clogged base model
20	1.5	90	1h 30m	90	83	0.334	30.680	30.634	0.046	Clogged base model
20	1	60	1h 00m	60	74	0.309	30.680	30.609	0.071	Clogged base model
20	0.75	45	0h 45m	45	69	0.293	30.680	30.593	0.087	Clogged base model
20	0.5	30	0h 30m	30	61	0.269	30.680	30.569	0.111	Clogged base model
20	0.4167	25	0h 25m	25	57	0.259	30.680	30.559	0.121	Clogged base model
20	0.3333	20	0h 20m	20	53	0.244	30.680	30.544	0.136	Clogged base model
20	0.25	15	0h 15m	15	47	0.225	30.680	30.525	0.155	Clogged base model
20	0.1667	10	0h 10m	10	40	0.197	30.680	30.497	0.183	Clogged base model
20	0.4167	25	0h 15m	15	17	0.102	30.680	30.402	0.278	Green & Amp plus Shallow WT models
20	0.25	15	0h 10m	10	16	0.097	30.680	30.397	0.283	Green & Amp plus Shallow WT models
20	0.3333	20	0h 15m	15	16	0.094	30.680	30.394	0.286	Green & Amp plus Shallow WT models
20	0.5	30	0h 15m	15	15	0.089	30.680	30.389	0.291	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	15	0.089	30.680	30.389	0.291	Green & Amp plus Shallow WT models
20	1	60	0h 25m	25	10	0.066	30.680	30.366	0.314	Green & Amp plus Shallow WT models
20	0.75	45	0h 20m	20	10	0.063	30.680	30.363	0.317	Green & Amp plus Shallow WT models
20	1.5	90	0h 15m	15	8	0.051	30.680	30.351	0.329	Green & Amp plus Shallow WT models
20	2	120	0h 15m	15	8	0.050	30.680	30.350	0.330	Green & Amp plus Shallow WT models
20	3	180	0h 30m	30	4	0.028	30.680	30.328	0.352	Green & Amp plus Shallow WT models
20	4.5	270	0h 30m	30	2	0.011	30.680	30.311	0.369	Green & Amp plus Shallow WT models
20	72	4320	7h 30m	450	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
20	48	2880	5h 00m	300	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
20	36	2160	5h 00m	300	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
20	30	1800	5h 00m	300	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
20	24	1440	2h 30m	150	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
20	18	1080	2h 30m	150	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
20	12	720	1h 00m	60	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
20	9	540	1h 00m	60	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models
20	6	360	1h 00m	60	0	0.000	30.680	30.300	0.380	Green & Amp plus Shallow WT models

16.0 Appendix F – Concept Design Drawings

DRAFT

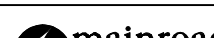
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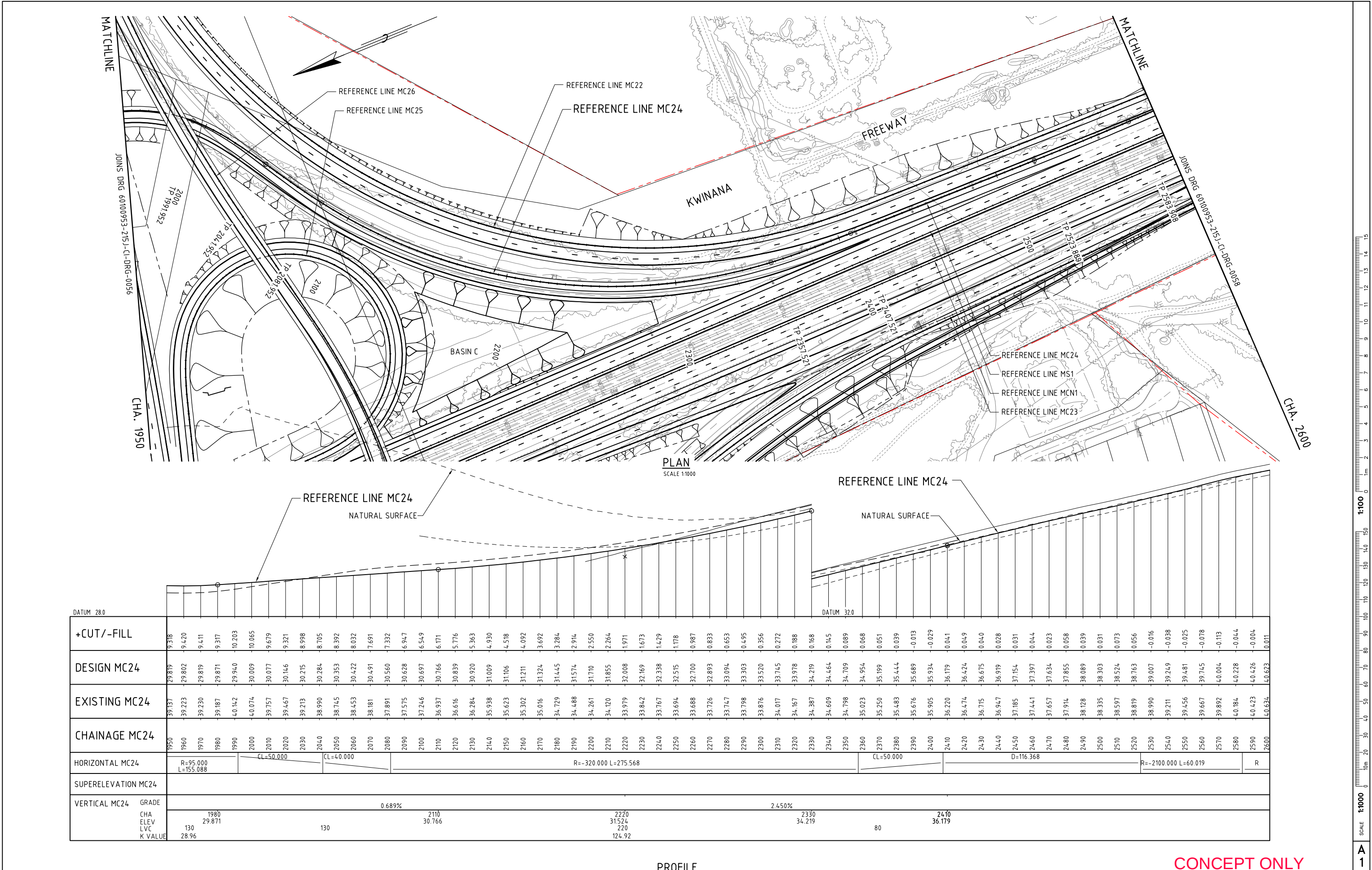
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PROFILE
SCALE VERTICAL 1:100
HORIZONTAL 1:1000

CONCEPT ONLY

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				GROUND SURVEY STANDARD:		DRAWN		VERIFIED / REVIEWED						ROE HIGHWAY (H18) EXTENSION – KAREL AVE TO STOCK RD	
				DATE OF CAPTURE:		AW/OI								PLAN & PROFILE – WESTBOUND	
				MAPPING SURVEY STANDARD: 67/08/44		DESIGNED		DESIGN MANAGER						CHA. 11300 TO 11900 (MCW1)	
				DATE OF CAPTURE: NOVEMBER 2008		GGM/ WN/ WB		ALLIANCE MANAGER							
A 02/02/11		ISSUED FOR INTERNAL REVIEW		TL		CHECKED		PROJECT DIRECTOR							
No.		DATE		DESCRIPTION		GGM/ NSW									
				APPROVED											
				MAIN ROADS PROJECT ZONE: PCG 94											
				HEIGHT DATUM: AHD											
				M\60100953 - Roe Hwy Ext\5 CADD\5.3 Working\Drwg\Roads\60100953-215J-CI-DRG-0035.dwg 1 February 2011											
														</	



PROFILE

SCALE VERTICAL 1:100

HORIZONTAL 1:1000

CONCEPT ONLY

MRWA DRAWING NUMBER

SOUTH METRO CONNECT

ROE HIGHWAY (H18) EXTENSION - KAREL AVE TO STOCK RD

PLAN & PROFILE - CHA 1950 TO 2600 (MC24)

E/B OFF-RAMP TO LEACH HWY S/B

DRAWING STATUS	DRAWING No.	REV
CONCEPT	60100953-215J-CI-DRG-0057	A

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DATE OF CAPTURE:		AW/OI			
MAPPING SURVEY STANDARD:		DESIGNED		DESIGN MANAGER	
DATE OF CAPTURE:		GGM/WN/WB			
MAIN ROADS PROJECT ZONE:		CHECKED		ALLIANCE MANAGER	
HEIGHT DATUM:		GGM/NSW		PROJECT DIRECTOR	



INFRASTRUCTURE DELIVERY DIRECTORATE

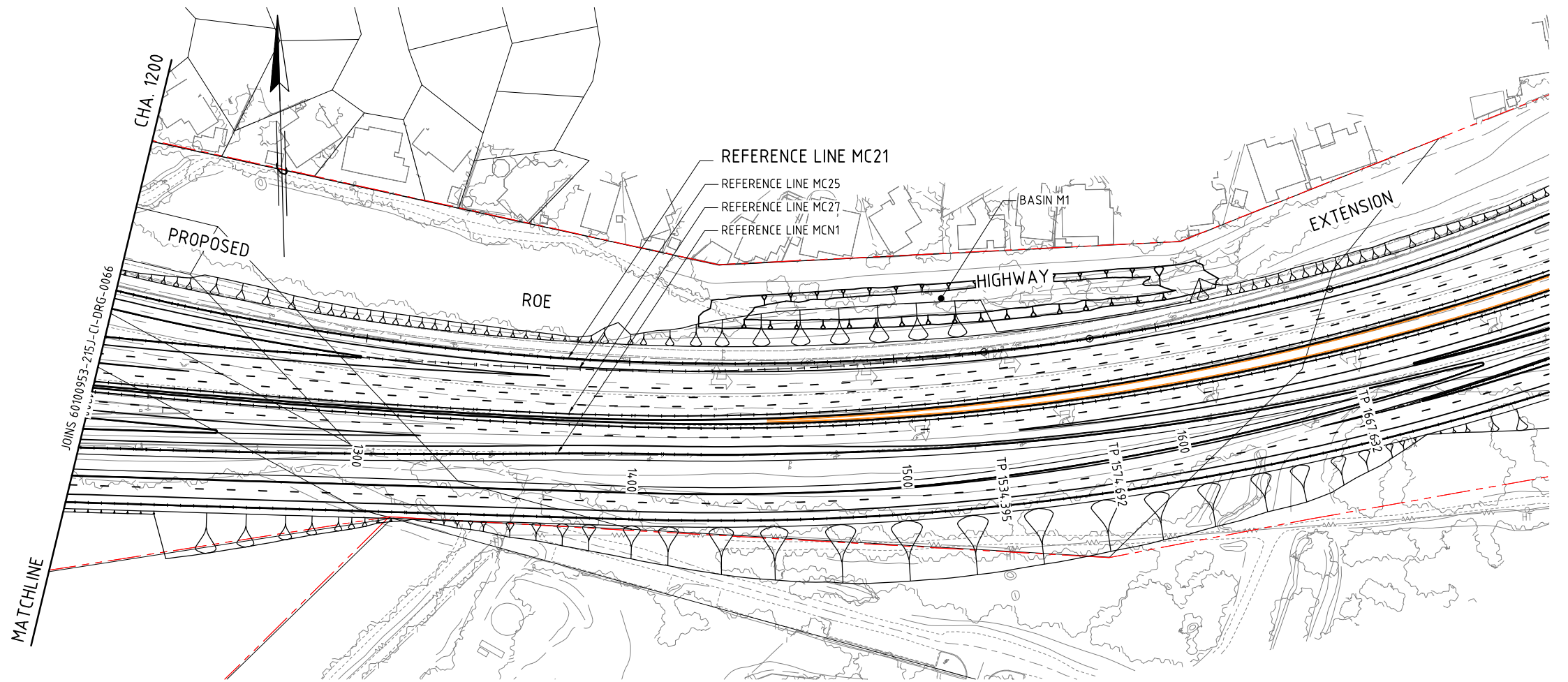
Waterloo Crescent
Telephone (08) 9323 4111

East Perth 6004
Fax (08) 9323 4430

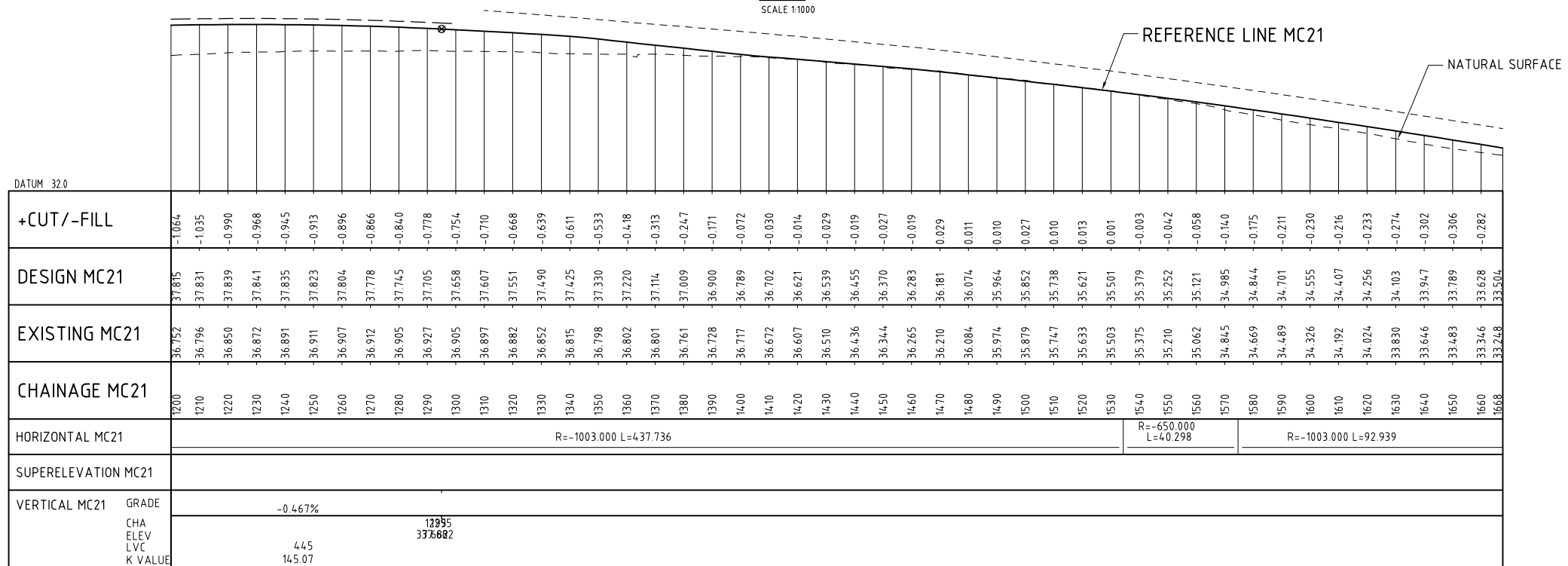
LOCAL AUTHORITY CITY OF COCKBURN (103) & CITY OF MELVILLE (119)

No.	DATE	ISSUED FOR INTERNAL REVIEW	DESCRIPTION	TL	APPROVED
A	02/02/11	ISSUED FOR INTERNAL REVIEW			

M:\60100953 - Roe Hwy Ext\5 CADD\5.3 Working\Drw\Roads\60100953-215J-CI-DRG-0057.dwg 1 February 2011



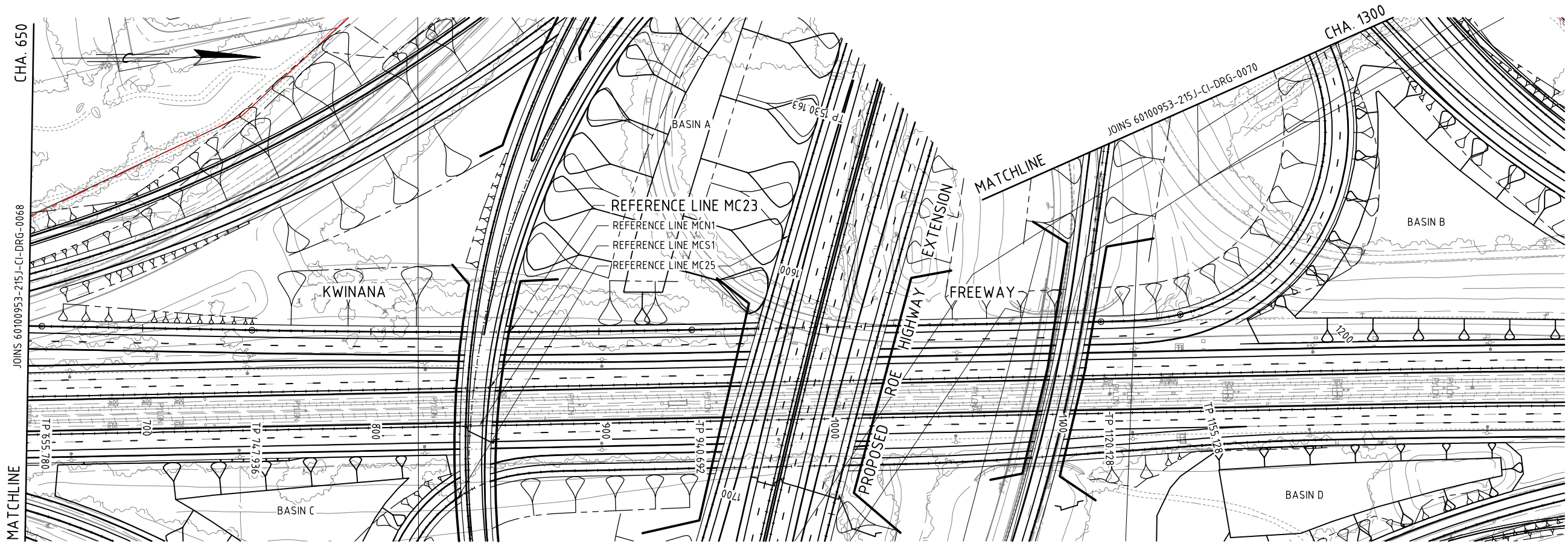
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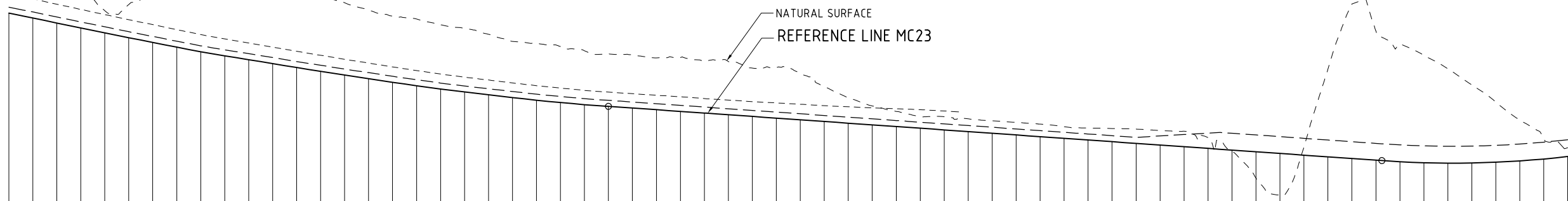
PROFILE
SCALE VERTICAL 1:100
HORIZONTAL 1:1000

CONCEPT ONLY

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			MAPPING SURVEY STANDARD:		CHECKED		ALLIANCE MANAGER				E/B ONRAMP FROM KWINANA FWY S/B	
			DATE OF CAPTURE:				PROJECT DIRECTOR				DRAWING STATUS	
			MAIN ROADS PROJECT ZONE:								CONCEPT	
			HEIGHT DATUM:								60100953-215J-CI-DRG-0067	
											REV	
											A	



PLAN
SCALE 1:1000



DATUM 24.0	
+CUT/-FILL	2.985 -2.937 -2.269 -1.662 -0.922 -1.380 -1.955 -2.335 -2.897 -3.492 -3.608 -3.449 -3.273 -3.140 -3.006 -2.858 -2.772 -2.671 -2.646 -2.515 -2.337 -2.365 -2.325 -2.244 -2.182 -2.206 -2.157 -2.241 -2.161 -2.215 -2.012 -2.099 -1.926 -1.453 -1.063 -0.785 -0.631 -0.475 -0.548 -0.531 -0.519 -0.523 -0.517 -0.479 -0.499 -0.549 -0.595 -0.603 -0.644 -0.449 -0.066 -1.096 -1.723 -0.331 -3.644 -6.426 -5.373 -4.860 -4.473 -3.925 -3.247 -2.500 -1.700 -0.848 0.366
DESIGN MC23	33.114 -32.917 -32.706 -32.502 -32.298 -32.096 -31.898 -31.700 -31.509 -31.342 -31.182 -31.019 -30.855 -30.698 -30.541 -30.391 -30.241 -30.098 -29.959 -29.837 -29.722 -29.608 -29.495 -29.401 -29.309 -29.241 -29.171 -29.101 -29.031 -28.961 -28.891 -28.821 -28.751 -28.681 -28.611 -28.541 -28.471 -28.401 -28.331 -28.261 -28.191 -28.121 -28.051 -27.981 -27.911 -27.841 -27.771 -27.701 -27.631 -27.561 -27.491 -27.421 -27.351 -27.281 -27.211 -27.141 -27.071 -27.001 -26.938 -26.898 -26.881 -26.888 -26.919 -26.973 -27.051 -27.153
EXISTING MC23	36.100 -35.854 -34.975 -34.164 -33.221 -33.475 -33.853 -34.036 -34.406 -34.834 -34.790 -34.469 -34.128 -33.839 -33.548 -33.250 -32.993 -32.870 -32.630 -32.483 -32.237 -31.944 -31.860 -31.727 -31.553 -31.424 -31.377 -31.258 -31.272 -31.122 -31.107 -30.833 -30.851 -30.607 -30.064 -29.604 -29.256 -29.032 -28.806 -28.810 -28.722 -28.640 -28.574 -28.499 -28.391 -28.341 -28.321 -28.296 -28.235 -28.205 -27.940 -27.356 -26.255 -25.558 -27.542 -30.786 -33.497 -32.375 -31.799 -31.371 -30.805 -30.134 -29.449 -28.673 -27.898 -27.518
CHAINAGE MC23	650 660 670 680 690 700 710 720 730 740 750 760 770 780 790 800 810 820 830 840 850 860 870 880 890 900 910 920 930 940 950 960 970 980 990 1000 1010 1020 1030 1040 1050 1060 1070 1080 1090 1100 1110 1120 1130 1140 1150 1160 1170 1180 1190 1200 1210 1220 1230 1240 1250 1260 1270 1280 1290 1300
HORIZONTAL MC23	R D=92.156 R=-5000.000 L=192.756 D=179.437 CL R=-82.500 L=315.035
SUPERELEVATION MC23	
VERTICAL MC23	GRADE CHA ELEV LVC K VALUE 900 29.241 322 1222 26.984 4223

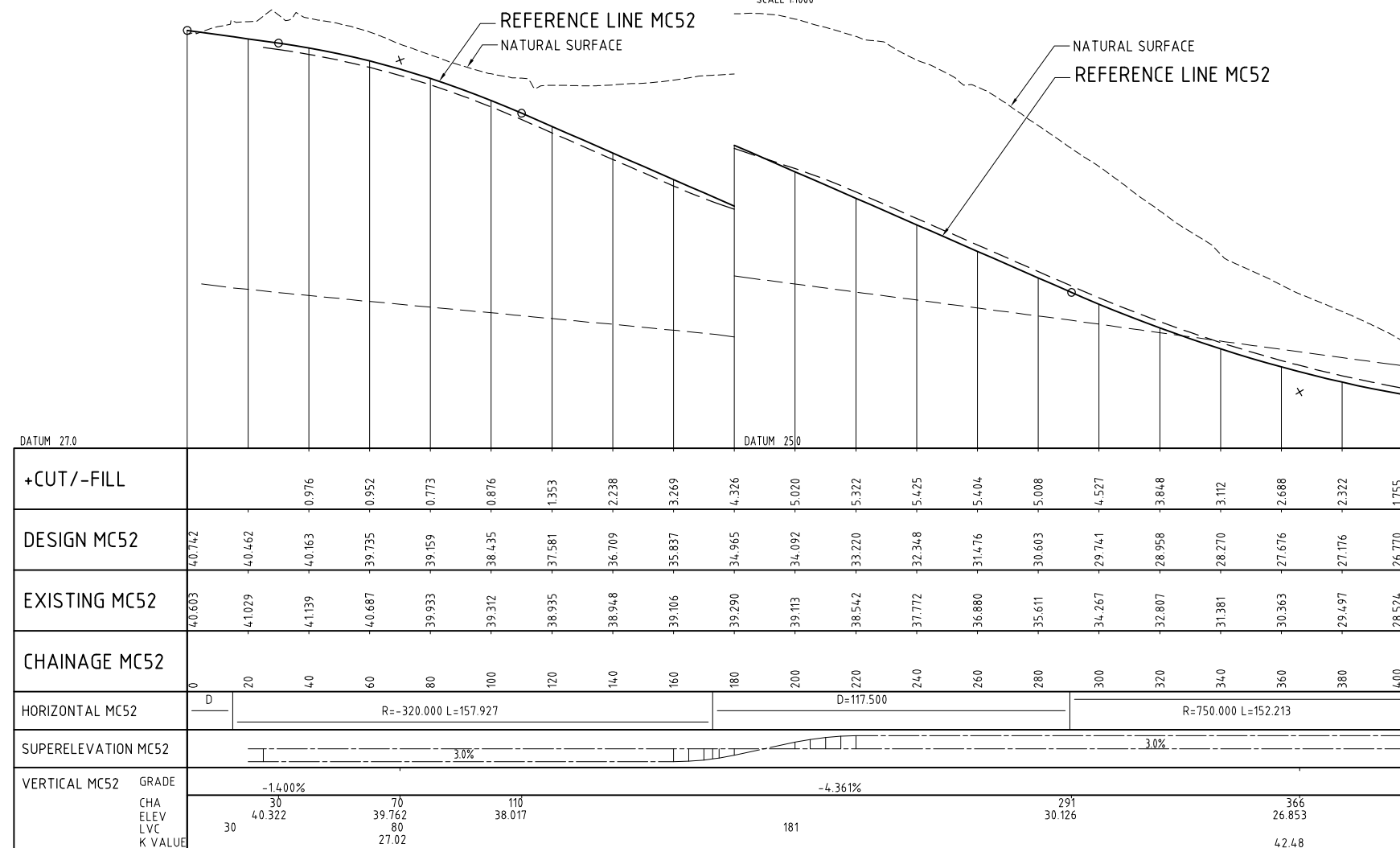
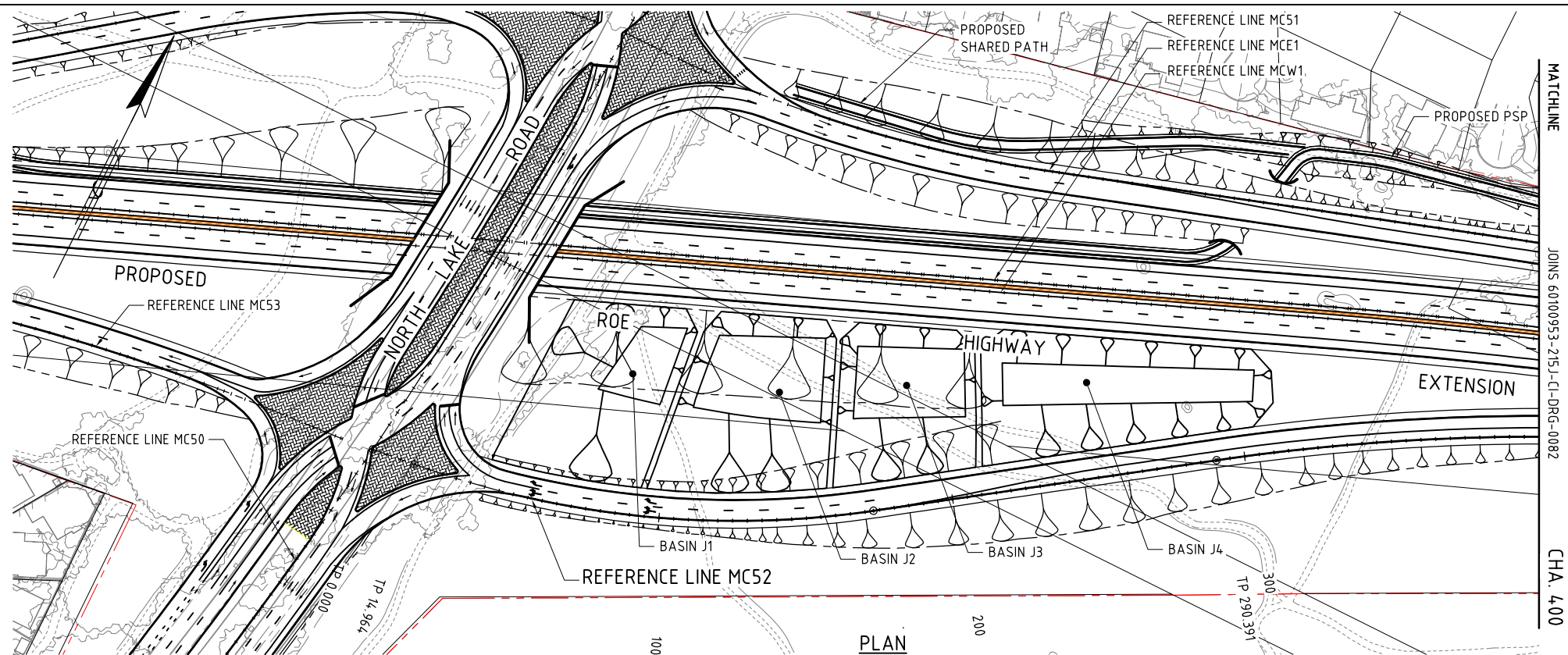
PROFILE
SCALE VERTICAL 1:100
HORIZONTAL 1:1000

CONCEPT ONLY

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			GROUND SURVEY STANDARD:		DRAWN		VERIFIED / REVIEWED				ROE HIGHWAY (H18) EXTENSION - KAREL AVE TO STOCK RD	
			DATE OF CAPTURE:		DESIGNED		DESIGN MANAGER				PLAN & PROFILE - CHA 650 TO 1300 (MC23)	
			MAPPING SURVEY STANDARD:		CHECKED		ALLIANCE MANAGER				E/B ONRAMP FROM KWINANA FWY N/B	
			DATE OF CAPTURE:				PROJECT DIRECTOR				DRAWING STATUS	
			MAIN ROADS PROJECT ZONE:								CONCEPT	
			HEIGHT DATUM:								DRAWING No.	
											60100953-215J-CI-DRG-0069	
											REV	
											A	



Government of Western Australia
mainroads
WESTERN AUSTRALIA
INFRASTRUCTURE DELIVERY DIRECTORATE
Waterloo Crescent Telephone (08) 9323 4111 East Perth 6004 Fax (08) 9323 4430
LOCAL AUTHORITY CITY OF COCKBURN (103) & CITY OF MELVILLE (119)



PROFILE
SCALE VERTICAL 1:100
HORIZONTAL 1:1000

CONCEPT ONLY

MRWA DRAWING NUMBER

SOUTH METRO CONNECT

ROE HWY (H18) EXTENSION - KAREL AVE TO STOCK RD
PLAN & PROFILE - STA. 0 TO 400 (MC52)
W/B OFF-RAMP TO NORTH LAKE ROAD

DRAWING STATUS CONCEPT	DRAWING No. 60100953-215J-CI-DRG-0081
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A	02/02/11	ISSUED FOR INTERNAL REVIEW	TL
No.	DATE	DESCRIPTION	APPROVED
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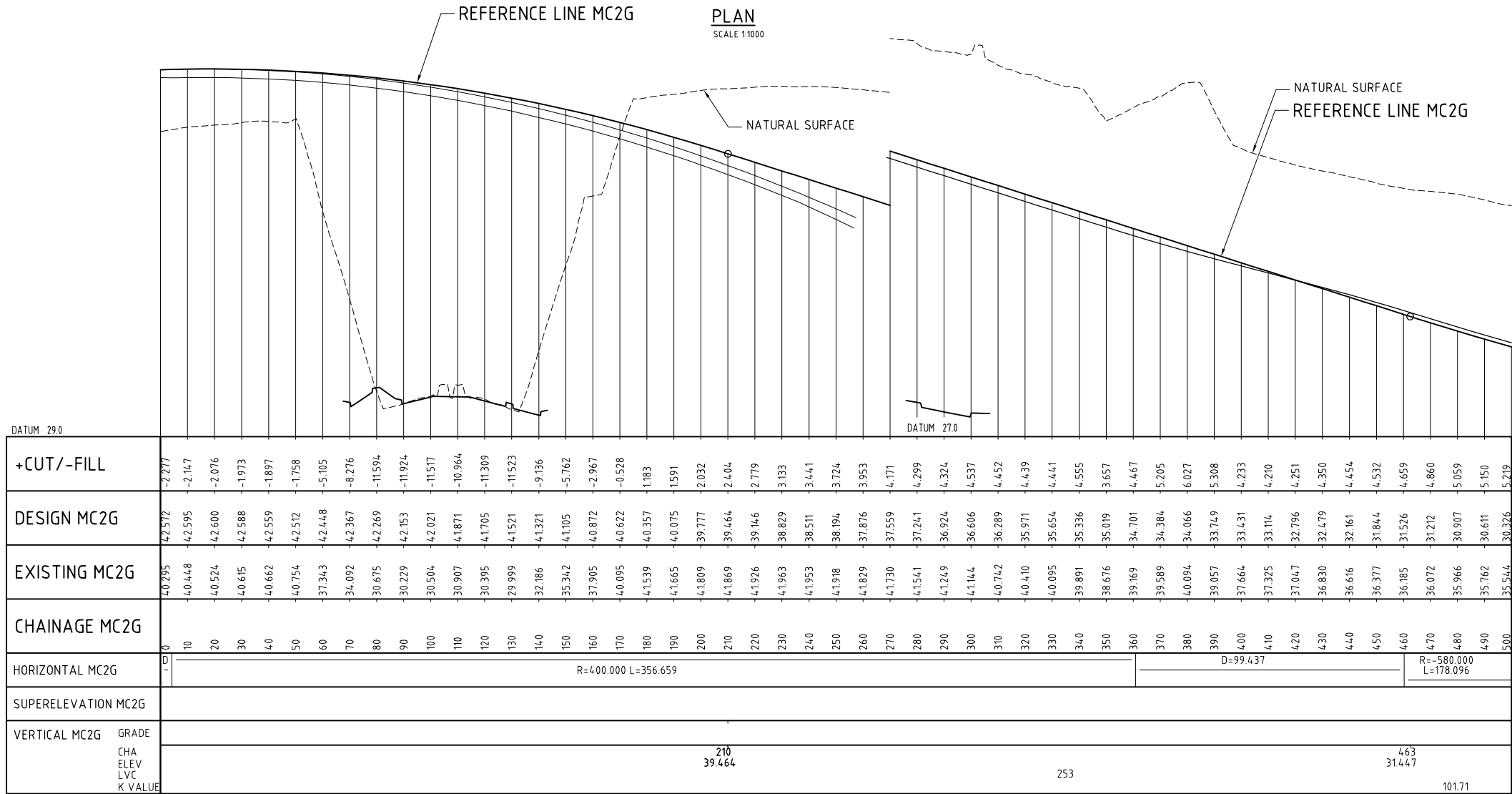
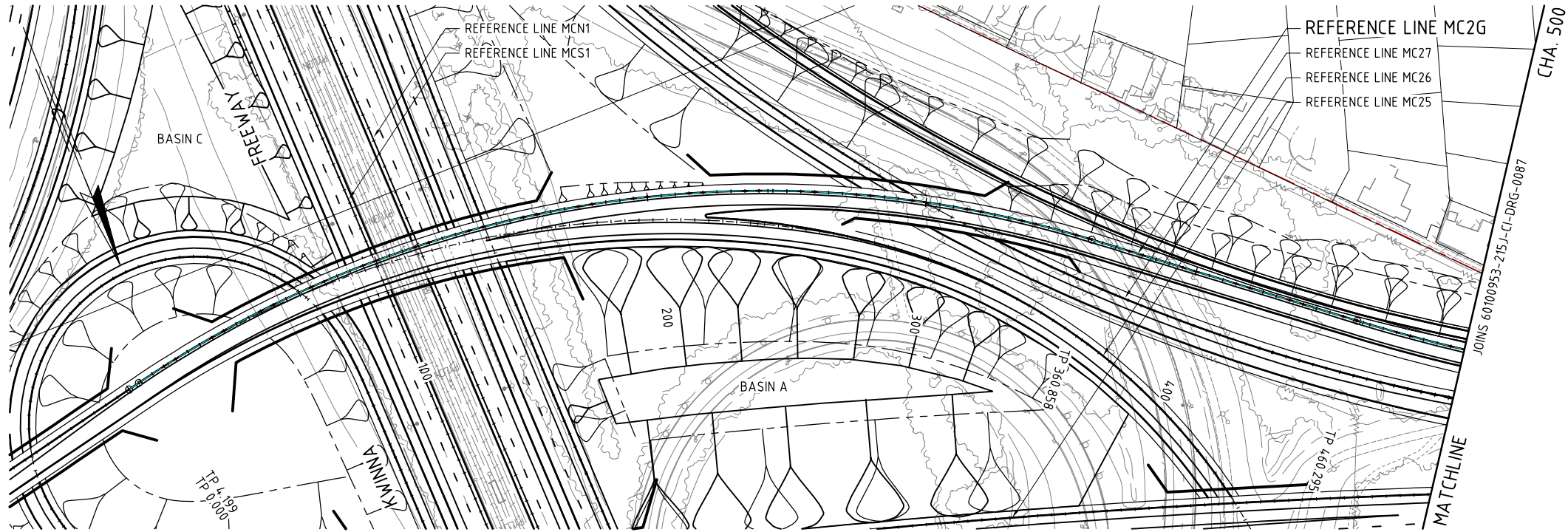
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GROUND SURVEY STANDARD:		DRAWN	VERIFIED / REVIEWED
DATE OF CAPTURE:		Aw/OI	
MAPPING SURVEY STANDARD:	67/08/44	DESIGNED	DESIGN MANAGER
DATE OF CAPTURE:	NOVEMBER 2008	GGM/WN/WB	
MAIN ROADS PROJECT ZONE:	PCG 94	CHECKED	ALLIANCE MANAGER
HEIGHT DATUM:	AHD	GGM/NSW	
			PROJECT DIRECTOR



INFRASTRUCTURE DELIVERY DIRECTORATE

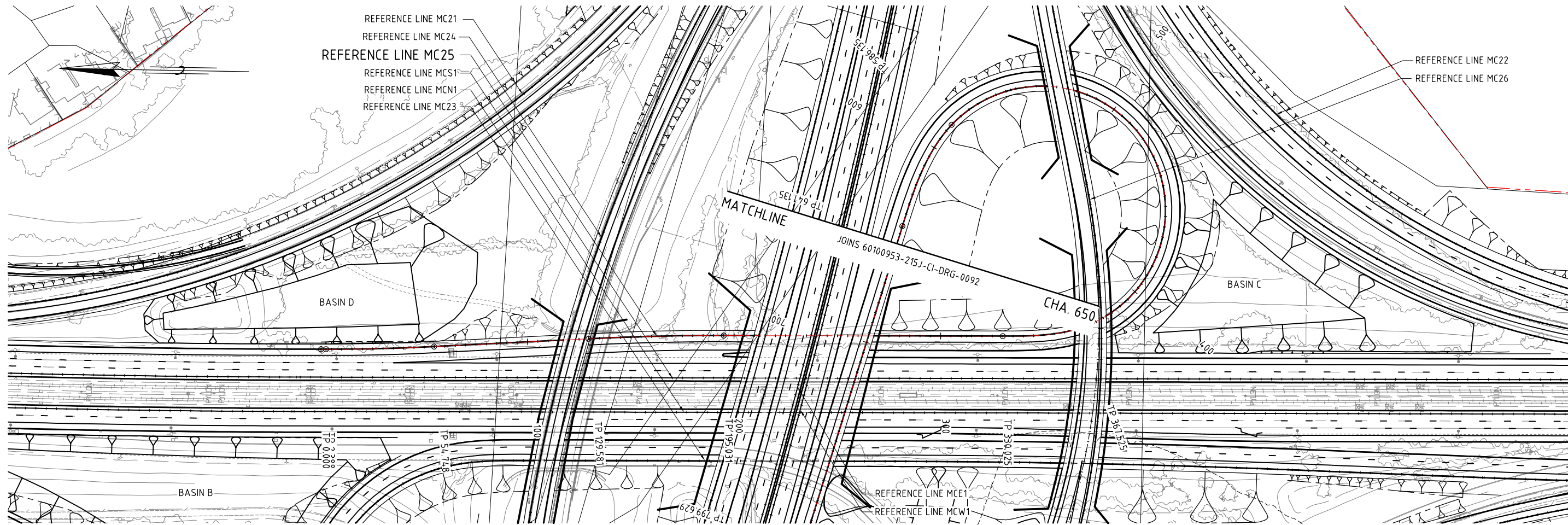
Waterloo Crescent East Perth 6004
Telephone (08) 9323 4111 Fax (08) 9323 4430
LOCAL AUTHORITY CITY OF COCKBURN (103) & CITY OF MELVILLE (119)





CONCEPT ONLY

			METADATA		NAMES PRINTED IN FULL		SIGNATURES AND DATE				SOUTH METRO CONNECT	
			GROUND SURVEY STANDARD:		DRAWN		VERIFIED / REVIEWED				ROE HIGHWAY (H18) EXTENSION - KAREL AVE TO STOCK RD	
			DATE OF CAPTURE:		AW/OI		DESIGN MANAGER				PLAN & PROFILE - CHA. 0 TO 500 (MC2G)	
			MAPPING SURVEY STANDARD:		GGM/WN/WB		ALLIANCE MANAGER				KWINANA FWY N/B OFF-RAMP TO MURDOCH DRIVE	
			DATE OF CAPTURE:		CHECKED		PROJECT DIRECTOR				DRAWING STATUS	
			MAIN ROADS PROJECT ZONE:		GGM/NSW						CONCEPT	
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											REV	
											A	



PLAN
SCALE 1:1000

NATURAL SURFACE
REFERENCE LINE MC25

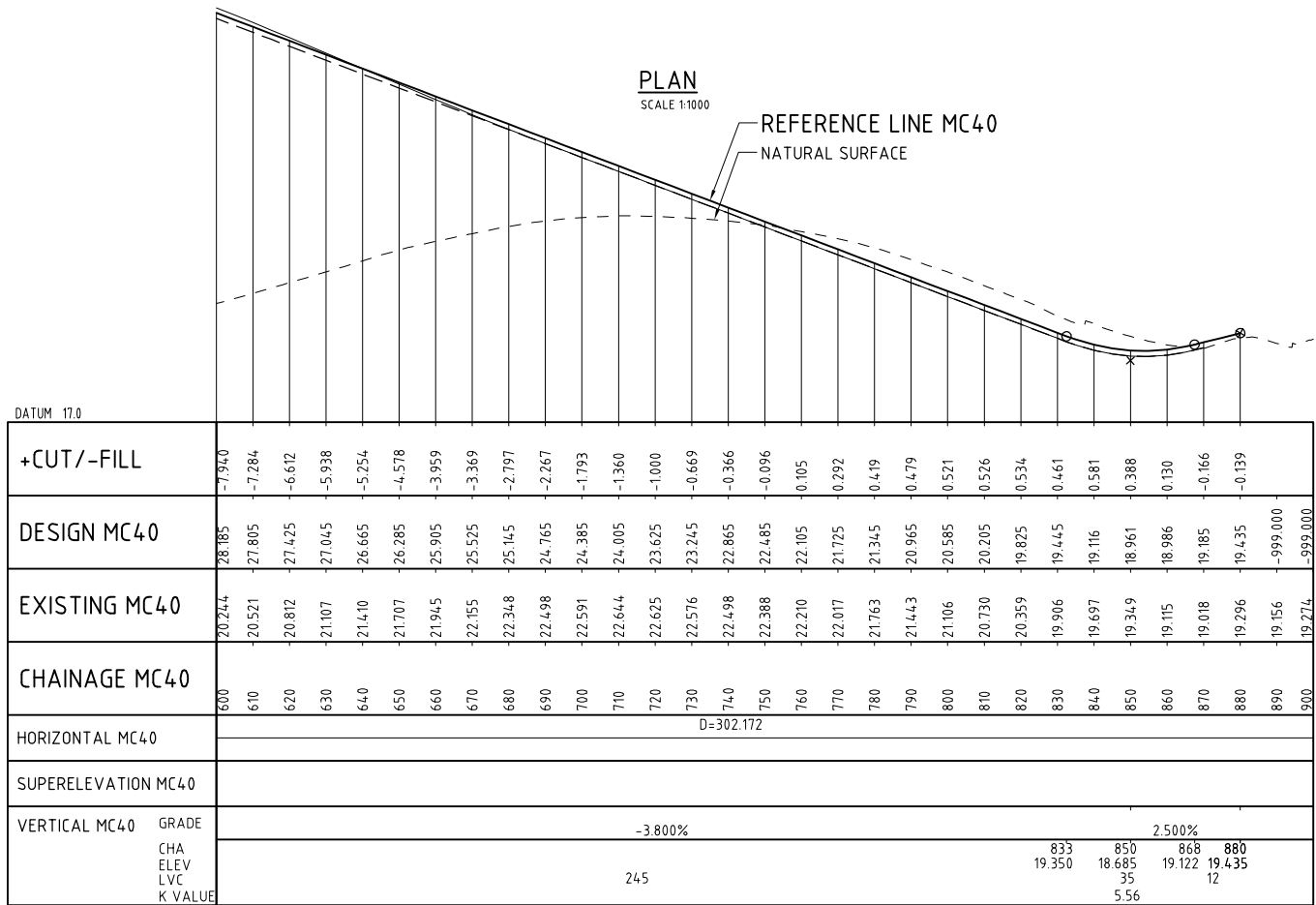
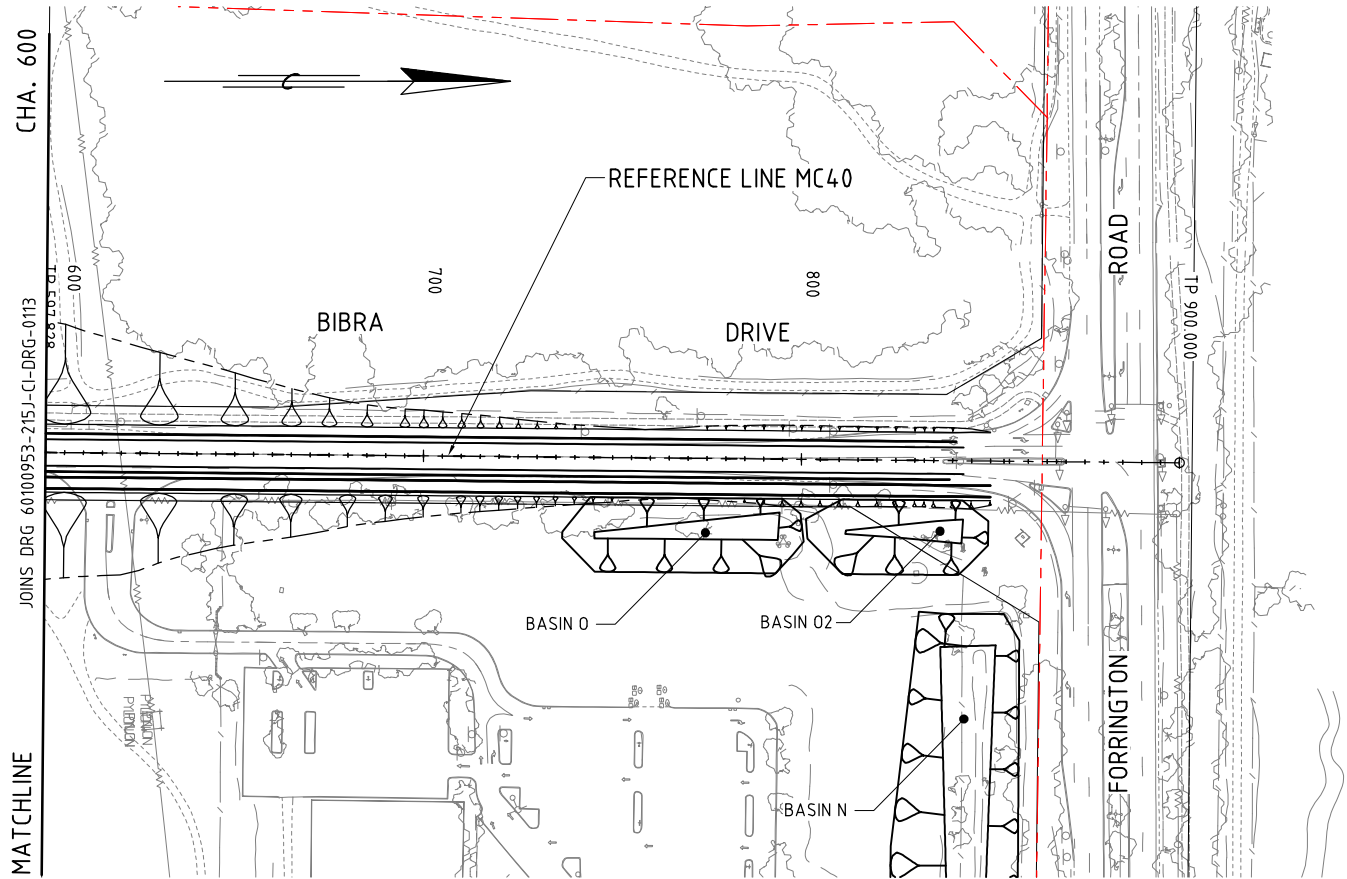
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DESIGN MC25	27.826 27.869 27.890 27.910 27.943 27.987 28.014 28.034 28.063 28.106 28.170 28.244 28.308 28.350 28.378 28.404 28.437 28.481 28.532 28.582 28.632 28.682 28.734 28.790 28.851 28.918 28.989 29.065 29.146 29.233 29.324 29.420 29.520 29.620 29.720 29.820 29.920 30.020 30.120 30.220 30.320 30.424 30.544 30.680 30.832 31.000 31.184 31.384 31.600 31.832 32.080 32.344 32.624 32.920 33.232 33.560 33.900 34.240 34.580 34.920 35.260 35.600 35.940 36.280 36.620 36.949
EXISTING MC25	27.736 27.768 27.802 27.867 27.939 27.968 28.024 28.128 28.125 28.432 28.461 28.308 28.420 28.462 28.498 28.505 28.647 28.792 28.933 29.291 29.048 29.926 30.127 30.250 30.071 30.030 30.063 30.158 30.144 30.122 30.287 30.348 30.402 30.403 30.557 30.842 31.638 32.667 34.137 36.105 38.733 41.148 42.173 42.303 42.003 42.209 42.091 41.758 41.682 41.283 40.862 40.316 39.569 39.094 38.693 38.073 37.444 36.724 36.265 35.892 35.419 34.972 34.694 34.266 33.996 33.793
CHAINAGE MC25	0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490 500 510 520 530 540 550 560 570 580 590 600 610 620 630 640 650
HORIZONTAL MC25	R=1000.000 L=52.360 D=74.833 R=1250.000 L=65.450 D=134.994 CL R=-60.000 L=218.610 CL=55.000 D
SUPERELEVATION MC25	
VERTICAL MC25	GRADE CHA ELEV LVC K VALUE
	0.501% 180 28.532 32 212 28.695 262 28.945 100 200.24 312 29.445 90 403 30.345 478 31.095 150 62.50 553 33.645 88 640 36.620 -

PROFILE
SCALE VERTICAL 1:100
HORIZONTAL 1:1000

CONCEPT ONLY

				METADATA		NAMES PRINTED IN FULL		SIGNATURES AND DATE			 	SOUTH METRO CONNECT					
				GROUND SURVEY STANDARD:		DRAWN		VERIFIED / REVIEWED				ROE HIGHWAY (H18) EXTENSION - KAREL AVE TO STOCK RD					
				DATE OF CAPTURE:		AW/OI						PLAN & PROFILE - CHA. 0 TO 650 (MC25)					
				MAPPING SURVEY STANDARD:		GGM/WN/WB		DESIGN MANAGER				W/B ONRAMP FORM KWINANA FREEWAY S/B					
				DATE OF CAPTURE:		CHECKED		ALLIANCE MANAGER		INFRASTRUCTURE DELIVERY DIRECTORATE							
A 02/02/11		ISSUED FOR INTERNAL REVIEW		TL		GGM/NSW		PROJECT DIRECTOR		Waterloo Crescent Telephone (08) 9323 4111		East Perth 6004 Fax (08) 9323 4430					
No. DATE		DESCRIPTION		APPROVED		MAIN ROADS PROJECT ZONE:				LOCAL AUTHORITY CITY OF COCKBURN (103) & CITY OF MELVILLE (119)		DRAWING STATUS		DRAWING No.		REV	
						PCG 94						CONCEPT		60100953-215J-CI-DRG-0091		A	
						HEIGHT DATUM:											



PROFILE

SCALE VERTICAL 1:100
HORIZONTAL 1:1000

METADATA

GROUND SURVEY STANDARD:
DATE OF CAPTURE:
MAPPING SURVEY STANDARD: 67/08/44
DATE OF CAPTURE: NOVEMBER 2008
MAIN ROADS PROJECT ZONE: PCG 94
HEIGHT DATUM: AHD

NAMES PRINTED IN FULL

DRAWN
AW/OI
DESIGNED
GGM/WN/WB
CHECKED
GGM/NSW

SIGNATURES AND DATE

VERIFIED / REVIEWED
DESIGN MANAGER
ALLIANCE MANAGER
PROJECT DIRECTOR



INFRASTRUCTURE DELIVERY DIRECTORATE

Waterloo Crescent
Telephone (08) 9323 4111

East Perth 6004
Fax (08) 9323 4430

LOCAL AUTHORITY CITY OF COCKBURN (103) & CITY OF MELVILLE (119)

CONCEPT ONLY

MRWA DRAWING NUMBER

SOUTH METRO CONNECT

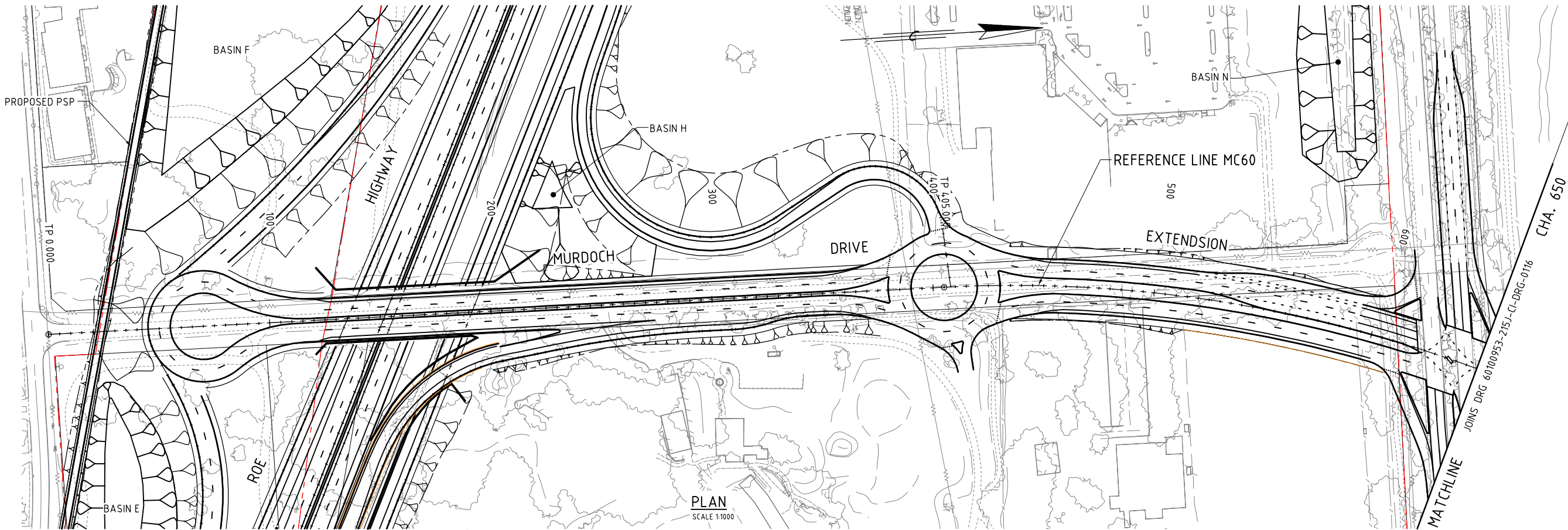
ROE HIGHWAY (H18) EXTENSION - KAREL AVE TO STOCK RD
PLAN & PROFILE - BIBRA DRIVE
CHA. 600 TO 900 (MC40)

DRAWING STATUS
CONCEPT

DRAWING No.
60100953-215J-CI-DRG-0114

REV
A

A	02/02/11	ISSUED FOR INTERNAL REVIEW	TL
No.	DATE	DESCRIPTION	APPROVED

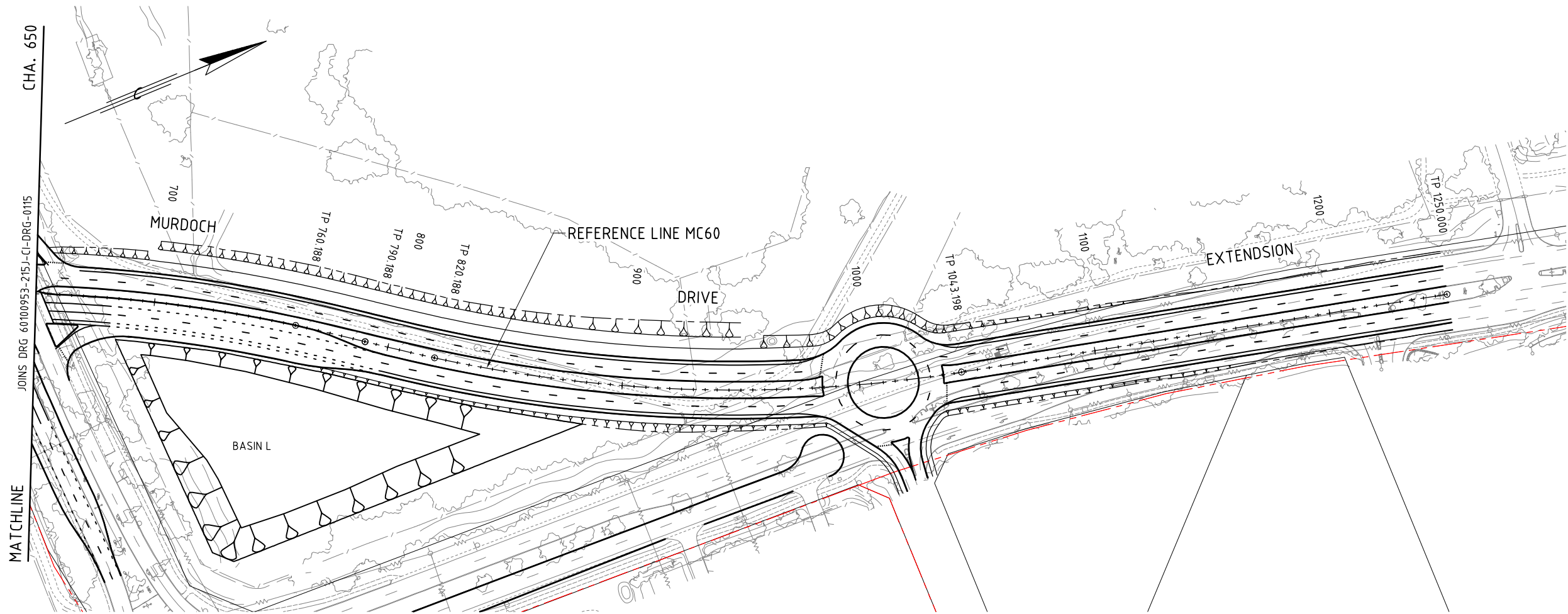


DATUM 19.0	
+CUT/-FILL	-5.762 -5.261 -4.792 -4.331 -3.930 -3.486 -3.113 -2.762 -2.487 -2.211 -1.966 -1.711 -1.516 -1.277 -1.080 -0.899 -0.698 -0.507 -0.355 -0.185 0.002 0.178 0.338 0.526 0.669 0.756 0.886 0.983 1.070 1.165 1.208 1.218 1.245 1.255 1.275 1.218 1.185 1.096 1.003 0.879 0.748 0.621 0.506 0.431 0.401 0.442 0.459 0.396 0.587 0.777 0.996 1.229 1.446 1.596 1.751 1.706 0.208 -0.195 -0.238 0.117 -0.095
DESIGN MC60	29.000 29.100 29.200 29.300 29.400 29.500 29.598 29.684 29.755 29.812 29.855 29.884 29.898 29.898 29.884 29.855 29.812 29.755 29.684 29.598 29.498 29.384 29.255 29.112 28.955 28.784 28.598 28.399 28.192 27.978 27.757 27.530 27.295 27.053 26.805 26.549 26.287 26.017 25.741 25.457 25.167 24.870 24.566 24.255 23.937 23.612 23.287 22.965 22.660 22.375 22.110 21.865 21.640 21.435 21.250 21.085 20.940 20.812 20.687 20.562 20.437
EXISTING MC60	23.239 23.840 24.408 24.969 25.471 26.015 26.485 26.922 27.268 27.602 27.889 28.172 28.383 28.621 28.803 28.957 29.115 29.248 29.328 29.414 29.500 29.562 29.593 29.638 29.624 29.540 29.485 29.383 29.263 29.143 28.966 28.748 28.539 28.309 28.079 27.768 27.472 27.113 26.744 26.337 25.915 25.490 25.072 24.685 24.337 24.054 23.716 23.361 23.247 23.152 23.106 23.094 23.086 23.031 23.000 22.792 21.148 20.617 20.449 20.679 20.342
CHAINAGE MC60	50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490 500 510 520 530 540 550 560 570 580 590 600 610 620 630 640 650
HORIZONTAL MC60	D=405.000 R=600.000 L=355.188
SUPERELEVATION MC60	
VERTICAL MC60	GRADE CHA ELEV LVC K VALUE
	1.0000% 2.0000% -3.250%
	105 29.550 210 30.600 210 70.00 315 28.500 405 26.700 180 144.00 495 23.775 515 23.125 565 21.500 100 50.00 615 20.875

PROFILE
SCALE VERTICAL 1:100
HORIZONTAL 1:1000

CONCEPT ONLY

			METADATA		NAMES PRINTED IN FULL		SIGNATURES AND DATE				SOUTH METRO CONNECT	
			GROUND SURVEY STANDARD:		DRAWN		VERIFIED / REVIEWED				ROE HIGHWAY (H18) EXTENSION - KAREL AVE TO STOCK RD	
			DATE OF CAPTURE:		DESIGNED		DESIGN MANAGER				PLAN & PROFILE-MURDOUCH DRIVE EXTENSION	
			MAPPING SURVEY STANDARD:		CHECKED		ALLIANCE MANAGER				CHA. 50 TO 650 (MC60)	
			DATE OF CAPTURE:				PROJECT DIRECTOR				DRAWING STATUS	
			MAIN ROADS PROJECT ZONE:								CONCEPT	
			HEIGHT DATUM:								DRAWING No.	
											60100953-215J-CI-DRG-0115	
											REV	
											A	



PLAN
SCALE 1:1000

