



Town Planning & Urban Design

Parkland Heights Local Structure Plan

Lot 1507 Eighty Road, Baldivis

Part 1

MARCH 2025

Parkland Heights Local Structure Plan.

PART 1

MARCH 2025

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DOCUMENT STATUS

Version	Comment	Prepared	Reviewed	Issued
1	Amendment 5 Lodgement	TV	KB	06.12.2018
2	Amendment 5 WAPC Modification	TV	KB	09.12.2020
3	Amendment 6 Lodgement	KG	KB	08.10.2024
4	Amendment 6 WAPC modification	KG	KB	27.03.2025

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ENDORSEMENT

This structure plan was prepared under the provisions of the City of Rockingham
Town Planning Scheme No. 2

IT IS CERTIFIED THAT AMENDMENT NO. 6 TO THE PARKLAND HEIGHT STRUCTURE PLAN
WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION
ON:

6 MAY 2025

Signed for and on behalf of the Western Australian Planning Commission



an officer of the Commission duly authorised by the Commission pursuant to Section 24 of the
Planning and Development Act 2005 for that purpose.

EXPIRY DATE: 19 OCTOBER 2032

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Table of Amendments

Amendment No.	Summary of Amendment	Amendment Type	Date Approved by Council/WAPC
1	Stage 4 & 5 Lot Product Alterations	Minor	N/A
2	Stage 6 Lot Product Alterations; and Introduce Part 1 & R-MD Code Provisions	Minor	N/A
3	Increased residential density from 'R20' to 'R25' in select locations over portion of the Structure Plan area east of Nairn Drive; Increased residential density from 'R30' to 'R40' for lots with laneway access over portion of the Structure Plan area east of Nairn Drive; and Introduced 'RMD' Provisions over lots east of Nairn Drive designated 'R25' and 'R40' to be developed for a single house	Minor	N/A
4	Introduce 'Commercial' zone over previous 'Village Centre' west of Nairn Drive and delete note 3 from Structure Plan Map; Introduce 'Special Use' zone over previous 'Village Centre' east of Nairn Drive; Introduce requirement to prepare Local Development Plan/s over land zoned 'Commercial' and 'Special Use'; Delete Table 1 - Single House (RMD) Standards for Medium Density Housing; and Update terms of reference and structure of Part 1 - Implementation Report consistent with the <i>Planning and Development (Local Planning Scheme) Regulations 2015</i> and the WAPC's 'Structure Plan Framework' (August 2015)	Standard	13/02/2019
5	Minor updates including: <ul style="list-style-type: none"> Removal of left in, left out access point located on the south bound land (eastern side) of Nairn Drive; Modify the access street internal road network in the north eastern portion of the Structure Plan area (Stages 13 and 14); Increase the residential density of the grouped dwelling site of the corner of Nairn Drive and the east/west neighbourhood connector road from R40 to R60; Modify the configuration of POS K; and Modify the southern portion of the structure plan area to reflect WAPC subdivision approval 156276. 	Minor	23/12/2020
6	Minor amendments including: <ul style="list-style-type: none"> Removal of 8x R40 grouped housing sites; Removal of the majority of the R40 rear loaded laneway product; Introduction of additional R30 & R40 single residential lot product. Minor re-alignment and re-design of the road structure to respond to the change in lot product. Minor re-alignment of lot boundaries within existing cell boundaries. 	Minor	25/03/25

Table of Density Plans

Density Plan No.	Area of Density Plan Application	Date Endorsed by WAPC
RHPPH-2-001 Rev B	Changes to the Structure Plan to accord with Amendment 6	25/03/25

Executive Summary.

This Structure Plan has been prepared to facilitate the coordinated development of the residual balance of Lot 1507 Eighty Road, Baldivis (Parkland Heights Estate).

The subject site is located within the South West Corridor of the Perth Metropolitan Region within the municipality of the City of Rockingham, approximately 10km south-east of the Rockingham Strategic Metropolitan Centre and 2.5km south of the Baldivis Town Centre.

The Structure Plan proposes continued development of the land predominantly for residential purposes, inclusive of a range of residential densities and associated public reserves.

The subject land is owned by Rockingham Park Pty Ltd.

Table 1: Executive Summary Table

Item	Data
Total area covered by the Structure Plan	120.8ha
Area of each land use proposed (approx.)	
Residential (nett)	60.48ha
Commercial	5.11ha
Special Use	1.31ha
Roads	37.06ha
Public Open Space	12.94ha
Public Purposes (Primary School)	4.03ha
Estimated lot yield	1,200 lots
Estimated dwellings	1,580 dwellings
Estimated commercial floorspace	10,000m ² NLA of retail/shop 4,500m ² GFA other non-residential
Estimated residential density	~ 15+ dwellings/gross urban zone ¹ ~26+ dwellings/site hectare ²
Estimated population (based on 2.8 persons per dwelling)	4,420 people
Primary School	1 site
Estimated number and % of Public Open Space given over to:	
Local Parks (< 3,000m ²)	4 @ 0.88ha (6.9%)
Neighbourhood Parks (> 3,000 ² - 2.5ha)	9 @ 6.22ha (48.3%)
District Open Space (> 2.5ha)	1 @ 5.77ha (44.8%)

FOOTNOTES:

¹ 'Gross Urban Zone' refers to the definition under WAPC's Directions 2031 and supporting documents.

² 'Residential Site Hectare' refers to the definition under Element 1 of WAPC's Liveable Neighbourhoods.

Parkland Heights Local Structure Plan

PART ONE - IMPLEMENTATION REPORT



1 Structure Plan Area

This Structure Plan shall apply to Lot 1507 Eighty Road being the land contained within the inner edge of the line denoting the structure plan boundary on the Structure Plan Map.

The Structure Plan is identified as the Parkland Heights Structure Plan.

2 Operation

Pursuant to clause 28, Schedule 2 of the *Planning and Development (Local Planning Schemes) Regulations 2015* ('the Regulations'), this Structure Plan came into effect on the day in which it is approved by the Western Australian Planning Commission and is valid for a period of 10 years from the date of gazettal of the Regulations, being 19 October 2015, unless the period of approval is otherwise extended in accordance with the Regulations.

3 Interpretation and Relationship with Statutory Planning Framework

This Structure Plan has been prepared pursuant to clause 4.2 of the City of Rockingham Town Planning Scheme No. 2 ('the Scheme') as the subject land is zoned 'Development' and contained within Development Area No. 19 (shown on the Scheme Map and detailed within Schedule No.9).

The Structure Plan Map outlines the Zones and Reserves applicable within the Structure Plan area.

Pursuant to clause 27 (1), Schedule 2 of the Regulations, a decision maker of an application for development approval or subdivision approval on land within the boundaries of the Structure Plan is to have due regard to the provisions of the Structure Plan.

4 Subdivision and Requirements

The following development standards are to be read in addition to the provisions of the Scheme and other relevant City of Rockingham local planning policies.

4.1 Land Use Permissibility

Land use permissibility within the Structure Plan area shall be in accordance with the corresponding Zone under the Scheme.

4.1.1 Special Use Zone

A person shall not use any land, or any building or structure within the Special Use zone, except for the purposes set out in Table 2 and subject to compliance with any conditions set out under Table 2.

Table 2: Special Use Zone

No.	Site Description	Use	Special Conditions
1	Parkland Heights Neighbourhood Centre (east of Nairn Drive)	Group Dwelling Multiple Dwelling Short Stay Accommodation Child Care Premises Club Premises Consulting Rooms Health Studio Medical Centre Office Private Recreation	N/A

No.	Site Description	Use	Special Conditions
		Restaurant Shop Veterinary Clinic Educational Establishment	

4.2 Residential Density

4.2.1 Residential Zone

Residential Densities applicable to the Structure Plan area shall be those residential densities shown on the Structure Plan Map.

4.2.2 Commercial Zone and Special Use Zones

Residential development on land zoned 'Commercial' and 'Special Use' on the Structure Plan Map shall be in accordance with the R60 density code.

4.3 Notifications on Title

In respect of applications for the subdivision of land, the City may recommend the WAPC impose a condition of subdivision approval for a notification to be placed on the Certificates(s) of Title(s) for the following:

- Lots within 300m of a market garden which may be affected by odours, noise, spray drift and dust; and
- Lots identified as Bushfire Prone on the Department of Fire and Emergency Services *Map of Bush Fire Prone Areas* and with a Bushfire Attack Level (BAL) rating of 12.5 or above.

4.4 Residential Design Code Variations

All single dwelling development on land zoned R25 – R60 shall be assessed in accordance with the City of Rockingham's Planning Policy No. 3.3.22 – *Medium-Density Single House Development Standards – Development Zones*.

4.5 Lot Access

An average lot width of not less than 12 metres, with no more than five (5) adjoining lots with a frontage of less than 12 metres, is required in any street block where garage access is provided to the primary street.

5 Local Development Plans

5.1 Residential

Local Development Plans (LDP), are required to be prepared and approved pursuant to clause 47, Schedule 2, of the Regulations for lots with one or more of the following site attributes:

- Lots with rear-loaded vehicle access; and
- Lots with direct boundary frontage (primary or secondary) to an area of Public Open Space.

5.2 Commercial and Special Use

An LDP is required to be prepared and approved pursuant to clause 47, Schedule 2, of the Regulations prior to development or subdivision of the land zoned 'Commercial' and 'Special Use' on the Structure Plan Map.

Separate LDP's may be prepared for each side of Nairn Drive and, notwithstanding the above, a decision maker may approve development or subdivision over 'Commercial' or 'Special Use' zoned land in the

absence of an LDP if it is satisfied that the proposed development or subdivision would not prejudice the coordinated development of the land.

The LDP/s shall coordinate development of the 'Commercial' and 'Special Use' zoned land and address the following matters:

- The location of vehicle access points and indicative intersection treatments;
- The alignment of a 'Main Street' and other key internal vehicle circulation routes including service access and loading areas;
- The siting and orientation of key buildings and their interface with the street;
- The indicative location and distribution of retail and commercial uses;
- Key pedestrian routes and linkages through the site;
- Indicative car park locations and sizes;
- Provisions to ensure that ground level building facades appropriately respond to adjoining roads, footpaths and public spaces with particular regards to any buildings fronting the main street; and
- Variations to any built form development controls contained within a City of Rockingham Local Planning Policy or the R-Codes.

6 Other Requirements

6.1 Developer Contributions

This Structure Plan is located within Development Contribution Area No.2 of the Scheme. Residential uses are subject to contributions in accordance with Development Contribution Plan No.2 at Schedule 12 of the Scheme.

- ZONES/RESERVES**
- RESIDENTIAL R15
 - RESIDENTIAL R20
 - RESIDENTIAL R25
 - RESIDENTIAL R30
 - RESIDENTIAL R40
 - RESIDENTIAL R60
 - COMMERCIAL
 - SPECIAL USE
 - EDUCATION
 - PUBLIC OPEN SPACE

- OTHER**
- LOCAL STRUCTURE PLAN BOUNDARY
 - 400m NEIGHBOURHOOD WALKABLE CATCHMENT
 - PUMP STATION ODOUR BUFFER
 - POWERLINE EASEMENT
 - ROAD WIDENING (SIXTY EIGHT ROAD)
 - PLANNED BUS ROUTE
 - VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
 - SEWER PUMP STATION (900m² - 1220m²)

NOTES

- 1 The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
- 2 The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
- 3 POS Areas are indicative only and subject to further detailed design and drainage considerations.
- 4 All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-call and final survey and may vary from figures shown.
- 5 Baseline attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS2959 - Construction in Bushfire Prone Areas.
- 6 Sixty-Eight Road widening to accommodate future upgrade to boulevard standard. Construction requirements to be renegotiated at subdivision stage of development.



Scale: 1:5000 @ A3

0 60 120 180m

PLN: RHPH2-2001 REVISION: B
 DATE: 26/08/2024 DRAWING: P
 PROJECTION: PCS 94 PLANNER: CH
 DTD/ML: AHD CHECKER: B

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LOCAL STRUCTURE PLAN MAP
 Lot 1507 Eighty Road, BALDIMS
 A Rockingham Park Project



cdp



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Parkland Heights Local Structure Plan

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3. *ADDENDUM 2 - AMENDMENT NO.5 (2021)*
4. *ADDENDUM 3 - AMENDMENT NO.6 (2025)*



DOCUMENT HISTORY AND STATUS

Lot 1507 Eighty Road, Baldivis - Local Structure Plan		00/075	Revision	Reviewer	Date Issued
Prepared By:	Taylor Burrell Barnett Town Planning and Design 187 Roberts Road SUBIACO WA 6008 Phone: 9382 2911 Fax: 9382 4586 admin@tbbplanning.com.au	0	BDM	14.07.2011	
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		2	DR	05.04.2012	
		3	DR	19.07.2012	
		4	DR	18.12.2012	
In association with:	Emerge Associates: Landscape Architect ENV Australia : Environment & Urban Water Management Serling Consulting: Civil Engineering Transcore: Transport Planning Whelans: Mapping & Survey				

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APPENDICES

Appendix No.	Document Title	Approval Required or Support Document Only	Approval Status	Approval Agency
A	Pre-Lodgement Consultation Table	Support Document	-	-
B	Certificate of Title	Support Document	-	-
C	Environmental Assessment Report	Support Document	-	-
D	Supplementary Tree Information	Support Document	-	-
E	Fire Management Plan	Support Document	APPROVED	City of Rockingham
F	DoE Acceptance of Primary School Site	Support Document	-	-
G	Public Open Space Concepts	Support Document	-	-
H	Transport Assessment	Support Document	-	-
I	Nairn Drive Access Strategy	Support Document	-	-
J	Local Water Management Strategy	Approval Required	APPROVED	Department of Water
K	Service Infrastructure Report	Support Document	-	-

1 PLANNING BACKGROUND

1.1 BACKGROUND

This Local Structure Plan (LSP) has been prepared on behalf of Rockingham Park Pty Ltd, the owners of Lot 1507 Eighty Road, Baldvis and developer of Parkland Heights Estate.

An approved Comprehensive Development Plan (CDP) currently exists over approximately half of the site (west of Nairn Drive), with two stages of subdivision and a display home village currently under construction in accordance with that plan.

Due to the length of time since the original CDP's 2002 adoption, and the significant change in planning policy and market acceptance that has occurred since it was designed, Rockingham Park now wish to proceed with a comprehensive review of the total landholding including all undeveloped land either side of Nairn Drive.

1.2 INTRODUCTION & PURPOSE

Local Structure Plans are forward-planning documents that resolve regional and/or localised issues concerning land use and infrastructure and are often prepared as a precursor to extensive subdivision and development.

This Structure Plan has been prepared in accordance with Section 4.2 of Council's Town Planning Scheme in order to facilitate urbanisation of the subject site, being the site's transition from a rural to urban use. Through the use of graphics and supporting technical data, the Structure Plan recommends the preferred:

-  pattern of land use;
-  network and hierarchy of roads;
-  public open space network; and
-  servicing strategy for the precinct.

Once endorsed, the LSP will become the new reference document for all future subdivision and development within the subject site. It has been prepared with due regard to the requirements of Council's Scheme and is supported by a range of technical reports including environmental, traffic, hydrological and servicing analysis that can be found as Appendices to the rear of the report.

As required by the Department of Planning, the LSP has been prepared in accordance with the requirements of *Liveable Neighbourhoods Edition 3*, and has been structured having regard for both the City's Planning Procedure 1.6 (*Preparation and Assessment of Structure Plans*), and the Western Australian Planning Commission's *DRAFT Structure Plan Preparation Guidelines (August 2011)*.

1.3 PROJECT TEAM

This Local Structure Plan has been prepared by Taylor Burrell Barnett (TBB) in collaboration with the following team of specialist consultants:

ENV Australia
Environment &
Urban Water Management

Emerge Associates
Landscape Architect

Transcore
Transport Planning

Serling Consulting
Civil Engineering

Whelans
Mapping & Survey

Formulation of the LSP has involved consultation with the City of Rockingham, relevant Service Authorities and the Department of Planning, as summarised in the Pre-Lodgement Consultation Table attached as **Appendix A**.



LOCATION PLAN

Lot 1507 Eighty Road, Baldvis
 A Rockingham Park Pty Ltd Project



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figure
01

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1.4 LAND DESCRIPTION

1.4.1 LOCATION

Lot 1507 lies 10 km south east of the Rockingham Strategic Metropolitan centre and 45 km south of the Perth Central Business District (refer **Figure 1**). The Kwinana Freeway lies approximately 4 km to the east of the site providing convenient access to the rest of the Perth Metropolitan Region and beyond.

1.4.2 AREA & LAND USE

Measuring 120.8249 ha, research indicates that the site was not subject to any specific land use prior to 1963. Sometime between 1963 and 1974 the land was cultivated for forestry product purposes. There is no indication that the site was utilised for any other land use between 1973 and 2000. The Forest Products Commission began harvesting at the site sometime between 2001 and 2004 and completely withdrew from the land in 2010.

Prior to the commencement of the Stage 1 works, infrastructure associated with the site is limited to unsealed roads which run through the site and along the site perimeter. No other man-made infrastructure or dwellings were located on the site.

1.4.3 LEGAL DESCRIPTION & OWNERSHIP

The land is described as Peel estate Lot 1507 on Diagram 94627 being the whole of the land in Crown Title Volume 3115 Folio 948. The land is wholly owned by Rockingham Park Pty Ltd, with the only encumbrance being an existing 18m wide power line easement running along the western boundary of the property. A copy of the Certificate of Title is included as **Appendix B**.

1.5 PLANNING FRAMEWORK

1.5.1 METROPOLITAN REGION SCHEME

Lot 1507 is predominantly zoned 'Urban' under the Metropolitan Region Scheme (MRS). The only exception is the future alignment of Nairn Drive, which divides the site diagonally in half and is identified as an 'Other Regional Road' within a 40m wide reservation (refer **Figure 2**).

1.5.2 CITY OF ROCKINGHAM - TOWN PLANNING SCHEME NO.2

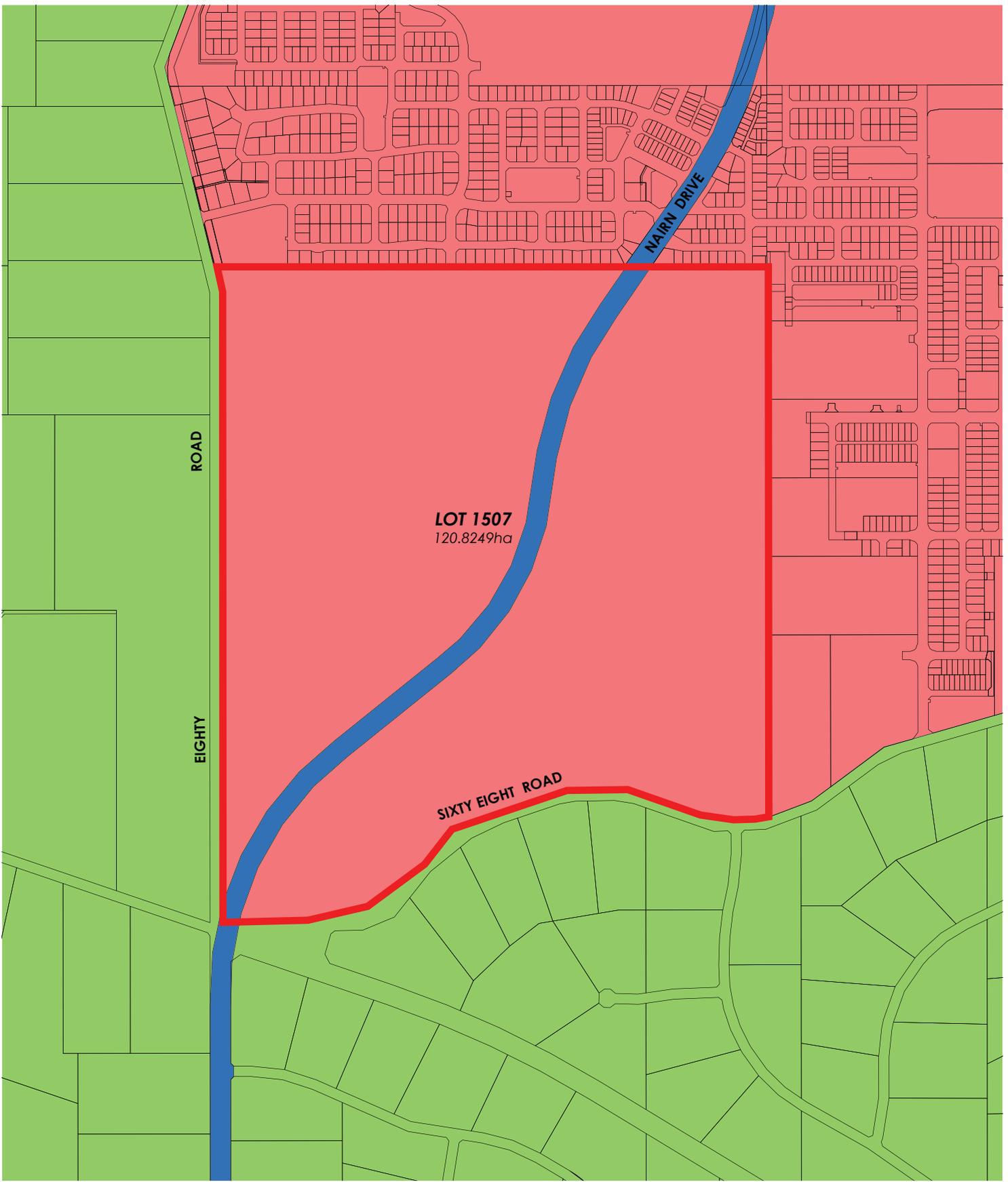
Aside from the MRS 'Other Regional Road' reservation the entirety of Lot 1507 is zoned 'Development' under the City of Rockingham's Town Planning Scheme No. 2 (TPS2 - refer **Figure 3**).

Clause 4.2.3 of the TPS2 defines the purpose of the Development Zone as follows:

-  To identify areas requiring comprehensive planning prior to subdivision and development; and
-  To coordinate subdivision, land use and development in areas requiring comprehensive planning.

Clause 4.2.4 goes on to specify the requirement for an LSP to be adopted over Development zoned land prior to substantive subdivision or development.

This requirement is then reiterated within Schedule 9 of TPS2, which identifies the land as Development Area No.19 for which an approved Structure Plan is required to guide future subdivision and development. The purpose of this LSP is to fulfil these requirements of TPS2.



LEGEND

	OTHER REGIONAL ROAD		URBAN		SUBJECT SITE
			RURAL		

EXISTING ZONING
METROPOLITAN REGION SCHEME

Lot 1507 Eighty Road, Baldvis
A Rockingham Park Pty Ltd Project

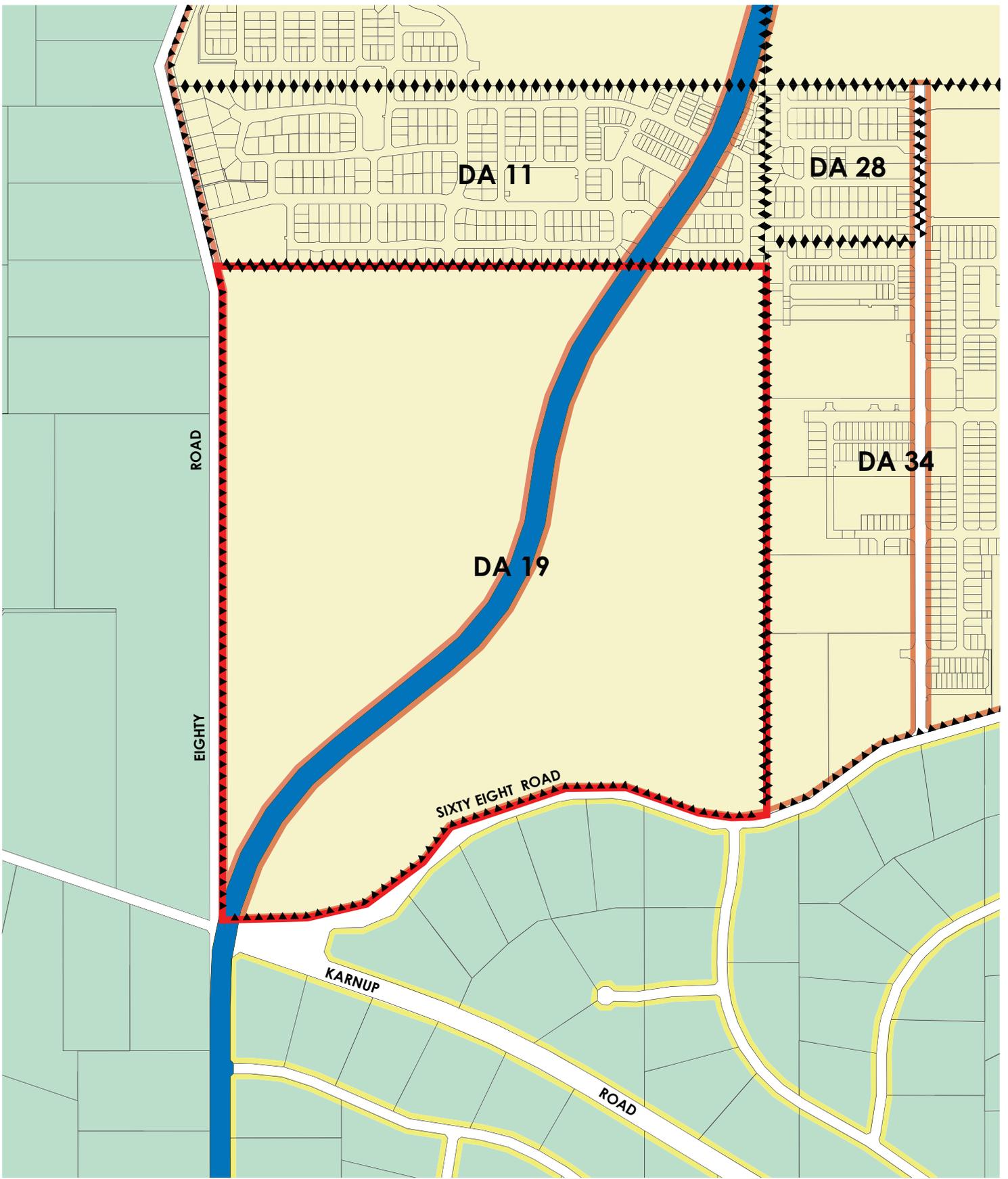


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figure
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LEGEND

METROPOLITAN REGION SCHEME RESERVES
 OTHER REGIONAL ROADS
 LOCAL ROADS

ZONES
 DEVELOPMENT
 RURAL
 SPECIAL RURAL

OTHER
 DEVELOPMENT AREA (see scheme text)
 SUBJECT SITE

EXISTING ZONING TOWN PLANNING SCHEME No. 2
 Lot 1507 Eighty Road, Baldvis
 A Rockingham Park Pty Ltd Project

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TAYLOR BURRELL BARNETT
 figure 03

LEGEND

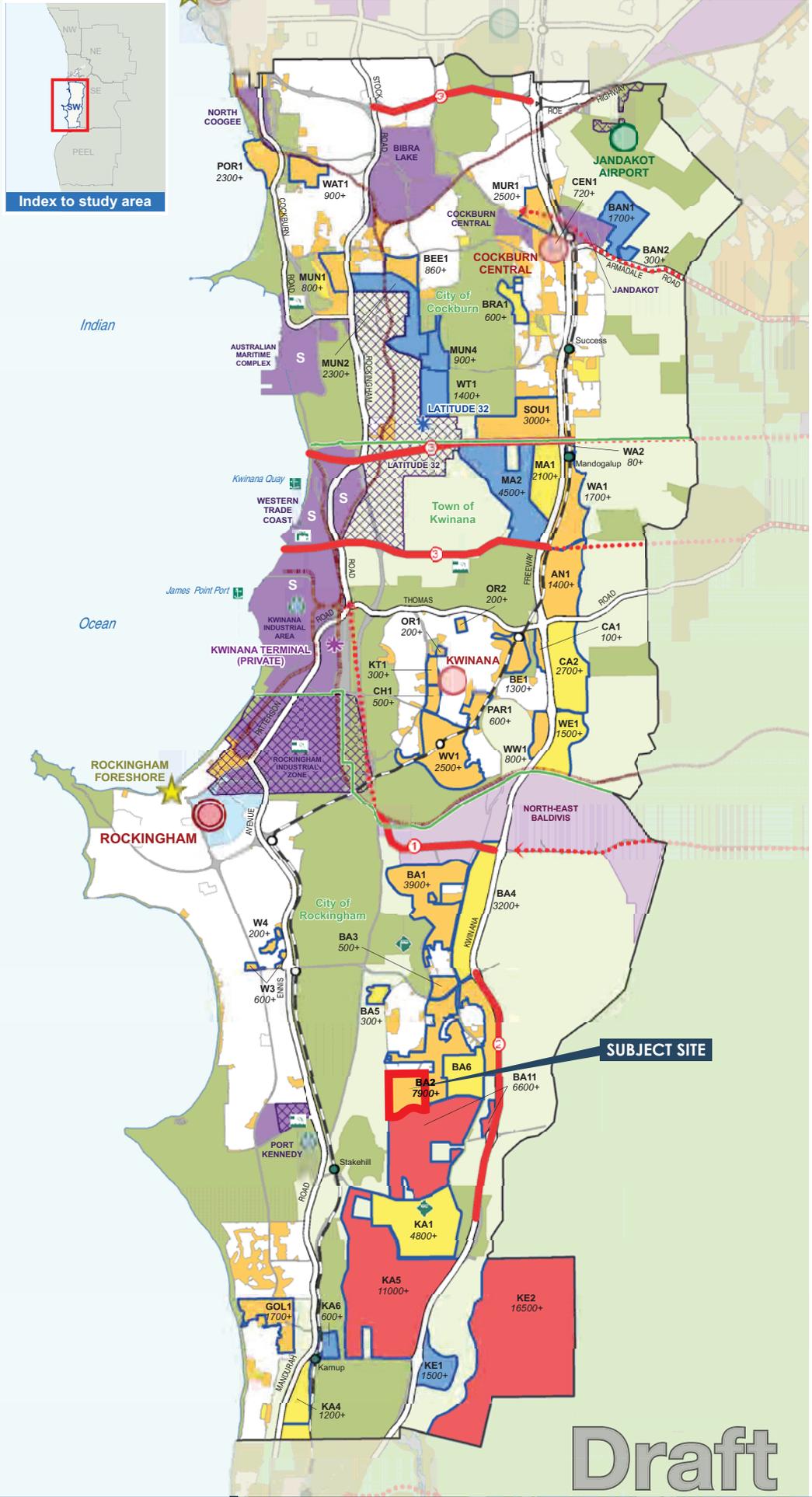
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Fig64_SouthWestSubRegionSpatialFrameworkMap.mxd

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Note:
Map is based on Region Scheme zones and
does not include redevelopment authority areas.

- S strategic industrial centre
- existing industrial centre
- priority industrial site - subject to investigation
- 2009 draft industrial land strategy area
- existing developed area
- central city area
- road or rail reservation
- region scheme reserves
- rural
- waterways
- urban expansion area 2011-2015
- urban investigation area 2011-2020
- urban zoned undeveloped
- urban deferred zoned undeveloped
- rural land being rezoned
- ABC1 area identifier
- 1234+ connected city scenario dwelling yield
- strategic metropolitan centre
- secondary centre
- specialised centre
- metropolitan attractor
- intermodal freight terminal
- planned intermodal freight terminal
- proposed water treatment plant
- major water storage / reservoir
- proposed water recycling plant
- proposed waste water treatment plant
- proposed port facility
- existing passenger railway station
- proposed passenger railway station
- existing metropolitan railway (indicative)
- existing freight railway
- major roads
- 1 new road construction (MRWA)
- 2 road upgrading (MRWA)
- 3 road planning (MRWA)
- strategic road planning
- local government boundary
- sub-region boundary



Draft

DRAFT SOUTH WEST SUB-REGIONAL SPATIAL FRAMEWORK
Lot 1507 Eighty Road, Baldvis
A Rockingham Park Pty Ltd Project



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1.5.3 STRUCTURE PLANNING

1.5.3.1 DRAFT OUTER METROPOLITAN SUB REGIONAL STRATEGY

Sub-Regional strategies provide a framework for delivering the objectives of Directions 2031 (the highest level of strategic metropolitan planning in Western Australia). They identify a strategic plan of actions, stakeholder responsibilities and timeframes for delivery. Importantly, they also express dwelling targets based on defined areas that strive to improve land efficiency and counter the trend towards urban sprawl.

The *Draft Outer Metropolitan Sub-Regional Strategy* (2010) identifies Lot 1507 as being located within the Cell 'BA2' area, being undeveloped land within the existing Urban zone. Encompassing the undeveloped balance of the Baldvis South District Structure Plan area and small portions of surrounding land, a target of an additional 7,900 dwellings is identified in the Draft Strategy for this cell (refer **Figure 4**).

A finalised version of the Strategy was due to be released by the Department of Planning in late 2011.

1.5.3.2 SOUTH WEST CORRIDOR STRUCTURE PLAN

The *South West Corridor Structure Plan* (1993) provides the current framework for urban development within the South West corridor. The Structure Plan also identifies the location and hierarchy of activity centres, major employment areas and proposals for regional open space and regional roads.

The SWCSP classifies the subject site as Category 'A1 – Future Urban', being land that has no constraints to urban development within the short-term future (refer **Figure 5**).

1.5.3.3 SOUTH BALDIVIS DISTRICT STRUCTURE PLAN

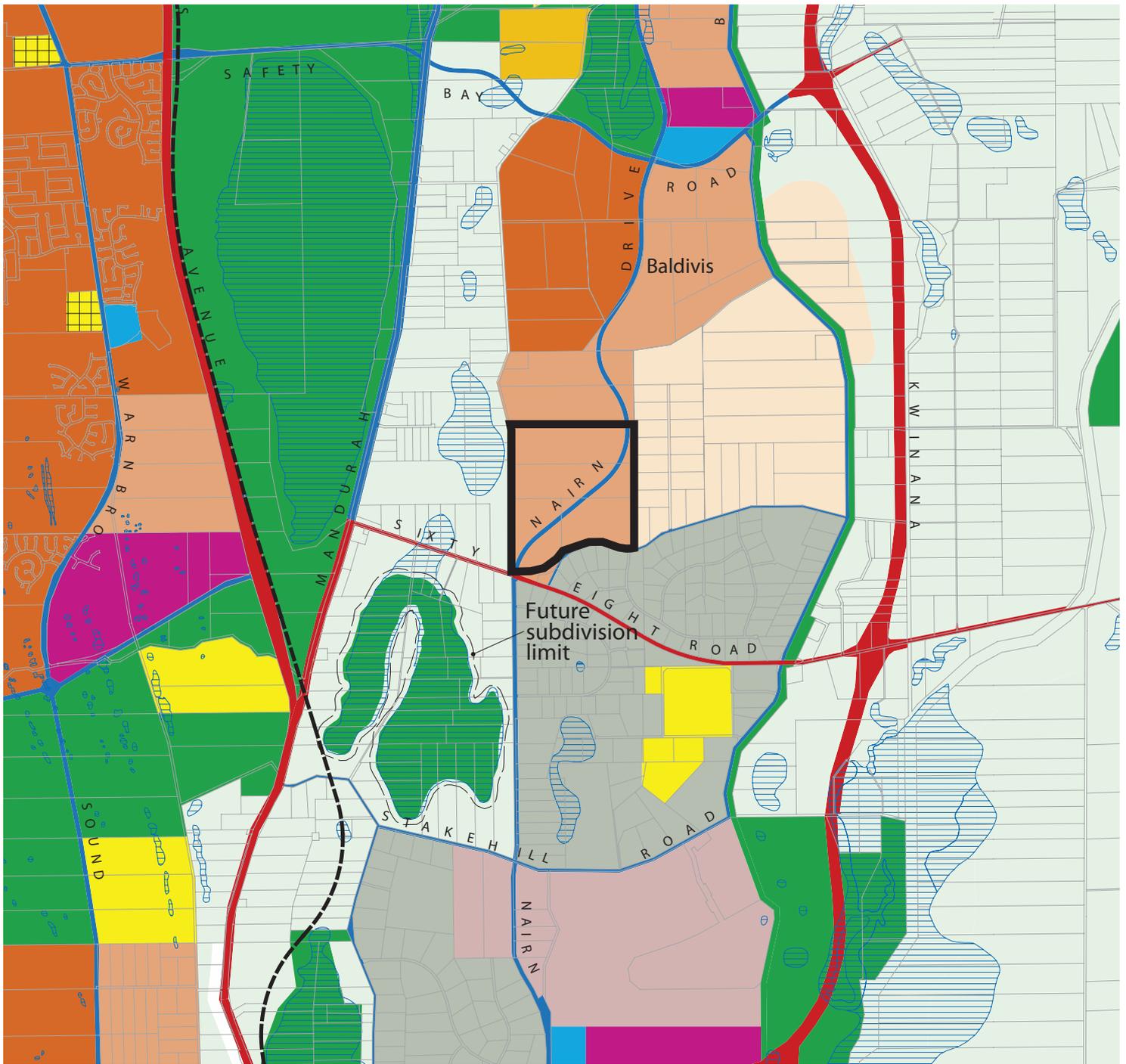
The South Baldvis District Structure Plan (DSP) provides the strategic framework for the coordination and preparation of LSP's in this locality. The subject land is identified as being located within Precinct 2 of the DSP (refer **Figure 6**), for which the following development parameters are attributed:

-  Gross area of 193.68 ha, with a predominant zoning of 'Urban';
-  Approximate yield of 1,593 lots with an ultimate population of 4,301 people;
-  A Neighbourhood Centre with a maximum Retail NLA of 2,070m²;
-  Approximately 22.76 ha of Public Open Space (POS) and Drainage; &
-  A government Primary School.

On a proportional basis the LSP satisfies the requirements of the DSP as demonstrated in the following table:

Category	DSP Target	LSP	Relative Proportion
Gross Area	193.68 ha	120.82 ha	62.4%
Dwelling Yield	1593	1447	90.8%
Population (@ 2.7 persons / dwelling)	4301	3907	90.8%
Neighbourhood Centre (2,070m ² NLA)	✓	(Lot 731)	-
POS & Drainage	22.76 ha	13.01 ha	57.2%
Primary School	✓	✓	-

The LSP is therefore consistent with strategic direction provided by the DSP and the nominal requirements pertaining to the land. The higher than expected yield is a direct response to the targets set in the Outer Metropolitan sub-Regional Strategy. Its performance against the criteria expressed in Liveable Neighbourhoods is outlined in **Section 3.4.1**.



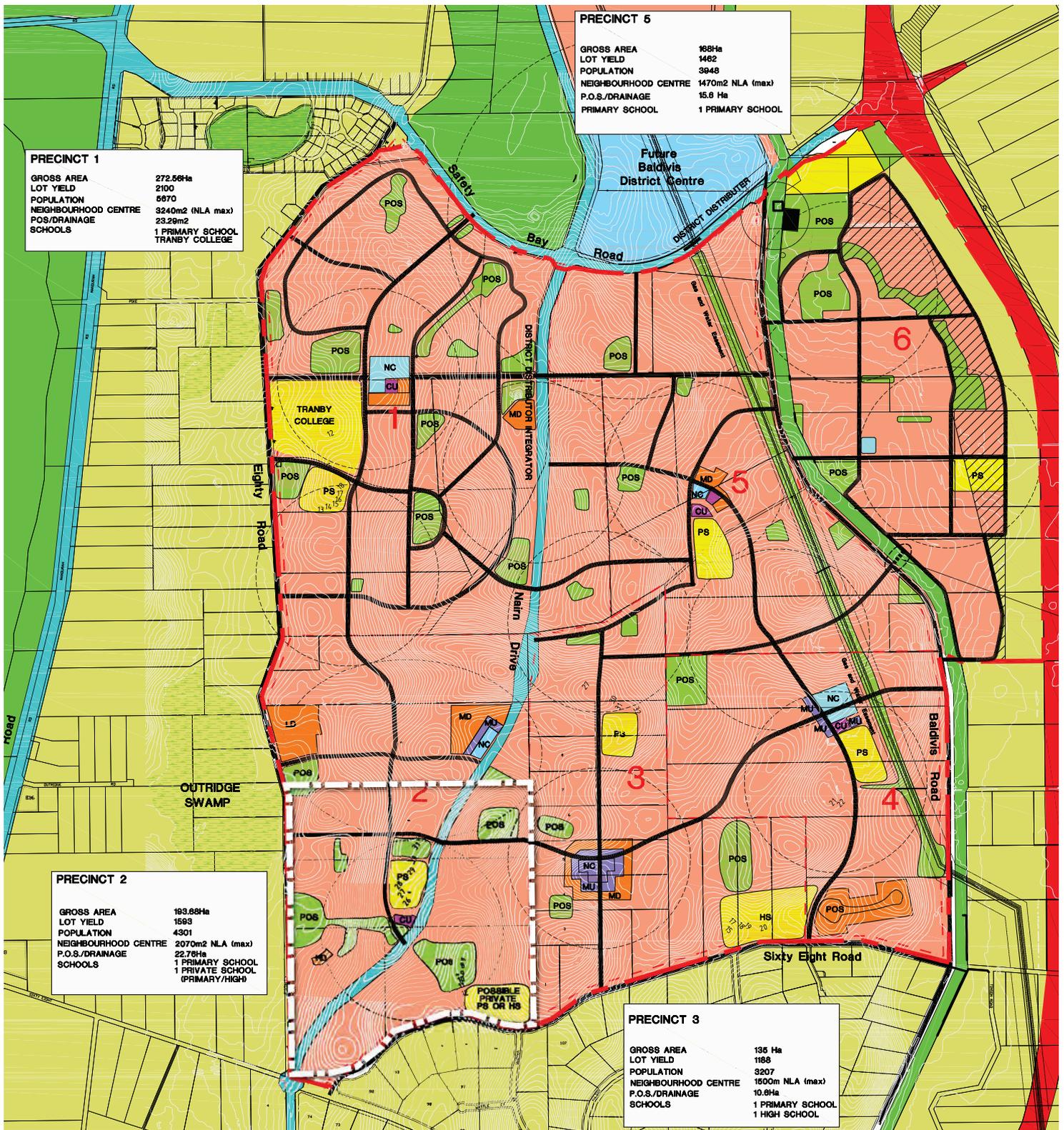
LEGEND

- | | | |
|--|--|--|
|  SUBJECT SITE |  Institutional |  Mining Related Activities |
|  MRS Urban and Urban Deferred |  Tourist and Recreational Development |  Wetlands |
|  Category A1 Future Urban |  Public Utilities |  Primary Road |
|  Category A2 Future Urban |  Open Space |  District (Distributor) Road |
|  Category B Future Urban |  Rural |  Existing Railway Reserve |
|  Major Commercial/Institutional and Employment C |  Rural Living - Ultimate Urban |  Proposed Rapid Transport Route |
|  Industrial |  Area subject to further study |  Air Pollution Shadow |
|  Mixed Business Areas |  Basic Raw Materials | |

* Refer to the Urban Expansion Policy Statement (1990)
 Note: All alignments and boundaries are indicative only

EXTRACT OF SOUTH WEST
 CORRIDOR STRUCTURE PLAN
 Lot 1507 Eighty Road, Baldvis
 A Rockingham Park Pty Ltd Project





LEGEND

- SUBJECT SITE
- STRUCTURE PLAN BOUNDARY
- PRIMARY DISTRIBUTOR ROAD
- DISTRICT DISTRIBUTOR ROAD A & B
- NEIGHBOURHOOD CONNECTOR ROADS
- REGIONAL OPEN SPACE
- PUBLIC OPEN SPACE & DRAINAGE
- RURAL
- LOCAL CENTRES (LC)
- URBAN

- POTENTIAL URBAN LAND
- SCHOOLS
- NEIGHBOURHOOD CATCHMENTS
- WALKABLE CATCHMENTS
- PUBLIC PURPOSE**
- NC Neighbourhood Centre
- LD Low Density
- MD Medium Density
- MU Mixed Use
- CU Community Use

* Home Stores not included, refer to Retail Strategy

1.5.3.4 EXISTING COMPREHENSIVE DEVELOPMENT PLAN

A Comprehensive Development Plan (CDP) for Lot 1507 was approved by the Western Australian Planning Commission on the 27th November 2002. Limited to west of Nairn Drive, the CDP provides for conventional residential development across the site inclusive of a Primary School, community centre, POS network and limited commercial opportunities. An indicative road network is also depicted over the land east of Nairn Drive.

Clause 4.2.11 of TPS2 empowers any CDP duly approved by the Council and the Commission under Clause 5.25 of the former Town Planning Scheme No.1 as if it were approved as a Structure Plan under Clause 4.2.6.15 of TPS2. Thus, pending approval of this LSP, the CDP remains the current operational Structure Plan for Lot 1507.

On the 2nd December 2010, and again on the 21st March 2011, minor modifications to the CDP relating to Stages 1 and 2 of Parkland Heights Estate were approved by the City pursuant to Clause 4.2.7 of TPS2. A copy of the current Structure Plan is included as **Figure 7**.

1.5.4 RELEVANT PLANNING POLICIES

1.5.4.1 LIVEABLE NEIGHBOURHOODS (WAPC, 2007)

Liveable Neighbourhoods (LN) is the Western Australian Planning Commission's operational policy guiding the design and approval of structure plans for greenfield sites. The objective of LN is the delivery of new developments that provide high quality living, working and recreational environments, thereby contributing to the successful implementation of the *State Planning* and *State Sustainability Strategies*.

The LSP meets the requirements of LN, with a particular focus on the following key aims:

-  An urban structure based on interconnected, safe and walkable neighbourhoods;
-  Creating a sense of community, identity and a sense of place;
-  Providing a variety of lot sizes and housing types to cater for the diverse housing needs of the community at density that can support local services and public transport; and
-  Maximising land efficiency wherever possible.

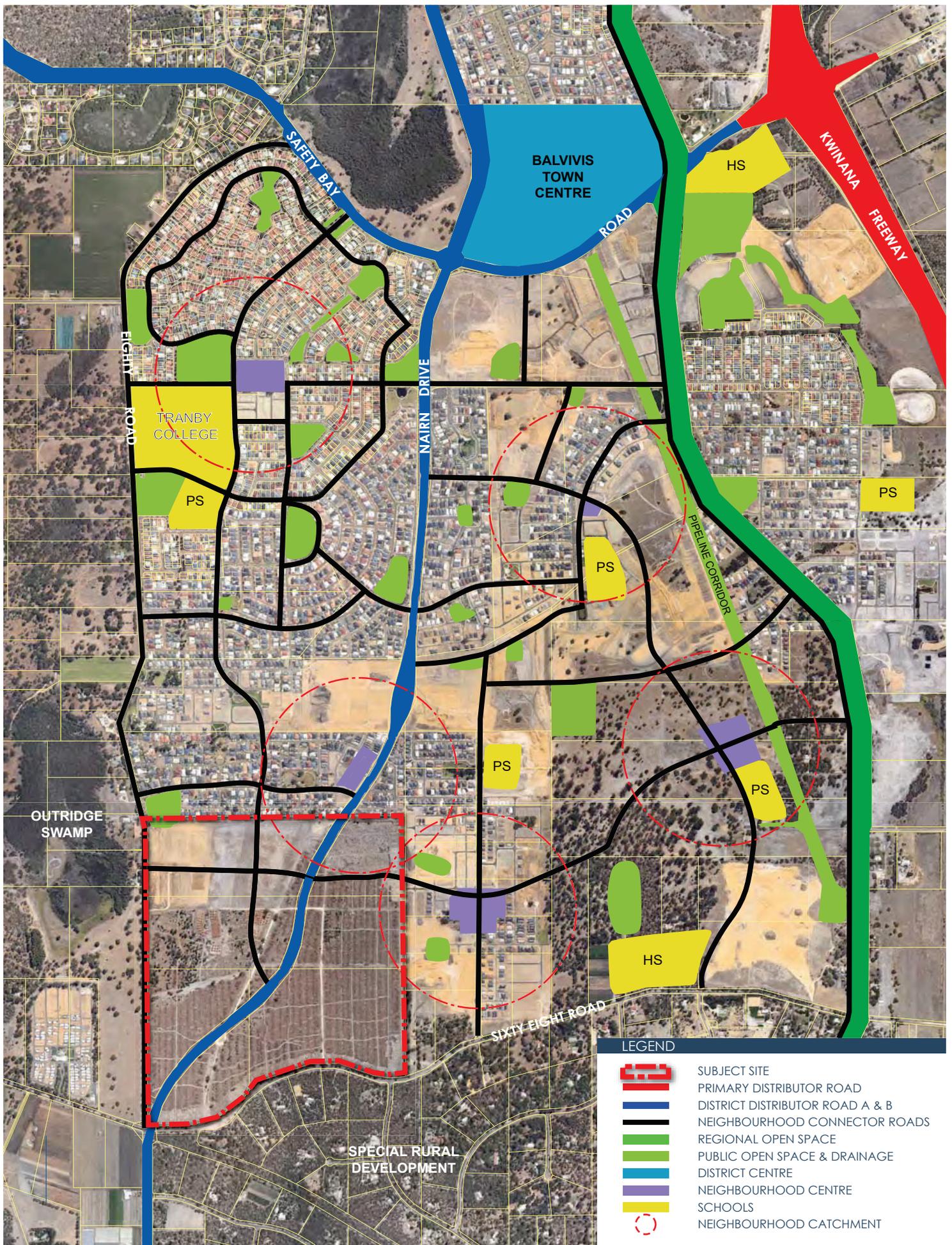
1.5.4.2 PLANNING POLICY NO 3.4.1 – PUBLIC OPEN SPACE (CITY OF ROCKINGHAM, 2009)

This Policy sets out “the objectives and policy provisions which the Council shall have due regard to in assessing the provision, location, design and development of POS within the City of Rockingham.

Some of the key policy statements include:

-  Requirement for the lodgement of a POS Concept Plan, POS Schedule and Local Water Management Plan to accompany proposed Structure Plans;
-  Criteria for the provision of restricted POS, community purpose sites and the joint use of POS;
-  Criteria for the location, design, development and maintenance of POS; and
-  Provisions for cash-in-lieu and urban water management.

The proposed LSP meets the requirements of the Policy other than where detailed in **Section 3.5** of this report.



LEGEND

-  SUBJECT SITE
-  PRIMARY DISTRIBUTOR ROAD
-  DISTRICT DISTRIBUTOR ROAD A & B
-  NEIGHBOURHOOD CONNECTOR ROADS
-  REGIONAL OPEN SPACE
-  PUBLIC OPEN SPACE & DRAINAGE
-  DISTRICT CENTRE
-  NEIGHBOURHOOD CENTRE
-  SCHOOLS
-  NEIGHBOURHOOD CATCHMENT

LOCAL CONTEXT PLAN

Lot 1507 Eighty Road, Baldvis

A Rockingham Park Pty Ltd Project



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figure
08

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1.6 CONTEXT ANALYSIS

Figure 8 outlines the planning context of Lot 1507 and the surrounding area. Significant elements within the locality include:

-  **Kwinana Freeway:** Primary regional transport route connecting Baldivis with the Perth Central Business District (CBD) to the north, Mandurah to the south, and the South West Region beyond;
-  **Safety Bay & Karnup Roads:** Primary east-west aligned regional transport routes linking Baldivis with Rockingham to the west, and existing and planned connections eastward to the Kwinana Freeway;
-  **Nairn Drive:** Secondary north-south aligned transport route through the Centre of the Baldivis Urban Area, connecting Mundijong Road in the north to Paganoni Road in the South;
-  **Public Transportation:** Limited to bus services from Warnbro Train Station on the South West Metropolitan Railway Line inclusive of connections to the nearest major activity centre (Baldivis District Centre), located at the convergence of Nairn Drive, Baldivis and Safety Bay Roads;
-  **Major Employment Areas in the Region:** Rockingham and Kwinana Industrial Areas in addition to the Rockingham Strategic Metropolitan Centre and Perth CBD;
-  **Two Public High School sites servicing the South Baldivis Area:** An existing facility located at the corner of Safety Bay and Baldivis Roads, and a second future facility to the east of Lot 1507 along Sixty-Eight Road;
-  **Parmelia High Pressure Gas Pipeline Corridor:** Running through the Urban Area well east of Lot 1507;
-  **Outridge Swamp:** A conservation category EPP Wetland located a short distance north west of Lot 1507;
-  **Rural Wedge:** Land west of Eighty Road used for grazing, market gardens and lifestyle accommodation purposes. The rural character of the land is protected via its 'Rural Living' designation under the City's *Rural Landuse Strategy*;
-  **Rural Residential:** A developed 'Special Rural' estate lies immediately to the south of the Lot 1507, although there is a strong likelihood that overtime this will change, with the land being identified as Cell 'BA11' in the Outer Metropolitan Sub-Regional Strategy – an 'Urban Investigation Area (2011-2020)'.
-  **Urban Fringe:** Land to the north and east forms part of the rapidly developing Baldivis Urban Area.

The Context Analysis plan highlights the lack of a neighbourhood nodal point within the central part of Lot 1507, and the significant impediment Nairn Drive has the potential to be in terms of creating a cohesive and integrated residential community.



AERIAL PHOTOGRAPH

Lot 1507 Eighty Road, Baldvis
A Rockingham Park Pty Ltd Project



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figure
09

2 SITE CONDITIONS & ENVIRONMENT

2.1 ENVIRONMENTAL ASSETS & CONSTRAINTS

A consolidated Environmental Assessment Report for the land was prepared by ENV Australia in April 2011 (refer **Appendix C**). The report identifies that the environmental aspects of Lot 1507 are heavily influenced by its former use as a pine plantation. This component of the land's history has now ceased with the trees having reached maturity and been clear-felled. Key elements of ENV Australia's report appear in the sections below.

2.1.1 FLORA AND VEGETATION

A recent aerial photograph of the site is included as **Figure 9**. The site is mapped as the Karrakatta Complex – Central and South, which on the Swan Coastal Plain is estimated to have 29.5% of its pre-European extent. This complex remains above the 10% pre-European native retention extent threshold set by the Environmental Protection Authority for constrained areas.

On-site investigation undertaken by ENV Australia in October 2009 identified the small amount of natural remnant vegetation on-site as ranging between 'Completely Degraded' to 'Degraded' in condition, due to weed invasion, rubbish dumping, public access and the land's use as a pine plantation.

No Endangered or Vulnerable species pursuant to the *Environmental Protection Biodiversity and Conservation Act* (1999), no Declared Rare Flora pursuant to the *Wildlife Conservation Act* (1950), no Declared Plant species under the *Agriculture and Related Resources Protection Act* (1976), nor any Priority Flora species or locally significant species were identified within the site.

In summary there are no flora species or vegetation communities of significance on the site. There are no areas of vegetation or particular trees of environmental significance that are required to be retained in planning urban development for the site and no particular requirements have been identified as being necessary for future management of the site.

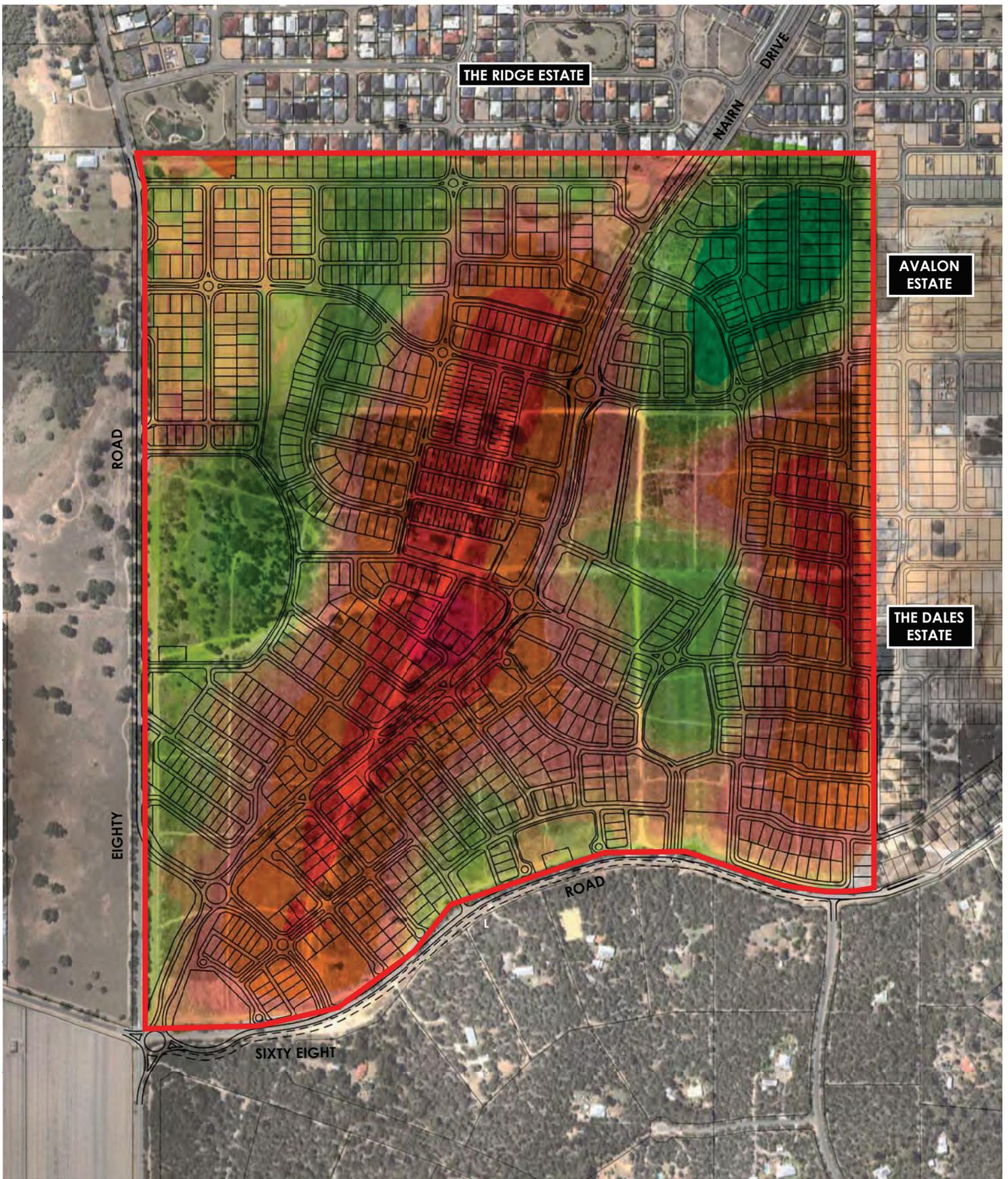
2.1.2 FAUNA

Reflective of the limited habitat that remains on-site, fauna surveys of the site are limited to a Black Cockatoo Site Assessment undertaken by ENV Australia in October 2010. Within the limited remnant vegetation that remains on-site the survey did identify foraging evidence of the Forest Red-tailed Black Cockatoo, however the extent of suitable habitat identified was extremely limited and highly degraded in condition.

In terms of breeding habitat no trees containing existing hollows were identified on-site, and only four trees were identified as being large enough to likely develop breeding hollows within the next 20 years, well below the DEC guidelines which recommend further investigation and the potential protection of areas containing three or more mature breeding trees per 0.5ha. Upon further investigation (refer **Appendix D**), it was noted that the four trees previously identified are located external to the site, within the adjoining Sixty Eight road reservation.

Based on ENV Australia's extensive experience with fauna surveys in the Perth Metropolitan Region, the lack of remnant vegetation and high level of site degradation, it is considered highly unlikely that any species of conservation significance will be affected by the proposed development.

Whilst small in size, the Health Department has identified Outridge Swamp (as per all other wetlands in the locality) as a potential breeding ground for mosquitoes known to carry viruses and other diseases. It is therefore anticipated that memorials will be required on all residential lots advising future purchasers of the hazard.



LEGEND

Site Boundary

Depth Key - CUT

- 0.00m to 1.00m
- 1.00m to 2.00m
- 2.00m to 4.00m
- 4.00m to 8.00m
- 8.00m to 12.00m
- 12.00m to 16.00m

Depth Key - FILL

- 12.00m to 9.00m
- 9.00m to 6.00m
- 6.00m to 3.00m
- 3.00m to 2.00m
- 2.00m to 1.00m
- 1.00m to 0.00m

VEGETATION OVERLAYED ON BULK EARTHWORKS

Lot 1507 Eighty Road, Baldvis
A Rockingham Park Project



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2.2 LANDFORM & SOILS

2.2.1 LANDSCAPE

From a topographical perspective, there are two main ridges running roughly north-south through the landholding. A small ridge with a high point of 19m AHD is located just inside the western boundary of the site. The second, with a high point of 33m AHD is located in the middle of the site and loosely forms the basis of the future alignment of Nairn Drive. A third ridge is located just east of the site within the adjoining Avalon and Dales Estates. Whilst these ridges require substantive modification in order to accommodate urbanisation of the land, they provide opportunities for views from housing and from streets, both to the Darling Scarp to the east and across rural and natural areas to the south and west.

A low point midway along the western boundary of the site could readily be modified for active open space purposes, inclusive of a curved amphitheatre that would provide a great viewing aspect and protection for spectators during sporting events.

Due to removal of the pine plantation and the significant earthworks required to service the estate (discussed further in **Section 3.9** of this report), opportunities for the retention of existing vegetation are limited to within and adjacent the existing Sixty-Eight and Eighty Road reservations. **Figure 10** clearly demonstrates the issue with all remaining vegetation on-site located in areas shown as requiring earthworks beyond the tolerance at which vegetation can practically be retained.

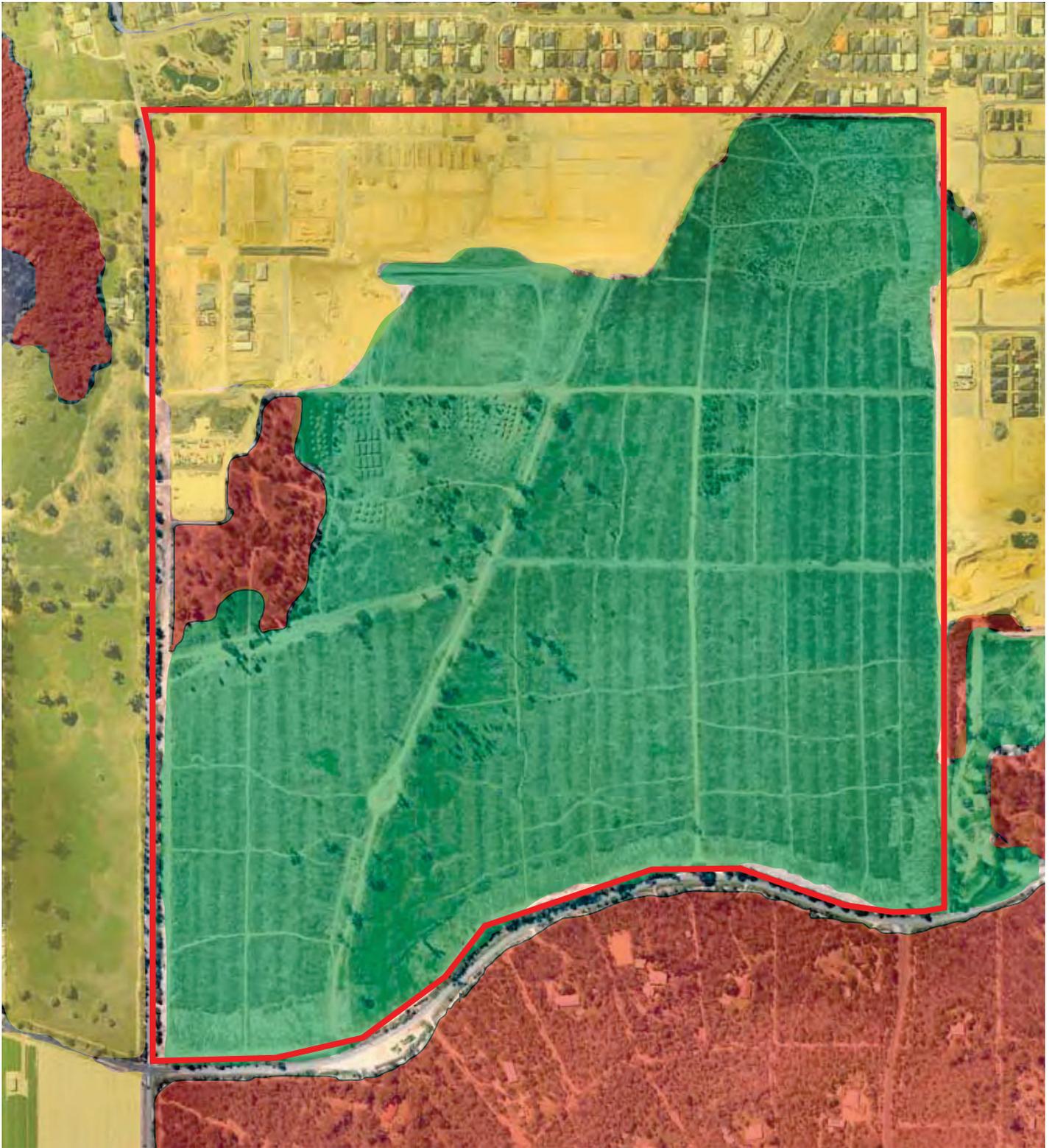
The land is unique however, in its relationship to adjacent land use. To the north and east are existing and/or rapidly developing suburban residential estates. To the south however are bush blocks associated with Rural Residential land use, whilst to the west of Eighty Road are wetlands combined with rural pursuits that provide a natural outlook and amenity. Given the limited landscape features within Lot 1507 it is important that the development embrace and takes advantage of this landscape reference, rather than turn its back on these areas.

2.2.2 SOILS

The geology of the site (S7 – Sand) is characterised by a low corrosion potential, low to medium slope stability, high ease of excavation and low to medium bearing capacity, characteristics that ENV Australia advise will not constrain development of the site.

2.2.2.1 ACID SULFATE SOILS

Department of Environment and Conservation mapping identifies the site as having “*No Known risk of ASS occurring within 3m of the natural soil surface (or deeper)*”. ENV Australia advise that there is limited potential for ASS disturbance along the low lying western boundary of the site, however this can be effectively characterised and managed, meaning that it poses no constraint to development of the site.

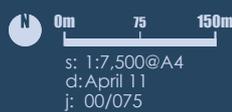


LEGEND

- Local Structure Plan Boundary
- Low
- Moderate
- Extreme

Source : Bushfire Safety Fire Management Plan

BUSHFIRE HAZARD ASSESSMENT
 Lot 1507 Eighty Road, Baldavis
 A Rockingham Park Pty Ltd Project



2.3 HYDROLOGY

2.3.1 SURFACE WATERS

There are no permanent or ephemeral water bodies or existing drainage lines on-site and a low potential for flooding due to relatively dry climatic conditions and highly permeable soils.

2.3.2 GROUNDWATER

Groundwater levels are greater than 1.2m below ground level across most of the site meaning fill will not be required to manage groundwater levels at the site except possibly in isolated areas around public open space and other low points. Subsoil drainage is not considered necessary to manage groundwater levels at the site.

2.4 BUSH FIRE MANAGEMENT

At the City's request, a Fire Management Plan (FMP) including a Bush Fire Hazard Assessment has been prepared by Bushfire Safety Consulting in accordance with the criteria set out in the WAPC's *Planning for Bush Fire Protection Guidelines (Edition 2)*. The FMP concludes that the LSP provides acceptable solutions and responses to the performance criteria that fulfil the intent of the bushfire hazard management issues outlined in WAPC policy. Key findings and recommendations of the plan appear on **Figure 11** and are detailed below. A full copy of the report appears as **Appendix E**.

Bushfire hazard levels across the site are rated as predominantly moderate to low due to the existing grass and pine tree slash. All bushfire hazards on-site will be removed during development and the public open space areas created populated with vegetation established and maintained to building protection zone standards as "low threat vegetation" as defined in the Australian Standard AS3959.

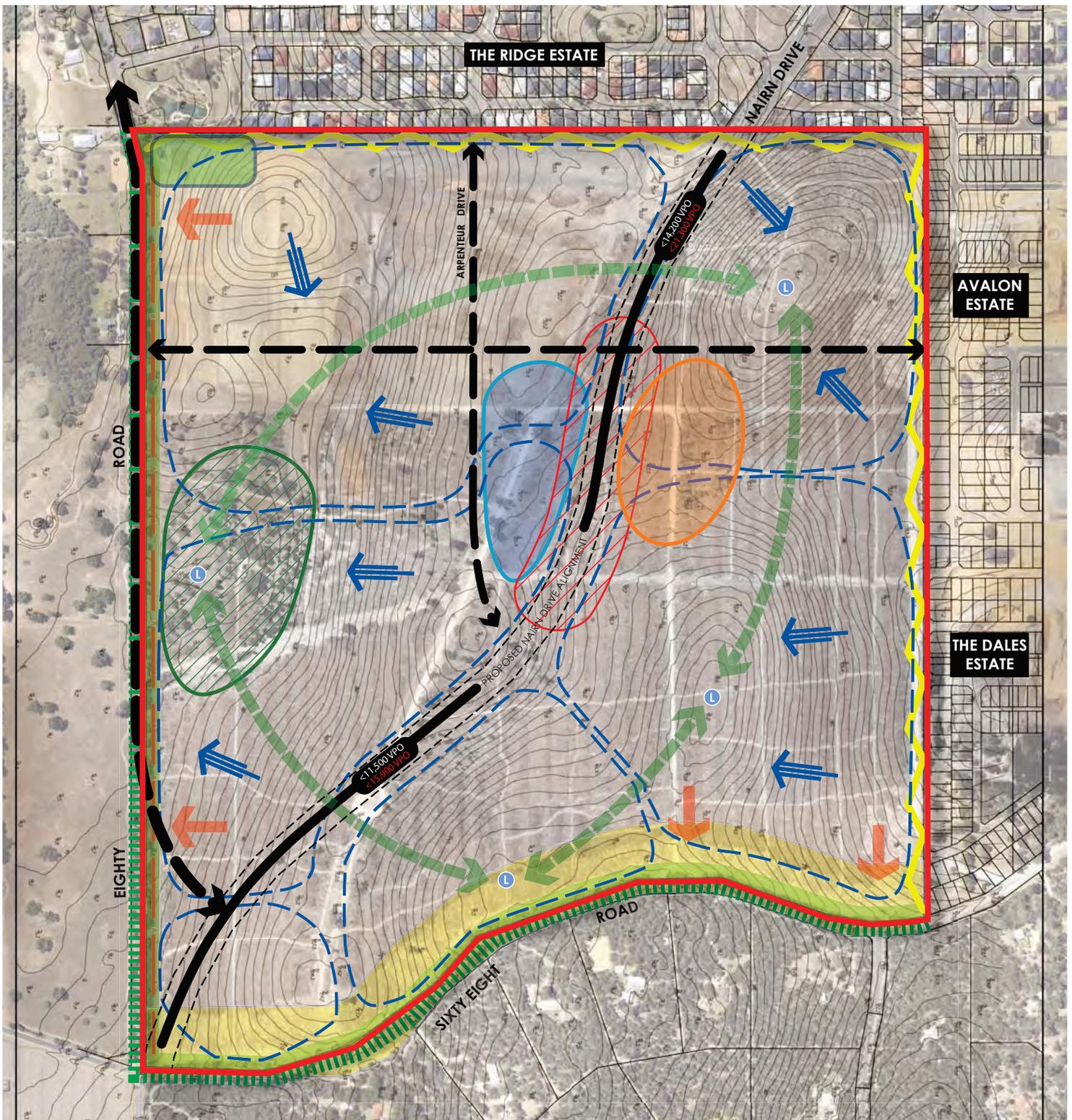
The only undeveloped area of potential concern is that located along the southern boundary within 100m of banksia woodland vegetation south of Sixty Eight Road, with dwellings in this area of the site the most vulnerable to attack. Sixty Eight Road provides good access and separation distance between the bushfire hazard and development. This combined with internal roads, setback distances on lots facing the hazard and management of vegetation on the development side of Sixty Eight Road establish an adequate building protection zone. Nevertheless the FMP recommends that if fuel loads remain at current Bushfire Attack Levels (BAL) a Section 70A Memorial be applied to the Title of all lots within the 100m hazard setback, alerting purchasers and successors in Title of the FMP and the requirement to construct dwellings in accordance with *AS3959 – Construction of Homes in Bushfire Prone Areas*.

As the affected area is contained within what is expected to be the final stages of development, and the land to the south of Sixty Eight Road is identified as an urban investigation area in the Outer Metropolitan Sub-Regional Strategy (refer **Figure 4**), there is a strong possibility that fuel loads in this area will be reduced by the time that development occurs in this portion of the estate. Allowance should be made therefore for BAL's to be re-evaluated prior to the creation of Titles for this portion of the estate.

In the interim, the FMP recommends that a 100m low fuel buffer be created and maintained around development throughout progressive staged development of the estate.

2.5 HERITAGE

There are no known or listed Aboriginal Heritage or European Heritage sites within the site.



LEGEND

Site Boundary

ISSUES

Nairn Drive Traffic Volumes

- VPD Retention of existing land use south of Sixty Eight Road
- VPD Including urbanisation of land south of Sixty Eight Road

- Key linkages (including)
 - Future alignment of Karnup & Sixty Eight Roads
 - Requirement to realign Eighty Road
 - Arpenteur Drive & East-West connector provide primary access into adjoining estates

Existing 132kv Powerlines

Low Points

Existing Drainage Catchments

Gradient of Landform requires streets to be aligned perpendicular to contours

Interface with existing and proposed residential lots

AS3959 Bushfire Protection Zone

Department of Education and Training preferred Primary School location

OPPORTUNITIES

Opportunity to intergrade in central location

Preferred location for Retail / Commercial land use

Interface with and views towards existing rural and special residential land use

Long Distance Scenic Amenity

Extended low ground with clumps of native trees forming a natural amphitheatre

Intergrade public open space with adjacent parkland

Public Open Space connection between low points

Enhance vegetation and streetscape along Sixty Eight and Eighty Roads

ISSUES AND OPPORTUNITIES

Lot 1507 Eighty Road, Baldvis

A Rockingham Park Project



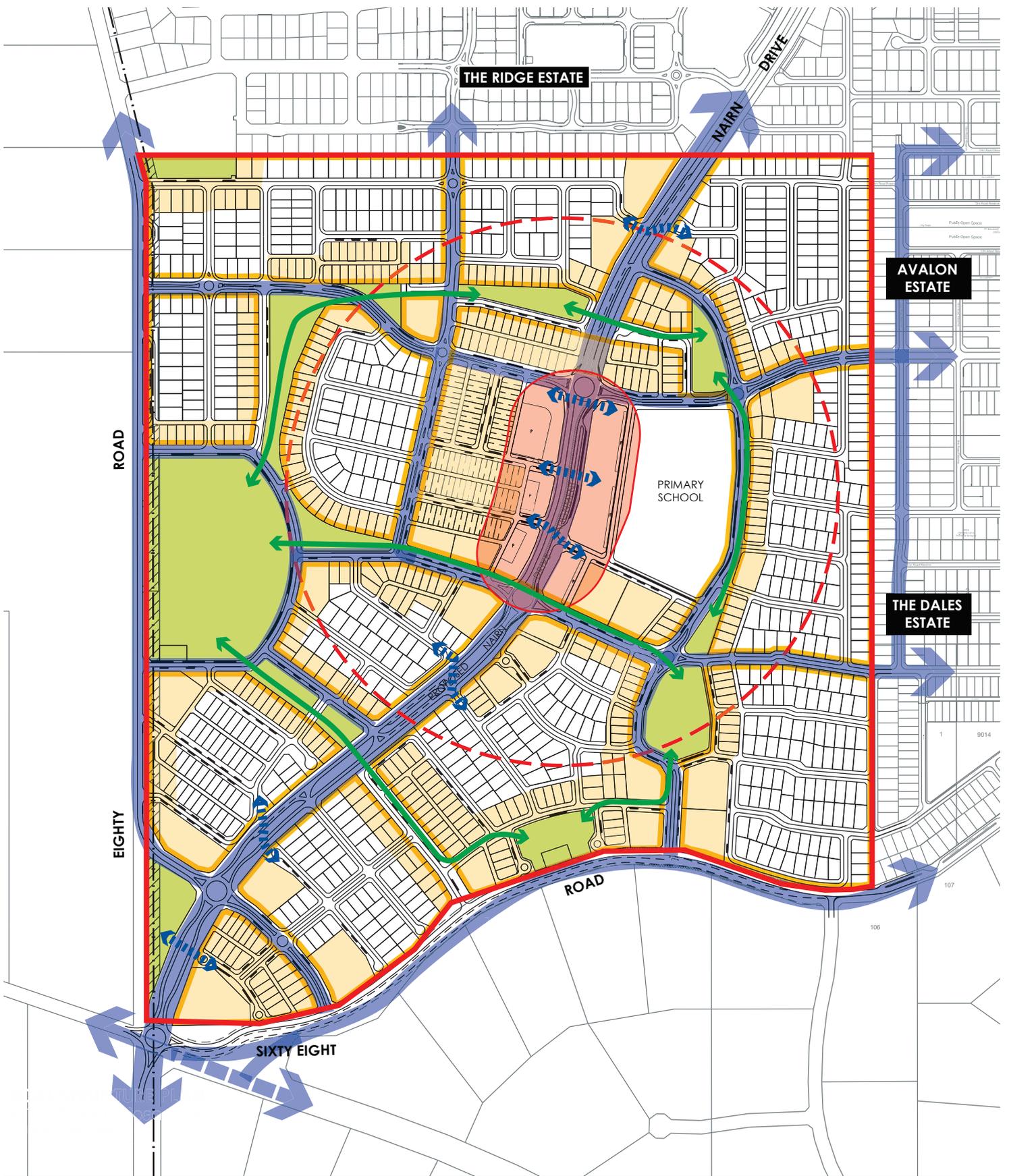
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2.6 SUMMARY OF ISSUES & OPPORTUNITIES

Site analysis issues and opportunities are provided diagrammatically in **Figure 12**. The key elements of the site that need to be taken into account when planning for Lot 1507 include:

-  Integration with existing and approved residential estates, immediately north and east of Lot 1507;
-  Creation of an appropriate interface with land to the west and south, that is likely to be retained for rural, conservation or rural residential purposes;
-  Existing vegetation provides excellent streetscape opportunities along both Eighty and Sixty-Eight Roads;
-  Proximity to the Outridge Swamp creates the need for notifications advising of a potential mosquito nuisance on resultant residential Titles.
-  Bushfire risk across the site is manageable, with the only impact on development being the need for a review of fuel loads prior to the creation of Titles within 100m of banksia woodland south of Sixty Eight Road. If loads remain as they are Memorials should be applied to Titles specifying the need to build in accordance with *AS3959 – Construction of Homes in Bushfire Prone Zones*.
-  A 132kv power line lies 9m within and runs parallel to the Eighty Road reserve boundary. An 18m easement (9m either side of the centre point of the distribution line) will be required to retain its overhead alignment;
-  The north-south ridges running through the site provide for expansive views, particularly to the west;
-  Low points scattered throughout the site provide appropriate opportunities for the location of drainage facilities. Suitably connected, these areas could form the spine of an integrated public open space network;
-  The gradient of the landform requires streets in various areas to be aligned perpendicular to the contour in order to minimise the size of necessary retaining walls;
-  There are only two areas that can practicably be flattened out for expansive land use activities such as playing fields, a primary school and/or commercial development. The first is in the low point adjacent to Eighty Road with the second being located near the crest of the central ridge in the middle of the site, either side of the future alignment of Nairn Drive;
-  Nairn Drive has the potential to act as a significant barrier to cohesive integrated development of the site;
-  Arpenteur Road, an important neighbourhood connector containing the likely bus route, extends into the LSP from the adjoining Ridge Estate and needs to continue through to intersect with Nairn Drive;
-  An east-west neighbourhood connector also needs to be accommodated within the northern portion of the site linking the approved design for Avalon Estate through to Eighty Road.
-  The east-west neighbourhood connector's intersection with Nairn Drive will create a highly energised location ideal for civic and/or commercial land use; and
-  Eighty Road requires realigning at its southern end to allow Nairn Drive to intersect with future construction of the Karnup Road freeway interchange.



LEGEND

- Site Boundary
- Community Hub at the heart of the Estate
- Diversity of active and passive recreation opportunities
- Medium and high density adjacent to activity nodes and open space
- Nain Drive inclusive of opportunities to maximise integration
- Key Neighbourhood connector network
- Future Upgrade
- Fitness / Walk Trail intergrating Network of open spaces
- 400m / 5min walkable catchment
- Character Precincts incorporating diversity of housing types, urban form and public realm qualities

DESIGN PRINCIPLES

Lot 1507 Eighty Road, Baldvis
A Rockingham Park Project



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3 STRUCTURE PLAN

3.1 DESIGN PRINCIPLES

This LSP has been prepared adopting a cooperative and collaborative approach with stakeholders in the planning process including the City of Rockingham and the State Government Departments of Planning and Education & Training. At its core are a number of fundamental design principles, as summarised below:

-  Respect for the inherent features/attributes of the land and its location;
-  A sound rationale for the unfolding of development including its integration with the wider Baldvis locality;
-  To achieve a distinct identity and sense of place for future residents of the area;
-  To facilitate innovation in built form in terms of housing typologies, affordability and sustainability;
-  To ensure that the Estate is fully integrated across Nairn Drive;
-  To ensure that the Estate completes and builds upon the arterial road network set out on the Baldvis DSP;
-  Creation of attractive network of engaging and well-utilised gathering places;
-  To establish an environment that provides a variety of active and passive recreational facilities that specifically seek to promote the mental and physical health and wellbeing of future residents; and
-  Establish character precincts as true neighbourhoods in a manner that is consistent with contemporary planning principles.

Their influence spatially on the LSP design is depicted diagrammatically in **Figure 13**.

3.2 LAND USE

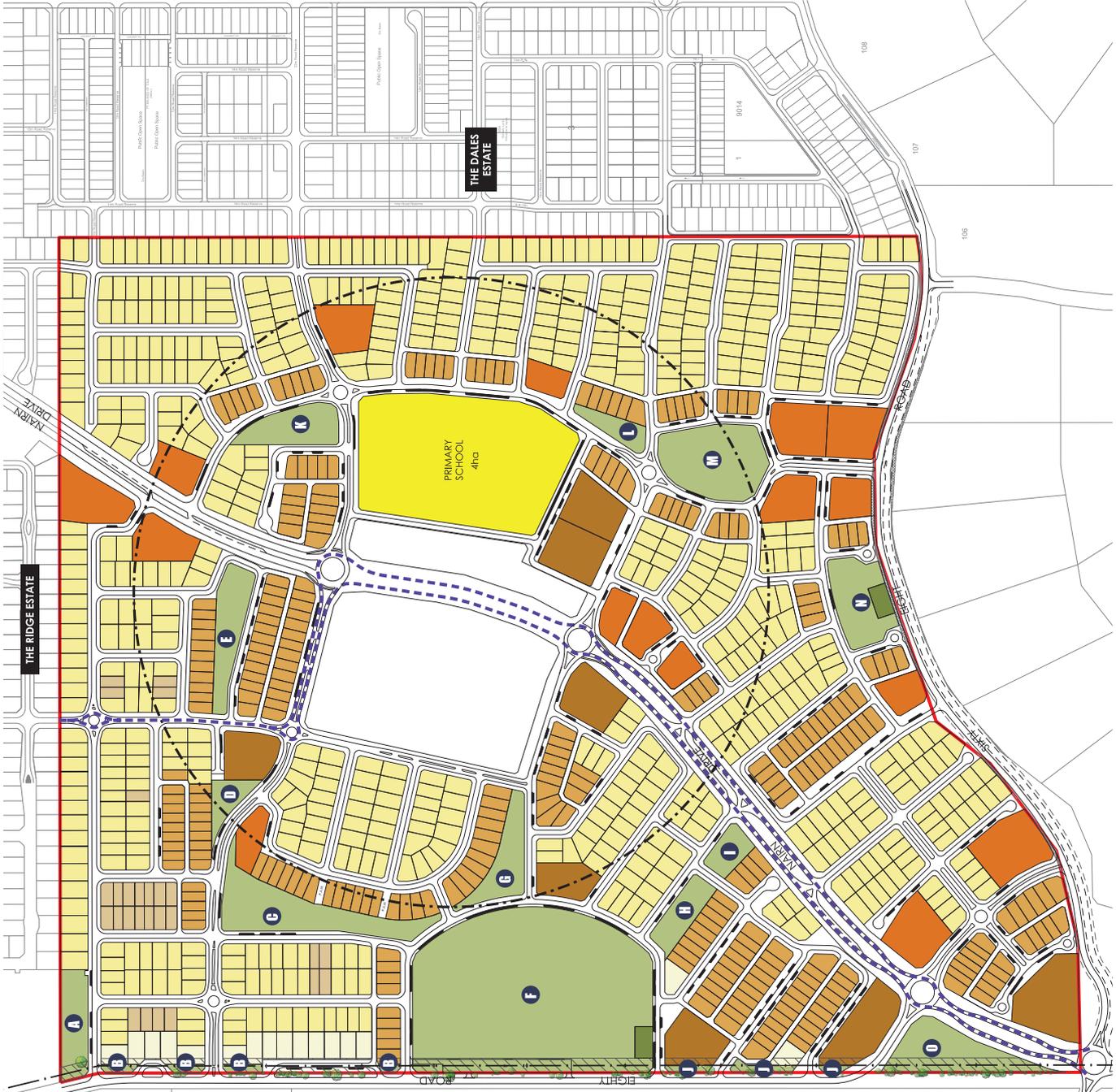
The following sections, detail the nature and location of the various land uses proposed by the LSP. A breakdown of the proposed land use as they appear on **Figure 14** is contained in the following table:

STRUCTURE PLAN SUMMARY TABLE			
Total LSP Area (ha):	120.82	Dwelling Yield Range:	1,300 – 1,600
 Commercial:	Nil (excluded from LSP)	Estimated Population @ 2.7 per dwelling:	3,510 – 4,320
 Education:	4.00	Number of Primary Schools:	1
 POS / Drainage:	12.96	Retail Floorspace:	N/A
 Residential:	63.73	Estimated Employment:	40
Estimated No. of Lots:	1049 x Single Residential 27 x Grouped Housing 4 x Mixed Use / Commercial	Number and Approximate Size of Key Open Space Areas:	20 Reserves encompassing 12.83 ha

3.3 EDUCATION & COMMUNITY FACILITIES

Education facilities within the LSP are limited to the provision of one government operated Primary School. The Department of Education and Training (DET) was consulted early on in the LSP's preparation and indicated acceptance of the location shown which is central to its intended catchment. At the City's request this advice has been confirmed in writing at **Appendix F**. The site will be earth worked to meet the requirements of DET's internal site criteria planning policy.

The City has advised that it has no plans to develop or operate any community facility within the boundaries of the LSP, other than sporting facilities and clubrooms on the District Playing Field site (refer to **Section 3.5.1**).



- LEGEND**
- ZONES / RESERVES
 - RESIDENTIAL R60
 - RESIDENTIAL R40
 - RESIDENTIAL R30
 - RESIDENTIAL R25
 - RESIDENTIAL R20
 - RESIDENTIAL R15
 - EDUCATION
 - PUBLIC OPEN SPACE
 - OTHER
 - LOCAL STRUCTURE PLAN BOUNDARY
 - 400M NEIGHBOURHOOD WALKABLE CATCHMENT
 - POWERLINE EASEMENT
 - ROAD WIDENING (SIXTY EIGHT ROAD)
 - PLANNED BUS ROUTE
 - VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
 - SEWER PUMP STATION (900m²)

- NOTES**
- 1 The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
 - 2 The access street and associated lot layout shown on the Plan is indicative only and subject to refinement as part of the detailed subdivision process.
 - 3 The Village Centre shall form the subject of a separate planning exercise and is excluded from this proposal.
 - 4 POS areas are indicative only and subject to further detailed design and drainage considerations.
 - 5 All road carriageway detail depicted on this Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of the road network standards preferred for this subdivision. All dimensions and areas depicted on this Plan are subject to pre-cad and final survey and may vary from the figures shown.
 - 6 Bushfire attack level to be reviewed prior to the creation of fillies. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
 - 7 Sixty-Eight Road widening to accommodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

PUBLIC OPEN SPACE TABLE

NOTES	CREDITABLE AREA (ha)	NOTES	CREDITABLE AREA (ha)
A	0.4009	J	0.2388
B	0.1730	K	0.1618
C	0.8576	L	0.3439
D	0.2305	M	0.2328
E	0.5242	N	0.8281
F	5.3703	O	0.4755
G	0.4931	P	0.7076
H	0.3574		
TOTAL AREA OF POS & DRAINAGE		11.3955	
% OF GROSS LANDHOODING		18.97%	

**BACK
OF
A3 PAGE**



LEGEND						
RESIDENTIAL DENSITIES	AREA (ha)	SINGLE LOTS	GH LOTS	GH DWELLINGS	TOTAL DWELLINGS	OTHER
Residential R60	3.7253	0	8	203	203	Local Structure Plan Boundary
Residential R40	5.4665	0	16	243	243	400m Neighbourhood Walkable Catchment
Residential R30	12.0900	299		299	299	Planned Bus Route
Residential R25	1.1489	27		27	27	Local Amenity
Residential R20	36.2858	659		659	659	General Building Orientation
Residential R15	1.2328	16		16	16	
RESIDENTIAL TOTALS	59.9493	1001	24	446	1447	

RESIDENTIAL DENSITIES PLAN

Lot 1507 Eighty Road, Baldvis

A Rockingham Park Project



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d: Dec 12
j: 00/075

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3.4 RESIDENTIAL

3.4.1 DENSITY TARGETS

Directions 2031 and Beyond sets a target of '15 dwellings per gross urban zoned hectare' of land in new development areas within the Perth and Peel Metropolitan Regions. Element 1 of Liveable Neighbourhoods embraces this target, equating the measurement to '22 dwellings per site hectare' (encompassing land purely zoned for residential purposes) and asks that this be measured as a means of determining whether the residential densities proposed in a LSP will deliver the dwelling aspirations outlined in *Directions 2031 and Beyond*, the Outer Metropolitan Sub-Regional Strategy and Liveable Neighbourhoods.

In terms of 'Gross Hectare' some 107.43ha of the subject land is zoned 'Urban' in the MRS (which reduces to 100.78ha once the central area excluded from the LSP is deducted). Based on the lot and dwelling predictions outlined in Section 3.2 and an estimated 1,447 dwellings, this equates to '14.4 dwellings per urban hectare'. Once you then reduce the site area to land solely identified for residential land use, the 'Site Hectare' comes down to 59.95ha, with the same maximum number of houses equating this time to '24.1 dwellings per site hectare'. This number is very close to the target set in Liveable Neighbourhoods, but is expected to be whittled down as grouped housing development responds to the market and delivers yields below the maximums identified in this document. The creation of local services will also have a significant impact on the ultimate density of development realised.

3.4.2 LOT SIZE, VARIETY & ORIENTATION

Figure 15 depicts the proposed residential density codings for all residential development within the LSP area. Specifically in relation to the subject site, the LSP proposes:

-  'Medium Density (R30-R60) Grouped Housing' sites shaped to accommodate Rockingham Park's Building Company (Summit's) own building product within immediate proximity to high amenity locations such as the network of public open space outlined in **Section 3.6**. Twenty-seven (27) sites ranging between 3,000m² and 1.1ha in area are proposed, capable of accommodating up to a maximum of 532 additional dwellings on sites ranging between 160m² and 240m² in area.
-  'Medium Density (R30) Rear-loaded Cottage Lots' with frontages of 7.5m-15m, and depths of 28-32m that create sites between 240m² and 480m² in area.
-  'Low Density (R20-R25) Single Housing' over the balance of residential zoned land with 15-22m frontages and lot depths of 28-32m, that create sites between 440m² and 700m² in area.
-  A small strip of larger ('R15') lots located along Eighty Road that are slightly wider or longer to include portions of the land encumbered by the existing power line easement.

In accordance with the requirements of the City's Local Planning Policy on the matter, in the limited instances where lots are proposed directly adjacent POS, lot levels will be raised above, a footpath will be constructed to clearly demarcate the boundary between public and private land, and DAP's will be imposed as conditions of subdivision approval in order to ensure that the fencing and building orientation of subsequent dwellings adequately surveil the adjoining reserve

The residential densities proposed provide for a diverse variety in residential lot and dwelling product befitting an estate of this size, having regard for local site characteristics, market research, and the dwelling targets of the District Structure Plan, Liveable Neighbourhoods and the Outer Metropolitan Sub-Regional Strategy.

POS A

- Neighbourhood Active POS**
- Retention of Existing trees
 - 'Blend' into existing northern POS
 - Recreational facilities such as a small playground and street furniture
 - Open active informal grassed area
 - Fully irrigated
 - All native trees and shrubs
 - Drainage basin requirements
 - Limited off street parking

POS C

- Neighbourhood Active POS**
- No existing vegetation
 - Residential direct access into POS
 - Recreational facilities such as a medium playground, street furniture, BBQ and shelter
 - Open active informal grassed area
 - 'Parkland Circuit'
 - Fully irrigated
 - All native trees and shrubs
 - Drainage basin requirements
 - Limited off street parking
 - Limited lighting

POS D

- Local Passive POS**
- No existing vegetation
 - Residential direct access into POS
 - Recreational facilities such as street furniture
 - 'Parkland Circuit'
 - High proportion of tree planting
 - Fully irrigated
 - All native trees and shrubs
 - Limited lighting

POS E

- Local Passive POS**
- No existing vegetation
 - Residential direct access into POS
 - Recreational facilities such as street furniture
 - 'Parkland Circuit'
 - High proportion of tree planting
 - Fully irrigated
 - All native trees and shrubs
 - Limited off street parking
 - Limited lighting

POS K

- Neighbourhood Passive POS**
- No existing vegetation
 - Recreational facilities such as a small playground, street furniture
 - 'Parkland Circuit'
 - Open active informal grassed area
 - Fully irrigated
 - All native trees and shrubs
 - Large drainage basin requirements
 - Limited off street parking
 - Limited lighting

POS B

- Local Passive POS**
- Retention of Existing trees
 - No recreational facilities
 - All native trees and shrubs
 - Sub-surface drainage infrastructure

POS F

- District Active POS**
- Retention of existing vegetation
 - Community facility (by others)
 - Informal Amphitheatre
 - Recreational facilities such as a medium playground, street furniture, BBQ and shelter
 - POS lighting
 - Open active formal grassed oval
 - 'Parkland Circuit'
 - Fully irrigated
 - All native trees and shrubs
 - Drainage basin requirements
 - Waste Water Treatment Plant location
 - Car parking

POS G

- Neighbourhood Passive POS**
- No existing vegetation
 - Residential direct access into POS
 - Recreational facilities such as a street furniture
 - High proportion of tree planting
 - 'Parkland Circuit'
 - Fully irrigated
 - All native trees and shrubs
 - Drainage basin requirements
 - Limited off street parking
 - Limited lighting

POS H + I

- Local Passive POS**
- No existing vegetation
 - Residential direct access into POS
 - Recreational facilities such as a street furniture
 - Small informal grassed area
 - 'Parkland Circuit'
 - Fully irrigated
 - All native trees and shrubs
 - Limited lighting

POS J

- Local Passive POS**
- Retention of Existing trees
 - No recreational facilities
 - Fully irrigated
 - All native trees and shrubs

POS L

- Local Passive POS**
- No existing vegetation
 - Residential direct access into POS
 - Recreational facilities such as street furniture
 - 'Parkland Circuit'
 - Small informal grassed area
 - Fully irrigated
 - All native trees and shrubs
 - Limited off street parking
 - Limited lighting

POS M

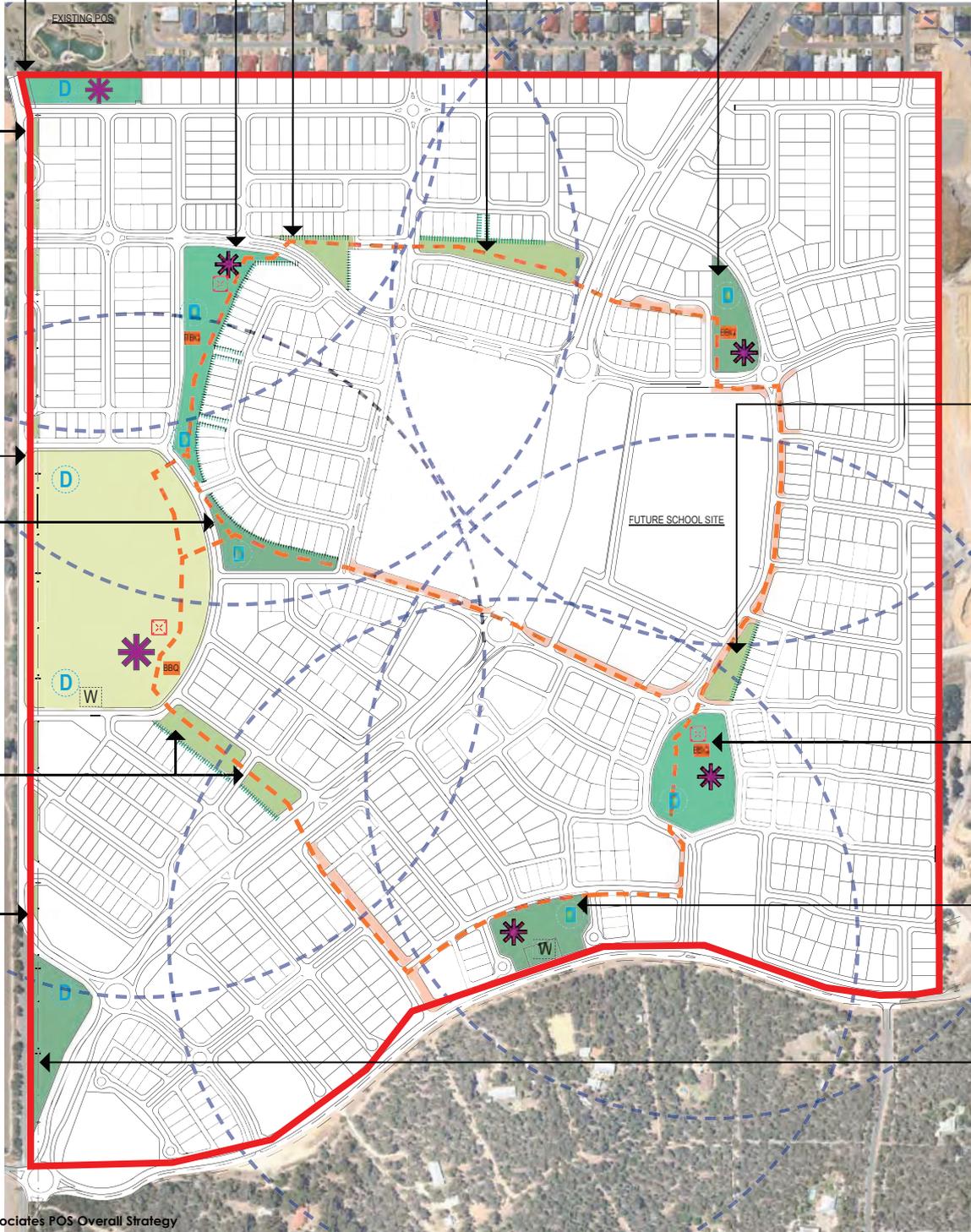
- Neighbourhood Active POS**
- No existing vegetation
 - Recreational facilities such as a small playground, street furniture and shelter
 - 'Parkland Circuit'
 - Open active informal grassed area
 - Fully irrigated
 - All native trees and shrubs
 - Drainage basin requirements
 - Limited off street parking
 - Limited lighting

POS N

- Neighbourhood Passive POS**
- No existing vegetation
 - Recreational facilities such as a street furniture
 - Open informal grassed area
 - Fully irrigated
 - All native trees and shrubs
 - 'Parkland Circuit'
 - Drainage basin requirements
 - Waste Water Treatment Plant (to be confirmed)
 - Limited off street parking

POS O

- Neighbourhood Passive POS**
- No existing vegetation
 - Recreational facilities such as a street furniture
 - High proportion of tree planting
 - Open informal grassed area
 - Fully irrigated
 - All native trees and shrubs
 - Drainage basin requirements



Source : **Emerge Associates POS Overall Strategy**

LEGEND

District POS	Green Link (Widened Verge)	Residential facing POS
Neighbourhood Active POS	'Parkland Circuit' Path Network	Drainage Requirements
Neighbourhood Passive POS	Existing Tree to be retained (Where Possible)	Small Open Shelter Location
Local Passive	Waste water treatment plant location	BBQ Facilities Location
	Playground location	400m Walkable Catchment (from playground)

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Lot 1507 Eighty Road, Baldvis Local Structure Plan

3.5 PUBLIC OPEN SPACE

Figure 16 shows the proposed distribution and arrangement of Public Open Space across the LSP area. The table below demonstrates that the LSP is compliant in its 10% POS requirement, having regard for both the requirements of *Liveable Neighbourhoods* and the City's Planning Policy 3.4.1, with some additional allowance for ultimate development of the central area that has been excluded from the current proposal.

PUBLIC OPEN SPACE SCHEDULE				[18 December 2012]			
Lot 1507 Eighty Road				120.8250			
less Nam Drive Regional Road Reservation				6.1563			
less Sixty-Eight Road Reservation Widening				0.1982			
Nett Site Area				114.4705			
Deductions							
Primary School				4.0000			
Central Exclusion Area				6.6513			
2 x Sewer Pump Stations				0.1800			
Dedicated Drainage (up to 1:1 year event)							
	B1	0.1878	1.4977				
	B2	0.2654					
	B3	0.1508					
	B4	0.1043					
	B5	0.1414					
	B6	0.1732					
	B7	0.0798					
	B8	0.0750					
	B9	0.1924					
	B10	0.0814					
	S5	0.0462					
Surplus Restricted Open Space				0.0000			
Gross Subdivisible Area				102.1415			
Public Open Space @ 10%				10.2142			
Unrestricted Public Open Space							
Public Open Space (as shown on Plan)							
ID	Total	Drainage ID	less 1:1 event (deduction)	less 1:5 event (restricted)	less Pump Stations (deduction)	Easement (restricted)	
A	0.4823	B10	0.0814	0.0147		0.0652	0.3210
B	0.1730					0.1730	0.0000
C	1.1250	B8 & B9	0.2674	0.0248			0.8328
D	0.2305						0.2305
E	0.5704	S5	0.0462	0.0111			0.5131
F	5.7749	B5 & B6	0.3146	0.0322	0.0900	0.5561	4.7820
G	0.5129	B7	0.0798	0.0080			0.4251
H	0.3574						0.3574
I	0.2388						0.2388
J	0.1618					0.1618	0.0000
K	0.5317	B1	0.1878	0.0207			0.3232
L	0.2328						0.2328
M	1.0935	B2	0.2654	0.0239			0.8042
N	0.7163	B3	0.1508	0.0247	0.0900		0.4508
O	0.8119	B4	0.1043	0.0163		0.3603	0.3310
TOTAL Unrestricted						9.8427	
Restricted Open Space							
Powerline Easement							
A						0.0652	
B						0.1730	
F						0.5561	
J						0.1618	
O						0.3603	
Drainage Surface Area (between 1:1 year event and 1:5 year event)							
A		(B10)		0.0147			
C		(B8 & B9)		0.0248			
E		(S5)		0.0111			
F		(B5 & B6)		0.0322			
G		(B7)		0.0080			
K		(B1)		0.0207			
M		(B2)		0.0239			
N		(B3)		0.0247			
O		(B4)		0.0163			
TOTAL Restricted						1.4928	
Maximum Permitted						2.0428	
TOTAL Restricted Credited						1.4928	
TOTAL Public Open Space Provision						11.3355	
Unrestricted POS						9.8427	
Restricted POS						1.4928	
Difference						1.1214	

	1:1	1:5	1:10	1:100
B1	0.1878	0.2085	0.2159	0.2495
B2	0.2654	0.2893	0.2977	0.3365
B3	0.1508	0.1755	0.1839	0.2227
B4	0.1043	0.1206	0.1265	0.1546
B5	0.1414	0.1673	0.1759	0.2095
B6	0.1732	0.1795	0.1840	0.2119
B7	0.0798	0.0878	0.0902	0.0935
B8	0.0750	0.0810	0.0836	0.0942
B9	0.1924	0.2112	0.2180	0.2501
B10	0.0814	0.0961	0.1012	0.1245
S5	0.0462	0.0573	0.0607	0.0711

1:10 event	%	NOTES
0.1012	21%	
0.3016	27%	22% when divided by combined area of D & E (which form one linear park)
0.0607	11%	
0.3589	6%	
0.0902	18%	
0.2159	41%	Variation requested on the basis of having to accommodate late change to Primary School location, whilst maintaining secondary N/S connection activating eastern side of school
0.2977	27%	20% when divided by combined area of L & M (which form one linear park)
0.1839	26%	24% if Sixty-Eight Road Widening not imposed
0.1265	16%	

	Un	Restricted	TOTAL
A	0.3210	0.0799	0.4009
B	0.0000	0.1730	0.1730
C	0.8328	0.0248	0.8576
D	0.2305		0.2305
E	0.5131	0.0111	0.5242
F	4.7820	0.5883	5.3703
G	0.4251	0.0080	0.4331
H	0.3574		0.3574
I	0.2388		0.2388
J	0.0000	0.1618	0.1618
K	0.3232	0.0207	0.3439
L	0.2328		0.2328
M	0.8042	0.0239	0.8281
N	0.4508	0.0247	0.4755
O	0.3310	0.3766	0.7076
Excess	N/A	9.8427	1.4928
		11.10%	of Gross Subdivisible Area

In addition to meeting the land area requirements and drainage limitations as they relate to the relevant policies, the LSP also creates a variety of reserves which cater for a diverse range of both active and passive recreational activities. A summary of the different types of reserves is detailed in the following section:

3.5.1 DISTRICT PLAYING FIELD

One of two fundamental design elements of the LSP is the creation of a District Playing Field within an expansion of the natural amphitheatre identified midway along Eighty Road.

Early on in discussions over a potential review of the LSP design, the City advised of a desire to provide a senior sized AFL oval within the site. The LSP embraces this opportunity, viewing the provision of such a facility as an asset to the development.

In order to create a level playing surface of a size capable of meeting the requirements of the City, extensive earthworks are required including the creation of a relatively steep bank along the eastern side of the reserve. This creates the opportunity for terraced seating that compliments the main spectator and clubroom facilities accessed directly off Eighty Road.

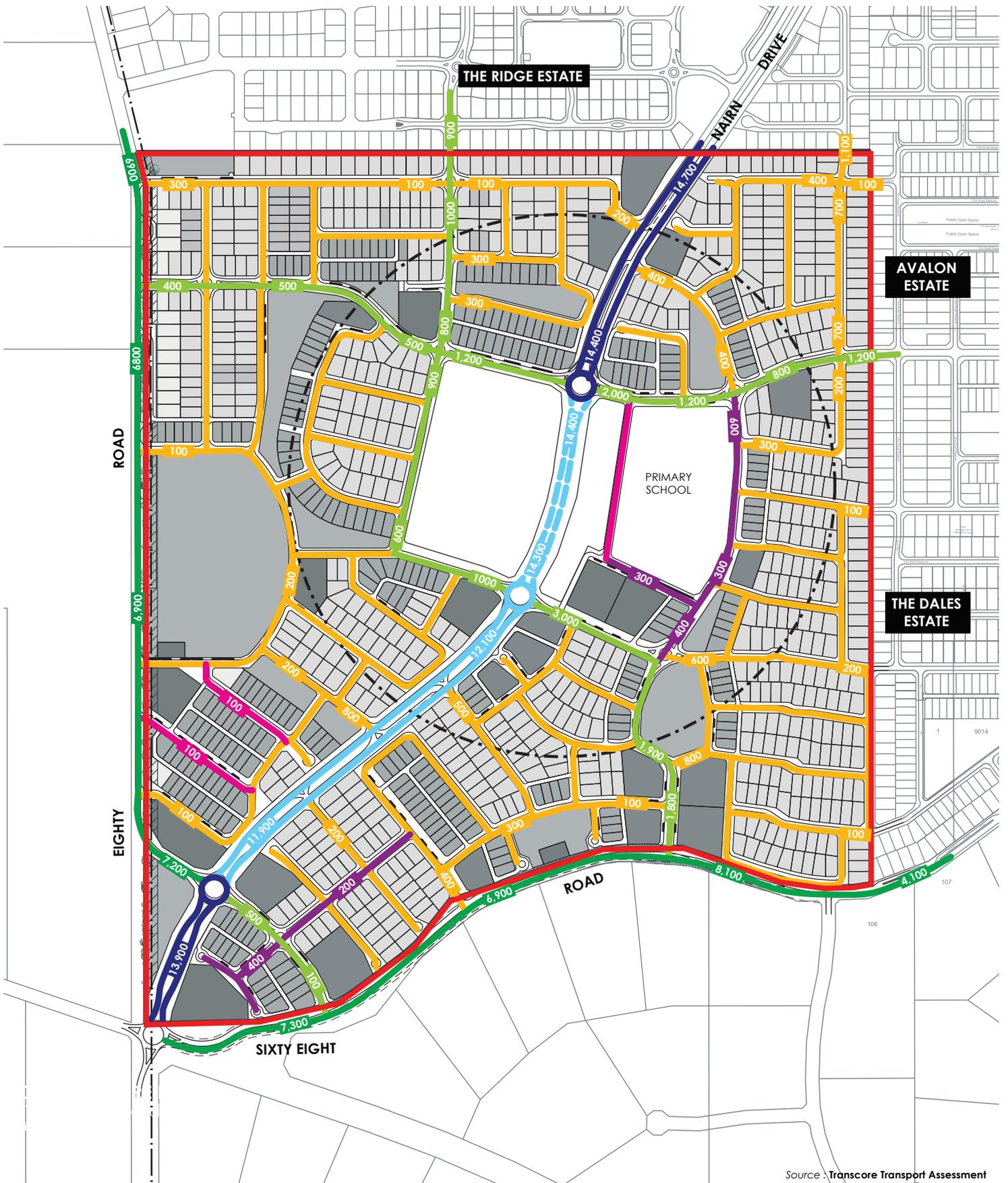
Other key elements of the District Playing Fields concept shown at **Figure 17** include:

-  A community facility inclusive of opportunities for a grandstand, ablutions, change rooms and storage;
-  An associated car park that makes use of land constrained by the existing power line easement, and by virtue of being accessed directly from Eighty Road separates recreation from local residential traffic;
-  A shade or similar structure located atop the terraced seating that announces the location of the playing fields and acts as a magnet to residents and visitors uphill of the facility;
-  A children's playground inclusive of shelter and barbecue facilities;
-  A hardstand area for informal basketball play;
-  A series of paths that utilising the adjacent road network radiate out from the reserve, inclusive of key connections that form part of the Parkland Circuit network (detailed in **Section 3.6.6**);
-  Fitness equipment similar to that located along the length of the Parkland Circuit, that contribute to the overall network established within the LSP;
-  Drainage facilities and a Waste Water Pumping Station required to service this portion of the LSP catchment; and
-  Opportunities for supplementary embayed car parking areas (where practical) along the northern, southern and eastern perimeter of the site.

3.5.2 COMMUNITY PARKS

Strategically located throughout the balance of the LSP area is a series of community parks. Located central to the various residential precincts identified within the LSP the parks ensure that all lots are within a walkable catchment of a POS facility, including more than 90% of future residents being located within 400m of a proposed playground location.

The Community parks provide for a high degree of aspect and amenity for surrounding residences, thereby representing an opportunity for housing innovation and diversity. This has been reflected in the LSP, which provides for 'traditional', laneway, direct frontage and grouped housing adjacent to Community Parkland areas. Broad Concept Plans prepared by Emerge for each of the reserves proposed in the LSP are included at **Appendix G**.



Source : Transcore Transport Assessment

LEGEND

ROAD HIERARCHY

- Integrator A
- Integrator B
- Neighbourhood Connector A
- Neighbourhood Connector B
- Access Street B
- Access Street C & D
- Special Access Street
- 100 Forecast Traffic Flows

OTHER

- Local Structure Plan Boundary
- 400m Neighbourhood Walkable Catchment

MOVEMENT NETWORK

Lot 1507 Eighty Road, Baldvis
A Rockingham Park Project



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3.6 MOVEMENT NETWORK

Transcore was engaged by Rockingham Park to undertake a Transport Assessment of the Local Structure Plan design. A full copy of the report can be found at **Appendix H**. Key points are summarised below.

3.6.1 ROAD HIERARCHY & TRAFFIC VOLUMES

The proposed road hierarchy for the subject land, and projected traffic volumes attributed to each road are depicted on **Figure 18**, and can be summarised as follows:

ARTERIAL INTEGRATOR

Nairn Drive is an 'Arterial Integrator Road', with its alignment and reservation width set by its 40m wide 'Other Regional Road' reservation in the MRS. Nairn Drive serves the function of an 'Integrator A' at its northern and southern ends within Lot 1507, however projected traffic volumes in the middle of the LSP area allow it to be classified as an 'Integrator B' through this section for the foreseeable future. A 70km/h speed limit on the 'Integrator A' sections shown on **Figure 18** is proposed, however a lower speed is recommended for the Integrator B section. A 60km/h speed limit would assist pedestrian crossing and general integration of the estate across Nairn Drive.

NEIGHBOURHOOD CONNECTORS

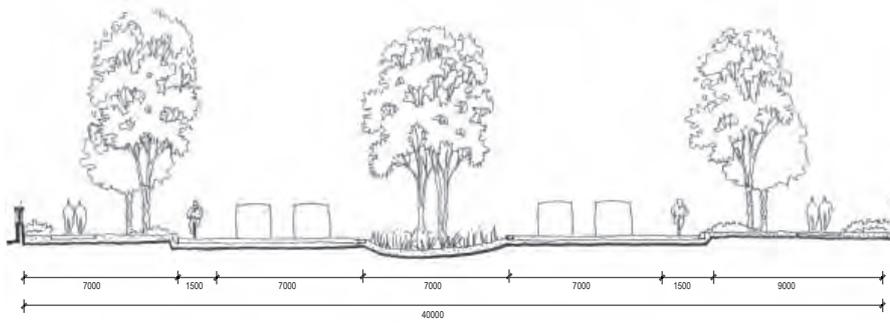
Eighty Road is classified as a 'Neighbourhood Connector A' Road. Similar to what has occurred to the north, the road is proposed to be upgraded to a fully kerbed and drained, 7.4m wide single carriageway, with a reduced traffic speed of 60km/h adjacent and through the LSP area. Development on the eastern side of Eighty Road will need to be setback by virtue of retention of the existing high voltage power line. Access to lots fronting Eighty Road shall be limited to Controlled Access Place (CAP or Service) Roads in a similar manner to that which has been approved and is being constructed in the initial stages of development in the northwest corner of the estate.

Sixty-Eight Road is also classified as a 'Neighbourhood Connector A' Road. Widening of the reserve to accommodate a boulevard road treatment is accommodated in the LSP, based on a 25m wide reservation that due to the unique road geometry of the location is based upon the centreline of the existing carriageway. Similar to Eighty Road, until urbanisation proceeds south of Sixty Eight Road it is proposed that the road be upgraded to a fully kerbed and drained, 7.4m wide single carriageway, with a reduced traffic speed of 60km/h adjacent the LSP area. Access (where proposed), will be restricted to the use of CAP Roads as has been used in 'The Dales Estate' immediately to the east.

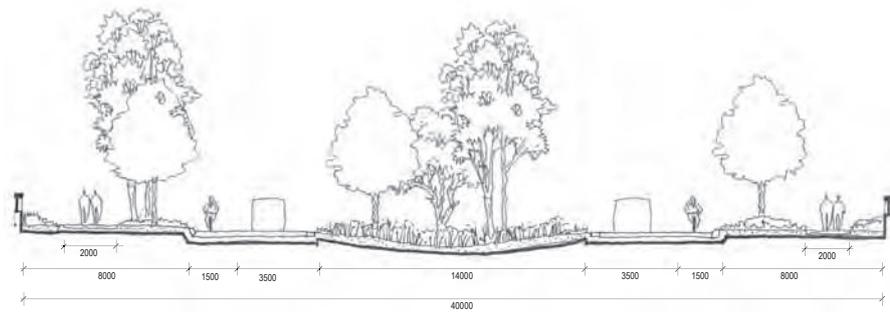
Arpenteur Drive and the continuation of that route through to Sixty-Eight Road are classified as 'Neighbourhood Connector B' Roads. Similar to Eighty and Sixty-Eight Roads, it is proposed that the 7.4m carriageway established within The Ridge Estate be continued on through the LSP, with road reserves to accommodate the service varying from between 16m (adjacent to POS) to 25m where the carriageway has been divided with a median as the southern entrance to the estate. A speed limit of 50km/h is expected to apply to this route.

Furnivall Parade / Regency Avenue located in the northern part of the LSP area is the final Neighbourhood Connector within or adjoining the LSP area. Also classified as a 'Neighbourhood Connector B' Road it is proposed to be constructed as a boulevard-style road within a varying reservation width of 20-25m. At its western end the road acts as the initial estate entrance, with the additional reserve width allowing for a landscaped entry treatment.

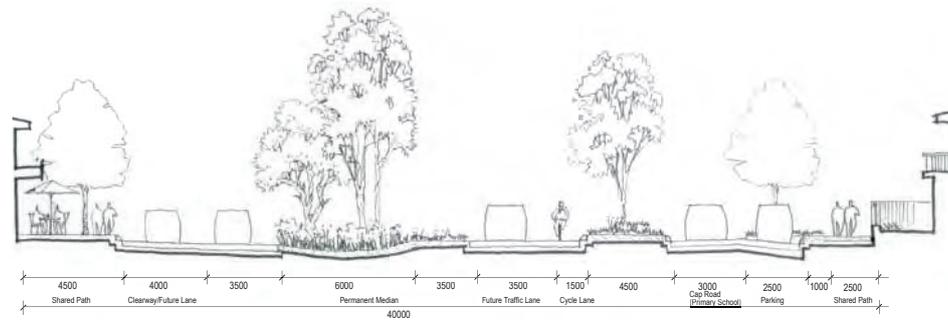
At the request of the City, two additional high order Access Street connections, being a direct **north-south link** between Nairn Drive and Sixty-Eight Road (running along the eastern boundary of the school site), and extension of the east-west aligned **Baroness Road** within 'Avalon Estate' in order to provide a direct connection between Smirk Road and the District Playing Field.



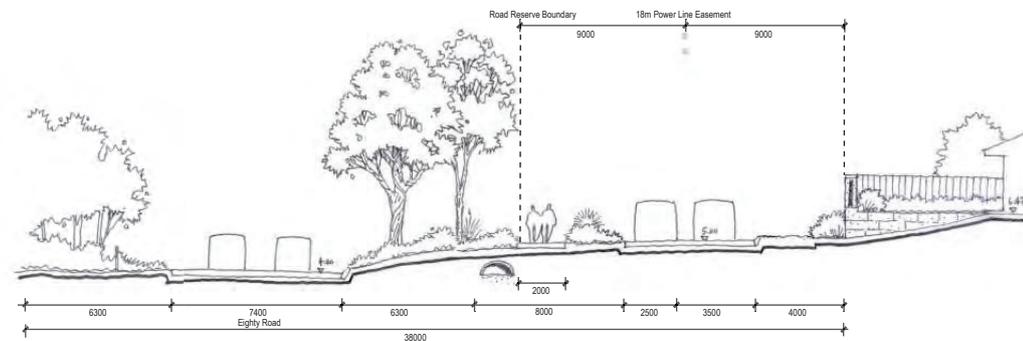
Intergrator A



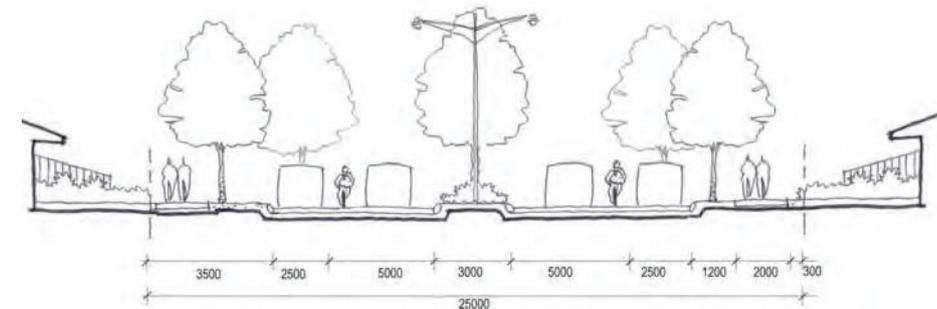
Intergrator B - 40m Reserve - 14m Median



Intergrator B - 40m Reserve - 6m Median



Neighbourhood Connector A - Eighty Road



Neighbourhood Connector B - Boulevard 25m

Source : Emerge Associates Street Sections

TYPICAL ROAD CROSS SECTIONS

Lot 1507 Eighty Road, Baldvis

A Rockingham Park Project

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d: Dec 12
j: 00/075



figure
19A

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ACCESS STREETS

With the exception of laneways and the special streets discussed below, all other roads within the LSP area are designated as 'Access Streets'. Each of the roads will encompass a 6m wide carriageway within a typical reserve width of 16m. Whilst none of the roads are expected to experience volumes in excess of 1,000 VPD, four of the roads have been designated as 'Access Street B' (as opposed to Access Street 'C' or 'D') which involves a slightly wider 18m reserve width purely to assist with the location of street furniture in areas of higher activity.

Adjacent to public open space *Liveable Neighbourhoods* allows verge widths to be reduced down to 1m as a result of there being no need to accommodate service alignments for the development of adjacent land. The LSP proposes 13.5m reserve widths where access streets abut POS, including a more conservative 2.5m verge on the reserve side on the basis that this width can accommodate street trees and visitor parking embayments without the infrastructure extending outside of the road reservation.

HILLSIDE RELIEF

In the eastern portion of the site where roads rapidly descend from 'The Dales' down towards POS Areas 'L' and 'M', a number of specially landscaped pockets are strategically located so as to provide visual relief, particularly to pedestrians and POS patrons as they traverse and/or look back up the slope in that direction.

SPECIAL ACCESS STREETS

In the southwest corner of the LSP area is a special precinct that has been designed differently. Similar to sections of the Parkland Circuit (discussed in **Section 3.6.7**), two streets have a widened verge on one side where the absence of crossovers allows for additional landscaped connections to be created linking cottages to the nearby District Playing Field. A meandering carriageway embedded with visitor parking and urban water initiatives such as rain gardens will be considered at the subdivision and detailed design stages of implementation.

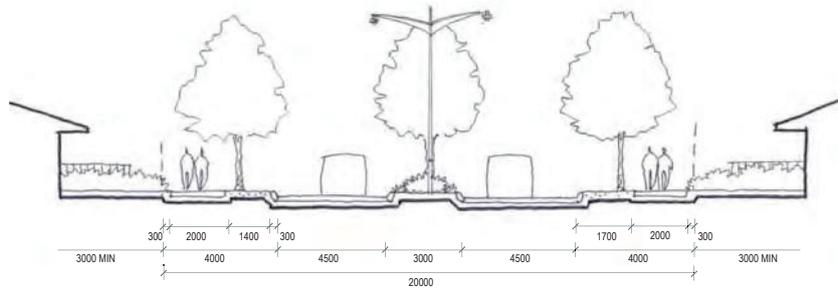
LANEWAYS

At the City's direction reduced carriageway widths and the introduction of a landscaping strip as per the Subi Centro laneway example is no longer proposed. Instead laneways will constitute the typical 6m wide carriageway with 1m building setbacks on both sides to accommodate the requirements of the City's refuse collection vehicle. Along Arpenteur Drive medians have been used to manage intersection spacing in accordance with Liveable Neighbourhoods requirements.

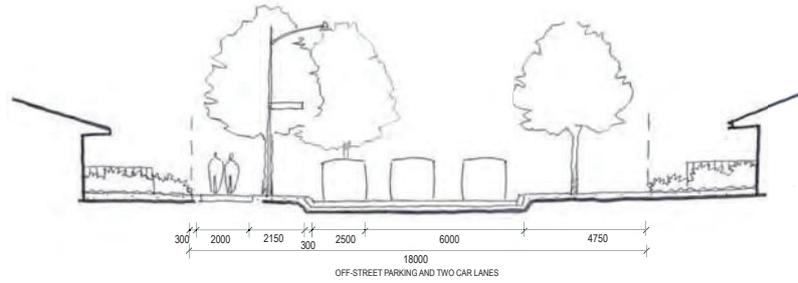
PEDESTRIAN ACCESS WAYS

A limited number of Pedestrian Access Ways (PAW)'s are also proposed in key locations where they open up local residential cells, allow direct access and draws the amenity of local POS reserves further back within each cell. In all instances the PAW's adhere to the guidelines expressed in the WAPC's Planning guidelines for '*Reducing Crime and Anti-Social Behaviour in Pedestrian Access Ways (October 2009)*', inclusive of an 8m minimum width with clear sight lines along their entire length. The two located within the dress circle near the District Playing Field also involve a significant level change further minimising impacts on neighbours and opportunities for anti-social behaviour.

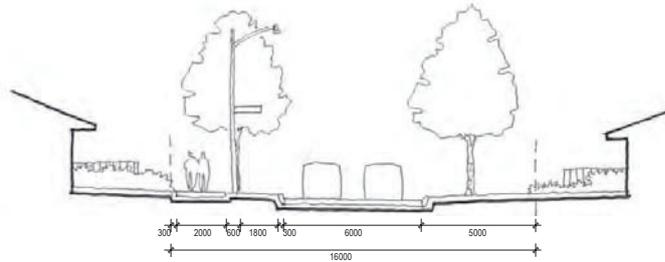
Indicative cross sections for each road in the above hierarchy are depicted on **Figures 19a & 19b**.



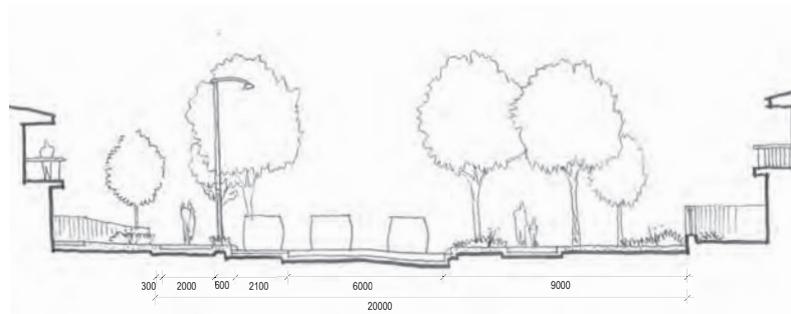
Neighbourhood Connector B - Boulevard 20m



Residential Road - 18m Reserve - Access Street B

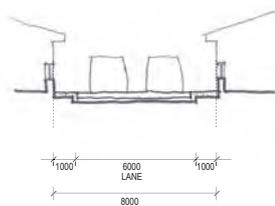


Residential Road - 16m Reserve - Access Street C/D

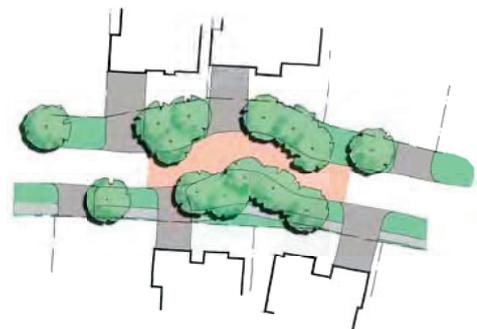


Special Access Street - 20m Reserve

Landscaped Midpoint Concept



Laneway - 6m Reserve



Source : **Emerge Associates Street Sections**

TYPICAL ROAD CROSS SECTIONS

Lot 1507 Eighty Road, Baldvis

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figure
19B

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3.6.2 PERMEABILITY & ACCESSIBILITY

Overall the road layout accommodates a high level of interconnectivity with the surrounding area, with regular connections to Nairn Drive (the primary transport route through the area) and relatively short and straight street blocks being arranged in a manner that achieves a high degree of legibility, permeability and walkability in accordance with the principles of *Liveable Neighbourhoods*.

3.6.3 TRAFFIC MANAGEMENT ISSUES

The Local Structure Plan incorporates each of the management devices recommended by Transcore, including:

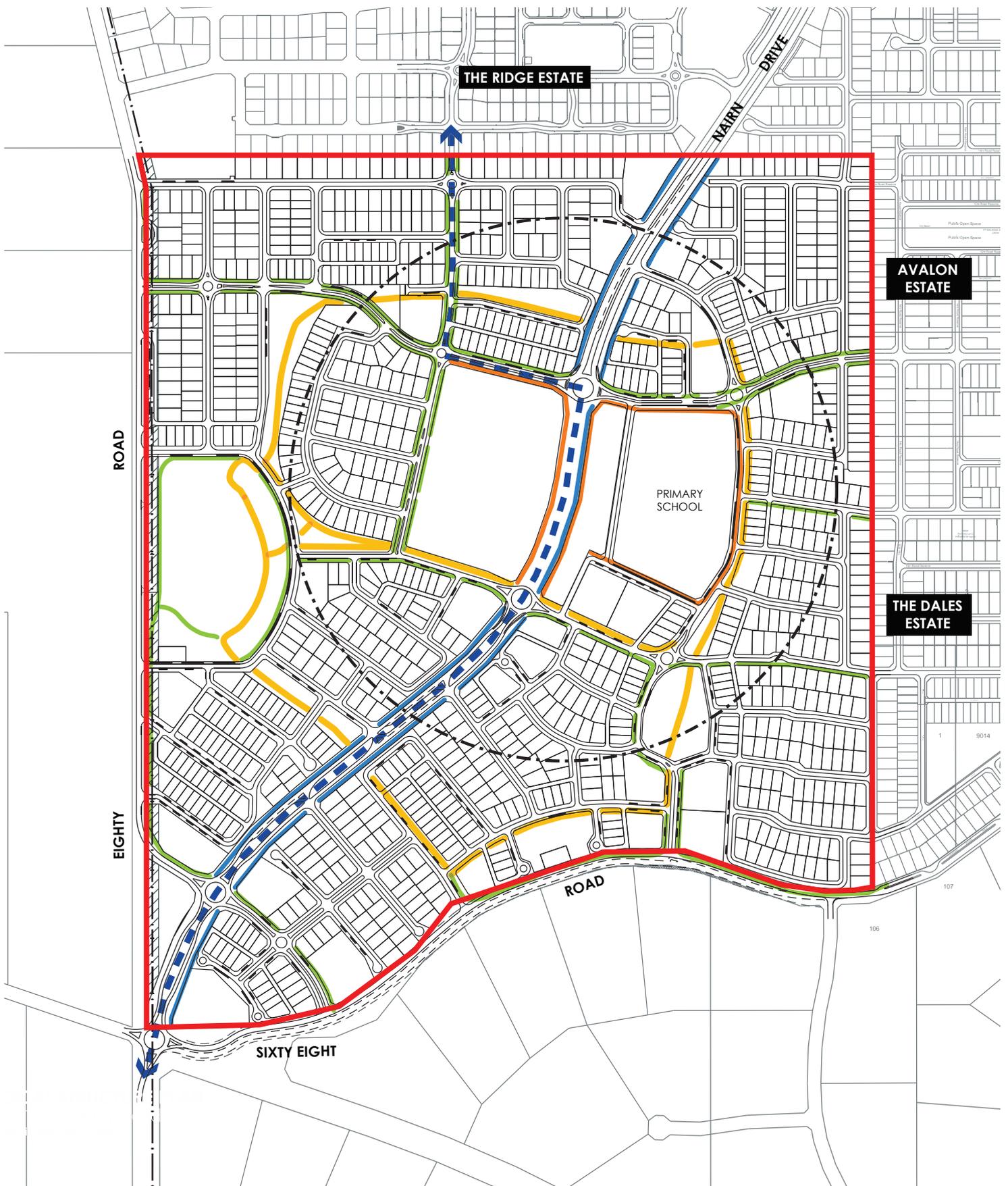
-  Nairn Drive being initially designed and constructed as a single carriageway through the middle of the LSP;
-  A roundabout intersection treatment at the southern end of Nairn Drive as an interim solution pending construction of the Karnup Road extension and future freeway connection;
-  Three other roundabouts along Nairn Drive where four-way intersections are proposed at the intersections of Arpenteur Drive, the east-west aligned 'Neighbourhood Connector' and the realignment of Eighty Road;
-  The staggering of intersections elsewhere along Nairn Drive such that they meet the intersection spacing requirements of *Liveable Neighbourhoods* (or specific techniques are proposed as set out below, to manage traffic where compliance is impractical);
-  Right turn pockets but no left turn deceleration lanes along Nairn Drive, to assist in managing speed;
-  The northern pair of access street intersections with Nairn Drive being configured as left-in, left-out only, so as to eliminate the need for overlapping turning pockets;
-  Use of a wider (14m) median where right turn pockets in the southern portion of the LSP design would otherwise overlap;
-  The creation of a right turning pocket along Sixty-Eight Road at its intersection with the boulevard configured 'Neighbourhood Connector B' Road that in time will become the southern entrance to the estate;
-  Restriction of access along Eighty Road to the use of Controlled Access Plan (CAP) Roads for residential development and limited car parking access for the District Playing Field; and
-  The use of three priority controlled four-way intersection treatments at the convergence of short, low traffic volume access streets within the LSP. Appropriate entry treatments will be provided on side roads to help alert drivers to the presence of the intersection and that traffic on the major road has priority.

A plan showing key intersection treatments within the LSP area appears as **Figure 9 of Appendix H**.

3.6.4 INTERFACE WITH ADJOINING DEVELOPMENT

Careful consideration has been given to the interface of adjoining landholdings. Specifically, the LSP considers:

-  Existing connections to The Ridge Estate to the north;
-  Approved connections to the east through 'The Dales' and 'Avalon Estate';
-  The use of loop or controlled access roads so that where possible, development provides a frontage towards both Sixty-Eight and Eighty Roads, whilst minimising direct access;
-  Use of a variety of lot interface treatments along Nairn Drive that maintain an adequate level of surveillance along its route whilst minimising anticipated impacts on resident amenity; and
-  Potential for closure of some or all of the Eighty Road reservation west of POS Area 'O', such that the park will form a landscaped extension of the adjoining private school facility.



LEGEND

PATH NETWORK

- 'Parkland Circuit' - 2.5m min path
- On-road cycle lanes + 2m footpath
- High use areas (2.5m wide path proposed)
- Major Pedestrian Routes (2m path proposed)

OTHER

- Local Structure Plan Boundary
- 400m Neighbourhood Walkable Catchment
- Planned Bus Route
- P Indicative Parking Locations (to be reviewed @ subdivision)

BUS ROUTE, PATH NETWORK & PARKING EMBAYMENTS

Lot 1507 Eighty Road, Baldvis
A Rockingham Park Project



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3.6.5 PUBLIC TRANSPORT

A Transperth operated **Bus Route 564** currently provides a limited service to the South Baldvis locality, linking Settlers Hill Estate with Warnbro Station on the SW Metropolitan Railway Line.

The *Baldvis Road Needs Study Traffic and Infrastructure Report (2005)* identifies three bus routes ultimately servicing the locality, inclusive of two routes in or around Lot 1507. The South Baldvis Western Bus Route enters Lot 1507 via Arpenteur Road and continues through the middle of the landholding via Nairn Drive, before terminating at Sixty Eight Road. The South Baldvis Central Bus Route follows a similar north-south aligned route through the adjoining The Dales and Avalon Estates (some 300m east of Lot 1507), this time linking back to the Baldvis District Centre in addition to Warnbro Station.

The LSP accommodates the Western Bus Route alignment both in terms of reservation width and carriageway design. In addition the LSP embraces the opportunities that the bus route presents, by proposing medium density housing adjacent its entire route. Consistent with advice from the Public Transport Authority on similar proposals, bus embayments are not proposed. Wider carriageways and reserves are also provided surrounding the Primary School and District Playing Fields where regular bus use is anticipated.

3.6.6 PEDESTRIAN & CYCLIST NETWORK

A highly permeable road network within the LSP area creates excellent opportunities for the provision of good pedestrian and cyclist facilities that maximise the use of non-motorised transport modes. **Figure 20** outlines the key pedestrian and cyclist routes through the LSP area.

In accordance with the requirements of *Liveable Neighbourhoods*, paths shall be provided on one side of all roads and on both sides of roads classified as an 'Integrator' or 'Neighbourhood Connector' (refer **Figure 18**). In accordance with the current practice of the City of Rockingham all paths will be constructed 2m in width so that they can be designated as shared paths for pedestrians and cyclists. Slightly wider 2.5m widths will be applied in high pedestrian-traffic locations such as adjacent to the Primary School.

On-street cycle lanes will be included along Nairn Drive and along both sides of all internalised 'Neighbourhood Connectors'.

3.6.7 PARKLAND CIRCUIT

The 'Parkland Circuit' path network is the second fundamental design element of the LSP. Identified on **Figure 20**, the circuit is essentially a shared path located within wider landscaped road verges that link the estate's expansive network of public open space reservations, inclusive of on-route facilities that encourage both passive and active recreational use.

Initial thoughts beyond seating and shade structures involve the provision of fitness equipment strategically located at various positions along its route. At the City's suggestion the developer is also investigating the potential to include Calico infrastructure that through the use of totem poles and personal mobile phones, allow users of the route to track their individual performance. Cross-sections detailing the different environment along various sections of the route are shown on **Figure 21a** and **21b**.

3.6.8 VISITOR PARKING

At the City's request visitor parking embayments have been identified in key areas of the LSP, such as adjacent laneway development (which lack driveway depths that accommodate visitor parking); around Grouped Housing sites (to assist in catering for overflow parking having regard for likely future access and egress opportunities); and in and around public open space reservations. These locations are purely notional and will be reviewed at the subdivision and detailed engineering stages of design.

THE 'PARKLAND CIRCUIT' IS A PEDESTRIAN PATH NETWORK CONNECTING PUBLIC OPEN SPACES WITHIN PARKLAND HEIGHTS.

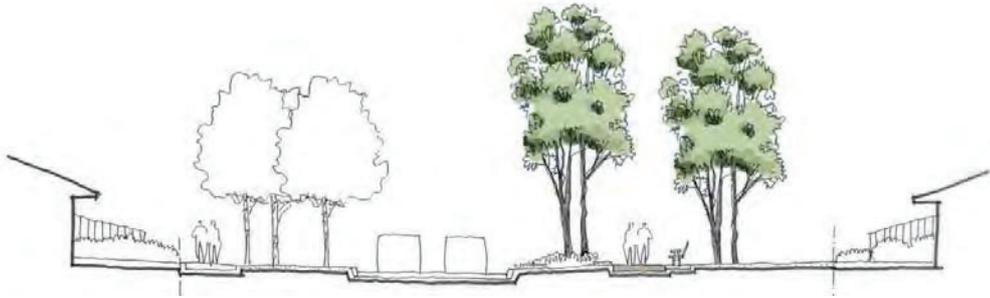
CHARACTERISTICS OF THE 'PARKLAND CIRCUIT' INCLUDE;

- WIDENED PEDESTRIAN PATH (2.5 - 3.0m)
- TREES ALONG THE 'PARKLAND CIRCUIT' PATH NETWORK TO BE THE SAME SPECIES - PROVIDING SHADE AND CHARACTER
- EXERCISE NODES PROVIDED ALONG THE ROUTE TO ENCOURAGE THE COMMUNITY TO CREATE THEIR OWN FITNESS CIRCUIT
- PATH TO BE A DIFFERENT MATERIAL THAN ANY OTHER USED IN THE DEVELOPMENT
- SEATS/PASSIVE NODES TO ALLOW FOR REST ALONG THE CIRCUIT.

THE BELOW SECTIONS PROVIDE AN INDICATIVE GUIDE TO THE VARYING CONCEPTS ALONG THE 'PARKLAND CIRCUIT' (CONCEPT SUBJECT TO DETAILED DESIGN)

1. 'PARKLAND CIRCUIT' TYPOLOGY ONE

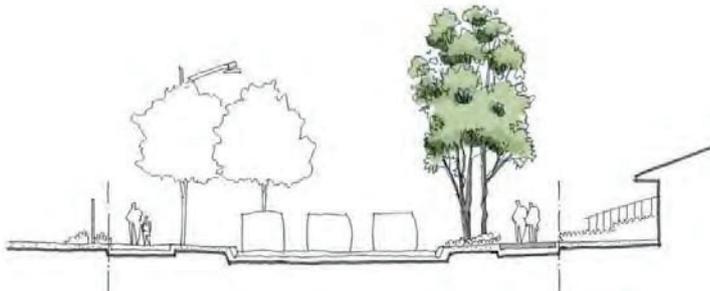
SECTION THROUGH RESIDENTIAL CUL-DE-SAC ROAD (WIDTH VARIES)



- WIDE PATH THROUGH GROVE OF TREES
- PASSIVE NODE

2. 'PARKLAND CIRCUIT' TYPOLOGY TWO

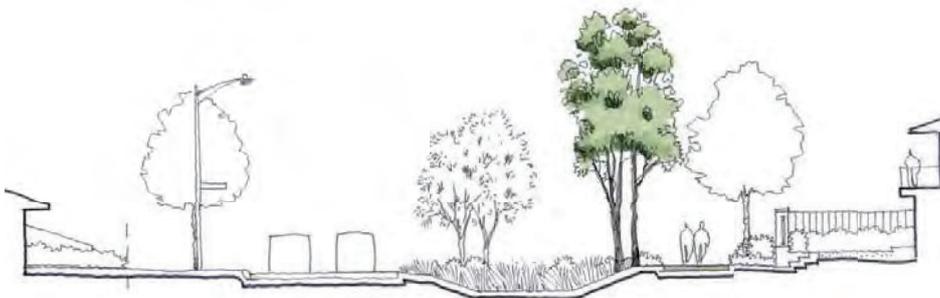
SECTION ADJACENT TO PRIMARY SCHOOL



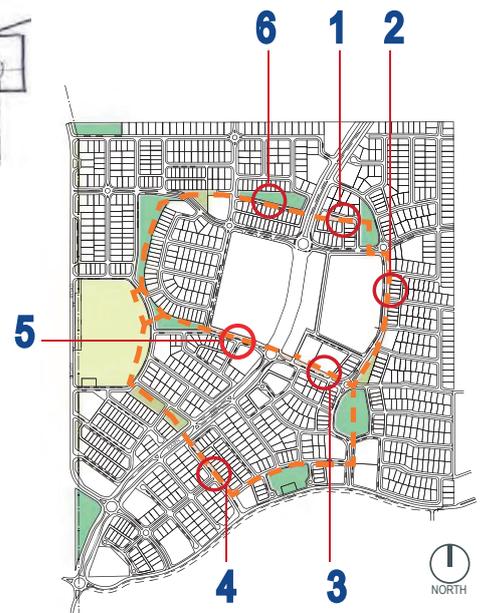
- WIDE PATH ALONG BOUNDARY
- CO-ORDINATION WITH SERVICES AND BOUNDARY FENCING REQUIRED

3. 'PARKLAND CIRCUIT' TYPOLOGY THREE

SECTION THROUGH WIDENED VERGE WITH DRAINAGE (25 M GREEN LINK)



- WIDE PATH THROUGH GROVE OF TREES
- ROAD SIDE SWALE TO PROVIDE A SOFT BUFFER TO ROAD



Source : **Emerge Associates POS Overall Strategy June 2011**

PARKLAND CIRCUIT

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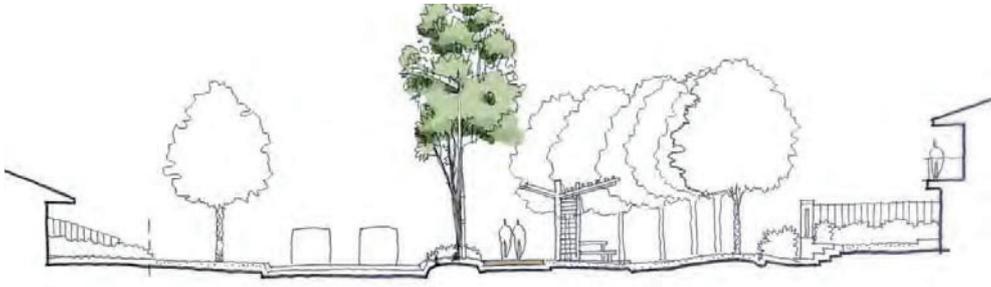


figure
21A

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4. 'PARKLAND CIRCUIT' TYPOLOGY FOUR

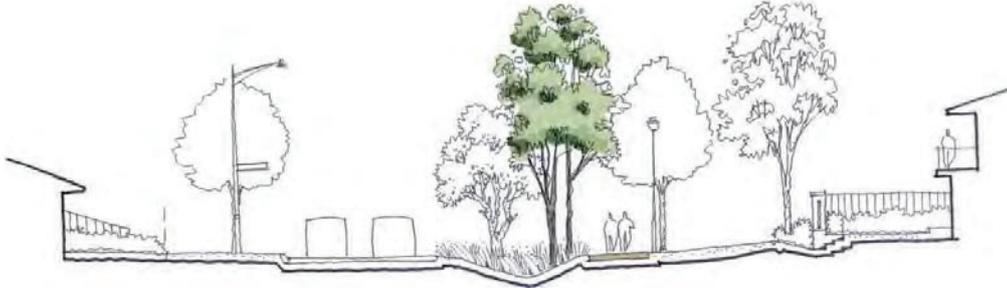
SECTION THROUGH WIDENED VERGE WITH PASSIVE NODE/SHELTER (25 M GREEN LINK)



- WIDE PATH THROUGH GROVE OF TREES
- PASSIVE NODE

5. 'PARKLAND CIRCUIT' TYPOLOGY SIX

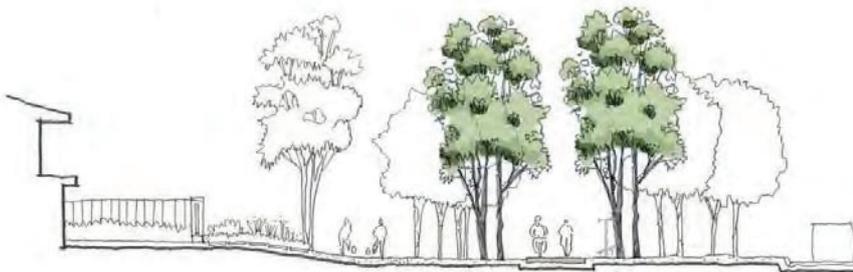
SECTION THROUGH WIDENED VERGE WITH DRAINAGE (25 M GREEN LINK)



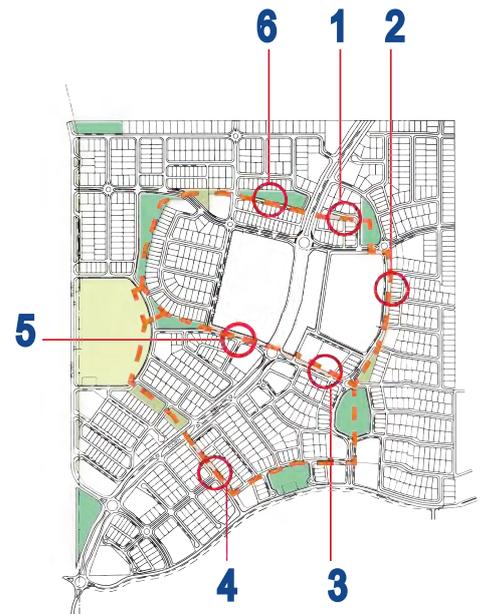
- WIDE PATH THROUGH GROVE OF TREES
- ROAD SIDE SWALE TO PROVIDE A SOFT BUFFER TO ROAD
- TURFED AREA TO PROVIDE OPPORTUNITIES FOR REST
- LIGHTING PROVISIONS

6. 'PARKLAND CIRCUIT' TYPOLOGY SEVEN

SECTION THROUGH PUBLIC OPEN SPACE



- WIDE PATH THROUGH GROVE OF TREES
- MEANDERS THROUGH PUBLIC OPEN SPACE
- EXERCISE NODES LOCATED THROUGHOUT PUBLIC OPEN SPACES



Source : **Emerge Associates POS Overall Strategy June 2011**

PARKLAND CIRCUIT

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figure
21B

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OVERLAND FLOW FOR 1 IN 100 YEAR STORM EVENT

LEGEND

DESIGN ASSUMPTIONS

- Where Subdivision layout not available impervious area equals 25% of total catchment area.
- Infiltration area is estimated at 25% of all
 - POS
 - Road / median area within catchment
 - Below ground infiltration network area

LEGEND

- Generalised drainage flow direction
- Extent of site catchment boundary
- Drainage sub catchment boundary
- Existing surface contour
- Proposed public open space
- Proposed below ground infiltration storage
- Denotes drainage infiltration basin. Shape to be determined at detail design
 - Denotes 1 in 1 storm twl
 - Denotes 1 in 5 storm twl
 - Denotes 1 in 10 storm twl
 - Denotes 1 in 100 storm twl

TABLES

AREAS AND STORAGE 1 IN 5 STORM					
SWALE	CATCHMENT AREA	IMPERVIOUS AREA	INFILTRATION RATE	SWALE AREA	STORM VOLUME
1	1.33 ha	1.20 ha	3.0m/DAY	691m ²	120m ³
2	1.89 ha	1.70 ha	3.0m/DAY	1232m ²	190m ³
3	2.17 ha	1.95 ha	3.0m/DAY	1000m ²	250m ³
4	1.73 ha	1.56 ha	3.0m/DAY	755m ²	180m ³
5	0.99 ha	0.89 ha	3.0m/DAY	573m ²	80m ³

BASIN	CATCHMENT AREA	IMPERVIOUS AREA	INFILTRATION RATE	BASIN AREA	STORM VOLUME
B1	3.77 ha	3.39 ha	3.0m/DAY	2085m ²	714m ³
B2	6.32 ha	5.69 ha	3.0m/DAY	2893m ²	1070m ³
B3	5.09 ha	4.58 ha	3.0m/DAY	1755m ²	1050m ³
B4	2.06 ha	1.85 ha	3.0m/DAY	1206m ²	430m ³
B5	2.75 ha	2.48 ha	3.0m/DAY	1673m ²	440m ³
B6	1.27 ha	1.14 ha	3.0m/DAY	1795m ²	140m ³
B7	1.89 ha	1.70 ha	3.0m/DAY	878m ²	270m ³
B8	1.10 ha	0.99 ha	3.0m/DAY	810m ²	150m ³
B9	3.43 ha	3.09 ha	3.0m/DAY	212m ²	650m ³
B10	2.72 ha	1.91 ha	3.0m/DAY	96m ²	400m ³

Source : Serling Service Infrastructure Report

BULK EARTHWORKS & DRAINAGE

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figure 22

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3.7 URBAN WATER MANAGEMENT

ENV Australia was engaged by Rockingham Park to prepare a Local Water Management Strategy (LWMS) pursuant to the requirements of the WAPC's *Better Urban Water Management (2008)*. Key information is depicted on **Figure 22** whilst a general overview of the report appears below. A copy of the full report submitted to the Department of Water for its consideration can be found at **Appendix J**.

The objective of the LWMS is to ensure that sustainable management of the total water cycle within the estate occurs through water sensitive urban design. This includes water conservation, stormwater and groundwater management. Rockingham Park Pty Ltd aims to manage these issues at the site through the following initiatives:

WATER CONSERVATION

-  Participating in the EnviroDevelopment program to achieve a maximum potable water usage of 80 kL/person/year and meet the EnviroDevelopment target of a 20% reduction in scheme water use from the State Water Plan target of 100kL/p/a. This will be achieved through implementation of the following:
 - Developer provided free waterwise landscaping for all residential front yards; and
 - Behaviour change of householders, encouraging water conservation through education packages and 'Living Smart' (The Behaviour Change Program).
-  Providing waterwise landscaping for Public Open Space (POS) that includes waterwise plants, soil amendments to improve water and nutrient retention, minimising turf areas and water efficient irrigation;
-  Investigating the possibility of using an alternative water source to irrigate the POS.

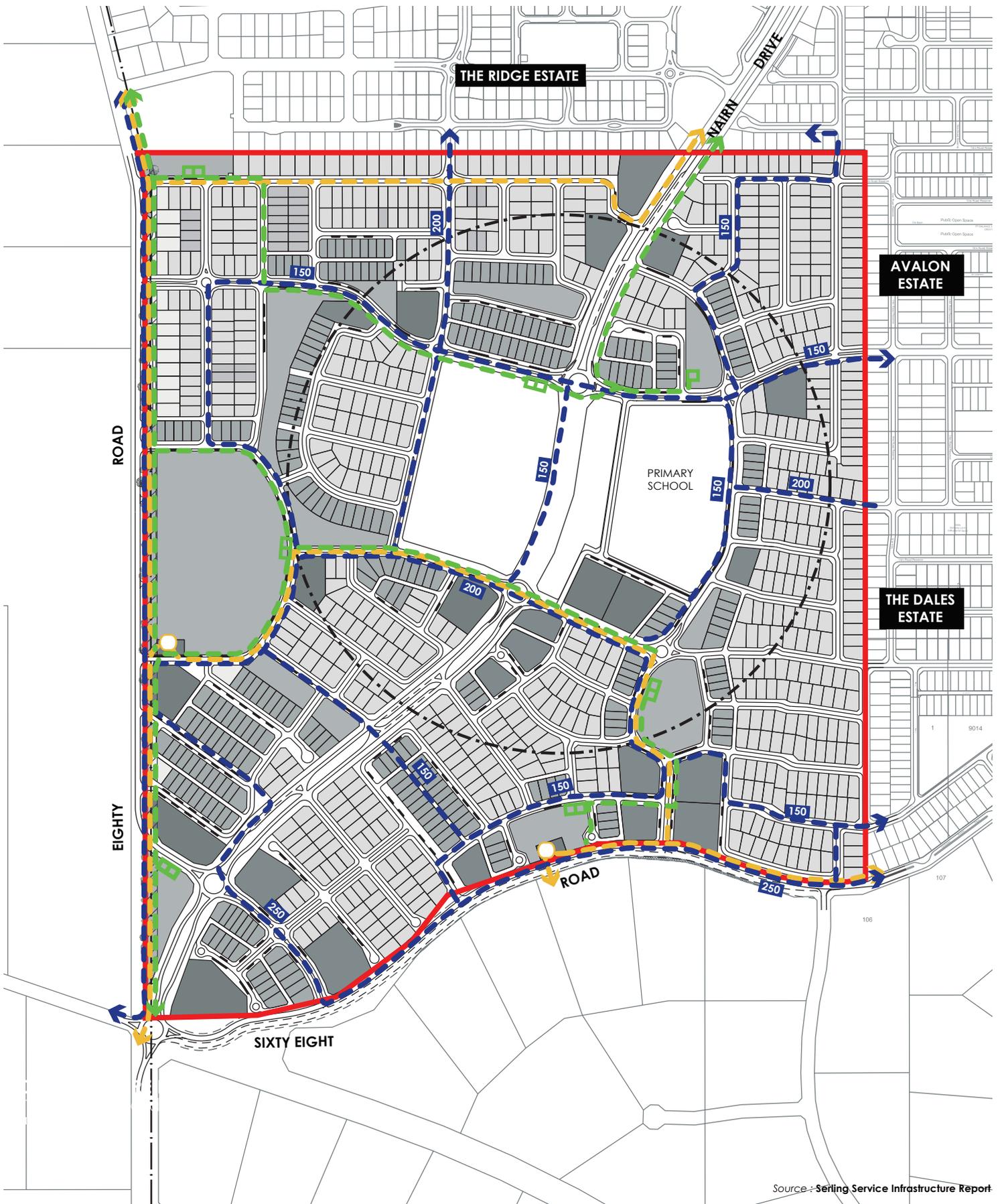
STORMWATER MANAGEMENT

-  Implementing a drainage design that ensures pre-development discharge rates in the event of a 1:100 year ARI event will be maintained through storage and infiltration on-site; and
-  Maximising infiltration by developing swales and rain gardens in road reserves where possible, planted with native vegetation to encourage nutrient and suspended solids uptake and removal prior to infiltration. Open based manholes will be used to maximise infiltration. Infiltration basins in Public Open Space will manage larger events.

GROUNDWATER MANAGEMENT

-  Recognising the issue of restricted groundwater availability and planning low water use POS.

The LWMS demonstrates that Parkland Heights can be developed without significant constraints. Underlying Urban Water Management Plans (UWMP's) prepared on a subdivision stage by stage basis will include information relating to implementation and on-going management responsibilities, maintenance schedules, irrigation and nutrient management, groundwater and surface water monitoring programs and confirm proponent commitments relating to demand reduction within the development.



Source : Serling Service Infrastructure Report

LEGEND

Local Structure Plan Boundary	Water Mains (>150mm)
Potential WWPS Sites	Major Electrical Distribution Lines
Potential Pressure Main Alignments	Transformers and / or Switchgear

MAJOR SERVICE ALIGNMENTS

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3.8 INFRASTRUCTURE CO-ORDINATION, STAGING & SERVICING

Serling Consulting were engaged by Rockingham Park to prepare a Service Infrastructure Report to support the Local Structure Plan design. The report confirms that the land can be connected to all services, either by extension from neighbouring developments or by extension from Eighty Road. Major service alignments are depicted on **Figure 23**. A copy of Serling's report can be found at **Appendix K**, key elements of the report are detailed below:

3.8.1 SEWER

Water Corporation waste water planning identifies the need to construct two Waste Water Pumping Stations (WWPS) and Pressure Mains (PM), (being Baldvis South WWPS's "K" and "N") in order to service the development of Lot 1507 and the surrounding locality.

Negotiations over the construction of the Baldvis South WWPS "K" is currently being sought from the Water Corporation to service the initial stages of development located in the northwest corner of the landholding fronting Eighty Road. The WWPS is a Type 40 permanent station that will be located on the eastern side of Eighty Road contiguous with the District Playing Field public open space. A site of approximately 40m x 22.5m is proposed to accommodate the facility inclusive of vehicle turnaround facility and 3 hours of emergency storage pipe network. Overflow is accommodated within the 1:1 year ARI event level of an adjoining drainage basin, an area that is already deducted from the gross subdivisible area, and therefore doesn't affect POS calculations.

Initially sewerage will be pumped from the proposed WWPS through a 1,360m pressure main to an existing DN225 gravity sewer main on Ridge Boulevard within The Ridge Estate.

Once capacity is reached at the discharge point (expected after 3-5 years of development), this pressure main is to be extended to a discharge point more than 2,150m from the pumping station into an existing DN300 gravity main. This discharge point will be in use for several years of further development, as the ultimate pressure main option will only be completed and used following further Water Corporation headworks.

The proposed ultimate discharge arrangement is located around 300m east of the intersection of Smirk and Sixty-Eight Roads where it is to discharge into DN450 gravity sewer reticulation. The WWPS required in this area and DN450 gravity main is not currently available nor a timeframe as to when it is expected to be available.

Due to the existence of significant vegetation and services within the Eighty Road reservation, open trenching along the majority of the gravity sewer alignment is not possible and boring (up to 6m deep) will be used to lay the sewer.

Land development to the east of Nairn Drive will trigger the need to construct WWPS "N" in the southern part of the development adjacent to Sixty Eight Road. Whilst allowance has been made for a similar sized site collocated with an area of POS located along Sixty-Eight Road, no detailed work has been completed for this pumping station so its location is yet to be confirmed. It is possible that the final location will be outside the LSP area.

3.8.2 WATER

The landholding is located within the Tamworth tank water reticulation area within which the Water Corporation has advised it is unable to service land without localised boosting above the RL 30m AHD contour.

Initial stages of subdivision in the northwest corner of the site are being serviced by an existing DN200 water main located in Arpenteur Drive. Extension of an existing DN375 water main located on the eastern side of Eighty Road will be required to service future development within the southwest corner of the site.

Water supply to the eastern part of the landholding is limited until the DN500 water distribution main in Nairn Drive is extended south to the DN250 reticulation main at The Ridge Boulevard. This work is currently underway with further extensions proposed to occur as the development front continues southward along Nairn Drive.



3.8.3 STORMWATER DESIGN

The undulating topography and sandy geology of the site provides an ideal environment for the adoption of water sensitive design principles focussing on infiltration. Building on the commitments outlined in the LWMS the drainage strategy proposed for the development incorporates progressive infiltration along the entire length of the stormwater system through the use of trapped “leaky” bases, swales and below ground StormTech infiltration systems as appropriate. This holds back the timing of the peak flow, dissipates the nutrients and first flush in a water sensitive design approach, reduces the pipe sizes and reduces the quantity of storm water discharging into the infiltration basins.

Open drainage infiltration basins have been strategically located in the POS areas that cater for the total of ten (10) sub catchments within the development. In accordance with Council Policy, preliminary modelling indicates that in all but one instance (POS Area ‘K’) where a variation has been accepted by the City at LSP adoption, all the infiltration basins within the landholding require no more than 25% of the area of the POS for the 10 year storm event, and the overall system is capable of handling the 100 year storm event without flooding the developed lots. Drainage Catchment Plans included within **Appendix K** detail the proposed drainage system showing the sub-catchment boundaries, the location of swales, below ground infiltration systems and the location and size of infiltration basins required for the 1 in 1yr, 1 in 5yr, 1 in 10yr and 1 in 100yr storm events.

3.8.4 GAS

WestNet gas infrastructure is located within Eighty Road and has sufficient capacity to supply the subdivision and development of Lot 1507.

3.8.5 ELECTRICITY

A 132kV high voltage aerial feeder line is located within the landholding along its frontage to Eighty Road. Retention and protection of this line is proposed via the creation of an 18m wide easement that precludes the construction of buildings underneath. Power will be distributed throughout the estate using high and low voltage underground power lines that connect back to this aerial service.

3.8.6 TELECOMMUNICATIONS

Existing Telstra infrastructure is located within the landholding immediately east of the aerial electricity feeder line. With the impending rollout of the national broadband service however there will no longer be a copper to node service installed. Instead the developer will arrange for an NBNCo approved pit and pipe system design. The external NBNCo connection will most likely use the existing Telstra infrastructure in the Eighty Road reservation.

3.8.7 EARTHWORKS

In order to bring the land below the 30m contour line (above which a reticulated water supply cannot be provided – refer **Section 3.9.2**), and to shape the landholding to facilitate appropriate residential development (including full access road grades where practical and essential, such as major routes to key facilities such as the Primary School, some 2M m³ of excess cut will be removed from the site.

Agreement has been reached with the owners of land located along the eastern boundary of the site to lower existing levels in the order of up to 6m to better suit the development proposed on these landholdings and to achieve a workable interface between the developments. This reduction assists in reducing grades in the eastern portion of the estate, meaning that retaining wall heights throughout the majority of the estate can be kept below 2m in height.

3.8.8 TIMEFRAMES AND STAGING

The development of Parkland Heights estate has already commenced. Construction of Stage 1, located in the north-west corner of the landholding was completed and released for sale in September 2011, whilst Stage 2 (an eastward extension of Stage 1), is scheduled to commence construction in July 2012. Upon approval of this new LSP, Rockingham Park intends to proceed with between 2-4 further stages west of Nairn Drive prior to transitioning across to the eastern side. A plan detailing Rockingham Park's current staging strategy is included as **Figure 24**.

It is worth noting that the earthworks staging is slightly different due to the cut-to-fill strategy adopted for the site. The change relates to the centre of the site which will be earthworked early on (potentially as part of Stage 3 or 4), but not being serviced or developed until later in the development program.

Given the central location and relatively level nature of this and the District Playing Field sites, Rockingham Park intend to approach the City regarding interim use of these areas for various community building and environmental sustainability initiatives it intends to pursue as the estate progresses through its anticipated 20 year lifetime.

An example is the Materials Recovery Centre, a temporary facility that will move along with staging of the estate. Initially located adjacent to the civil works compound on portion of the District Playing Fields site, it is essentially a central storage yard for waste generated by other legitimate activities on-site (civil works and housing construction), the aim being to recycle between 60-80% of unused building products, a significant increase to the 25% average currently achieved across the Metropolitan Region.

Other initiatives may involve the erection of a large multi-purpose building at the centre of the site that can be used for a variety of community activities pending resolution of the detailed planning of this area.

3.9 DEVELOPER CONTRIBUTION ARRANGEMENTS

Lot 1507 is capable of developing independently and is not the subject of any existing or proposed Developer Contribution arrangement as they relate to roads or service infrastructure (utilities, road upgrades etc).

The City is however, in the process of finalising a Community Infrastructure cost sharing initiative across the balance of its urban expansion areas via Amendment No.114 to TPS2. Advertised for public review and adopted for final approval by the City in late 2011, the Amendment is a seriously entertained proposal, meaning that any subsequent stages of development will be conditional upon a proportional contribution towards the final schedule of infrastructure, as subsequently determined by the Minister for Planning.

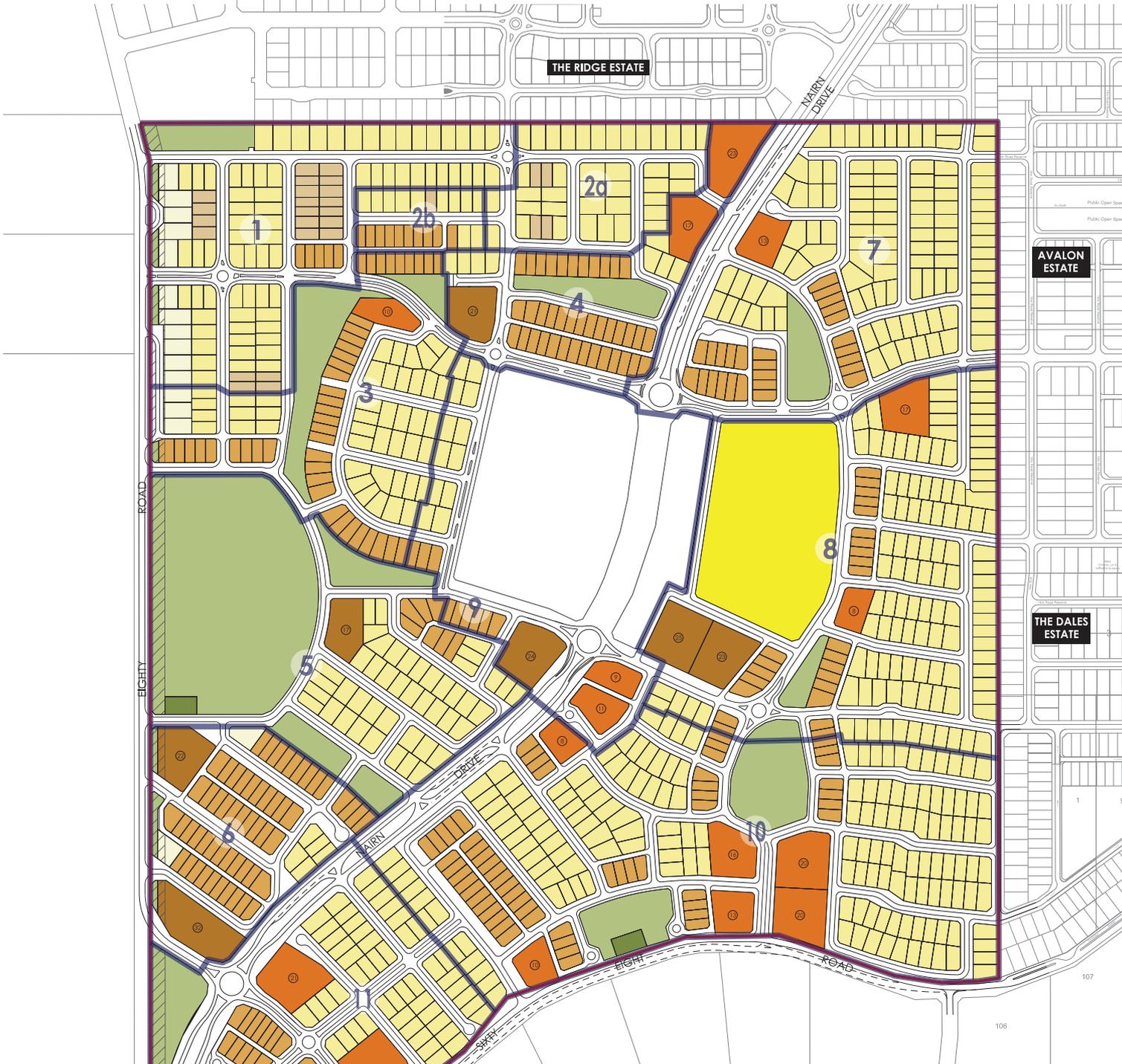
STAGE 1			
Lot Type	Area	Single Lots	GH Dwellings
RESIDENTIAL R30	1786m ²	5	357m ²
RESIDENTIAL R25	9365m ²	22	425m ²
RESIDENTIAL R20	40084m ²	70	572m ²
RESIDENTIAL R15	8438m ²	11	767m ²
TOTAL	59675m²	109	
PUBLIC OPEN SPACE	6284m²	4	

STAGE 2			
Lot Type	Area	Single Lots	GH Dwellings
RESIDENTIAL R30	3421m ²	10	342m ²
RESIDENTIAL R25	2114m ²	5	422m ²
RESIDENTIAL R20	29993m ²	50	599m ²
TOTAL	35528m²	65	

STAGE 3			
Lot Type	Area	Single Lots	GH Dwellings
RESIDENTIAL R40	2331m ²	1	2331m ²
RESIDENTIAL R30	18116m ²	43	421m ²
RESIDENTIAL R20	24974m ²	44	567m ²
RESIDENTIAL R15	2117m ²	3	705m ²
TOTAL	47538m²	91	10
PUBLIC OPEN SPACE	13821m²	3	

STAGE 4			
Lot Type	Area	Single Lots	GH Dwellings
RESIDENTIAL R60	3838m ²	1	21
RESIDENTIAL R40	8980m ²	2	40
RESIDENTIAL R30	15144m ²	39	388m ²
RESIDENTIAL R20	44666m ²	8	558m ²
TOTAL	57048m²	50	61
PUBLIC OPEN SPACE	5704m²	1	

STAGE 5			
Lot Type	Area	Single Lots	GH Dwellings
RESIDENTIAL R60	3137m ²	1	17
RESIDENTIAL R30	3421m ²	7	488m ²
RESIDENTIAL R20	25734m ²	45	571m ²
TOTAL	32292m²	53	17
PUBLIC OPEN SPACE	67940m²	4	
PUMP STATION	900m²	1	



STAGE 6			
Lot Type	Area	Single Lots	GH Dwellings
RESIDENTIAL R60	9916m ²	2	24
RESIDENTIAL R30	22646m ²	55	411m ²
RESIDENTIAL R20	2627m ²	5	525m ²
RESIDENTIAL R15	1764m ²	2	862m ²
TOTAL	36553m²	64	54

STAGE 7			
Lot Type	Area	Single Lots	GH Dwellings
RESIDENTIAL R40	2908m ²	1	13
RESIDENTIAL R30	10646m ²	26	409m ²
RESIDENTIAL R20	58969m ²	106	556m ²
TOTAL	72523m²	133	13
PUBLIC OPEN SPACE	5316m²	1	

STAGE 8			
Lot Type	Area	Single Lots	GH Dwellings
RESIDENTIAL R60	8903m ²	2	48
RESIDENTIAL R40	5775m ²	2	25
RESIDENTIAL R30	9934m ²	25	397m ²
RESIDENTIAL R20	60122m ²	114	527m ²
TOTAL	129546m²	143	73
EDUCATION	40312m²	1	
PUBLIC OPEN SPACE	3772m²	2	

STAGE 9			
Lot Type	Area	Single Lots	GH Dwellings
RESIDENTIAL R60	4428m ²	1	24
RESIDENTIAL R40	4644m ²	2	20
RESIDENTIAL R30	3891m ²	9	432m ²
RESIDENTIAL R20	7307m ²	12	608m ²
TOTAL	20270m²	24	44
BALANCE LAND	66512m²		

STAGE 10			
Lot Type	Area	Single Lots	GH Dwellings
RESIDENTIAL R40	19279m ²	4	87
RESIDENTIAL R30	22001m ²	57	385m ²
RESIDENTIAL R20	82739m ²	155	533m ²
TOTAL	124019m²	218	87
PUBLIC OPEN SPACE	15753m²	2	
PUMP STATION	900m²	1	

STAGE 11			
Lot Type	Area	Single Lots	GH Dwellings
RESIDENTIAL R60	7026m ²	1	39
RESIDENTIAL R40	10745m ²	2	48
RESIDENTIAL R30	9793m ²	23	425m ²
RESIDENTIAL R20	25566m ²	50	511m ²
TOTAL	5130m²	76	87
PUBLIC OPEN SPACE	9734m²	4	

OVERALL LEGEND

RESIDENTIAL DENSITY CODES	AREA (ha)	SINGLE LOTS	GH LOTS	GH DWELLINGS	TOTAL DWELLINGS
RESIDENTIAL R60	3.7253	0	8	203	203
RESIDENTIAL R40	5.4665	0	16	243	243
RESIDENTIAL R30	12.0900	299			299
RESIDENTIAL R25	1.1489	27			27
RESIDENTIAL R20	36.2858	659			659
RESIDENTIAL R15	1.2328	16			16
RESIDENTIAL TOTALS	59.9493	1001	24	446	1447

LAND USE ZONES

LAND USE ZONE	AREA (ha)	SINGLE LOTS	GH LOTS	GH DWELLINGS	TOTAL DWELLINGS
EDUCATION	4.0312	1			1
PUBLIC OPEN SPACE	12.8330	21			21
PUMP STATION	0.1800			2	2
OTHER	120.7577				

OTHER

OTHER	AREA (ha)
LSP BOUNDARY	120.7577
POWERLINE EASEMENT	1.7074

Note: Lot Layout Indicative Only.

4 STATUTORY PLANNING IMPLEMENTATION

The Parkland Heights Local Structure Plan and report is submitted to the City of Rockingham for consideration in accordance with the requirements of Clause 4.2.3 of the City's Town Planning Scheme No.2. Upon its approval by the City and endorsement by the WAPC there are no further impediments to continued subdivision and development of Lot 1507.

As an interim measure approval has recently been granted to subdivide the parent land holding into two more manageable portions based on the eastern alignment of the Nairn Drive Other Regional Road Reservation. This should not be interpreted as an intent to sell portion of the site but is purely proposed for project budgeting purposes due to stricter regulations on money borrowing emanating from the Global Financial Crisis.

Upon the cessation of the LSP public advertisement period (at which stage any major issues with the proposal should have been identified), it is Rockingham Park's intention to lodge a subdivision application for the balance of the LSP landholding, encompassing all of the remaining landholding on both sides of Nairn Drive.

The need for notifications on title relating to mosquito nuisance is acknowledged. Also acknowledged is the potential for Section 70A Memorials to be applied along the southern boundary, a matter to be explored as and when clearance of the lot is requested but not prior to subdivision approval, as the physical siting of development is not in question, merely the standard of construction should the banksia woodland to the south of Sixty Eight Road remain.

Detailed Area Plans will be prepared in consultation with the City of Rockingham for the rear –loaded cottage lot product, lots adjacent PAW's and any other area identified in this document or as determined by the WAPC when approving subsequent subdivision proposals. Blanket variations to front setback and site coverage requirements of subsequent residential development, are currently being considered for future stages of the estate pending the outcomes of the ongoing Residential Design Codes Review.



**Lot 1507 Eighty Road, Baldivis
Local Structure Plan**



APPENDICES



**APPENDIX A
PRE-LODGEMENT CONSULTATION TABLE**



**Lot 1507 Eighty Road, Baldivis
Local Structure Plan**



APPENDIX B CERTIFICATE OF TITLE



**Lot 1507 Eighty Road, Baldvis
Local Structure Plan**



APPENDIX C ENVIRONMENTAL ASSESSMENT REPORT



**Lot 1507 Eighty Road, Baldvis
Local Structure Plan**



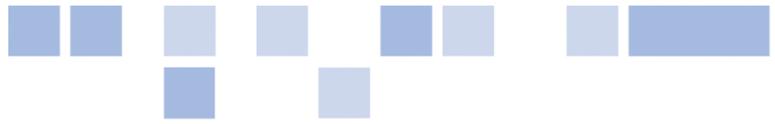
APPENDIX D SUPPLEMENTARY TREE INFORMATION



**Lot 1507 Eighty Road, Baldivis
Local Structure Plan**



APPENDIX E FIRE MANAGEMENT PLAN



**APPENDIX F
DET ACCEPTANCE OF PRIMARY SCHOOL SITE**



APPENDIX G POS CONCEPTS



APPENDIX H TRANSPORT ASSESSMENT



APPENDIX I NAIRN DRIVE ACCESS STRATEGY



**Lot 1507 Eighty Road, Baldivis
Local Structure Plan**



**APPENDIX J
LOCAL WATER MANAGEMENT STRATEGY**



**Lot 1507 Eighty Road, Baldivis
Local Structure Plan**



APPENDIX K SERVICE INFRASTRUCTURE REPORT

Parkland Heights Local Structure Plan

ADDENDUM 1 - EXPLANATORY REPORT
AMENDMENT 4 (2019)



**PARKLAND
HEIGHTS**

AMENDMENT 4

LOCAL STRUCTURE PLAN

PART TWO - EXPLANATORY REPORT

FEBRUARY 2019



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PARKLAND HEIGHTS LOCAL STRUCTURE PLAN
AMENDMENT 4
PART TWO - EXPLANATORY REPORT

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3039Rep23D
February 2019

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FIGURES

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Figure 2: Preliminary Concept Plan

Figure 3: Parklands Heights Neighbourhood Centre – Retail Catchment

Figure 4: Total Catchment Turnover Growth

Figure 5: Road Hierarchy Comparison

Figure 6: Intersection Treatment Comparison

Figure 7: Pedestrian and Cyclist Facilities

APPENDICES

Appendix 1: Retail Sustainability Assessment (Pracsys)

Appendix 2: Traffic Impact Assessment (Transcore)

This plan has been prepared for general information purposes only and uses potentially uncontrolled data from external sources. CLE does not guarantee the accuracy of the plan and it should not be used for any detailed design. This plan remains the property of CLE.



- LEGEND**
- ZONES / RESERVES**
 - RESIDENTIAL R40
 - RESIDENTIAL R40
 - RESIDENTIAL R30
 - RESIDENTIAL R25
 - RESIDENTIAL R20
 - RESIDENTIAL R15
 - EDUCATION
 - PUBLIC OPEN SPACE
 - OTHER**
 - LOCAL STRUCTURE PLAN BOUNDARY
 - 400M NEIGHBOURHOOD WALKABLE CATCHMENT
 - PUMP STATION CIRCULAR BUFFER
 - POWERLINE EASEMENT
 - ROAD WIDENING (SIXTY EIGHT ROAD)
 - PLANNED BUS ROUTE
 - VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
 - SEWER PUMP STATION (0.00m³ - 1200m³)

NOTES

- The boundary of the local structure plan (LSP) is in accordance with the original Comprehensive Development Plan (CDP) 2009 and original Lot 1,507 boundary.
- The access street (circles) associated (or) layout shown on the Plan is indicative only and subject to refinement as part of the detailed subdivision process.
- The Village Centre (star) form the subject of a separate planning review and is excluded from this proposal.
- PUS areas are indicative only and subject to further detailed design and strategic considerations.
- All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of the road network standards preferred for the subdivision. All dimensions and curves depicted on the Plan are subject to a separate and final survey and may vary from the figures shown.
- Buying a block level to be reviewed prior to the creation of Bills. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
- SixtyEight Road widening to accommodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

PUBLIC OPEN SPACE TABLE		NOTES		CONVERTED TO ROAD RESERVE	
AREA	AREA (m ²)	AREA	AREA (m ²)	AREA	AREA (m ²)
1	0.4009	1	0.5830	CONVERTED TO ROAD RESERVE	
2	0.1483	2	0.3439		
3	0.8566	3	0.2238		
4	0.2283	4	0.8281		
5	0.5230	5	0.4755		
6	5.3314	6	0.7076		
7	0.4668				
8	0.2747				
TOTAL AREA BY PUS & RESERVE		TOTAL		TOTAL	



1.0 PLANNING BACKGROUND

1.1 Introduction and Purpose

The Parkland Heights Local Structure Plan (LSP) was endorsed by the Western Australian Planning Commission (WAPC) on the 13th February 2013 and is the overarching framework guiding the development of the residential estate known as 'Parkland Heights' at Lot 1507 Eighty Road, Baldivis. The Parkland Heights LSP comprises a 120.82 hectare area in the south west corner of the South Baldivis District Structure Plan. Parkland Heights is in the single ownership of Rockingham Park Pty Ltd who are progressing staged development from the northern and eastern boundaries.

The current LSP identifies a 'Village Centre' at the centre of the LSP Map, co-located with the future Primary School (refer Figure 1). Note 3 of the LSP Map states that *"the Village Centre shall form the subject of a separate planning exercise and is excluded from this approval"*. Whilst the current LSP Map identifies the location and land area of the future Centre, it defers consideration of the zoning and composition to a subsequent planning stage.

Parkland Heights and Southern Baldivis in general, are planned to accommodate substantial population growth over the coming decades which has led to further investigation into the size of the activity centre planned for Parkland Heights. To this end, Rockingham Park Pty Ltd commissioned the preparation of a Retail Sustainability Assessment (RSA) by Pracsys (refer Appendix 1). The RSA concluded that, without a Neighbourhood Centre sized retail development, South Baldivis residents would need to travel outside of their local area to fulfil their shopping needs, resulting in longer trip requirements.

This Amendment to the Parkland Heights LSP (Amendment No.4) has been prepared to facilitate the development of a 10,000m² Neighbourhood Centre in response to the identified future shortfall in retail offerings within South Baldivis. The amended Part 1 – Implementation Report, this Part 2 – Explanatory Report and the accompanying appendices constitute the 'separate planning exercise' required under note 3 of the current approved LSP Map.

This Part 2 – Explanatory Report explains and justifies the amendments to the Part 1 – Implementation Report and the LSP Map. It does not replace the previous Explanatory Report prepared in support of the current LSP (Taylor Burrell Barnett, December 2012) rather, it forms an addendum and is supplementary to, the previous Explanatory Report and addresses only the proposed amendments to the Part 1 – Implementation Report and LSP Map.

The following technical appendices have been prepared in support of this LSP amendment and are appended in full:

Appendix 1: Retail Sustainability Assessment (Pracsys)

Appendix 2: Traffic Impact Assessment (Transcore)



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1.2 Planning Framework

1.2.1 Zoning

The proposed Neighbourhood Centre is zoned 'Urban' under the Metropolitan Region Scheme (MRS) and 'Development' under the City of Rockingham's Town Planning Scheme No.2 (TPS2). The Neighbourhood Centre directly abuts an 'Other Regional Road' reserve under the MRS in the form of the future Nairn Drive extension.

As previously stated, the Neighbourhood Centre is covered by the approved Parkland Heights LSP however, the LSP Map states that the Centre is subject to a separate planning exercise which this Amendment proposes to address.

1.2.2 Planning Strategies

Given the approved status of the LSP and its identification of a 'Village Centre' (by exclusion) on the approved LSP Map, the review of planning strategies in association with this Amendment is limited to those relevant to the proposed Neighbourhood Centre. The approved status of the LSP and subsequent development of the first stages of Parkland Heights confirm that the land is suitable for urban development and so the matter is not discussed in further detail as part of this Amendment.

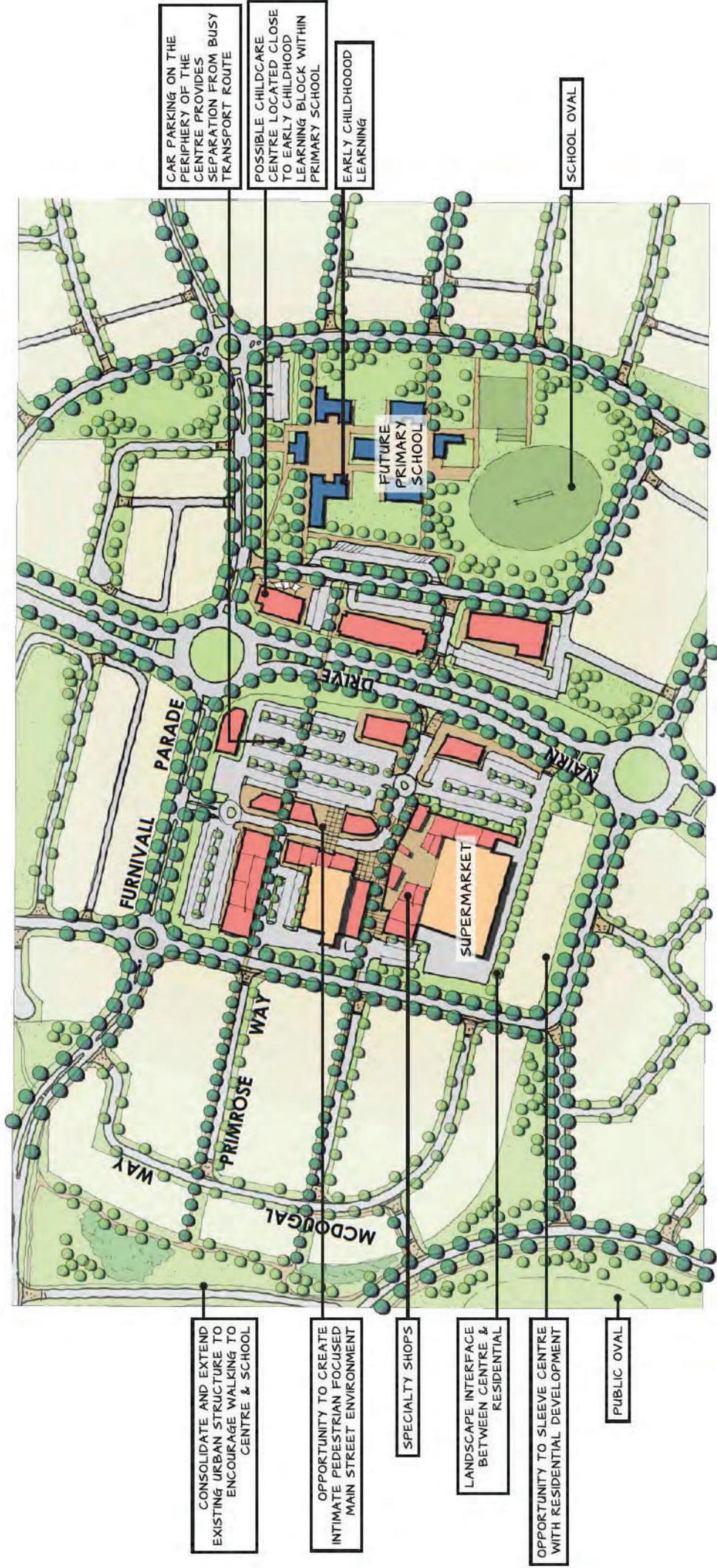
Draft South Metropolitan Peel Sub-regional Planning Framework

The draft South Metropolitan Peel Sub-regional Planning Framework ('the Framework') has been prepared by the State Government to establish a long-term integrated framework for land use and infrastructure provisions to plan for and coordinate Perth's growth to a city of 3.5 million people by the year 2050. The Framework Plan identifies area for future growth as well as higher order activity centres (District Centres and above). The Framework does not specifically identify lower order activity centres such as Neighbourhood Centres and Local Centres however, does identify large areas of future urban land in South Baldivis. Future development and growth within these areas warrants and will sustain a Neighbourhood Centre for Parkland Heights.

A key objective of the Framework is to increase the number of people living close to where they work to reduce travel times and decentralise employment from the Perth CBD. As demonstrated in the RSA (Appendix 1), the Parklands Heights Neighbourhood Centre is expected to generate 57 full time jobs during construction and 294 permanent jobs when operating, assisting to deliver the objectives of the Framework.

PARKLAND HEIGHTS LOCAL STRUCTURE PLAN AMENDMENT 4 PART TWO - EXPLANATORY REPORT

This plan is an indicative land use concept depicting one hypothetical development scenario for the land and is prepared for illustrative purposes only. It has no formal endorsement or approval status. Any lot boundaries, areas, road networks, public open space or any other land use detail depicted should be considered notional and will be subject to change as part of any subsequent formal planning approval processes. This plan remains the property of CLE.



Source: NH Architecture (Core Centre Concept Design)
3039-27-01 (02.03.2017), Not to scale

Liveable Neighbourhoods

Liveable Neighbourhoods is the WAPC's operational policy for the design of new subdivisions and the assessment of structure plans. In addition to shop retail, Liveable Neighbourhoods advocates local-scale office uses and higher density residential development in and around Neighbourhood Centres. The current LSP allocates higher density precincts around the Centre to maximise the potential population living within a walkable catchment. As demonstrated by the Preliminary Concept Plan (refer Figure 2), the Neighbourhood Centre is capable of accommodating a range of commercial uses as well as a residential precinct on the southern boundary. The residential precinct is subject to detailed design however, can potentially accommodate multiple dwelling or medium density-style attached housing.

Liveable Neighbourhoods promotes 'main street' activity centres. As depicted at the Preliminary Concept Plan (refer Figure 2), the proposed Neighbourhood Centre will have a strong main street character at the core of site, providing a pedestrian-friendly environment with active uses engaging the street. Further detail with regards to the design of the Centre will be addressed via a Local Development Plan and at the development application stage.

1.3.3 Planning Policies

City of Rockingham Planning Policy No. 3.1.2 – Local Commercial Strategy

The City of Rockingham's Planning Policy No. 3.1.2 – Local Commercial Strategy ('the Commercial Strategy') was prepared by the City to "promote the development of a hierarchy of centres which are viable, sustainable and which provide maximum benefit to the community". The Commercial Strategy, as it relates to the Baldivis Precinct, was reviewed in August 2012 to guide long-term retail and commercial floor space through a distribution of activity centres, consistent with the WAPC's State Planning Policy 4.2 – Activity Centre for Perth and Peel (SPP 4.2). The Commercial Strategy supports an activity centre hierarchy and the need for retail offerings to be readily accessible and encourages the concentration of future retail expansion.

With specific reference to the Baldivis area, the Commercial Strategy identifies the following key objectives:

- "Provide sufficient development opportunities to enable a diverse supply of commercial and residential floorspace to meet projected community needs;
- Cater for a full range of needs from shopping, commercial and community services from local convenience to higher-order comparison retail/goods and services;
- Mitigate the potential for an over-concentration of shopping floorspace in large activity centres at the expense of a more equitable level of service to communities; and

- Promote the walkable neighbourhoods principle of access to employment, retail and community facilities by distributing activity centres to improve access by foot or bicycle, rather than having to depend on access by car in urban areas."

The Commercial Strategy divides Neighbourhood and Local Centres into precincts, with the Parkland Heights Neighbourhood Centre located within Precinct 4 – Baldivis. The provisions for Precinct 4 were reviewed in 2012 to incorporate the recommendations of SPP 4.2, particularly to become more flexible and encourage the need to identify and assess the role of a centre rather than specify it's size. Specific maximums were subsequently removed in favour of identifying ranges of retail floor space. The Commercial Strategy identifies the following indicative ranges as appropriate:

- Neighbourhood Centre – Servicing between 5,000 and 20,000 residents and with generally 4,500m² – 10,000m² of retail floor space; and
- Local Centre – up to 5,000 residents with generally less than 1,500m² of retail floor space.

The Commercial Strategy identifies Parkland Heights as a Local Centre however, detailed modelling undertaken in association with this LSP Amendment identifies the need for a higher order centre. To reflect this, the Commercial Strategy will need to be updated to refer to Parkland Heights as a Neighbourhood Centre. In discussions with the City's officer's, it was agreed that the City will progress an amendment to the Commercial Strategy concurrently with this LSP Amendment. The update to the Commercial Strategy will be undertaken pursuant to clause 4.6.6 of TPS2 which foreshadows the need for the Commercial Strategy to be refined to reflect best planning outcomes.

The Commercial Strategy requires the preparation of an RSA for a proposal that would result in the alteration to the role or function of a centre. As this LSP amendment seeks to reclassify Parkland Heights from a Local Centre to a Neighbourhood Centre, an RSA has been prepared by Pracsys and is appended in full to this Report (Appendix 1). The findings of the RSA are discussed in further detail under section 3.1 of this Report.

State Planning Policy 4.2 – Activity Centres for Perth and Peel

SPP 4.2 specifies the broad planning requirements for the planning and development of new activity centres, focussing on the distribution, function, broad land use and urban design criteria. The key objectives of SPP 4.2 as they relate to this LSP Amendment are to:

- Reduce the overall need to travel; and
- Support the use of public transport, cycling and walking for access to services, facilities and employment.

SPP 4.2 advocates a hierarchical structure for activity centres and specifically identifies the higher order centres in the Perth and Peel metropolitan area. Neighbourhood Centres are not specifically identified and are intended to be coordinated through the local planning framework. SPP 4.2 does however, refer to Neighbourhood Centres in general terms, confirming that they are important community focal points for weekly household shopping and community needs and should be located within a walkable catchment of the surrounding population.

SPP 4.2 describes Neighbourhood Centres as generally accommodating supermarket and convenience shopping retail with local professional-type office uses. Residential is typically delivered at medium densities with a minimum density of 15 dwellings per gross hectare and a desirable density of 25 dwellings per gross hectare.

SPP 4.2 sets out the circumstances in which an RSA should be prepared and outlines the specific scope and requirements. As discussed earlier, an RSA has been prepared by Pracsys in accordance with SPP 4.2 (Appendix 1) and is discussed in further detail at section 3.1 of this Report.

1.3.4 Pre-lodgement Consultation

The project team has met twice with the City's officers to discuss the LSP amendment process, the necessary accompanying information and the design principles that should shape the Neighbourhood Centre.

The City advised that it would require the following information to support the reclassification of Parkland Heights from a Local to Neighbourhood Centre under the Commercial Strategy:

- Preparation of an RSA to demonstrate that the Parkland Heights Neighbourhood Centre would not have an unreasonable impact on the viability of existing or planned activity centres in the area. It would also need to demonstrate that 10,000m² of retail NLA would be sustainable for Parkland Heights;
- Preparation of a Traffic Impact Assessment to demonstrate that the planned road network and intersections could accommodate the additional traffic demand generated by the larger Neighbourhood Centre; and
- Preparation of a Local Development Plan (LDP) to coordinate the future development of the Neighbourhood Centre, and which incorporates the City's design feedback. The LDP would be progressed post-approval of the LSP amendment, but would be advertised and considered concurrently.

The City of Rockingham will progress a separate amendment to its Commercial Strategy concurrently with this LSP Amendment provided it is satisfied that the above matters have been appropriately addressed.

In response to the above:

- An RSA has been prepared to demonstrate the viability of the Parkland Heights Neighbourhood Centre (Appendix 1);
- A Traffic Impact Assessment has been prepared, demonstrating that the planned road network can accommodate the increased traffic volumes estimated to be generated by the Neighbourhood Centre (Appendix 2); and
- An LDP has been prepared to coordinate the future development of the Neighbourhood Centre and deliver an integrated shopping centre layout that addresses key design principles such as setbacks, building orientation and façade treatments.

Further details in relation to the above matters is provided in the following sections of this Report.

2.0 AMENDMENT PROPOSAL

The approved LSP map spatially identifies an area for a future 'Village Centre' at the centre of the Parkland Heights estate. At the time the LSP was prepared and approved, the necessary retail floorspace was unknown. It was subsequently decided to review the Centre as part of a separate planning exercise when the necessary size could be more accurately quantified.

Rockingham Park Pty Ltd, as the developers for Parkland Heights, have remained cognisant of the fact that the centre would likely be capable of accommodating greater than the 1,500m² of retail net leasable area (NLA) identified in the City's Commercial Strategy. Development of the residential land both within Parkland Heights and the surrounding South Baldivis area is progressing rapidly and will generate substantial retail demand in the coming years. It has subsequently been determined that the planning for the centre should be progressed.

The RSA commissioned by Rockingham Park confirms that the anticipated population numbers and demographic in South Baldivis are sufficient to warrant a Neighbourhood Centre of 10,000m² without unreasonably impacting the financial viability of other existing and planned centres in the area. In fact, the RSA concludes that without the development of the Parkland Heights Neighbourhood Centre, there is likely to be a large gap in the local capacity to service the retail needs of South Baldivis and that a significant amount of the local population would be forced to commute to other centres outside their primary catchment to fulfill their retail needs.

The purpose of this LSP amendment is therefore to allow for the development of the Centre with up to 10,000m² of retail NLA, which would align with a Neighbourhood Centre designation under the City's Commercial Strategy. To achieve this, the following amendments are proposed to the LSP Map:

- Zone the Parkland Heights Centre 'Commercial' west of Nairn Drive, consistent with the approach outlined in the Commercial Strategy and the objectives of the 'Commercial' zone under IPS2;
- Zone the Parkland Heights Centre 'Special Use' east of Nairn Drive. This will ensure that only specific land uses that are compatible with the adjacent Primary School are permitted within this portion of the Centre; and
- Delete 'note 3' referencing the future planning exercise for the Centre.

To facilitate the orderly and proper planning of the Neighbourhood Centre, the following amendments are proposed to the Part 1 – Implementation Report:

- Insert part 5.2 requiring a Local Development Plan to be prepared over the Neighbourhood Centre as a prerequisite to development and subdivision. Part 5.2 of the Part 1 report identifies the specific matters that are required to be addressed as part of the LDP in order to coordinate the staged development of the Centre and ensure that appropriate development controls are in place to deliver a high standard built form outcome; and
- Insert part 4.2.2 specifying a density code of R60 for any residential development within the 'Commercial' or 'Special Use' Zone.



Other administrative modifications are proposed to the Part 1 – Implementation Report in order to align the Part 1 with changes in the overarching planning framework that have occurred since the LSP was approved. These modifications are summarised as follows:

- Restructure and format the LSP to be consistent with the WAPC's 'Structure Plan Framework' (August 2015);
- Amend part 2.0 'Operation' consistent with the Regulations to clarify the 10 year operational period of an LSP under the Regulations;
- Amend part 3.0 'Interpretation and Relationship with Statutory Planning Framework' to reference the 'due regard' status of structure plans under the Regulations;
- Revise the bushfire provisions to reflect the WAPC's adoption of *State Planning Policy 3.7 – Planning in Bushfire Prone Area* (SPP 3.7) and the operation of the Department of Fire and Emergency Services *Map of Bushfire Prone Areas* as the means for determining land that is classified as 'bushfire prone'; and
- Amend part 4.4 'Residential Design Code Variations' to reflect the City's adoption of Planning Policy No. 3.3.22 – *Medium-Density Single House Development Standards* – *Development Zones* and delete Table 1 'Single House (RMD) Standards for Medium Density Housing' accordingly.

3.0 PLANNING CONSIDERATIONS

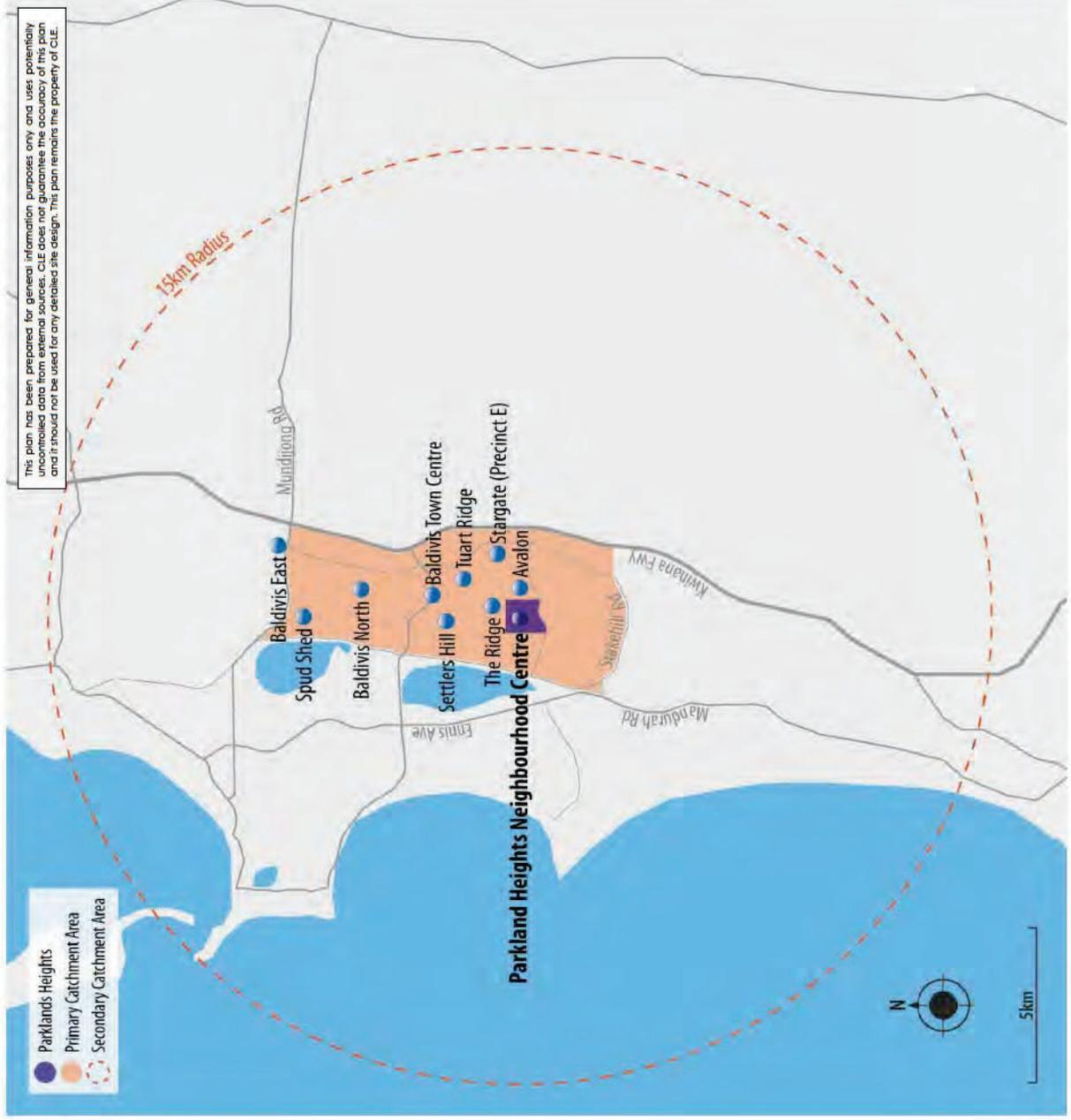
The following sections explain and justify the proposed amendments as outlined above. The explanatory sections are limited to the planning matters relevant to the proposed Neighbourhood Centre LSP Amendment and do not revisit or discuss matters that have already been addressed through the preparation of the original Part 2 – Explanatory Report.

3.1 Neighbourhood Centre Size

This amendment does not propose to spatially increase the size of the Centre currently depicted on the LSP Map. The size and location of the centre was previously defined and approved under the previous LSP process and development of the residential stages of Parkland Heights is proceeding based on the subdivision layout depicted on the current LSP Map.

With the size of the Centre footprint already defined, the LSP amendment seeks only to address the amount of retail floorspace that can be delivered under a subsequent development application for a shopping centre on the site. Specifically, the Amendment will allow for up to 10,000m² of retail floorspace in response to the findings of the RSA undertaken for Parkland Heights. To coordinate the development of the proposed 10,000m² of retail floorspace, the Amendment introduces a requirement to prepare a Local Development Plan for 'Commercial' and 'Special Use' zoned land prior to development.

The Preliminary Concept Plan for the Neighbourhood Centre that has informed the LSP and LDP processes is included as Figure 2 to this Report. Preliminary planning for the Centre indicates that 10,000m² of retail floorspace will be located within the 'Commercial' zone west of Nairn Drive.



3.1.1 Retail and Employment Analysis

To support this LSP amendment, Pracsys were engaged to prepare an RSA (Appendix 1) consistent with the provisions of SPP 4.2, the Commercial Strategy and IPS2. The RSA confirms two key matters relevant to the consideration of the proposal to increase the allowable retail floorspace in accordance with the Commercial Strategy and SPP 4.2:

1. That the proposed Neighbourhood Centre and the associated 10,000m² of retail NLA will be easily viable given the rapid population growth in the region and the provision of other retail offerings within the catchment; and
2. That the development of the Parkland Heights Neighbourhood Centre as proposed will not have an unreasonable impact on other existing and planned centres within the locality i.e. less than 10% impact on profitability.

In its assessment of the above matters, the RSA considered a hypothetical development scenario that all planned centres would be developed by the year 2021, which Pracsys consider a conservative assumption used for retail modelling purposes only.

3.1.2 Retail Sustainability Assessment

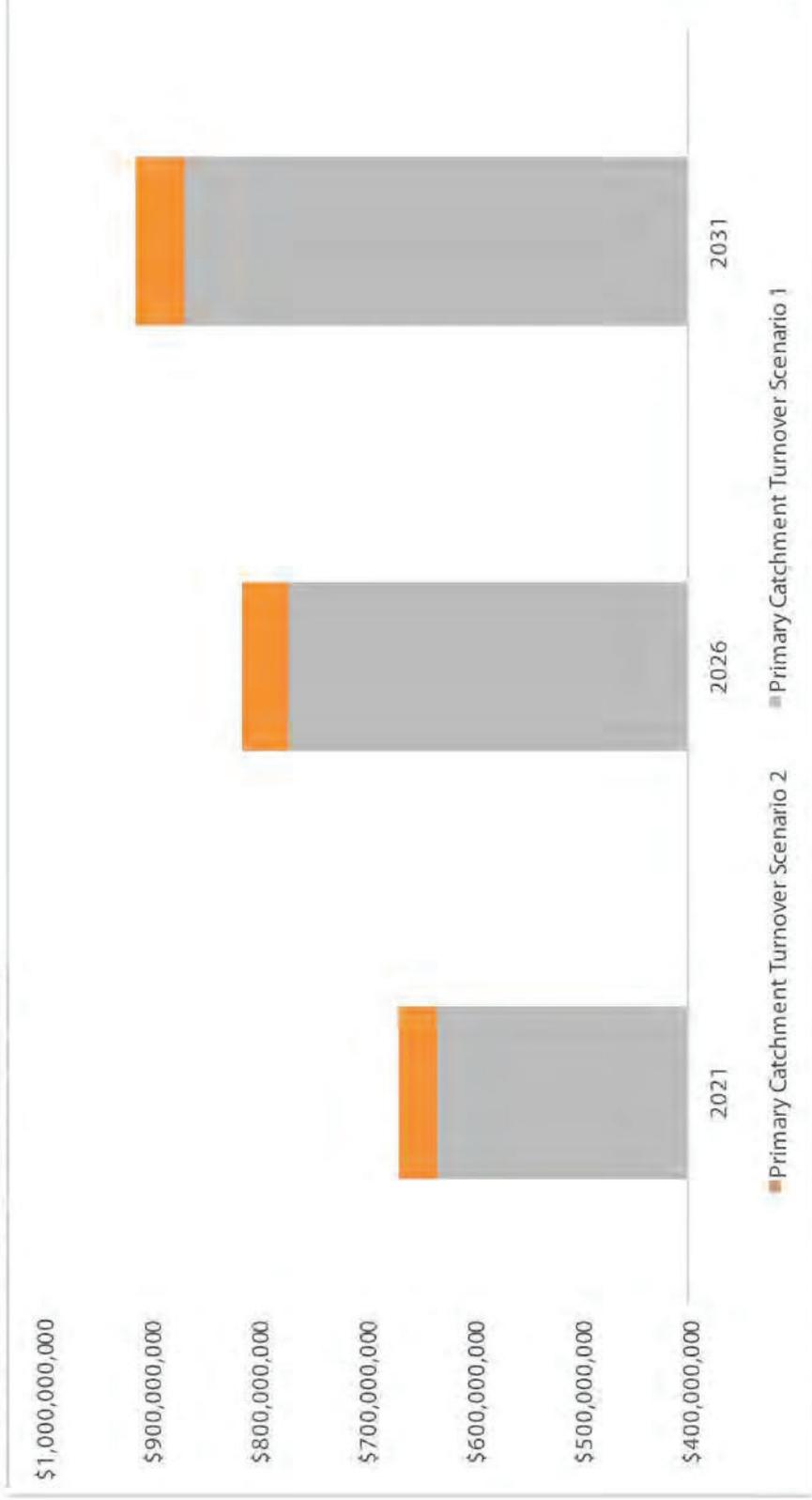
The RSA uses retail modelling and a catchment analysis to assess the need / demand for the Neighbourhood Centre and therefore its sustainability. The RSA assigns a 15km secondary catchment as the study area which is relatively larger, but allows for consideration of the full activity centre hierarchy in Baldivis as well as the attractiveness of retail offerings at the Rockingham Strategic Metropolitan Centre (refer Figure 3 – Parkland Heights Neighbourhood Centre - Retail Catchment). The RSA analyses the catchment based on factors that affect demand such as population growth, catchment expansion and population demographics including income and retail leakage.

The RSA estimates that population within the primary catchment will double between the years 2016 to 2031 from 12,000 to 24,000 residents. Growth within the secondary catchment is expected to grow by 26,000 residents from 57,000 in 2016 to 83,000 in 2031. The RSA also considers disposable income of the population demographic within the primary catchment which indicate that over half the households would be considered to have a 'high average level of income' with discretion to expend disposable income within the catchment.

The RSA assesses the supply of retail floor space within both the primary and secondary catchments and, for the purpose of a conservative model, assumed that all planned centres would be developed by 2021.



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Source: HHES 2009/2010, ABS Place of Usual Residence 2011, Forecast.id 2016, Pracsys 2016

Based on this analysis of the supply and demand factors for retail floorspace within the catchment, the RSA concludes that there is an undersupply of retail floorspace within Baldivis that has the potential to result in a significant amount of leakage of retail spending from within the local area as residents are forced to commute greater distances to access their retail needs. Given the anticipated lack of supply and expected population growth, the proposed Parkland Heights Neighbourhood Centre is expected to operate at a high level of productivity in 2021. The RSA goes on to conclude that if Parkland Heights is not developed with a Neighbourhood Centre as proposed, it is likely that there will be a large gap in the local capacity to provide retail services for South Baldivis.

3.1.3 Potential Impact on Other Centres

The RSA confirms that development of the Parkland Heights Neighbourhood Centre at 10,000m² NLA will not negatively impact the viability of existing or future planned activity centres in the surrounding area. Whilst the performance of surrounding centres will be affected in the short-term, the estimated impacts on these centres will not be significant. The sustainability of a centre is typically considered significantly impacted when their profitability is reduced by more than 10%.

The modelling undertaken as part of the RSA indicates that no centre is impacted by more than 9.11% to 2021, with the centres in closest proximity (The Ridge and Avalon) likely to be the most affected (-9.05% and -9.11% respectively). It should be noted that whilst the City's Commercial Strategy identifies 'The Ridge' as a

Neighbourhood Centre, its floorspace of approximately 2,240m² gross leasable area is significantly less than the amount generally associated with a Neighbourhood Centre and is more akin to a Local Centre designation.

Despite these impacts, the modelling undertaken by the RSA shows that the centres will still be trading at healthy and profitable levels indicating that consumer amenity will not be affected. The modelling further confirms that by the year 2026, it is estimated that the total retail turnover within the catchment will be higher than if Parkland Heights were only to be developed as a Local Centre (1,500m²) with productivity further increasing up to 2031 (refer Figure 4 – Total Catchment Turnover Growth).

The modelling undertaken as part of the RSA confirms a 10,000m² Neighbourhood Centre at Parkland Heights is necessary to meet the future increase in retail demand generated by the forecast rapid population growth in Parkland Heights and South Baldivis. Importantly, productivity levels are only impacted in the short-term up to the year 2021 with productivity then increasing over the next 10 years. No centres within the catchment are significantly impacted in terms of productivity. The proposed Parkland Heights Neighbourhood Centre is therefore justified on the basis of projected demand and limited impact on other existing and planned centres.



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3.2 Movement Network

The original LSP was accompanied by a detailed Traffic Impact Assessment (TIA) prepared by Transcore (July 2011) which addressed all necessary transport planning matters for Parkland Heights. The traffic modelling undertaken as part of the original TIA however, only assumed a retail floorspace of 700m² NLA for the Centre. In preliminary discussions with the City of Rockingham, it was agreed that a revised TIA would be required to model and assess the potential impact of the proposed 10,000m² Neighbourhood Centre on the planned road and intersection network. Transcore were subsequently commissioned to prepare a revised TIA in support of the LSP Amendment which is appended in full to this Report (Appendix 2).

The revised TIA confirms that, whilst the larger Neighbourhood Centre will generate additional traffic volumes, no significant modifications are required to the proposed road hierarchy or intersections to manage the additional traffic. The findings and recommendation of the revised TIA are discussed in further detail below.

3.2.1 Traffic Modelling

The current TIA maintains the following assumptions from the original traffic modelling:

- 1,400 dwelling generating approximately 10,300 vehicle per day (VPD); and
- A primary school with 400 students generating 800 vpd (400 movements in / 400 movements out).

The only change to the modelling assumptions is therefore the increase in retail floorspace proposed as part of the LSP Amendment. The road network that the revised model is based upon has also been updated to reflect the latest approved LSP which varies slightly from the original road network upon which the 2011 TIA was based.

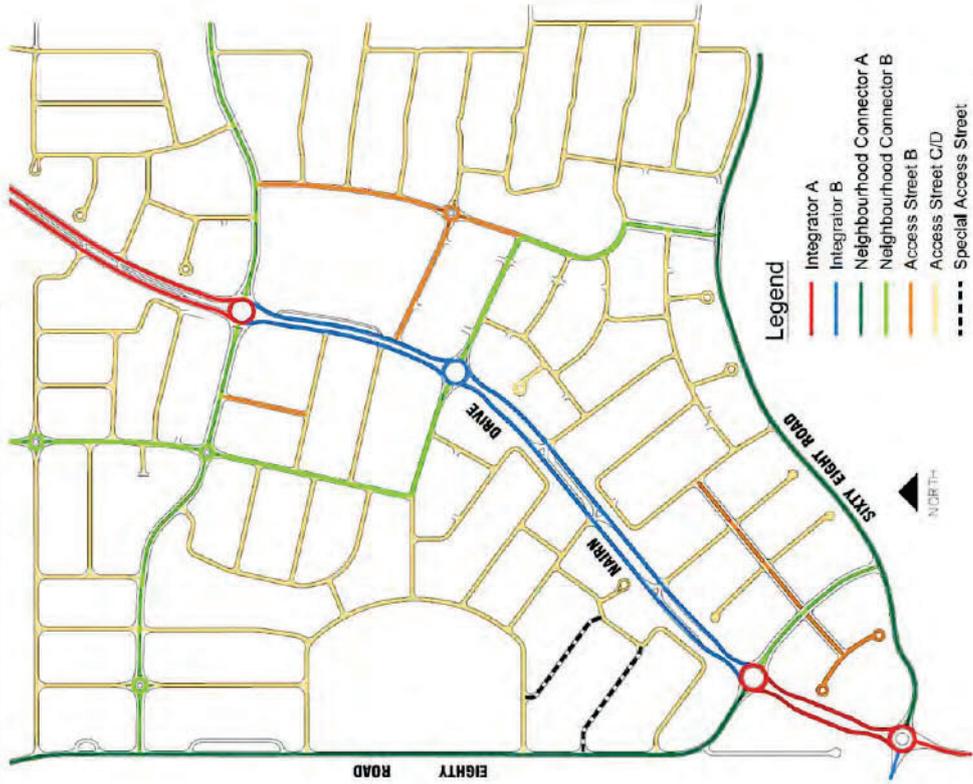
The traffic model used for the proposed LSP Amendment is based on a conservative estimate of:

- 11,500m² of retail NLA; and
- 3,000m² gross floor area (GFA) of non-retail commercial floorspace.

The LSP Amendment only proposes 10,000m² NLA of retail floorspace for the Neighbourhood Centre however, for the purpose of the TIA, a conservative estimate of 11,500m² NLA was used to ensure a robust analysis. 3,000m² of commercial floorspace has been allowed to provide local business and small scale office opportunities to support local employment. These land uses do not constitute 'retail' and so are not included within the 10,000m² of NLA.



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Current Road Hierarchy



Proposed Road Hierarchy

The updated TIA modelling resulted in an estimated 8,970 vehicles per day (vpd) (4,485 in / 4,485 out) with approximately 20% of this total (1,790 vpd) being passing trips along Nairn Drive. The 3,000m² of commercial floorspace anticipated for the Neighbourhood Centre is expected to generate approximately 510 vpd (255 in/255 out). The proposed Neighbourhood Centre is expected to increase traffic volumes by 7,780 vpd as compared to the originally modified scenario in 2011.

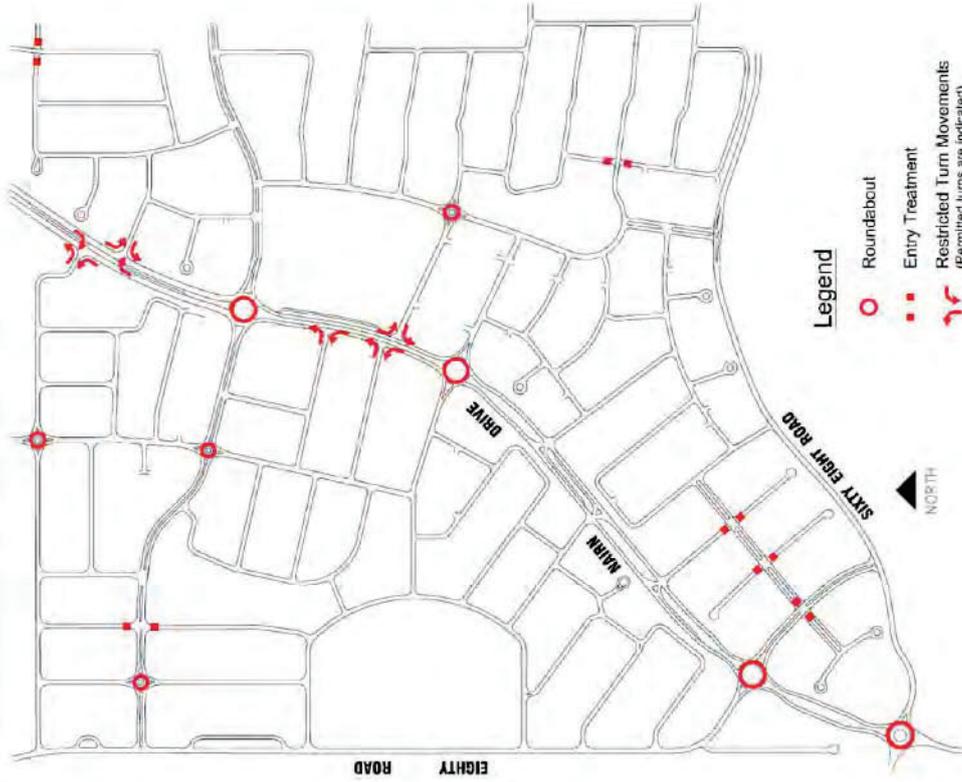
The traffic model demonstrates that the traffic generated by the Neighbourhood Centre can be accommodated by the originally planned road hierarchy with the exception of one minor upgrade. The key findings in relation to the planned road hierarchy and the expected 7,780 vpd increase are:

- Nairn Drive will remain an Integrator A road north of the Parkland Heights Neighbourhood Centre and south of the Eighty Road intersection;
- Nairn Drive will remain an Integrator B road abutting the Neighbourhood Centre and further south to the Eighty Road intersection;
- Arpenteur Road and the road abutting the western and southern boundary of the Neighbourhood Centre will remain Neighbourhood Connector B roads;

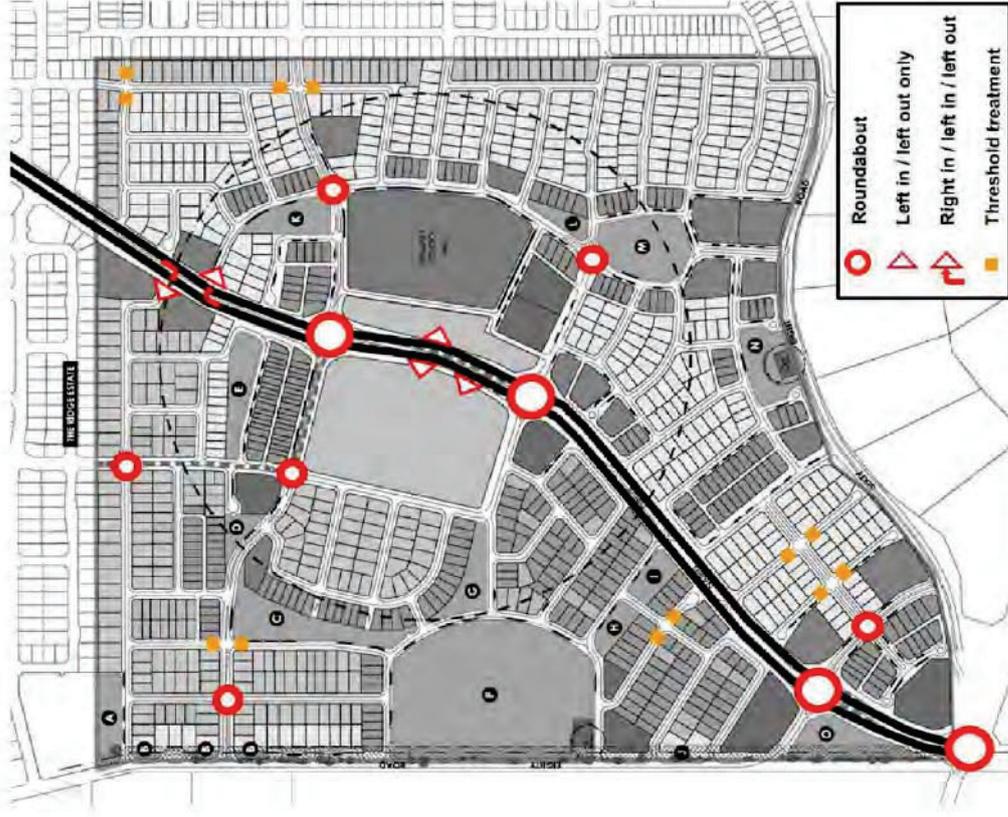
- Furnival Parade will remain a Neighbourhood Connector B road with the exception of the portion abutting the northern boundary of the Neighbourhood Centre. This is the only required change to the road hierarchy (increase from Neighbourhood Connector B to Neighbourhood Connector A) however the necessary road cross section can still be accommodated within the original planned road reserve width of 25m. The upgrade to Neighbourhood Connector A standards therefore does not impact the land requirement for the road, only the construction detail; and
- The roads abutting the future primary school will remain at Access Street B standard.

A comparison of the 2011 and the proposed road hierarchy under the revised TIA is provided at Figure 5 – Road Hierarchy Comparison. All road classifications are assigned based on the forecast traffic volumes consistent with Liveable Neighbourhoods road classification hierarchy.

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Current Intersection Treatment



Future Intersection Treatment

3.2.2 Intersections

The recommended intersections within the revised TIA are generally consistent with the original TIA prepared in 2011. A comparison plan of the original intersection treatments with the proposed is provided at Figure 6. The main changes in intersection treatments between 2011 and the current TIA are attributed to previous miscellaneous amendments to the LSP that were undertaken after the original TIA was prepared in 2011. For the sake of an accurate and robust traffic analysis, the TIA is based on the road network under the current LSP and therefore incorporates updates beyond the potential impact of the Neighbourhood Centre.

In relation to the proposed LSP amendment for the Neighbourhood Centre, all originally planned intersection treatments for the road network will operate satisfactorily and are not required to be upgraded.

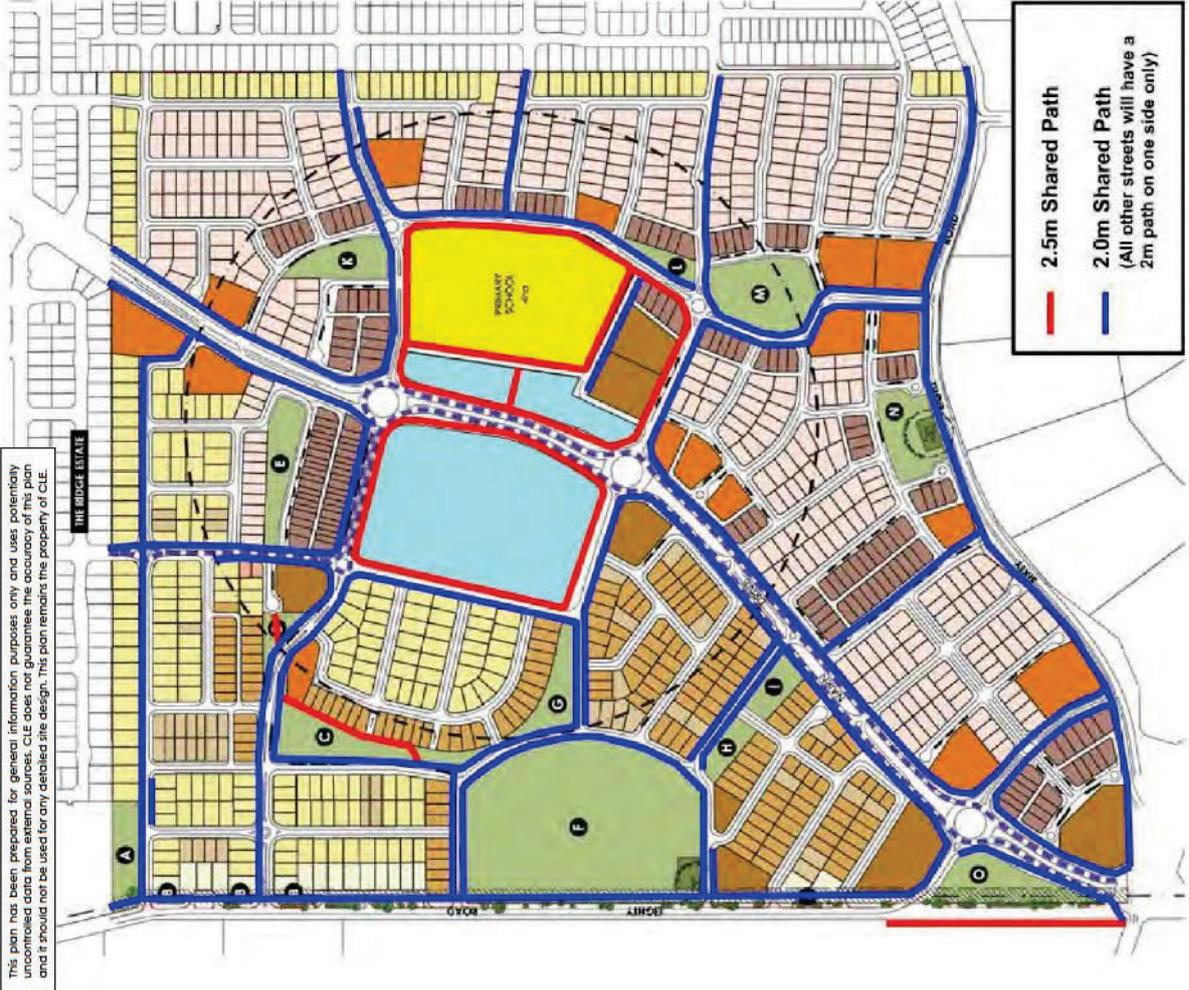
3.2.3 Access to the Neighbourhood Centre

The TIA has considered the preliminary concept design (refer Figure 2) and provides recommendations in relation to intersection treatments for the access points to and from the Neighbourhood Centre. As the concept design is preliminary, it does not form part of the LSP however, the TIA establishes principles for vehicle access to be implemented at future, more detailed stages of the planning process. The key principles for future access to the Neighbourhood Centre are:

- Access to and from Naim Drive is to be designed as left in/left out access only;
- The northern access from Furnivall Parade is to be designed as a full movement T-intersection; and
- The eastern access points to be designed as a full movement intersections.

The intersection treatments for the access points to the Centre will be defined as part of the LDP process, as discussed in further detail below.

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3.2.4 Pedestrian and Cycling Facilities

The TIA has revised the planned pedestrian and cyclist network and facilities based on the proposed Neighbourhood Centre as well as other miscellaneous changes to LSP road network under previous LSP amendments.

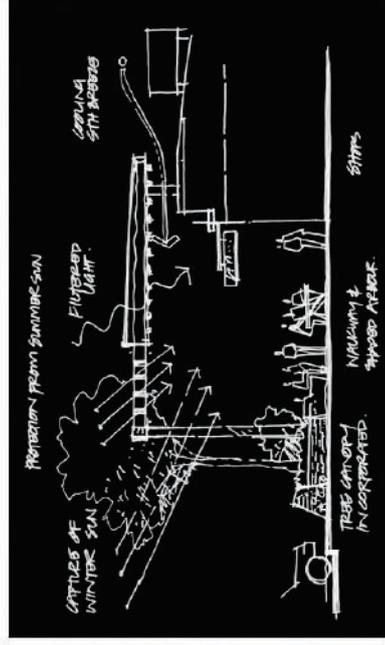
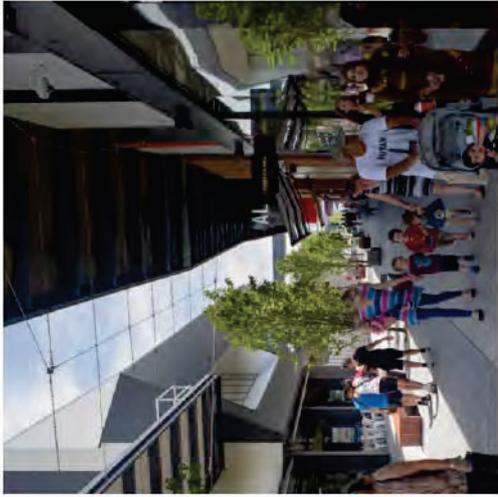
The key changes in relation to this LSP amendment are:

- A 2.5m wide shared path abutting the Neighbourhood Centre; and
- A 2.5m wide shared path around the portion of the Neighbourhood Centre east of Nairn Drive and the future Primary School.

As referenced above, other updates to the distribution of pedestrian and cyclist facilities have been undertaken consistent with the current LSP design and the as-constructed road and path network. Specifically, the as-constructed path network within the residential stages west of the Centre varies from the 'Parkland Circuit' depicted within the current LSP and the updated pedestrian and cyclist plan (refer Figure 7) reflects this. With regard to the Centre, the same standard of pedestrian and cyclist infrastructure is proposed as the current LSP and whilst the term 'Parkland Circuit' is no longer referenced on the revised pedestrian and cyclist plan (Figure 7), the path alignments and standard of infrastructure are consistent with the current LSP and the design intent to connect areas of POS throughout the estate.

Generally speaking, all lower order access streets will be provided with a 2m path to one side of the road with higher order roads accommodating either a 2.0m or 2.5m shared path (refer Figure 7 – Pedestrian and cyclist facilities). This approach is consistent with the originally approved TIA and reflects previous miscellaneous changes to the LSP road and path network.





Source: NH Architects

3.3 Design and Built Form

As referenced previously, the City of Rockingham's preference is for the LSP to contain provisions that ensure the future design and development of the Neighbourhood Centre will be to a high standard. Given that the LSP Amendment process is not intended to address detailed design matters, it was determined that an LDP would be required as a prerequisite to development in order to coordinate future development and demonstrate that key elements would be required to be addressed at the development application stage.

Whilst a separate process, the LDP would be prepared and lodged concurrently with this LSP amendment to demonstrate that the built form outcomes for the Neighbourhood Centre would be secured. The developers of Parkland Heights estate, Rockingham Park Pty Ltd, are committed to the delivery of a high standard Neighbourhood Centre that provides the necessary retail amenities in a form that is not only functional but achieves a high level of visual amenity, as proven through previous shopping centre developments within the City of Rockingham.

Consistent with *Liveable Neighbourhoods*, the Preliminary Concept Plan (refer Figure 2) depicts the Neighbourhood Centre in a main street configuration which will include on-street parking as well as additional parking areas behind buildings. It is envisaged that the Centre will be developed with active uses and building frontages addressing the core of the main street in an urban environment that caters for pedestrians as well as vehicles. Alfresco and piazza dining areas are anticipated east of the main street to create a vibrant setting that is activated outside of traditional business hours. The adjacent photo montage provides an example of

similar built form outcomes which Parkland Heights will seek to emulate.

Part 5.2 of the Part 1 – Implementation Report requires preparation of an LDP prior to development. The LDP is required to address key matters in terms of the design for the Centre such as vehicle access, main street alignment, the general siting of buildings as well as building orientation to assist coordinate the vision for the Centre.

The Implementation Report allows for separate LDP's to be prepared for the western and eastern portions of the Neighbourhood Centre, given that they are separated by Nairn Drive into two distinct land areas. This will allow for the east and west portions of the Neighbourhood Centre to be developed separately. The shopping centre will be developed over the western and majority portion of the Neighbourhood Centre whilst the eastern side will be developed at a later date with the exact timing and design layout subject to market forces.

The preparation of two separate LDP's is appropriate as it allows flexibility for the eastern portion of the Neighbourhood Centre without prejudicing the coordinated development of the shopping centre west of Nairn Drive. The development of the western site is not linked or contingent upon the east side of Nairn Drive and each can be progressed separately. Importantly, the draft LDP provides for the comprehensive planning of the shopping centre and will coordinate its staged development to deliver a high quality asset for Parkland Heights and the wider South Baldivis community.



3.4 Other Considerations

The following headings address other miscellaneous updates that are required to the Part 1 – Implementation Report that are not directly related to the purpose of the LSP amendment but are necessary to ensure the orderly and proper planning of the balance of the Estate.

3.4.1 Consistency with Planning Framework

Since the current version of the LSP was approved, important changes to the planning framework have been made that impact the operation and content of structure plans. As part of this LSP amendment process it is therefore necessary to update the Part 1 – Implementation Report to be consistent with these changes.

Planning and Development (Local Planning Scheme) Regulations 2015

The Regulations were gazetted on 19 October 2015 and by virtue of the 'deemed provisions' within Schedule 2, contain provisions in relation to structure plans that override those within the City's TPS2 under which the current LSP was approved. The key changes to the Part 1 – Implementation Report necessary to bring the LSP into line with the Regulations are:

- Insert part 2.0 'Operation' to confirm that the LSP (once approved) is operational for a period of 10 years pursuant to clause 28 (1), Schedule 2 of the Regulations; and
- Confirm the status of the LSP as a 'due regard' document pursuant to clause 27 (1), Schedule 2 of the Regulations.

This rectifies part 3.2 of the current Part 1 Report which refers to the Zones and Reserves under the LSP applying as if they exist under TPS2. Further, part 3.3 states that the standards and requirements under the LSP have the same force and effect as TPS2.

Structure Plan Framework

The WAPC adopted the Structure Plan Framework in August 2015 sets out the manner and form for the preparation of structure plans. The Structure Plan Framework prescribes a different layout and headings for Part 1 of structure plans and refers to them as an 'Implementation Report' rather than 'Statutory Report' as per previous practice.

The LSP Part 1 Report has been restructured to be consistent with the Structure Plan Framework and retitled so that it is now referred to as the Part 1 – Implementation Report.

State Planning Policy 3.7 – Planning in Bushfire Prone Areas

State Planning Policy 3.7 – Planning in Bushfire Prone Areas (SPP 3.7) was gazetted in December 2015 and establishes a new method for designating land as 'bushfire prone'. Structure Plans previously relied on Bushfire Management Plans to assess potential bushfire hazards and designate land that is required to respond to, and manage, potential bushfire hazards. This method is referenced within the current approved Part 1 report under part 6.4 'Other provisions / standards / requirements' and is required to be amended consistent with SPP 3.7.

SPP 3.7 confirms that a designated bushfire prone area is an area that is identified on the Department of Fire and Emergency Services Map of Bush Fire Prone Areas. Accordingly, the Part 1 – Implementation Report has been amended to refer to the Map of Bushfire Prone Areas when determining land as 'bushfire prone' within the LSP.

3.4.2 Density Coding for proposed Neighbourhood Centre

The LSP assigns a density coding of R60 to the land zoned 'Commercial' and 'Special Use' on the LSP Map. Table No.1 'Zoning Table' of TPS2 allows for 'multiple dwellings' and 'grouped dwellings' to occur within the 'Commercial' zone.

In the case that residential development is proposed within the Neighbourhood Centre, a density coding of R60 will deliver an appropriate density response based on immediate access to services and amenities within the Centre as well as the prevailing context around the Centre. The LSP Map currently identifies a number of R60 group housing sites adjacent the Neighbourhood Centre and development within the Centre at R60 would be consistent with the expected built form outcomes for these sites.

3.4.3 R-Code variations

The current approved Part 1 – Implementation Report contains R-Code variations at Table 1: Single House (RMD) Standards for Medium Density Housing consistent with the WAPC's Planning Bulletin 112/2016 'Medium Density single house development standards-DevelopmentZones'. Since the Part 1 – Implementation Report was amended to include Table 1 in 2015, the City of Rockingham have adopted Planning Policy No 3.3.22 – 'Medium-Density Single House Development Standards – Development Zones' which identifies Parkland Heights within the policy area. The policy duplicates the variations at Table 1 of the LSP, and as such, these variations are no longer required to be included within the structure plan. The Part 1 – Implementation Report has been modified accordingly to remove these variations.

3.4.4 Public Open Space

The purpose of this LSP Amendment does not impact on the provision or distribution of public open space (POS). It is noted that 'Grouped Dwellings' and/or 'Multiple Dwellings' may be approved within the Centre thereby increasing the gross subdivisible area.

The current POS schedule approved as part of the original LSP demonstrates that 11.1% of the gross subdivisible area is designated as POS which equates to a 1.12 hectare surplus above the required 10%. In the event that residential uses are proposed within the Centre, the 1.12 hectare POS surplus is more than capable of offsetting the potential increase in gross subdivisible area. Any subdivision application that proposes the creation of residential lot/s is required to demonstrate that 10% POS is maintained in accordance with Liveable Neighbourhoods.

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4.0 CONCLUSION

This amendment to the LSP will facilitate the delivery of an appropriately sized Neighbourhood Centre for Parkland Heights that will not only serve the surrounding estate, but the wider South Baldivis area. The LSP and accompanying RSA demonstrate that there is an identified retail demand within the locality that warrants development of the Neighbourhood Centre site incorporating 10,000m² of retail NLA. Further, the retail modelling undertaken as part of the RSA confirms that the Parkland Heights Neighbourhood Centre will not have an unreasonable impact on other existing or planned centres in the surrounding area. This amendment also addresses other key planning considerations such as traffic and built form/ design outcomes. The TIA confirms that, whilst the development of the Neighbourhood Centre for 10,000m² of retail NLA will increase traffic volumes, the originally planned road hierarchy and intersection treatments are able to accommodate these additional volumes with only minor upgrades.

The LSP amendment ensures that the Neighbourhood Centre will be designed to a high standard to integrate with the surrounding residential area through the requirement to prepare an LDP to inform key design matters at the development application stage. The end result will be an integrated, diverse, and vibrant Neighbourhood Centre based on main street principles that will be a valuable asset for Parkland Heights and the South Baldivis community.

Parkland Heights Local Structure Plan

ADDENDUM 2 - EXPLANATORY REPORT
AMENDMENT 5 (2020)





Town Planning & Urban Design

Parkland Heights Local Structure Plan

Lot 1507 Eighty Road, Baldivis
Appendix M - Explanatory Report

DECEMBER 2020

Parkland Heights Local Structure Plan.

APPENDIX M – EXPLANATORY REPORT

DECEMBER 2020

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2	WAPC Modifications	TV	KB	09.12.2020

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1 Introduction & Purpose

The purpose of this Amendment to the approved Structure Plan for the Parkland Heights Estate is to update the design of Stages 13 and 14, update the layout of previously approved stages and to remove the RMD References from the Plan 1.

2 Land Use & Subdivision Requirements

2.1 Land Use

The proposed land-uses and general design within Stages 13 and 14 has remained generally the same, the amendment proposes the following changes:

- Removal of the majority of the R40 rear-loaded products.
- Introduces new R40 rear loaded products which front the POS, serviced by a 9m laneway, which provides for visitor parking adjoining the Grouped Housing lot;
- Re-design of the Public Open Space (POS) to a more regular shape allowing more useable space;
- Relocation of the grouped housing site to the intersection of Nairn Drive and the east-west road, which is opposite the Neighbourhood Centre.

2.2 Design Elements

The redesign of Stages 13 and 14, is generally consistent with road layout of the approved Structure Plan. The indicative concept plan for the stages provides for approximately 162 single residential lots plus one grouped housing site, which is an increase of 28 single residential lots (refer to **Figure 1** – Concept Plan).

2.2.1 R40 Laneway Lots

A laneway lot precinct is proposed overlooking POS K, it is proposed to be supported by a 9m wide laneway which provides for visitor parking within the laneway, as well as opportunities for visitor parking surrounding the POS.

Under Element 3 of *Liveable Neighbourhoods*, rear laneway product adjoining a POS is supported where the maximum length is 80m and visitor parking is supplied on the adjoining streets. The proposal is consistent with *Liveable Neighbourhoods*.

2.2.2 R60 Grouped Housing Lot

A mid-higher density (R60) residential development is proposed in proximity to (and potentially within) the future Neighbourhood Activity Centre. The R60 density code offers a minimum and average lot product considered suitable for this location within the outer-metropolitan area of Perth and adjacent to a Neighbourhood Centre. It is anticipated that the product could accommodate approximately -30+ dwellings.

LEGEND

SUBJECT LANDHOLDINGS



CREATIVE
DESIGN & PLANNING

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Scale: 1:2000 @ A3
0 20 40 60m

PLAN: RPHM/13/004
DATE: 04/12/2018
PROJECTION: PG3/94
DRAWING: P
PLANNER: BK
CHECK: TV

CONCEPT SUBDIVISION PLAN
Stages 13-14 Parkland Heights, BALDVIS
A Rockingham Park Project

2.2.3 Road Pattern

The general road pattern of the approved Structure Plan within Stages 13 and 14 has been maintained, including the type of frontage to Nairn Drive, however more north-south streets facilitating more east-west lots which optimise solar penetration has been proposed. Consistent with the approved Structure Plan, two cul-de-sacs are proposed, with one portion being provided with an internal road frontage. The two proposed cul-de-sacs are compliant with *Liveable Neighbourhoods* (Element 2: Movement Network; Cul-de-sac), as they:

- are both well under the 120m maximum length permitted;
- serve no more than 20 dwellings each. The northern most cul-de-sac serves 6 lots and southern 10 lots only;
- serve only 16 lots, being under 10% of the overall 163 lot yield, well under the 15% permitted; and
- are designed in a way that allows for pedestrian and cyclist access to/from Nairn Drive, whilst not impeding on the overall interconnectivity of the pedestrian and vehicle movement system.

The proposed update to the design removes the current access from Nairn Drive, the desire to remove this connection is to avoid creating a 'rat-run' through Stages 13 and 14 to access the Primary School (to the south). It also assisted with design of the Stages, to regulate the configuration of the POS and other adjoining lots.

It is acknowledged that a 'Nib' road has been proposed in the redesign. The current street block layout provides for better pedestrian/cyclist connectivity to the near-by POS., whilst reducing the overall number of roads. This layout has enabled the design to create one portion of road parallel to Nairn Drive, where the previous design did not provide this. The design is limited due to the configuration of the cell and alignment of Nairn Drive. The 'Nib' road only services two lots and the garage locations, bin pads, setbacks of the two lots can be managed through a LDP. In addition, a similar 'Nib' road configuration was proposed to the north-west corner of the approved Structure Plan, serving five lots, whereas the 'Nib' road in question only serves two lots

2.3 Public Open Space

The POS schedule has been updated to reflect all the subdivisions approved to date, in addition the redesign of POS K.

Table 1: POS Schedule

PUBLIC OPEN SPACE SCHEDULE - PARKLAND HEIGHTS STRUCTURE PLAN		
Gross Site Area		120.825
Deductions		
Nairn Drive Regional Road Reservation	6.399	
Sixty Eight Road Widening	0.127	
Primary School	4.032	
Commerical/Special Use	6.292	
Pump Stations	0.181	
1:1 Drainage	1.402	
Surplus Restricted Open Space	0.000	
Total Deductions		18.433
Gross Subdivisible Area		102.392
<i>Maximum 2% Restricted POS Permitted</i>	2.048	
<i>Minimum 8% Unrestricted POS Required</i>	8.191	
10% POS Requirement		10.239
Restricted POS Provision		
>1:1 - 1:5yr Drainage	0.328	
Powerline Easement	1.129	
Creditable Restricted POS Provision		1.457
Unrestricted POS Provision		
Credited POS (inclusive >1:5 - 1:100yr drainage)	9.831	
Creditable Unrestricted POS Provision		9.831
TOTAL POS PROVISION	11.02%	11.288
OVER/UNDER PROVISION OF POS		1.049

Table 2: Detailed POS Breakdown

POS AND DRAINAGE PROVISION - DETAILED BREAKDOWN							
<i>All Figures in hectares (ha)</i>		Uncredited Green Space (Deduction)		Credited 'Restricted' Public Open Space		Credited 'Unrestricted' Public Open Space	Total Credited Public Open Space
POS/Easement Reference	Land Area	Pump Station	1:1yr drainage	Powerline Easement	>1:1 - 1:5yr Drainage	<i>Inclusive >1:5 - 1:100yr drainage</i>	
A	0.4823		0.0775	0.0652	0.0155	0.3241	0.4048
B	0.1463		0.0000	0.1463	0.0000	0.0000	0.1463
C	1.1240		0.2080		0.0732	0.8428	0.9160
D	0.2283		0.0000		0.0000	0.2283	0.2283
E	0.5681		0.0297		0.0213	0.5171	0.5384
F	5.7711	0.1200	0.3322	0.5562	0.1046	4.6581	5.3189
G	0.5129		0.0461		0.0279	0.4389	0.4668
H	0.2747		0.0000		0.0000	0.2747	0.2747
I	0.3235		0.0000		0.0000	0.3235	0.3235
K	0.5289		0.1878		0.0207	0.3204	0.3411
L	0.2328		0.0000		0.0000	0.2328	0.2328
M	1.0935		0.2654		0.0239	0.8042	0.8281
N	0.7366	0.0609	0.1508		0.0247	0.5002	0.5249
O	0.8475		0.1043	0.3610	0.0163	0.3659	0.7432
TOTAL	12.8705	0.181	1.402	1.129	0.328	9.831	11.288

The changes to the POS areas through the approved subdivisions and POS k, still result in a surplus of POS being provided in the Parkland Heights Estate.

2.4 Transport Assessment

An assessment of the proposed Structure Plan Modifications has been undertaken by Transcore and included as **Appendix 1**. The assessment by Transcore is summarised below.

The increase in dwellings within Stages 13 and 14, will increase traffic on the surrounding roads by approximately:

- +200vpd on the easternmost access street within the subject site (i.e. increase from 800vpd to 1000vpd);
- +400vpd on Nairn Drive from the deleted T-intersection to the neighbourhood connector south of the subject site (i.e. increase from 16,900vpd to 17,300vpd); and
- +600vpd on the neighbourhood connector south of the subject site (i.e. increase from 2,300vpd to 2,900vpd).

In terms of the surrounding network and road classifications, apart from short sections of Nairn Drive (+400vpd) and the neighbourhood connector road south of the subject site (+600vpd) all other roads are expected to have traffic increases of no more than 200vpd.

All the access streets within the subject land will have traffic volumes up to 1,000vpd and will remain as Access Street D. The Neighbourhood Connector Road south of the Stages 13 and 14 will still have traffic volumes less than 3,000vpd and will remain as Neighbourhood Connector B. Nairn Drive adjacent to the Stages 13 and 14 will still have traffic volumes above 15,000vpd and will remain as an Integrator A. Therefore, the traffic increases associated with the proposed modifications to the Structure Plan in this area do not have any impact on the road hierarchy of this structure plan.

2.5 Nairn Drive Signalised Intersection

The proposed Structure Plan incorporates the current approved design for the Nairn Drive intersection with a roundabout. It is acknowledged the CoR and DPLH's preference is for a signalised intersection. This too is supported by Rockingham Park, however is the subject of review and formal approval by Main Roads WA (MRWA). At the time of the preparation of this report, that status of the signalised intersection is as follows:

- The Traffic Signals Approval letter prepared jointly by CoR and Rockingham Park was submitted to MRWA on 26 November 2018 to satisfy the NA1 Application component of MRWA's Traffic Signal Approval Policy.
- Notwithstanding, there is a WAPC Approval 155055 for the School Site which shows the subject intersection as a roundabout. This plan was approved in July 2017.
- The 2021 School Site opening has been announced; the School Site approval will be activated, and construction delivered in accordance with the approved plan. The associated civil works will need to be completed by June 2019. In this regard, agreement on the intersection will need to be reached prior to the end of January 2019 to facilitate the necessary construction works.

2.6 Water Management

RPS have prepared an updated LWMS based on the Structure Plan Amendment and also to include other modifications to the drainage as a result of the approved UWMP for constructed Stages of the Estate.. The LWMS Update is contained as **Appendix 2**. The updated LWMS has been approved by both the City of Rockingham and Department of Water.



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Parkland Heights Local Structure Plan

ADDENDUM 3 - EXPLANATORY REPORT
AMENDMENT 6 (2025)





Town Planning & Urban Design

Parkland Heights Local Structure Plan

Lot 1507 Eighty Road, Baldivis
Amendment 6 - Explanatory Report

OCTOBER 2024

Parkland Heights Local Structure Plan.

AMENDMENT 6 – EXPLANATORY REPORT

OCTOBER 2024

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In Collaboration with.

Transcore
Pritchard Francis
Pentium Water

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1 Introduction & Purpose

The purpose of this Amendment to the approved Structure Plan for the Parkland Heights Estate is to update the design of Stage 9, and portions of Stage 10 and 11, and update the layout to reflect approved subdivisions in other stages of previously approved stages.

2 Proposed Amendment

The proposed land-uses, urban structure and general design within Stage 9, and portions of Stage 10 and 11, is generally consistent with structure and land use intent of the approved Structure Plan. The current approved Structure Plan is included at **Figure 1**.

The amendment proposes only the following changes:

- Removal of 8 x R40 grouped housing sites.
- Removal of the majority of the R40 rear loaded laneway product.
- Introduction of additional R30 and R40 single residential lot product.
- Minor re-alignment and re-design of the road structure to respond to the change in lot products.
- Minor re-alignment of lot boundaries within existing cell boundaries.

The proposed Structure Plan is included at **Figure 2**.

Figure 3 shows a comparison of the current LSP to the proposed LSP as per this amendment.

2.1 Dwelling Yield

Across the area subject to this LSP Amendment, the current LSP provides for in the order of 274 dwellings. This is made up of 188 single residential lots and an estimated 86 dwellings within the R40 grouped housing sites. The estimated dwelling yield for the grouped housing sites was calculate using the minimum average lot size for R40 (220m²) and less one dwelling to account for common property and inefficiencies in design.

The proposed LSP Amendment provides for 238 single residential lots (no grouped housing sites) within the area subject to the amendment. Thus, the estimated dwelling yield is reduced by 36 dwellings across the LSP amendment area.

Figure 4 shows the lot and dwelling yield estimates as per the above.

Referencing back to the overall estimate dwelling yield across the estate of 1,580 dwellings pursuant to the structure plan, a reduction by 36 dwellings resulting from this Structure Plan amendment represents only a 2.3% variation the ultimate dwelling yield across the whole estate. In addition, the estimate dwelling yields across the current grouped housing sites are likely to be less than that anticipated by the above calculations given the desired housing product in this area and inevitable design inefficiencies to accommodate access driveways, visitor parking and landscaping. Thus, the reduction in actual dwelling yield resulting from this Structure Plan Amendment is likely to be even less.

LEGEND

- AREA SUBJECT TO LSP AMENDMENT
- ZONES/RESERVES**
- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE
- OTHER**
- LOCAL STRUCTURE PLAN BOUNDARY
- 40m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SKY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m² - 1220m²)

NOTES

- 1** The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
- 2** The access street and associated lot layout shown on the plans is indicative only and subject to refinement as part of the detailed subdivision process.
- 3** PDS Areas are indicative only and subject to further detailed design and drainage considerations.
- 4** All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-construction survey and may vary from figures shown.
- 5** Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with ASS959 - Construction in Bushfire Prone Areas.
- 6** Sky-Eight Road widening to accommodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.



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Scale: 1:5000 @ A3
0 60 120 180m
PLAN: RHPH5-5018 REVISION: A
DATE: 26/09/2024 DRAWING: P
PROJECTION: PCS 94 PLANNER: CH
DATING: AHD CHECK: KB

PROPOSED LOCAL STRUCTURE PLAN AMENDMENT

Lot 1507 Eighty Road, BALDIMS

A Rockingham Park Project

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PROPOSED

CURRENT

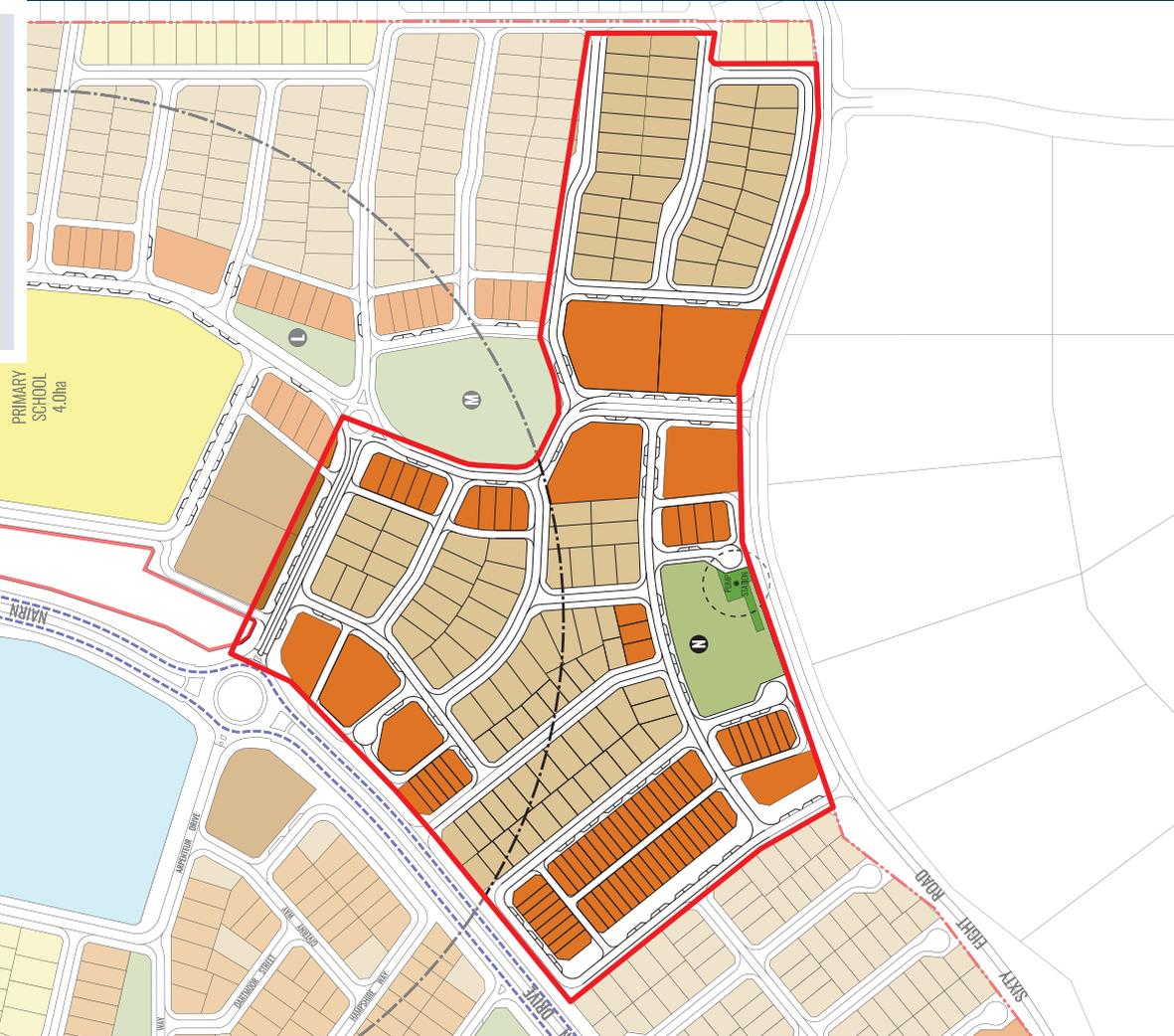
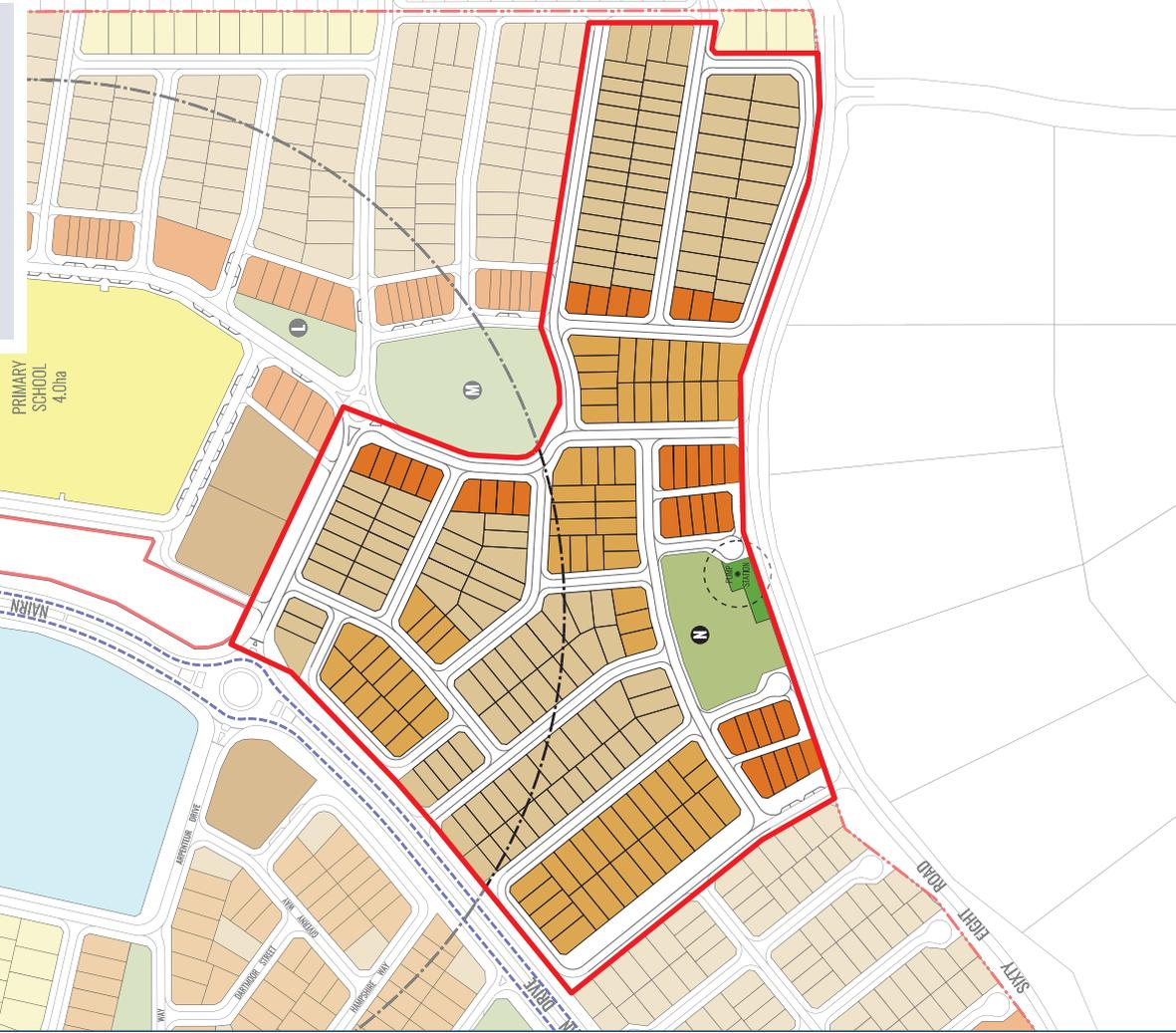
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LEGEND



AREA SUBJECT TO LSP AMENDMENT

AREA SUBJECT TO LSP AMENDMENT



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PLANS: HPPH-5-2018 REVISION: DRAWING: P

DATE: 10/07/2024 PLANNER: CH

PRODUCTION: PDS 94 CHECKER: B

DATUM: AHD

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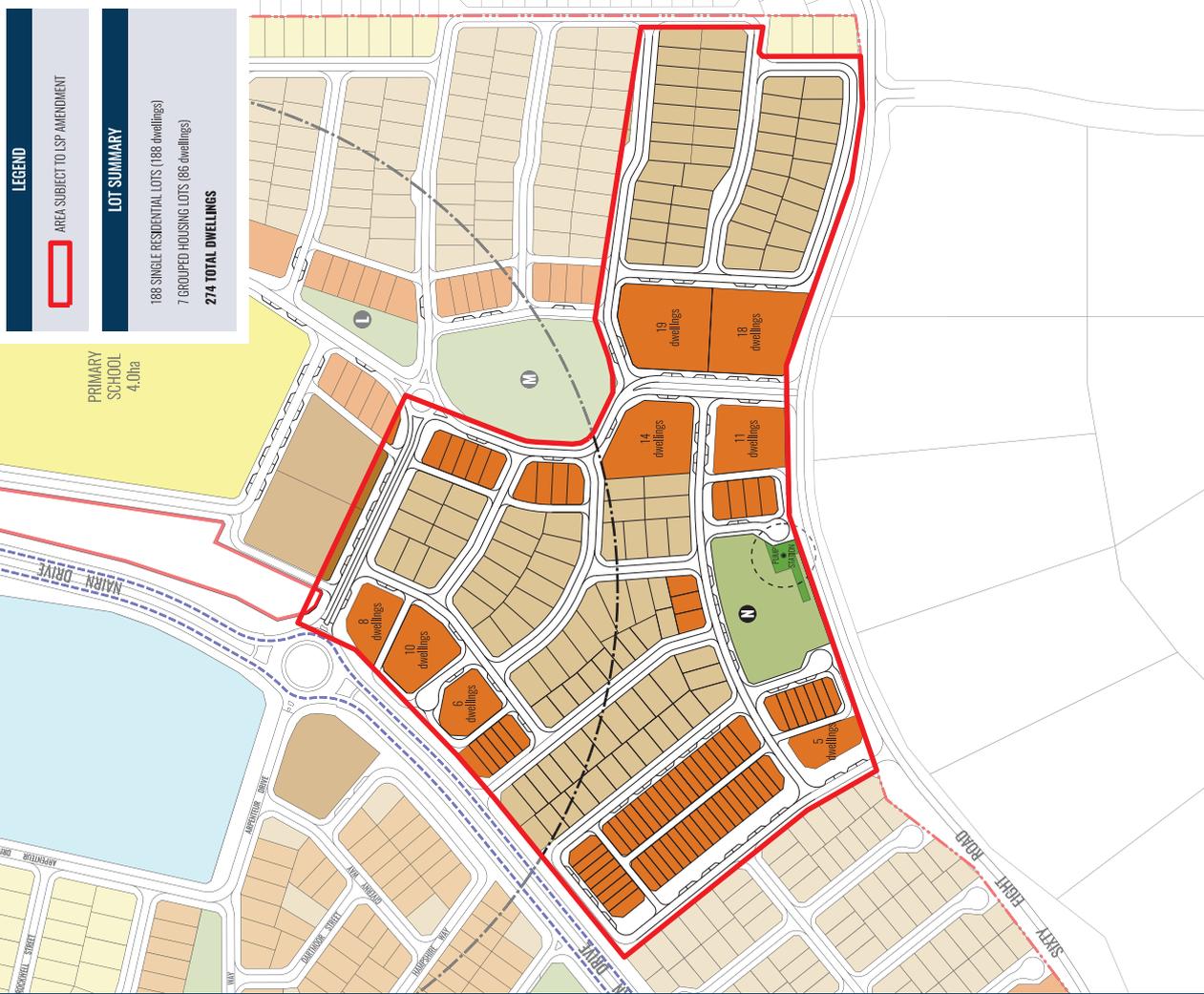
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LOCAL STRUCTURE PLAN AMENDMENT

Lot 1507 Eighty Road, BALDMS

A Rockingham Park Project

CURRENT

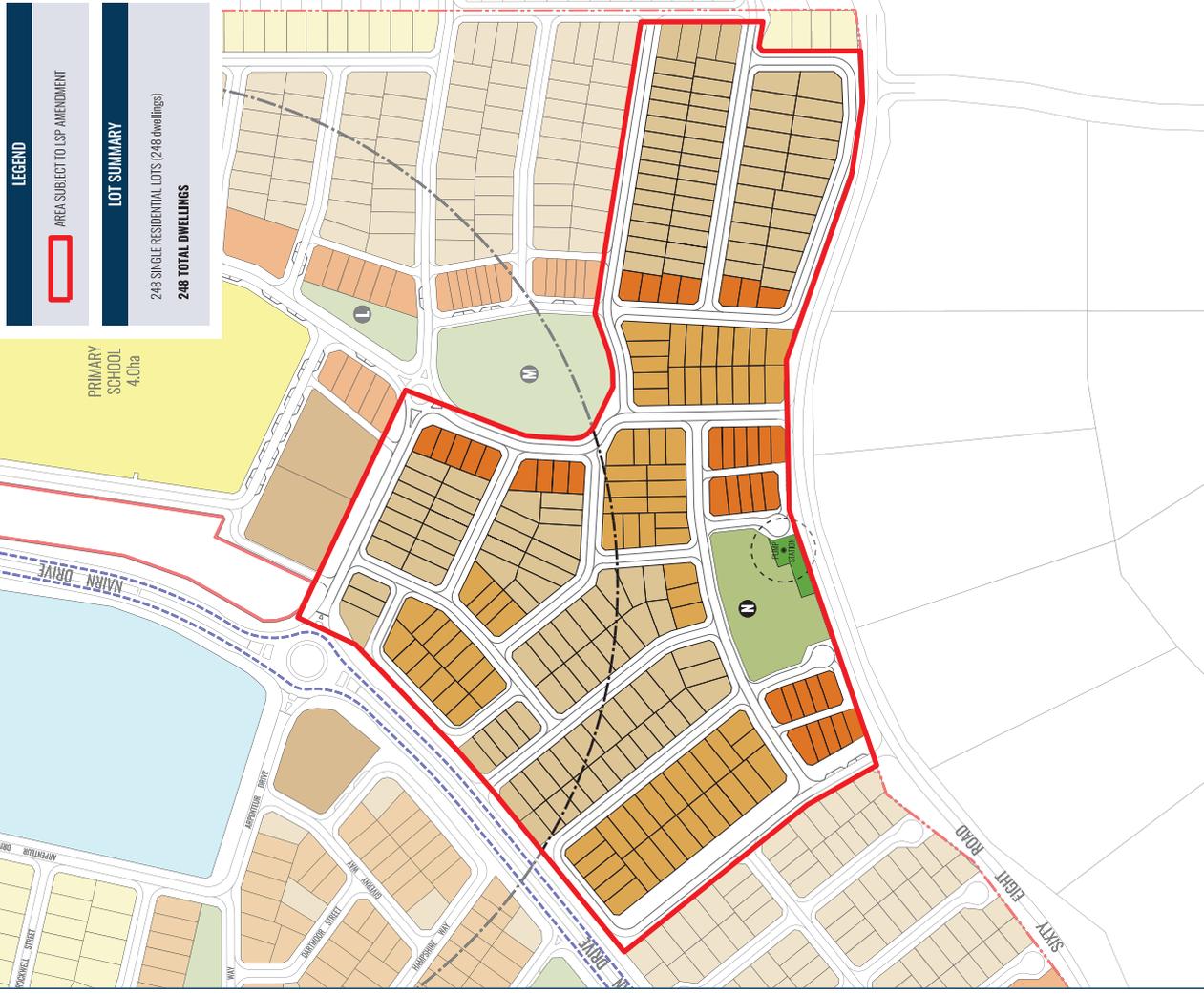


LEGEND
 AREA SUBJECT TO LSP AMENDMENT

LOT SUMMARY
 188 SINGLE RESIDENTIAL LOTS (188 dwellings)
 7 GROUPED HOUSING LOTS (65 dwellings)
274 TOTAL DWELLINGS

PRIMARY SCHOOL
 4.0ha

PROPOSED



LEGEND
 AREA SUBJECT TO LSP AMENDMENT

LOT SUMMARY
 248 SINGLE RESIDENTIAL LOTS (248 dwellings)
248 TOTAL DWELLINGS

PRIMARY SCHOOL
 4.0ha

LOCAL STRUCTURE PLAN AMENDMENT

Lot 1507 Eighty Road, BALDVIS

A Rockingham Park Project

Scale: 1:4000 @ A3
 0 40 80 120m

PLAN: RPPH-5-2018 REVISION:
 DATE: 10/07/2024 DRAWING: P
 PRODUCTION: PCS 94 PLANNER: CH
 DATING: AHD CHECK: KB

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2.2 R40 Laneway Lots

The current Structure Plan provides for 64 rear loaded R40 lots. This is considered to be a large proportion of small rear loaded lots within one stage area. The majority of these were serviced by a T-style laneway in the order of 70 metres x 150 metres in length. Laneways are also provided to service some of the grouped housing sites. A comprehensive review of the subdivision demonstrated clear design inefficiencies in regard to the amount of laneway required. The review also highlighted an oversupply of rear loaded small lot product which is against the current market preference trends for front loaded single residential product. In response, this LSP Amendment proposes to reduce the number of R40 rear loaded lots to 21 lots located directly adjacent to Public Open Space N (POS N) at Sixty Eight Road frontage of the Estate.

2.3 R40 Grouped Housing Sites

The current Structure Plan provides for 24 grouped housing sites within Parkland Heights Estate. Of these, 8 are located within the LSP Amendment area. This is considered to be a large proportion of grouped housing within one stage area and within the Estate overall. A design review highlighted an oversupply of grouped housing product which is against the current market preference trends for front loaded single residential product. Comparable approved structure plans through Baldivis require either nil or significantly less grouped housing development sites. Refer table below.

Approved Structure Plans in Baldivis	No. of Grouped Housing Sites in LSP
Parklands Heights	24
Baldivis South East	0
The Rivergum's East	0
Highbury Park	0
Paramount Estate	7
Brightwood Estate	0
Lot 19 Sixty Eight Road	0
Banksia Grove	0
Heritage Park	0
Paradiso Estate	3
The Spires	2
Lot 306 McDonald Road	0
Baldivis Parks	0
Greenlea	0
Millars Landing	0

In response, this LSP Amendment proposes to remove 8 grouped housing sites from the structure plan and alternatively provide for single residential product. There are still 16 x grouped housing sites within the estate which is significantly more than any other estate in Baldivis.

In addition, the majority of the grouped housing sites in this LSP Amendment area have dual road frontage. A comprehensive review of the subdivision demonstrated clear design inefficiencies in regard to the amount of road required to service these grouped housing sites.

2.4 Additional Single Residential Lot Product (R30)

As a direct consequence of the removal of the grouped housing sites and laneway products, it is proposed to introduce R30 single residential product into this area. The LSP Amendment area is now consisting of a diverse mix of R25 – R40 single residential product, ranging from ~ 280m² to 700m² in area.

2.5 Roads & Road Structure

A Transport Impact Assessment Addendum has been proposed by Transcore to support this LSP Amendment and review the minor changes proposed to the roads and road structure. Refer **Appendix 1**.

The road pattern and road hierarchy of the approved Structure Plan has been generally maintained. The majority of the laneways have been removed, however the local access street alignment and structure is generally consistent with the approved Structure Plan. The alignment of the north-south roads, including the Neighbourhood Connector B, located to the south of POS M has shifted westwards slightly. This is a direct result of removal of the grouped housing sites and the creation of residential cell depths that are adequate to accommodate and provide for front loaded single residential lot products in this area.

The width of roads has generally been maintained as per the current LSP, with the exception of the north-south Neighbourhood Connector B which has been reduced in width from 25 metres to 18 metres. This reduction in width is due to the removal of on street parking that was previously provided to service the grouped housing sites. The median has also been removed as it is deemed unnecessary. The proposed 18m width is consistent with the minimum required for Neighbourhood Connector B roads under Liveable Neighbourhoods. Importantly, this width is consistent with that approved for the section of the Neighbourhood Connector B abutting POS M pursuant to subdivision approval for Stage 11 of the Estate (WAPC 163429).

This Neighbourhood Connector B, which intersects with Sixty Eight Road, accommodates traffic volumes significantly less than 5,000vpd (which is the upper volume for unrestricted driveway access). Thus, no restriction on driveway access to this road is required. Accordingly, the LSP Amendment proposes single residential lots with direct frontage to this road.

The LSP Amendment proposes the removal of widened verge spaces in the east west roads at the south eastern corner of the amendment area. This is consistent with the approach required by the City, and approved by the WAPC, for the subdivision of Stage 11 to the north (WAPC 163429). The proposed LSP also shows the east west roads in Stage 11 without the widened verges as per the subdivision approval.

3 Public Open Space

There are no changes to the provision of POS proposed by this Structure Plan amendment. However, an updated POS schedule that reflects subdivisions and Urban Water Management Plans approved to date has been prepared and included below. A surplus of POS, above the 10% requirement, is being provided in the Parkland Heights Estate.

Table 1a: POS Schedule

PUBLIC OPEN SPACE SCHEDULE PARKLAND HEIGHTS STRUCTURE PLAN	
Gross Site Area	120.825
Deductions	
Nairn Drive Regional Road Reservation	6.399
Sixty Eight Road Widening	0.127
Primary School	4.032
Commerical/Special Use	6.292
Pump Stations	0.181
1:1 Drainage	1.330
Surplus Restricted Open Space	0.000
Total Deductions	18.362
Gross Subdivisible Area	102.464
<i>Maximum 2% Restricted POS Permitted</i>	2.049
<i>Minimum 8% Unrestricted POS Required</i>	8.197
10% POS Requirement	10.246
POS Provision	
Restricted POS Provision	
>1:1 - 1:5yr Drainage	0.425
Powerline Easement	1.129
Creditable Restricted POS Provision	1.554
Unrestricted POS Provision	
Credited POS (inclusive >1:5 - 1:100yr drainage)	9.805
Creditable Unrestricted POS Provision	9.805
TOTAL POS PROVISION	11.09% 11.359
OVER/UNDER PROVISION OF POS	1.113

Table 1b: Detailed POS Breakdown

POS AND DRAINAGE PROVISION - DETAILED BREAKDOWN							
<i>All Figures in hectares (ha)</i>		Uncredited Green Space (Deduction)		Credited 'Restricted' Public Open Space		Credited 'Unrestricted' Public Open Space	Total Credited Public Open Space
POS/Easement Reference	Land Area	Pump Station	1:1yr drainage	Powerline Easement	>1:1 - 1:5yr Drainage	<i>Inclusive >1:5 - 1:100yr drainage</i>	
A	0.4823		0.0775	0.0652	0.0155	0.3241	0.4048
B	0.1463		0.0000	0.1463	0.0000	0.0000	0.1463
C	1.1240		0.2080		0.0732	0.8428	0.9160
D	0.2283		0.0000		0.0000	0.2283	0.2283
E	0.5681		0.0370		0.0213	0.5098	0.5311
F	5.7711	0.1200	0.3322	0.5562	0.1046	4.6581	5.3189
G	0.5129		0.0461		0.0279	0.4389	0.4668
H	0.2747		0.0000		0.0000	0.2747	0.2747
I	0.3235		0.0000		0.0000	0.3235	0.3235
K	0.5289		0.0700		0.1390	0.3199	0.4589
L	0.2328		0.0000		0.0000	0.2328	0.2328
M	1.0935		0.3045		0.0028	0.7862	0.7890
N	0.7366	0.0609	0.1508		0.0247	0.5002	0.5249
O	0.8475		0.1043	0.3610	0.0163	0.3659	0.7432
TOTAL	12.8705	0.181	1.330	1.129	0.425	9.805	11.359

4 Transport Assessment

An assessment of the proposed Structure Plan amendment has been undertaken by Transcore and included as **Appendix 1**. The assessment by Transcore provides updated plans responding to the proposed LSP Amendment to illustrate road hierarchy, pedestrian and cyclist facilities, traffic volumes and intersection treatments.

5 Water Management

Pentium Water have prepared technical memo supporting the proposed Structure Plan amendment, refer **Appendix 2**. The memo demonstrates that adequate flood management provisions will be provided in line with the approved Local Water Management Strategy (LWMS). The memo provides updated stormwater modelling details to address the proposed changes to the approved LSP. Changes proposed by the LSP Amendment are considered relatively minor and the stormwater management will be largely consistent with the approved LSP and LWMS.

All runoff in the 1% AEP event from Stages 9, 10 and 11 are being managed within basins located in POS N or POS M. Stormwater modelling was undertaken to inform the Parkland Heights Stage 11 UWMP and demonstrated that sufficient flood storage will be provided in the POS M basin to cater for the 1% AEP event.

Allocated drainage area in POS N is specified at 2,227 m² basin top area as detailed in the LWMS. The catchment area draining into POS N basin will be significantly smaller than the catchment area proposed in the LWMS as the size of the catchment for the POS M basin has increased. This is as per the Stage 11 UWMP. Given the above, the required size of POS N basin is expected to be smaller than the 2,227 m² estimated in the LWMS.

In summary, the proposed changes to LSP Amendment will have negligible impact on total runoff to the basins and will result in relatively minor changes to the stormwater management strategy detailed in the approved LWMS. This technical memo prepared by Pentium Water demonstrates that all run-off generated in the 1% AEP event will be adequately managed and infiltrated within POS N and POS M basins consistent with the LWMS.

6 Civil Engineering and Services

Pritchard Francis has prepared a Civil Engineering Services Report to support the proposed Structure Plan amendment, refer **Appendix 3**. The report outlines the capacity of existing utilities to service the development. The subject area has planning carried out by all service authorities with all services within the existing development front.

7 Grounds for Amendment

The Structure Plan amendment is being pursued to remove the grouped housing sites and large extent of laneway product from this stage, whilst still aiming to generally maintain the intention around density and dwelling yields in this area. The local road layout is only modified very slightly and as required to service single residential lot product.

The changes to the lot products is being sought to meet market demand and a preference for front loaded single residential product. Specifically, the amendment is in response to:

- the LSP, and this stage in particular, currently being quite “heavy” with grouped housing sites and rear loaded laneway lot product;
- financial challenges associated with holding costs, building timeframes and resources associated with the development of these grouped housing sites; and
- market movement away from rear loaded laneway product.

7.1 Minor Amendment

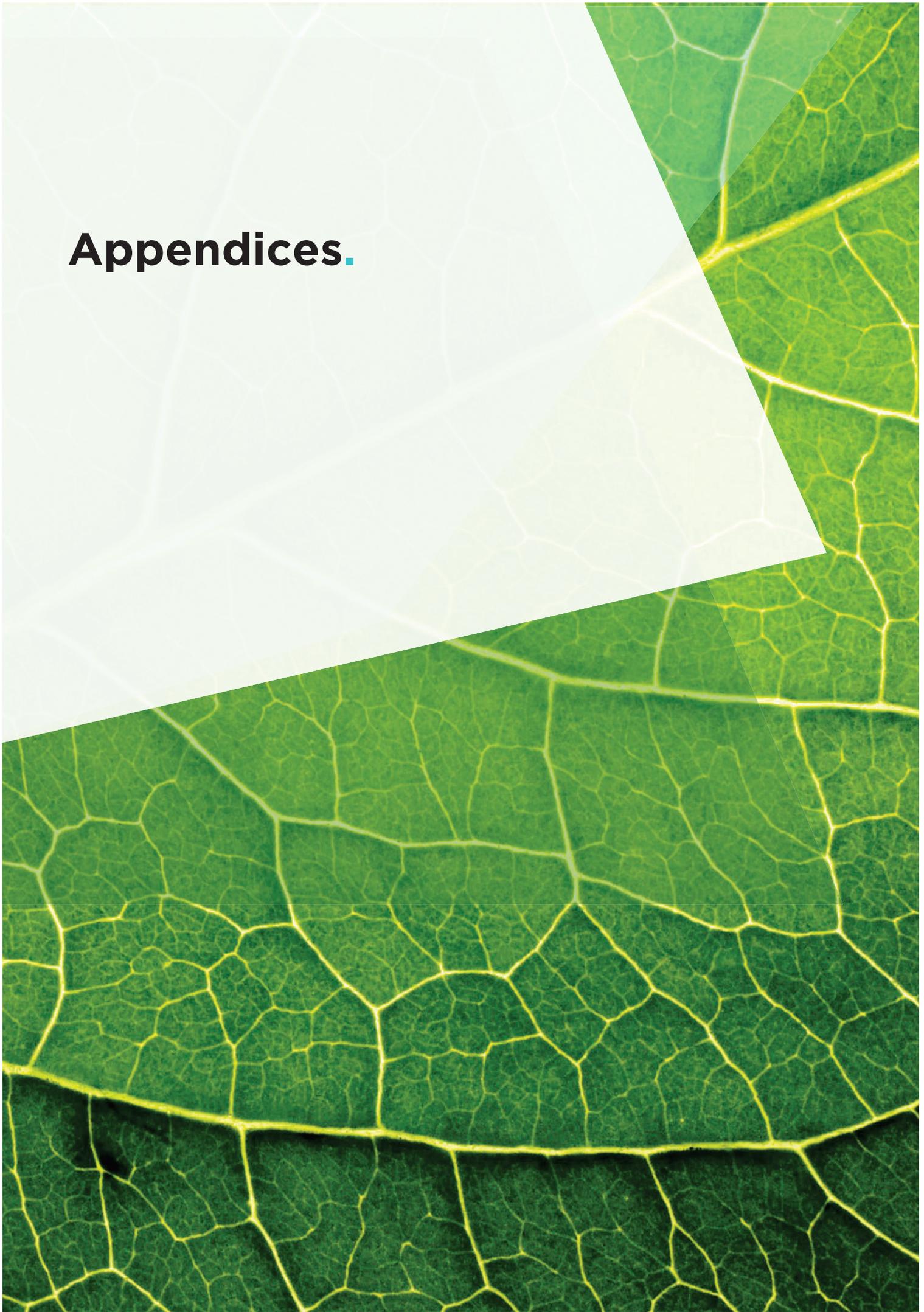
Section 7.1.1 of the WAPC’s Planning Manual ‘Guidance for Structure Plans’ states that an amendment to a Structure Plan can be considered minor if the proposed changes do not impact on the purpose, objectives, or the overall design response of the plan, and in addition the changes:

- are required to give effect to a State Planning Policy; or
- do not have a consequential impact on the land, landowners, or occupiers in and around the structure plan area; or
- are administrative in nature, for example, where required to remove redundant provisions or requirements); and
- the proposed changes do not impact on the infrastructure provision or the environment.

It is submitted that this Structure Plan amendment does not involve any changes that substantially alter the intent of the Structure Plan and/or would affect adjoining landowners /developers in a manner that would warrant public advertising. The proposed amendment has no consequential impact on the land, landowners, neighbours, infrastructure provision or the environment.

On this basis, we request that this amendment is assessed as a minor Structure Plan amendment.

Appendices.



Appendix 1

Traffic Impact Assessment

Addendum

Technical Note: No 1a**Date:** 25/03/2025**Project No:** t24.146**Project:** Parkland Heights, Baldivis – LSP Amendment**Subject:** Transport Impact Assessment Addendum

1 Introduction

Transcore has prepared a number of traffic reports in relation to the Local Structure Plan for Lot 1507 Eighty Road, Baldivis, known as Parkland Heights, on behalf of Rockingham Park Pty Ltd since the original preparation and approval of that LSP.

Relevant reports have included the following:

- *Parkland Heights Local Structure Plan, Lot 1507 Eighty Road, Baldivis Transport Assessment (July 2011);*
- *Parkland Heights Neighbourhood Centre LSP Amendment Transport Impact Assessment (December 2018);*
- *Parkland Heights, Baldivis - Neighbourhood Centre - Local Development Plan Transport Impact Assessment (November 2022)*
- *Transcore letter dated 24 June 2023 - RE: Stage 11 Subdivision, Parkland Heights, Baldivis*
- *Parkland Heights Neighbourhood Centre, Baldivis – Local Development Plan Transport Impact Assessment Addendum (March 2024).*

The 2018 TIA provided a comprehensive update of the 2011 LSP Transport Assessment report to address a substantial revision of planning for the Neighbourhood Centre to approximately 10,000m² NLA retail area. That December 2018 LSP TIA report is the most recent Transport Impact Assessment covering the whole LSP area.

The November 2022 TIA for the Neighbourhood Centre LDP and subsequent March 2024 LDP TIA Addendum addressed further changes with the Neighbourhood Centre now planned for a total of approximately 12,800m² NLA.

The 24 June 2023 letter discussed the appropriate road width for road “NS3”, which is located on the western side of POS area M on the LSP map.

Other minor changes have occurred within the overall LSP area as subdivision stages have been approved and developed. Proposed subdivision stage 9 now proposes further refinement of the local road network and lot layout in the southernmost section of the LSP area.

Accordingly, this Technical Note is intended to update key figures from the 2018 TIA report to include the current LSP Amendment proposal and other approved changes already incorporated in the current approved LSP plan. This Technical Note may be considered as an Addendum to that 2018 LSP TIA report.

2 Current Local Structure Plan

The current approved Local Structure Plan is shown at **Appendix A**.

The LSP area is anticipated to accommodate approximately 1,580 dwellings, one primary school and a neighbourhood centre. The neighbourhood centre comprises a commercial zone on the western side of Nairn Drive and a special use zone on the eastern side of Nairn Drive.

According to the Parkland Heights Structure Plan Report Part One Implementation (Dec 2020) the estimated commercial floorspace was 10,000m² NLA of retail/shop and 4,500m² GFA of other non-residential floorspace.

The recently approved Parkland Heights Neighbourhood Centre Local Development Plan (June 2024) is shown at **Appendix C**. The March 2024 TIA Addendum for that LDP is based on approximately 12,800m² NLA on the commercial zoned site on the western side of Nairn Drive, and no change to future land use in special use zone on the eastern side of Nairn Drive.

3 Proposed LSP Amendment

The proposed Amended Local Structure Plan is shown at **Appendix B**.

The main changes between the current approved LSP plan and the Proposed Amended LSP plan relates to the local road network and lot layout in the Stage 9 Subdivision area in the southernmost section of the LSP area. The Proposed Stage 9 Subdivision plan is shown at **Appendix D**.

The main changes relate to the road alignment of the north-south neighbourhood connector northward from Sixty Eight Road towards the primary school. Previously planned R40 grouped dwelling sites either side of this road (north of Sixty Eight Road) have been replaced with single residential lots, with some now having frontage access from this road. The future traffic volumes on this north south neighbourhood connector will be significantly less than 5,000vpd (which is the upper volume for unrestricted driveway access) so no restriction on driveway access to this road is required.

4 Road Hierarchy

The December 2018 LSP TIA report included a plan showing the proposed road hierarchy within the LSP area as Figure 6 of that TIA report. An updated version of the road hierarchy plan is shown in **Figure 1** in this Technical Note.

Some of the local roads have been realigned in this latest plan but the road hierarchy remains relatively consistent with that proposed in the 2018 TIA report.

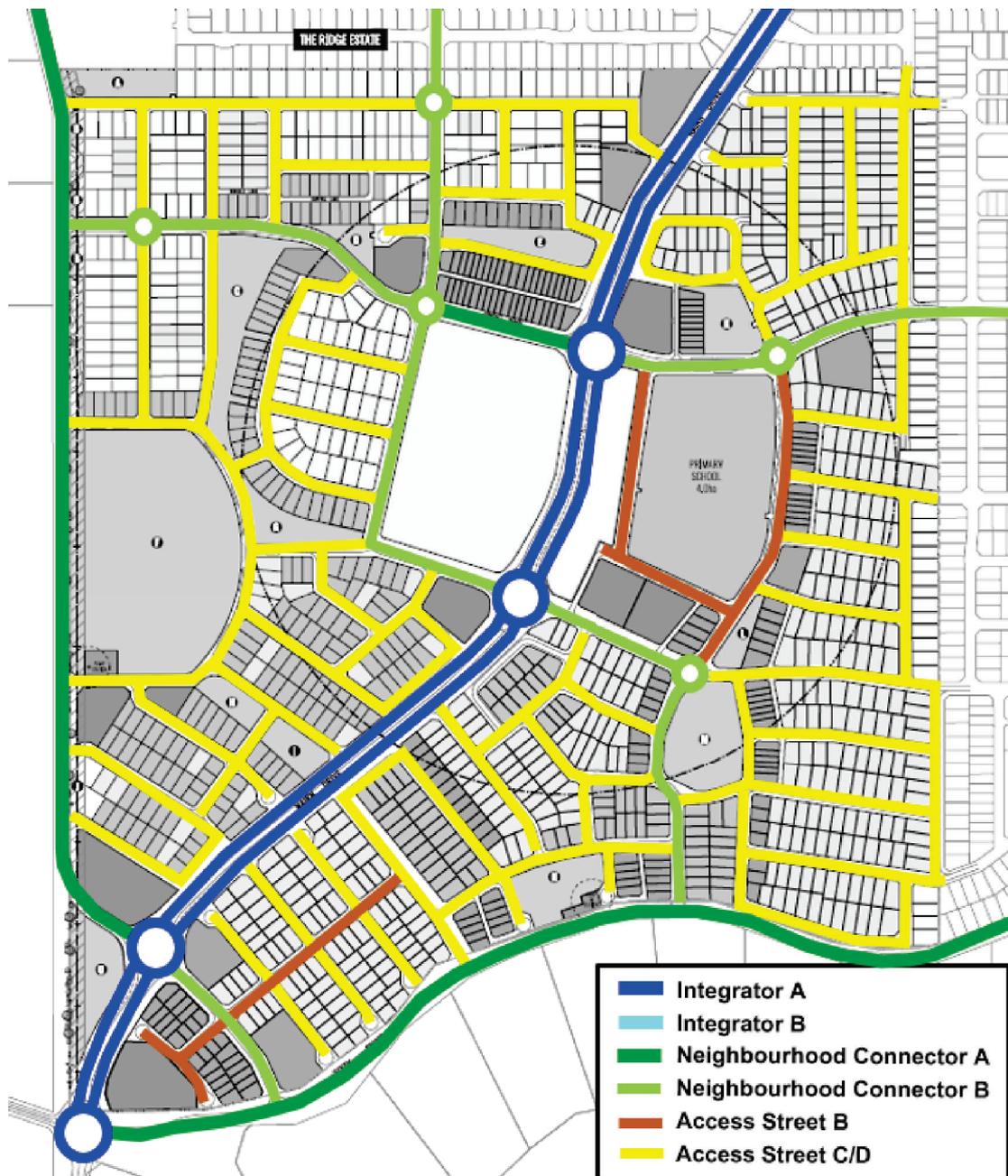


Figure 1: Road hierarchy



The only significant change in the road hierarchy is that all of Nairn Drive is now shown as an Integrator A, whereas the two sections of Nairn Drive through the centre of the LSP area (adjacent to the neighbourhood centre and the next section to the south) were previously shown as Integrator B because of lower traffic volumes on those sections. It is understood that the planning authorities consider it prudent to plan this section of Nairn Drive as the higher standard Integrator A (which has two traffic lanes each way and therefore higher capacity than an Integrator B) to ensure this important district distributor road has sufficient capacity for potential higher future traffic demands as the areas further south are developed in future. The subdivision plan at **Appendix D** reflects this Integrator A classification.

5 Public Transport

Future bus routes in Baldivis are shown in Figure 7 of the December 2018 LSP TIA report. The current approved LSP plan at **Appendix A** of this Technical Note and the proposed Amended LSP plan at **Appendix C** both show the planned future bus route (dark blue dashed lines) along Arpenteur Drive and Furnivall Parade (north of the neighbourhood centre) and along Nairn Drive from Furnivall Parade to Sixty Eight Road through the LSP area. The proposed LSP Amendment does not change this planned bus route at all.

6 Pedestrian and Cyclist Facilities

Planned path networks within the LSP area were shown in Figure 8 of the December 2018 LSP TIA report. An updated version of the path networks plan is shown in **Figure 2** in this Technical Note.

Some additional 2m paths are shown in the southern part of the LSP area based on those shown on the subdivision plan at **Appendix D**.

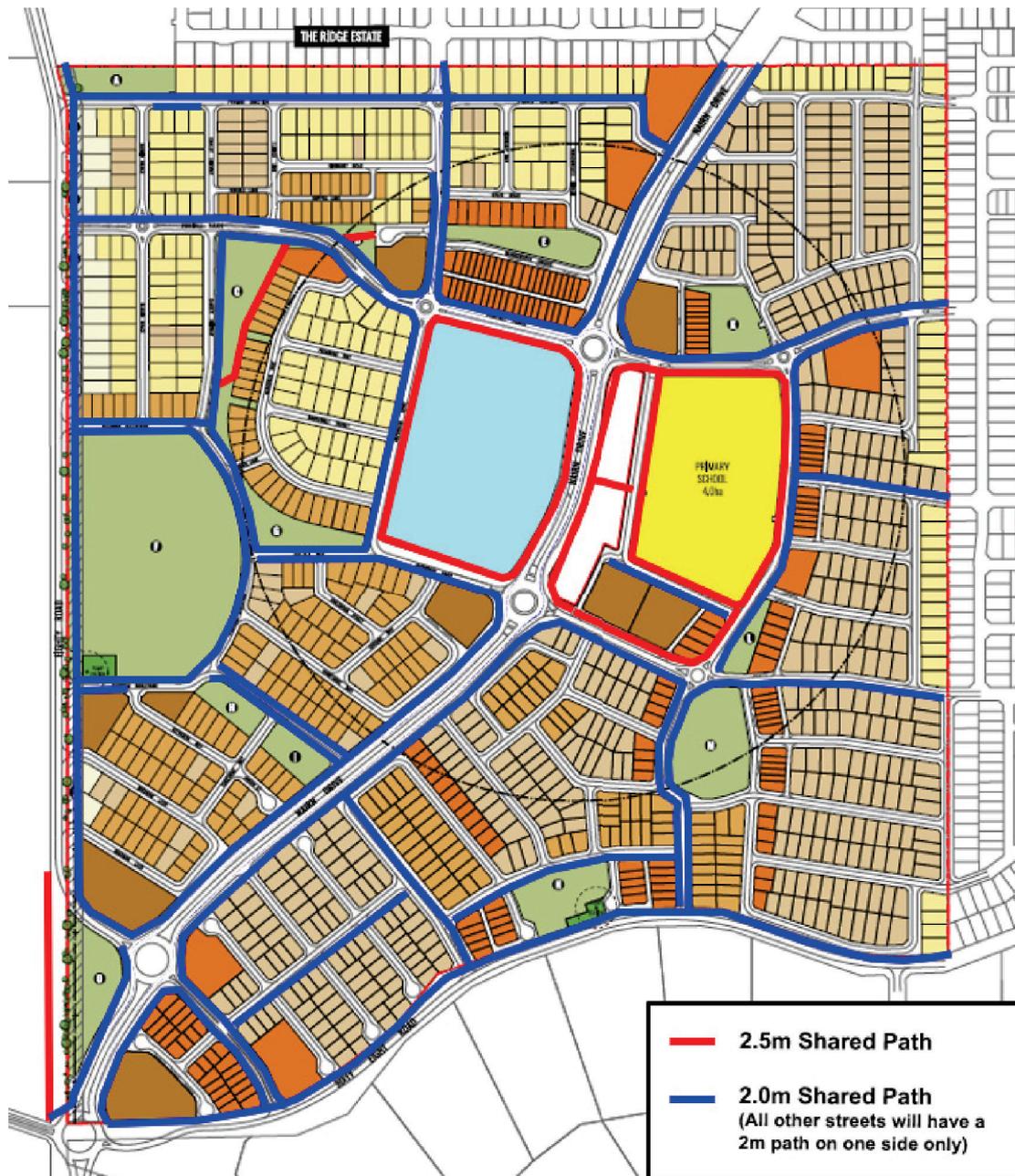


Figure 2: Pedestrian and cyclist facilities

7 Future Traffic Flows

Future daily traffic flows on the LSP area road network were shown in Figure 9 of the December 2018 LSP TIA report. An updated version of the future daily traffic flows is shown in **Figure 3** in this Technical Note.

been estimated as ten times the PM peak hour traffic flows in the 2024 LDP TIA Addendum.

8 Intersection Treatments

Planned intersection treatments on the LSP area road network were shown in Figure 9 of the December 2018 LSP TIA report. An updated version of the intersection treatments plan is shown in **Figure 4** in this Technical Note.

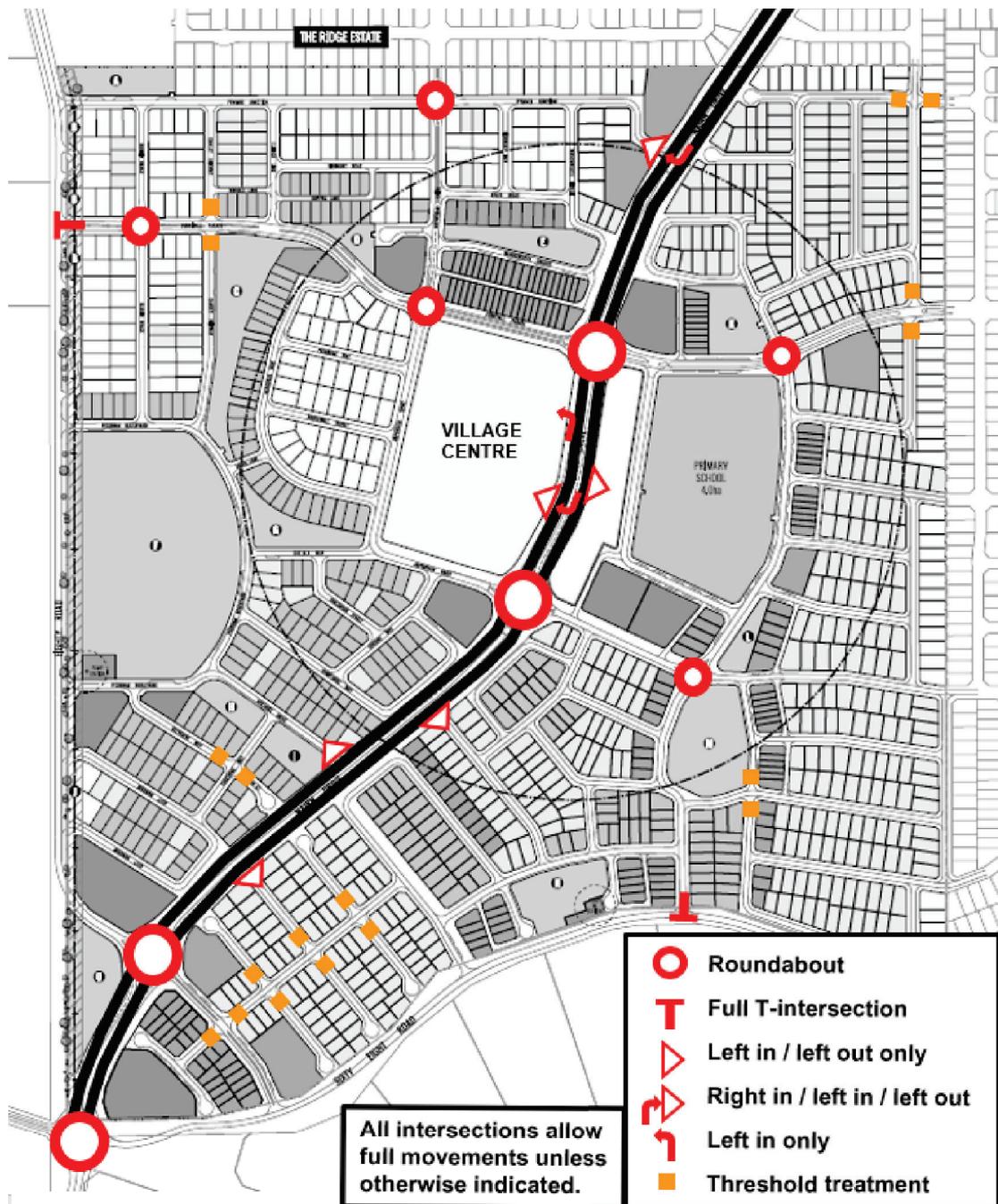


Figure 4: Intersection treatments



Most of the changes in **Figure 4** relate to the access arrangements for the neighbourhood centre and are consistent with the approved Neighbourhood Centre Local Development Plan shown at **Appendix C** of this Technical Note.

9 Conclusions

This Technical Note addresses a proposed Amendment to the Local Structure Plan for Lot 1507 Eighty Road, Baldivis, which is known as Parkland Heights. The proposed Amendment relates to proposed subdivision stage 9 which proposes further refinement of the local road network and lot layout in the southernmost section of the LSP area.

The *Parkland Heights Neighbourhood Centre LSP Amendment Transport Impact Assessment* (December 2018) is the most recent Transport Impact Assessment report covering the whole LSP area.

This Technical Note updates key figures from the 2018 TIA report to include the current proposed LSP Amendment and other approved changes already incorporated in the current approved LSP plan since 2018, including the recently approved Parkland Heights Neighbourhood Centre Local Development Plan.

Therefore, this Technical Note may be considered as an Addendum to that 2018 LSP TIA report as well as providing updated assessment in support of the current proposed LSP Amendment.



APPENDIX A

APPROVED LOCAL STRUCTURE PLAN

LEGEND

ZONES/RESERVES

- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m² - 1200m²)

NOTES

- The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
- The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
- POS Areas are indicative only and subject to further detailed design and drainage considerations.
- All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-call and final survey and may vary from figures shown.
- Boundary stacks need to be reviewed prior to creation of titles. Development may require construction in accordance with ASS959 - Construction in Bushfire Prone Areas.
- Sixty-Eight Road widening to accommodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.



PLAN RHPH 2.001
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 DATE: 20/11/2018
 PRODUCTION: PCC514
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Scale: 1:5000 @ A3
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PLANNER: BK
 CHECKER: TV

LOCAL STRUCTURE PLAN MAP

Lot 1507 Eighty Road, BALDWILS

A Rockingham Park Project



APPENDIX B

PROPOSED AMENDED LOCAL STRUCTURE PLAN

LEGEND

- ZONES/RESERVES**
- RESIDENTIAL R15
 - RESIDENTIAL R20
 - RESIDENTIAL R25
 - RESIDENTIAL R30
 - RESIDENTIAL R40
 - RESIDENTIAL R60
 - COMMERCIAL
 - SPECIAL USE
 - EDUCATION
 - PUBLIC OPEN SPACE

- OTHER**
- LOCAL STRUCTURE PLAN BOUNDARY
 - 400m NEIGHBOURHOOD VALUABLE CATCHMENT
 - PUMP STATION ODDUP BUFFER
 - POWERLINE EASEMENT
 - ROAD WIDENING (SIXTY EIGHT ROAD)
 - PLANNED BUS ROUTE
 - VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
 - SEWER PUMP STATION (900m² - 1220m²)

- NOTES**
- 1 The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2007 and original Lot 1507 boundary.
 - 2 The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
 - 3 PDS areas are indicative only and subject to further detailed design and drainage considerations.
 - 4 All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-civil and final survey and may vary from figures shown.
 - 5 Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with ASS559 - Construction in Bushfire Prone Areas.
 - 6 Sixty-Eight Road widening to accommodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.



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Information on this plan is provided for general information only. It is not intended to be used as a basis for any legal or financial decision. The user of this plan is advised to seek professional advice. The user of this plan is advised to verify the information shown on this plan against the relevant legislation and regulations. The user of this plan is advised to verify the information shown on this plan against the relevant legislation and regulations. The user of this plan is advised to verify the information shown on this plan against the relevant legislation and regulations.

LOCAL STRUCTURE PLAN MAP
Lot 1507 Eighty Road, BALDWIN
A Rockingham Park Project



APPENDIX C

PARKLAND HEIGHTS NEIGHBOURHOOD CENTRE LOCAL DEVELOPMENT PLAN

PARKLAND HEIGHTS NEIGHBOURHOOD CENTRE LOCAL DEVELOPMENT PLAN 1

APPLICATION OF LOCAL DEVELOPMENT PLAN

The provisions of this Local Development Plan (LDP) are in addition to any requirements under Local Planning Scheme No.2 (LPS No.2) and any development control provisions prescribed under a Local Structure Plan.

DEVELOPMENT STANDARDS

Main Street
1. The main street shall be designed as a low-speed traffic environment that prioritises pedestrian movement over vehicles. Traffic-calming measures should be incorporated into the design with pedestrian crossings provided that generally align with entrance points to buildings.
2. The main street shall accommodate on-street parking as well as loading zones for service vehicles on each side of the main street where practical and safe.
3. The main street shall be designed for a high-level of pedestrian amenity and incorporate features such as street furniture, low planting, street trees and lighting where practicable and safe.

Active Building Edges

Where identified, active building edges shall:
1. Have a fit setback to the footpath.
2. Have a continuous height with a minimum building facade height of 5.5m.
3. Comprise a minimum of 65% glazing for the length of the ground floor facade.
4. Provide continuous pedestrian shelter that extends over the width of the adjoining footpath to the extent that they do not pose a hazard for passing vehicles (eg. delivery and service trucks).
5. Comprise preferred uses with the exception of where entry points are required for access to internal stopping points pedestrian malls and buildings details with a # symbol. Preferred uses include 'fast food', 'cafe', 'retailer', 'small bar', 'barn', and 'shop'. Other uses may be considered in accordance with Clause 4.1 of the Parkland Heights Local Structure Plan and Table No.1 - Zoning Table of LPS No.2.

Other Building Facades

5. With the exception of 'Active Building Edges' and walls adjoining loading areas, building facades should avoid blank walls to enhance visual presentation through the use of features such as glazing (where conducive to the floor plan and use), alternative colours, finishes and textures and/or intrusions and articulations in the wall.
10. In addition to the above, 'Secondary Building Edges' are to be designed to provide visual relief through an architectural response.

Vehicle Access

11. Intersection treatments for vehicle access points to the Neighbourhood Centre are to be provided in accordance with the LDP.
12. Alternative intersection treatments may be considered where a Traffic Impact Assessment is provided to the satisfaction of the City of Rockingham.
13. Footpaths adjacent 'Active Building Edges' are to have a minimum width of 4.5m in order to accommodate alfresco dining opportunities and pedestrian movement. A reduction to 3.5m wide may be considered where alfresco dining is not proposed or contemplated by the specific land use.
14. For buildings abutting the main street, primary pedestrian access to building entries is to be provided from the main street.

Landscaping

15. Landscaping strips a minimum of 2.0m wide are to be provided within the property boundary in the general locations depicted on the LDP. Timing for the installation of the landscaping is to coincide with the construction of the adjoining car park to provide screening.
16. Where screening is required, landscaping areas and building facades, the Landscaping Plan that accompanies the Development Application is to provide details that demonstrate screening of these areas through the use of shrubs and tree planting.
17. A minimum of 10% of the site area should be provided as landscaping. This may include shade trees and landscaping areas within car parks.
18. Car parking areas are to include shade trees at a minimum rate of 1 tree per 6 car bays. Where shade structures are proposed over parking areas, the requisite number of trees may be provided on the periphery of, or adjacent to, the covered area.

Potential Residential Precinct

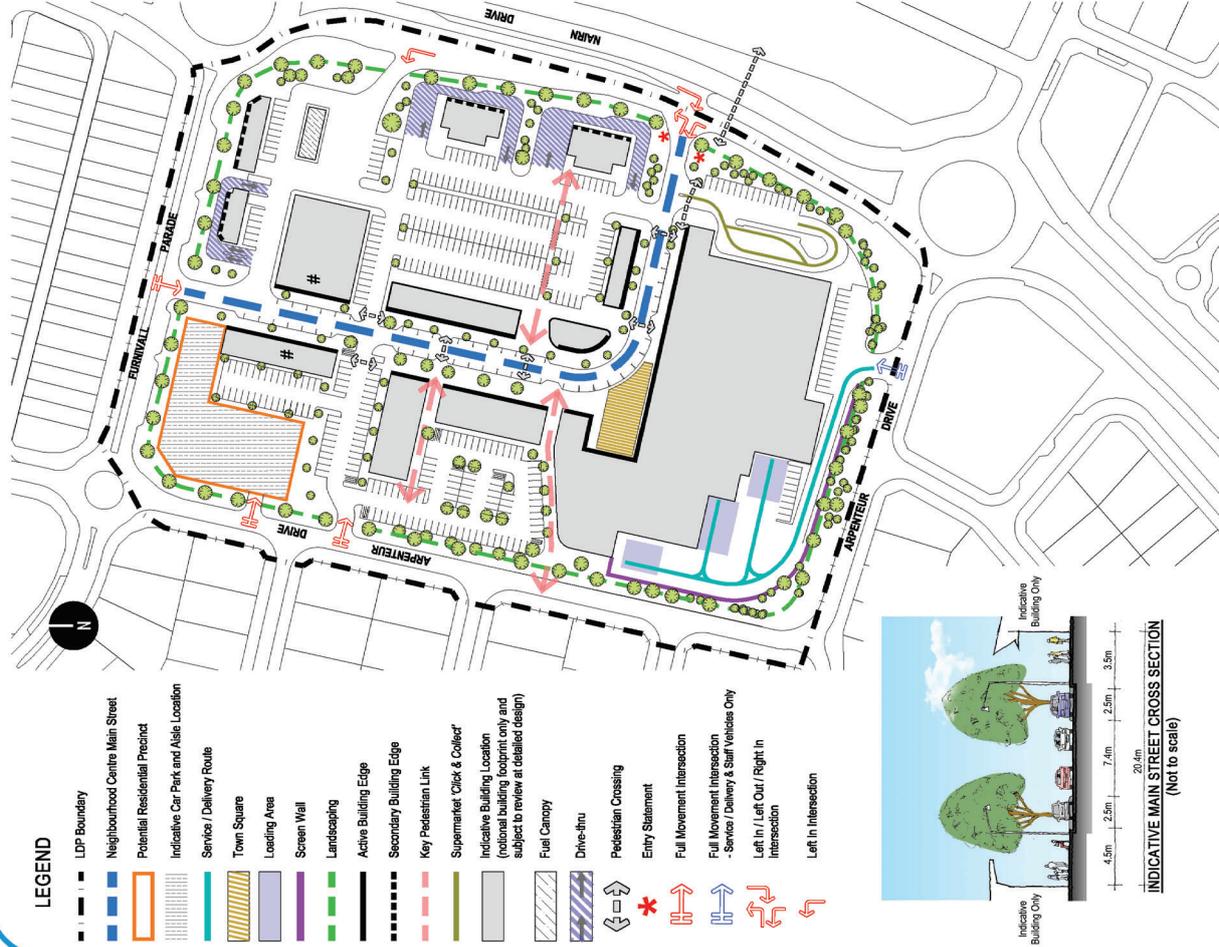
19. The north-west corner of the site identified as a 'Potential Residential Precinct' may be developed for residential purposes where it can be demonstrated that the land is not necessary to satisfy the parking requirements for the Neighbourhood Centre.
20. Should residential development be proposed within the 'Potential Residential Precinct' at a future stage, a separate LDP will be required in order to coordinate vehicle access and built form outcomes.
21. A separate LDP for the 'Potential Residential Precinct' shall consider and respond to potential sources of noise emanating from the Neighbourhood Centre. The LDP should be accompanied by an Acoustic Assessment prepared by a suitably qualified Acoustic Consultant that identifies potential sources of noise and outlines strategies to mitigate and manage the potential impact of noise on dwellings.

Noise Management

22. A Development Application that includes a 'Loading Area' depicted on the LDP is to be accompanied by an Acoustic Assessment prepared by a suitably qualified Acoustic Consultant that outlines strategies to mitigate and manage the potential impacts of noise from delivery vehicles and activities on surrounding sensitive land uses.
23. The screen wall is to be articulated and finished in materials and colours that match the overall development and seek to minimise the potential impact of bulk and form on the streetscape.

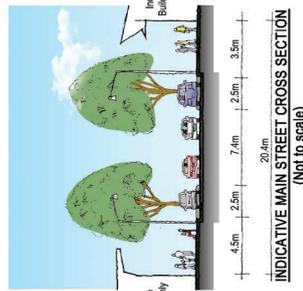
NOTES

- The LDP depicts indicative building and intersection locations only for the purpose of spatial planning. The building and intersection locations are subject to more detailed design which will be refined as part of the Development Application but shall be generally consistent with the LDP.
- The car park design and locations depicted on the LDP are indicative only for the purpose of spatial planning. The exact configuration and location of car parks is to be refined as part of the Development Application but shall be generally consistent with the LDP.
- The indicative 'Main Street Cross Section' depicted on the LDP has been prepared for illustrative purposes only and is subject to refinement at the Development Application stage. Widths and dimensions may vary from those shown on the indicative cross section as part of the detailed design process.
- Building truncations that maintain appropriate visual sightlines at the corners of intersections are to be demonstrated at the Development Application stage.
- The location and number of on-street parking bays is indicative only and subject to change at the detailed Development Application stage.
- The location and alignment of pedestrian crossings are indicative only and subject to change at the detailed Development Application stage.
- Stormwater management on the site is to be in accordance with the approved addendum to the Parkland Heights Local Water Management Strategy dated 22 February 2016 in accordance with NSUD provisions.
- Design details for intersection treatments are to be provided at the development application stage.
- Landscape drawings submitted with Development Applications are to include details of landscaping within verge areas.
- Trees along the perimeter of the site as depicted on the LDP are to be planted at a rate of one tree every 10 metres where vehicle access, parking and sightlines permit.



LEGEND

- LDP Boundary
- Neighbourhood Centre Main Street
- Potential Residential Precinct
- Indicative Car Park and Aisle Location
- Services / Delivery Route
- Town Square
- Loading Area
- Screen Wall
- Landscaping
- Active Building Edge
- Secondary Building Edge
- Key Pedestrian Link
- Supermarket 'Click & Collect'
- Indicative Building Location (national building footprint only and subject to review at detailed design)
- Fuel Canopy
- Drive-thru
- Pedestrian Crossing
- Entry Statement
- Full Movement Intersection
- Full Movement Intersection - Service / Delivery & Staff Vehicles Only
- Left In / Left Out / Right In Intersection
- Left In Intersection

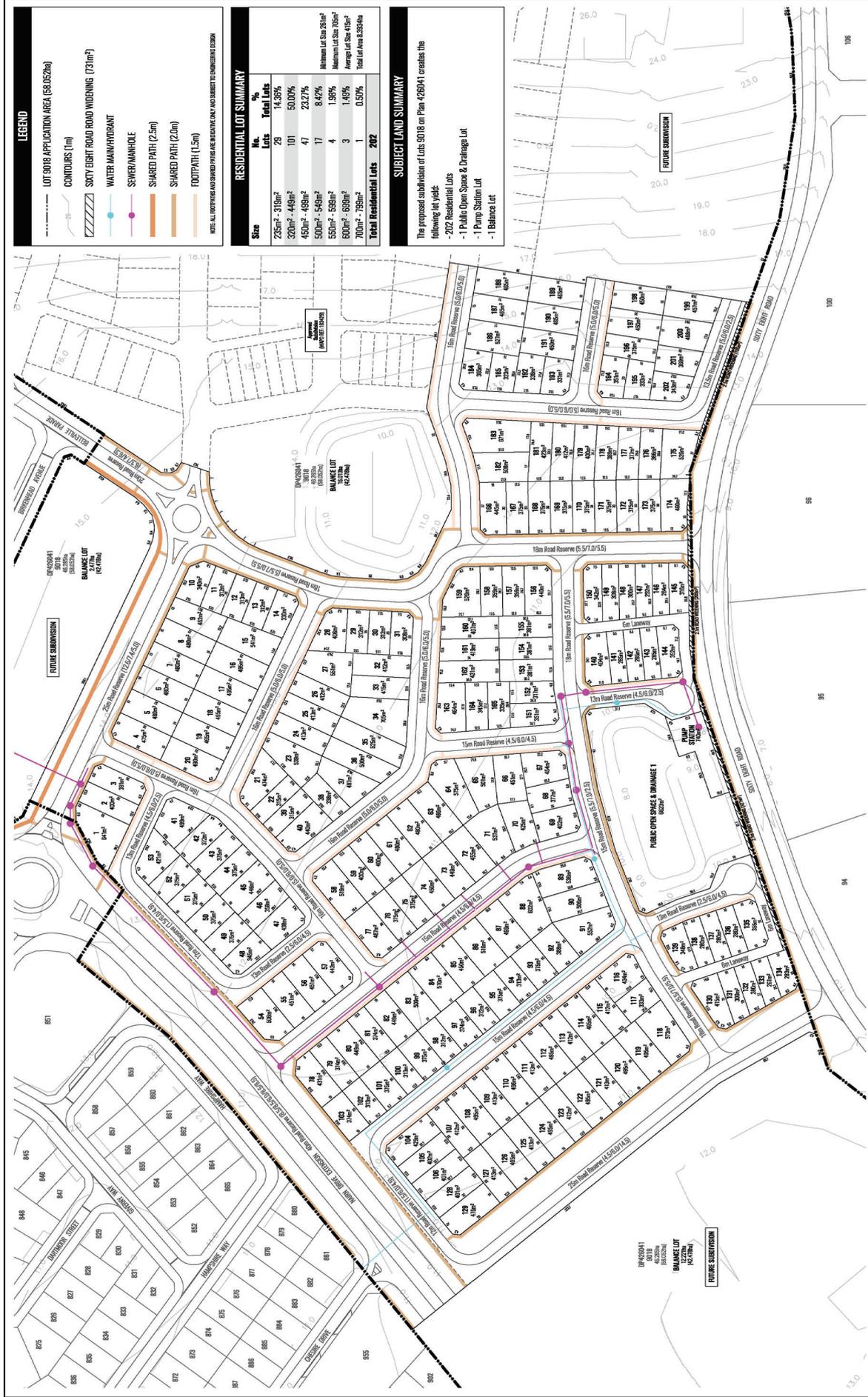


INDICATIVE MAIN STREET CROSS SECTION (Not to scale)



APPENDIX D

STAGE 9 SUBDIVISION PLAN



LEGEND

- LOT 9018 APPLICATION AREA (58,052ha)
- CONTOURS (1m)
- SKY EIGHT ROAD ROAD WIDENING (731m²)
- WATER MAIN/PIEDMONT
- SEWER/MAINHOLE
- SHARED PATH (2.5m)
- SHARED PATH (2.0m)
- FOOTPATH (1.5m)

NOTE: ALL FOOTPATHS AND SHARED PATHS ARE SUBJECT TO UNDERGROUND SERVICES.

RESIDENTIAL LOT SUMMARY

Size	No. Lots	% Total Lots
25m ² - 319m ²	70	14.38%
320m ² - 449m ²	101	50.00%
450m ² - 499m ²	47	23.27%
500m ² - 549m ²	17	8.47%
550m ² - 599m ²	4	1.99%
600m ² - 699m ²	3	1.49%
700m ² - 799m ²	1	0.50%
Total Residential Lots	202	

Minimum Lot Size 25m²
Maximum Lot Size 799m²
Average Lot Size 416m²
Total Lot Area 8,338ha

SUBJECT LAND SUMMARY

The proposed subdivision of lots 9018 on Plan 428041 creates the following lot yield:

- 202 Residential Lots
- 1 Public Open Space & Drainage Lot
- 1 Pump Station Lot
- 1 Balance lot

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Scale: 1:2000 @ A3

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DATE: 12/03/2024
PROJECTION: PCS 94
DUTUM: AHD

REVISION: B
DRAWN: J.P.
PLANNED: B.K.
CHECK: C.H.

PROPOSED FREEHOLD SUBDIVISION
Lot 9018 Nairn Drive, PARKLANDS HEIGHTS Page 1 of 2
A Rockingham Park Project

Appendix 2

Stormwater Technical Memo

2 July 2024

City of Rockingham
PO Box 2142
Rockingham DC WA 6967

Dear Sir/Madam,

Parkland Heights Lot 1507 Eighty Road, Baldivis LSP amendment – Stormwater Technical Memorandum

Introduction

This letter has been prepared as a technical memorandum to support the proposed amendment to the Parkland Heights Lot 1507 Eighty Road, Baldivis approved Local Structure Plan (LSP) (herein referred to as 'the site').

This memorandum details the changes proposed in the LSP amendment and demonstrates that adequate flood management provisions will be provided in line with the approved Local Water Management Strategy (LWMS) (ENV Australia 2011).

This letter should be read in conjunction with the following documents:

- Proposed - *Local Structure Plan, Lot 1507 Eighty Road, Baldivis* (Creative Design and Planning 2024) (Attachment A)
- Proposed - *Indicative Staging Plan, Parkland Heights, Baldivis* (Creative Design and Planning 2024) (Attachment B)
- Proposed - *Freehold Subdivision, Lot 9018 Nairn Drive, Parkland Heights* (Creative Design and Planning 2024) (Attachment C)
- Approved - *Freehold Subdivision Lot 9015 Nairn Drive, Parkland Heights Approval Subject to Conditions* (Western Australian Planning Commission 2023) (Attachment D)
- Approved - *Local Structure Plan, Lot 1507 Eighty Road, Baldivis* (Creative Design and Planning 2018) (Attachment E),
- Approved - *Addendum to the Parkland Heights Lot 1507 Eighty Road, Baldivis Local Water Management Strategy* (RPS Group 2020) (Attachment F).

Background

The purpose of this LWMS addendum is to provide updated stormwater modelling details to address the proposed changes to the approved LSP. The project history is summarised below:

- A LWMS for Parkland Heights was prepared by ENV Australia in 2011 to support the submission of the original LSP for Lot 1507 Eighty Road, Baldivis. The LWMS was approved by the City of Rockingham (CoR) and Department of Water and Environmental Regulation (DWER).
- A Stormwater Management Plan was prepared by Mortons Urban Solutions (2018) to assess the impact to downstream infrastructure of the proposed Neighbourhood Centre, located west of Nairn Drive and found that change to the LWMS overall drainage strategy was required.
- A revised LSP was prepared by Creative Design and Planning in 2018 (Attachment E) with modifications to the layout within Stages 13 and 14.

- An LWMS addendum was prepared by RPS Group in 2020 to address the changes proposed in the LSP 2018 amendment in Stages 13 and 14 and to demonstrate that stormwater would be adequately managed (Attachment F).
- The LSP was amended again in 2024 by Creative Design and Planning (Attachment A). The changes include realignment of lots and roads, and lot densities within Stages 9, 10 and 11. The main changes are presented in Figure 1. The corresponding Lot 9018 proposed freehold subdivision is provided as Attachment C. And the 2024 indicative staging plan is provided as Attachment B.
- Parkland Heights Stage 11 Urban Water Management Plan (UWMP) was prepared by Pentium Water in 2024 based on the amended 2024 LSP and demonstrates that sufficient flood storage will be provided in POS M basin to manage the 1% Annual exceedance probability (AEP) event.

Technical memo

Changes proposed in the amended 2024 LSP are summarized in Figure 1 and are considered relatively minor. The stormwater management will be largely consistent with the approved LSP and LWMS with all runoff in the 1% AEP event from Stages 9, 10 and 11 draining being managed within basins located in POS N or POS M. The proposed stormwater management in POS N and POS M is summarised in the subsections below.

POS M - Flood Management

Stormwater modelling was undertaken to inform the Parkland Heights Stage 11 UWMP and demonstrated that sufficient flood storage will be provided in POS M basin to cater for the 1% AEP event. The stormwater modelling adopted the amended 2024 LSP layout and land use type, as well as an increased catchment area relative to the approved LWMS. The stormwater management plan for POS M basin is presented in Figure 3.

POS N – Flood Management

In the amended 2024 LSP the:

- Allocated POS and drainage area in POS N is 6623 m² which is almost three times larger than the specified 2227 m² basin top area detailed in the LWMS (Figure 4)
- The catchment area draining into POS N basin will be significantly smaller than the catchment area proposed in the LWMS as presented in Figure 2, and
- The proposed changes to the LSP presented in Figure 1 will have negligible impact on total runoff to the basins.

Given the above, the required size of POS N basin is expected to be smaller than the 2227 m² estimated in the LWMS and significantly smaller than the allocated size of POS N.

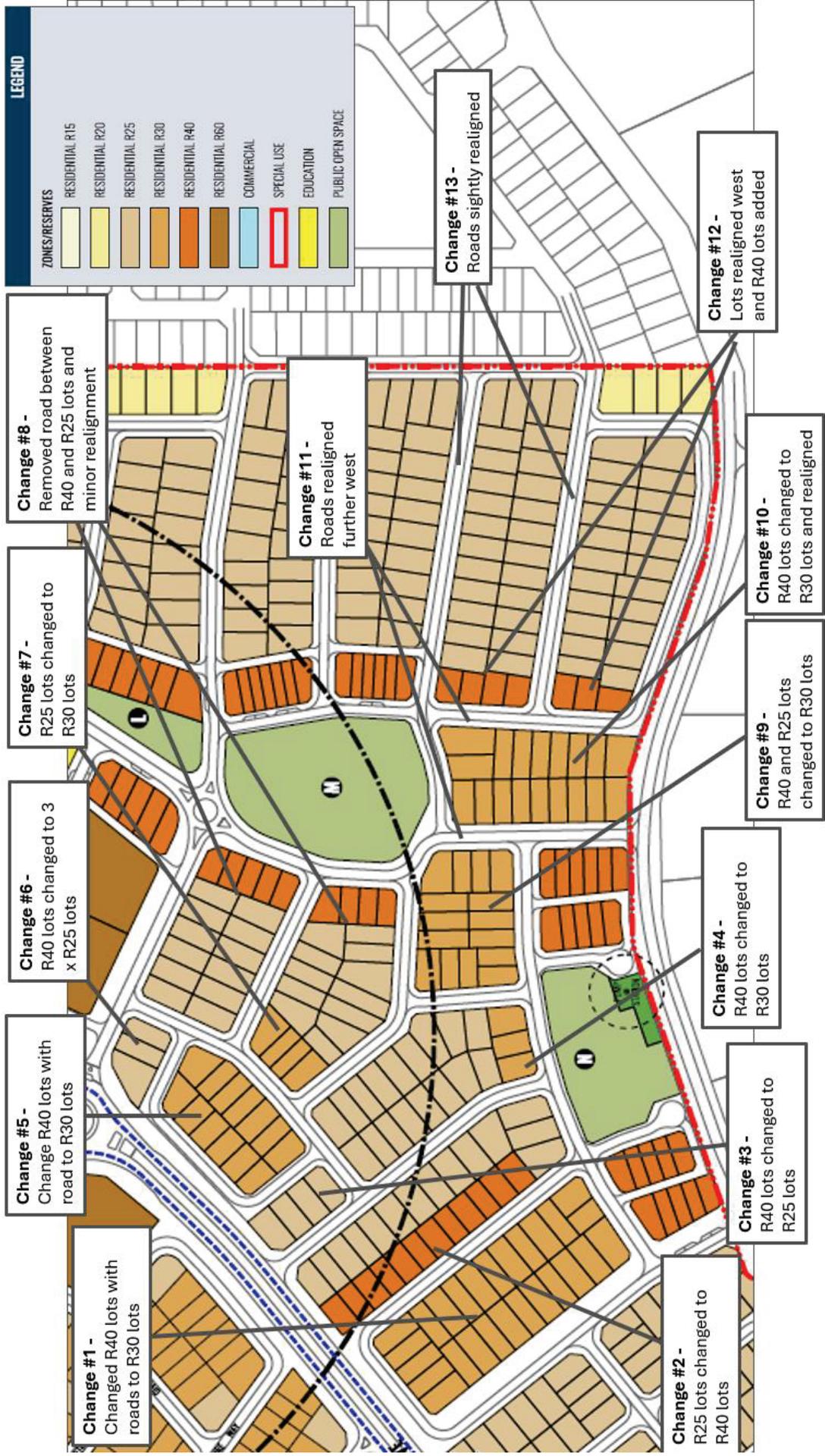


Figure 1: Main changes to 2024 LSP amendment



Figure 2: POS N basin catchment boundary

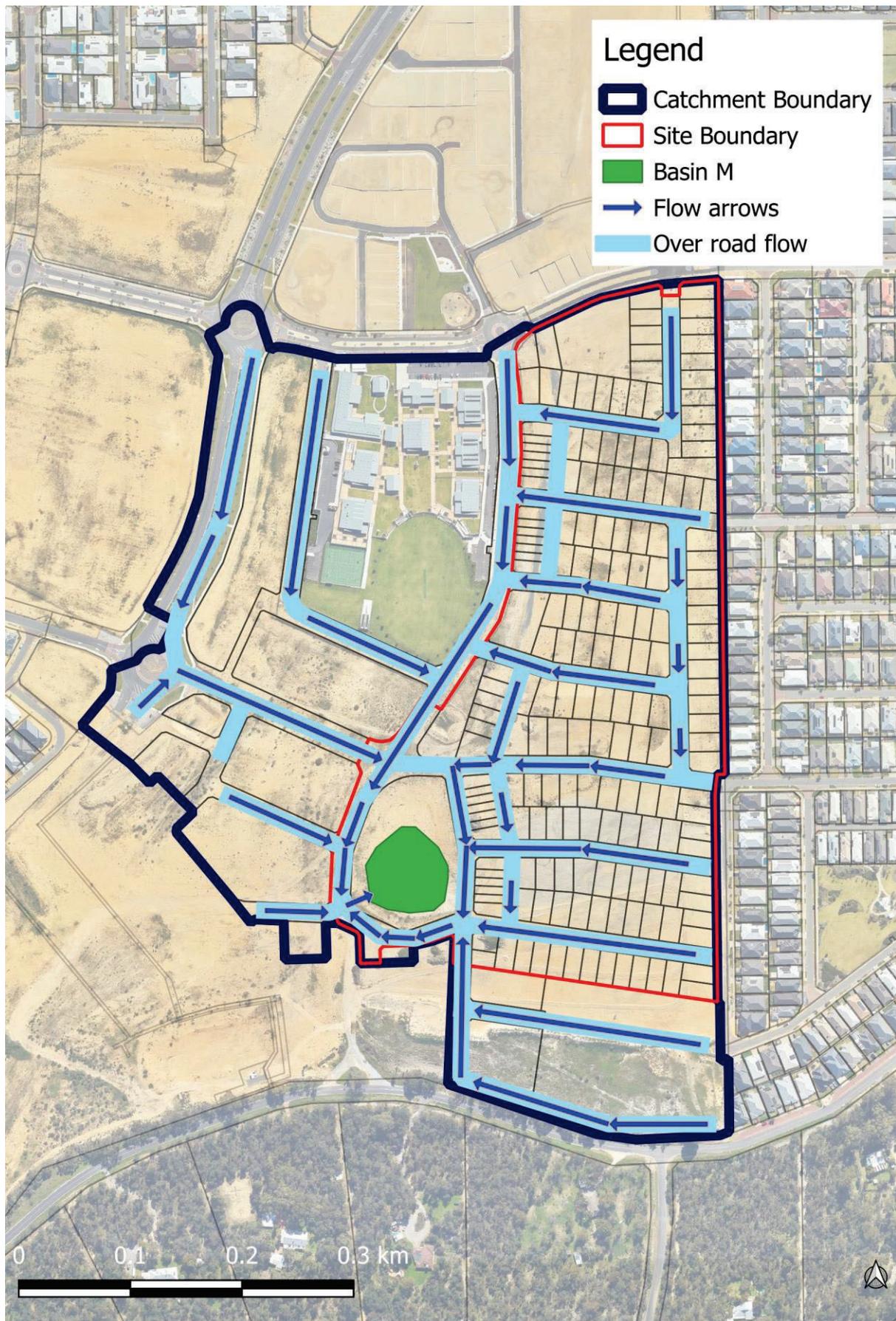


Figure 3: POS M Stage 11 UWMP stormwater management



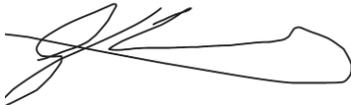
Figure 4: Stormwater plan proposed in the LWMS (ENV Australia 2011)

Conclusion

The changes to the layout and land use types proposed within stages 8, 9 and 10 of the amended 2024 LSP will result in relatively minor changes to the stormwater management strategy detailed in the approved LWMS. This technical memorandum demonstrates that all run-off generated in the 1% AEP event will be adequately managed and infiltrated within POS N and POS M basins consistent with the LWMS.

Further water management details will be provided at detailed design stage and documented in the future UWMPs to support subdivision application.

Yours sincerely,
for Pentium Water



Gerard Edwards
Principal Hydrologist
Urban Water Management
gedwards@pentiumwater.com.au
+61 8 6182 1790

Enc:

Attachment A: *Proposed Local Structure Plan, Lot 1507 Eighty Road, Baldivis* (Creative Design and Planning 2024)

Attachment B: *Indicative Staging Plan, Parkland Heights, Baldivis* (Creative Design and Planning 2024)

Attachment C: *Proposed Freehold Subdivision, Lot 9018 Nairn Drive, Parkland Heights* (Creative Design and Planning 2024)

Attachment D: *Proposed Freehold Subdivision Lot 9015 Nairn Drive, Parkland Heights Approval Subject to Conditions* (Western Australian Planning Commission 2023)

Attachment E: *Local Structure Plan, Lot 1507 Eighty Road, Baldivis* (Creative Design and Planning 2018)

Attachment F: *Addendum to the Parkland Heights Lot 1507 Eighty Road, Baldivis Local Water Management Strategy Local Water Management Strategy* (RPS Group 2020)

- ZONES/RESERVES**
- RESIDENTIAL R15
 - RESIDENTIAL R20
 - RESIDENTIAL R25
 - RESIDENTIAL R30
 - RESIDENTIAL R40
 - RESIDENTIAL R60
 - COMMERCIAL
 - SPECIAL USE
 - EDUCATION
 - PUBLIC OPEN SPACE

- OTHER**
- LOCAL STRUCTURE PLAN BOUNDARY
 - 400m NEIGHBOURHOOD WALKABLE CATCHMENT
 - PUMP STATION ODOUR BUFFER
 - POWERLINE EASEMENT
 - ROAD WIDENING (SKY EIGHT ROAD)
 - PLANNED BUS ROUTE
 - VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
 - SEWER PUMP STATION (900m² - 1220m²)

NOTES

- 1 The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
- 2 The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
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- 6 Sky-Eight Road widening to accommodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.



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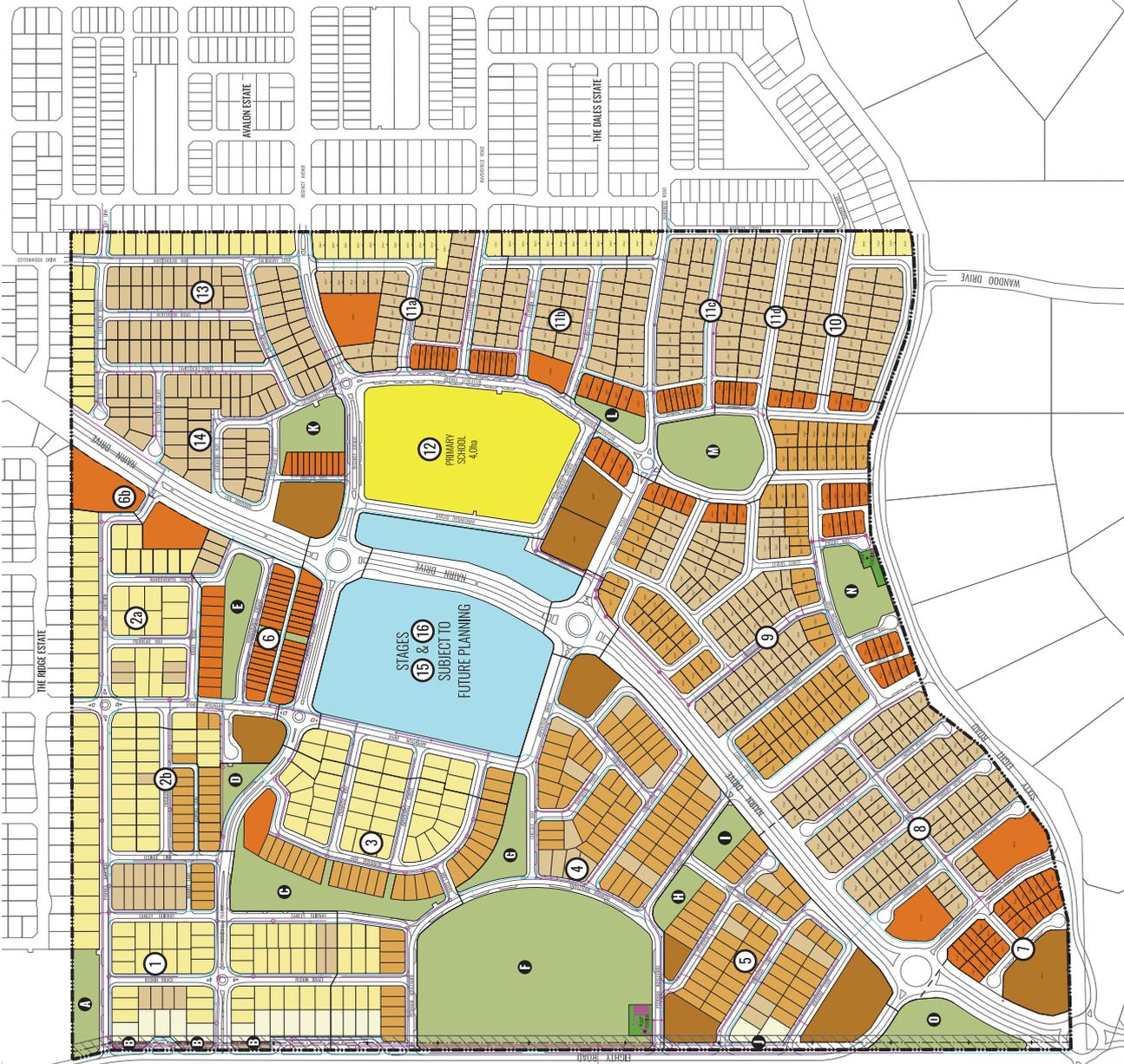
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 PROJECTION: PCS 94 PLANNER: CH
 DATUM: AHD CHECKER: B

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LOCAL STRUCTURE PLAN MAP
 Lot 1507 Eighty Road, BALDIMS
 A Rockingham Park Project



STAGE LOT SUMMARY	
STAGE 1	LOTS
RESIDENTIAL	108
GROUPED HOUSING	108
Total	216
STAGE 2A & 2B	LOTS
SINGLE RESIDENTIAL	85
GROUPED HOUSING	85
Total	170
STAGE 3	LOTS
SINGLE RESIDENTIAL	91
GROUPED HOUSING	92
Total	183
STAGE 4	LOTS
RESIDENTIAL	75
GROUPED HOUSING	74
Total	149
STAGE 5	LOTS
SINGLE RESIDENTIAL	50
GROUPED HOUSING	53
Total	103
STAGE 6 & 8B	LOTS
SINGLE RESIDENTIAL	61
GROUPED HOUSING	64
Total	125
STAGE 7	LOTS
SINGLE RESIDENTIAL	28
GROUPED HOUSING	28
Total	56
STAGE 8	LOTS
SINGLE RESIDENTIAL	83
GROUPED HOUSING	85
Total	168
STAGE 9	LOTS
SINGLE RESIDENTIAL	210
GROUPED HOUSING	212
Total	422
STAGE 10	LOTS
SINGLE RESIDENTIAL	39
GROUPED HOUSING	39
Total	78
STAGE 11B	LOTS
SINGLE RESIDENTIAL	46
GROUPED HOUSING	47
Total	93
STAGE 11D	LOTS
SINGLE RESIDENTIAL	30
GROUPED HOUSING	30
Total	60
STAGE 13	LOTS
SINGLE RESIDENTIAL	79
GROUPED HOUSING	79
Total	158
STAGE 14	LOTS
SINGLE RESIDENTIAL	83
GROUPED HOUSING	84
Total	167
STAGE 15/16	LOTS
SINGLE RESIDENTIAL	15
GROUPED HOUSING	15
Total	30

LEGEND	
ZONES/RESERVES	
[Color]	RESIDENTIAL R15
[Color]	RESIDENTIAL R20
[Color]	RESIDENTIAL R25
[Color]	RESIDENTIAL R30
[Color]	RESIDENTIAL R40
[Color]	RESIDENTIAL R60
[Color]	COMMERCIAL
[Color]	EDUCATION
[Color]	PUBLIC OPEN SPACE
OTHER	
[Symbol]	LOCAL STRUCTURE PLAN BOUNDARY
[Symbol]	STAGING BOUNDARY (APPROVED SUBDIVISION)
[Symbol]	STAGING BOUNDARY (FUTURE INDICATIVE SUBDIVISION - SUBJECT TO CHANGE)
[Symbol]	SEWER PUMP STATION
[Symbol]	POWERLINE EASEMENT
[Symbol]	ROAD WIDENING (SIXTY EIGHT ROAD)
[Symbol]	WATER
[Symbol]	SEWER

PUBLIC OPEN SPACE TABLE	
AREA (ha)	CREDITABLE AREA (ha)
0.4823	0.3235
0.1463	0.0256
1.1240	0.2328
0.2283	0.5575
0.5575	1.0983
5.7711	0.7364
0.5129	0.8475
0.2747	
TOTAL AREA OF POS & DRAINAGE	12.8566ha
% OF GROSS LANDHOLDING	10.82%

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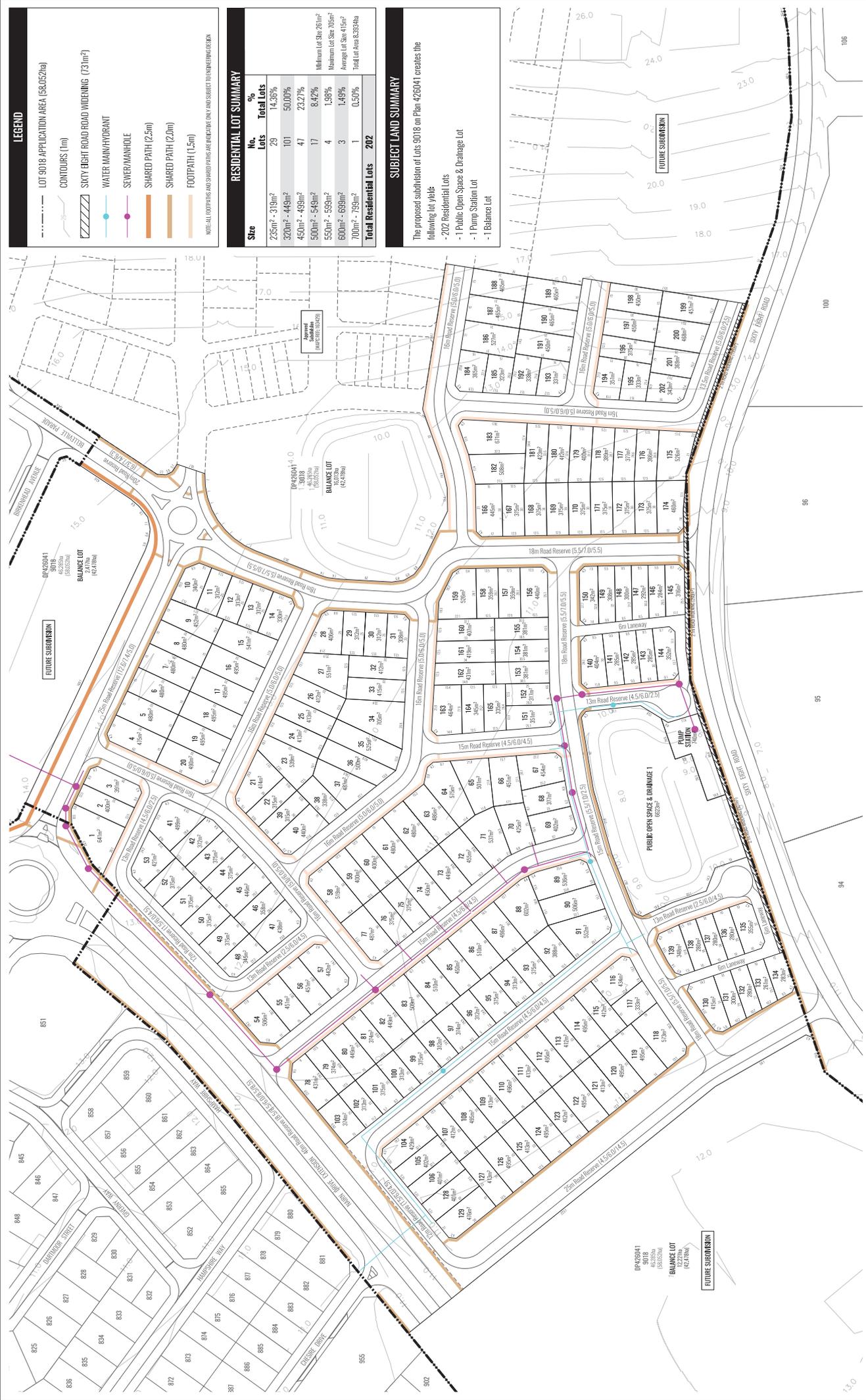
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PLANS: PPH-4108 REVISION: 6
DATE: 27/02/2024 DRAWING: P
PROJECT: POC 84 PLANNER: CH
DATE: 14/01/2024 CHECKER: JB

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INDICATIVE STAGING PLAN

Parkland Heights, BALDIVIS
A Rockingham Park Project



LEGEND

- LOT 9018 APPLICATION AREA (58,052ha)
- CONTOURS (1m)
- SIXTY EIGHT ROAD WIDENING (73m²)
- WATER MAIN/FOUNTAIN
- SEWER/MAINHOLE
- SHARED PATH (2.5m)
- SHARED PATH (2.0m)
- FOOTPATH (1.5m)

RESIDENTIAL LOT SUMMARY

Size	No. Lots	% Total Lots
235m ² - 319m ²	29	14.36%
320m ² - 449m ²	101	50.00%
450m ² - 499m ²	47	23.27%
500m ² - 549m ²	17	8.42%
550m ² - 599m ²	4	1.98%
600m ² - 699m ²	3	1.49%
700m ² - 799m ²	1	0.50%
Total Residential Lots	202	

Minimum Lot Size 205m²
Maximum Lot Size 105m²
Average Lot Size 415m²
Total Lot Area 83,354ha

SUBJECT LAND SUMMARY

The proposed subdivision of Lots 9018 on Plan 428041 creates the following lot yields

- 202 Residential Lots
- 1 Public Open Space & Drainage Lot
- 1 Pump Station Lot
- 1 Balance Lot

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Town Planning & Urban Design

Scale 1:2000 @ A3

0 20 40 80m

DATE: 12/02/2024
DRAWING: P
PROJECT: PDS 34
CHECKS: CH

PLANNING: PHIPPS/CH/2
REVISION: B
PLANNER: BK
CHECKS: CH



Your Ref : RHPHSUB

Cdp Town Planning & Urban Design
2/464 Murray Street
PERTH WA 6000

**Approval Subject To Condition(s)
Freehold (Green Title) Subdivision**

Application No : 163429

Planning and Development Act 2005

Applicant	:	Cdp Town Planning & Urban Design 2/464 Murray Street PERTH WA 6000
Owner	:	Rockingham Park Pty Ltd 242 Leach Highway Myaree MYAREE WA 6154
Application Receipt	:	28 March 2023

Lot Number	:	
Diagram / Plan	:	423718
Location	:	
C/T Volume/Folio	:	4029/667
Street Address	:	Lot 9015 Regency Av, Baldivis
Local Government	:	City of Rockingham

The Western Australian Planning Commission has considered the application referred to and is prepared to endorse a deposited plan in accordance with the plan date-stamped **28 March 2023** once the condition(s) set out have been fulfilled.

This decision is valid for **four years** from the date of this advice, which includes the lodgement of the deposited plan within this period.

The deposited plan for this approval and all required written advice confirming that the requirement(s) outlined in the condition(s) have been fulfilled must be submitted by **24 July 2027** or this approval no longer will remain valid.



Reconsideration - 28 days

Under section 151(1) of the *Planning and Development Act 2005*, the applicant/owner may, within 28 days from the date of this decision, make a written request to the WAPC to reconsider any condition(s) imposed in its decision. One of the matters to which the WAPC will have regard in reconsideration of its decision is whether there is compelling evidence by way of additional information or justification from the applicant/owner to warrant a reconsideration of the decision. A request for reconsideration is to be submitted to the WAPC on a Form 3A with appropriate fees. An application for reconsideration may be submitted to the WAPC prior to submission of an application for review. Form 3A and a schedule of fees are available on the WAPC website: <http://www.dplh.wa.gov.au>

Right to apply for a review - 28 days

Should the applicant/owner be aggrieved by this decision, there is a right to apply for a review under Part 14 section 251 of the *Planning and Development Act 2005*. The application for review must be submitted in accordance with part 2 of the *State Administrative Tribunal Rules 2004* and should be lodged within 28 days of the date of this decision to: the State Administrative Tribunal, Level 6, State Administrative Tribunal Building, 565 Hay Street, PERTH, WA 6000. It is recommended that you contact the tribunal for further details: telephone 9219 3111 or go to its website: <http://www.sat.justice.wa.gov.au>

Deposited plan

The deposited plan is to be submitted to the Western Australian Land Information Authority (Landgate) for certification. Once certified, Landgate will forward it to the WAPC. In addition, the applicant/owner is responsible for submission of a Form 1C with appropriate fees to the WAPC requesting endorsement of the deposited plan. A copy of the deposited plan with confirmation of submission to Landgate is to be submitted with all required written advice confirming compliance with any condition(s) from the nominated agency/authority or local government. Form 1C and a schedule of fees are available on the WAPC website: <http://www.dplh.wa.gov.au>

Condition(s)

The WAPC is prepared to endorse a deposited plan in accordance with the plan submitted once the condition(s) set out have been fulfilled.

The condition(s) of this approval are to be fulfilled to the satisfaction of the WAPC.

The condition(s) must be fulfilled before submission of a copy of the deposited plan for endorsement.

The agency/authority or local government noted in brackets at the end of the condition(s) identify the body responsible for providing written advice confirming that the WAPC's requirement(s) outlined in the condition(s) have been fulfilled. The written advice of the agency/authority or local government is to be obtained by the applicant/owner. When the



written advice of each identified agency/authority or local government has been obtained, it should be submitted to the WAPC with a Form 1C and appropriate fees and a copy of the deposited plan.

If there is no agency/authority or local government noted in brackets at the end of the condition(s), a written request for confirmation that the requirement(s) outlined in the condition(s) have been fulfilled should be submitted to the WAPC, prior to lodgement of the deposited plan for endorsement.

Prior to the commencement of any subdivision works or the implementation of any condition(s) in any other way, the applicant/owner is to liaise with the nominated agency/authority or local government on the requirement(s) it considers necessary to fulfil the condition(s).

The applicant/owner is to make reasonable enquiry to the nominated agency/authority or local government to obtain confirmation that the requirement(s) of the condition(s) have been fulfilled. This may include the provision of supplementary information. In the event that the nominated agency/authority or local government will not provide its written confirmation following reasonable enquiry, the applicant/owner then may approach the WAPC for confirmation that the condition(s) have been fulfilled.

In approaching the WAPC, the applicant/owner is to provide all necessary information, including proof of reasonable enquiry to the nominated agency/authority or local government.

The condition(s) of this approval, with accompanying advice, are:

CONDITIONS

Administrative

1. The plan of subdivision is to be modified in accordance with the attached plan (Attachment A) dated 29 June 2023. (Western Australian Planning Commission)
2. The landowner/applicant contributing towards development infrastructure provisions pursuant to the City of Rockingham Local Planning Scheme No.2. (Local Government)

Drainage and site works

3. Uniform fencing being constructed along the boundaries of lots abutting public open space. (Local Government)
4. Engineering drawings and specifications are to be submitted, approved, and works undertaken in accordance with the approved engineering drawings, specifications and approved plan of subdivision, for grading and/or stabilisation of the site to ensure that:



- (a) lots can accommodate their intended use; and
 - (b) finished ground levels at the boundaries of the lot(s) the subject of this approval match or otherwise coordinate with the existing and/or proposed finished ground levels of the land abutting. (Local Government)
5. Prior to the commencement of subdivisional works, an urban water management plan is to be prepared and approved, in consultation with the Department of Water and Environmental Regulation, consistent with any approved local water management strategy. (Local Government)
6. Engineering drawings and specifications are to be submitted and approved, and works undertaken in accordance with the approved engineering drawings and specifications and approved plan of subdivision, for the filing and/or draining of the land, including ensuring that stormwater is contained on-site, or appropriately treated and connected to the local drainage system. Engineering drawings and specifications are to be in accordance with an approved urban water management plan for the site, or where no urban water management plan exists, to the satisfaction of the Western Australian Planning Commission. (Local Government)
7. Prior to the commencement of subdivisional works, the landowner/applicant is to provide a pre-works geotechnical report certifying that the land is physically capable of development or advising how the land is to be remediated and compacted to ensure it is capable of development; and in the event that remediation works are required, the landowner/applicant is to provide a post geotechnical report certifying that all subdivisional works have been carried out in accordance with the pre-works geotechnical report. (Local Government)
8. Suitable arrangements being made for connection of the land to the comprehensive district drainage system at the landowner/applicant's cost. (Local Government)
9. Drainage easements and reserved as may be required by the local government for drainage infrastructure being shown on the diagram or plan of survey (deposited plan) as such, granted free of cost, and vested in that local government under Sections 152 and 167 of the *Planning and Development Act 2005*. (Local Government)

Lot design

10. Local development plan(s) being prepared and approved for lots that are accessed via a laneway and/or with direct frontage to public open space as shown on the plan dated 29 June 2023 (attached) that address the following:
 - (a) lots to be elevated a minimum 500mm above public open space, with open style front fencing;
 - (b) provision of a footpath at least 1.5 metres-wide between lots and public open space, with sufficient lighting to access the front of the property;
 - (c) access and parking arrangements; and
 - (d) garage locations.(Local Government)



11. The landowner/applicant shall make arrangements to ensure that prospective purchasers of lots subject of a local development plan are advised in writing that local development plan provisions apply. (Local Government)

Transport, roads and access

12. Engineering drawings and specifications are to be submitted, approved and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, to ensure that those lots not fronting an existing road are provided with frontage to a constructed road(s) connected by a constructed road(s) to the local road system and such road(s) are constructed and drained at the landowner/applicant's cost.

As an alternative, and subject to the agreement of the local government the Western Australian Planning Commission is prepared to accept the landowner/applicant paying to the local government the cost of such road works as estimated by the local government and the local government providing formal assurance to the Western Australian Planning Commission confirming that the works will be completed within a reasonable period as agreed by the Western Australian Planning Commission. (Local Government)

13. Engineering drawings and specifications are to be submitted and approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications to ensure that:
 - (a) street lighting in accordance with dark sky principles is installed on all new subdivisional roads to the standards of the relevant licensed service provider;
 - (b) roads that have been designed to connect with existing or proposed roads abutting the subject land are coordinated so the road reserve location and width connect seamlessly;
 - (c) temporary turning areas are provided to those subdivisional roads that are subject to future extension; and
 - (d) embayment parking is provided abutting the proposed public open space reserves, Grouped Housing Site 69 and lots subject to an R40 residential density code.(Local Government)
14. Engineering drawings and specifications are to be submitted, approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, for the provision of shared paths through and connecting to the application area. The approved shared paths are to be constructed by the landowner/applicant. (Local Government)
15. All local streets within the subdivision being truncated in accordance with Western Australian Planning Commission's *Liveable Neighbourhoods* policy. (Local Government)



Reserves

16. The proposed reserve(s) shown on the approved plan of subdivision being shown on the diagram or plan of survey (deposited plan) as reserve(s) for public open space and drainage (as applicable) and vested in the Crown under Section 152 of the *Planning and Development Act 2005*, such land to be ceded free of cost and without any payment of compensation by the Crown. (Local Government)
17. Arrangements being made for the proposed public open space to be developed by the landowner/applicant to a minimum standard and maintained for two summers through the implementation of an approved landscape plan providing for the development and maintenance of the proposed public open space in accordance with the requirements of Liveable Neighbourhoods and/or dark sky principles and to the specifications of the local government. (Local Government)

Servicing

18. Arrangements being made with a licensed electricity network operator for the provision of an underground electricity distribution system that can supply electricity to each lot shown on the approved plan of subdivision. (Western Power)
19. The transfer of land as a Crown reserve free of cost to Western Power for the provision of electricity supply infrastructure. (Western Power)
20. Suitable arrangements being made with the Water Corporation so that provision of a suitable water supply service will be available to lot(s) shown on the approved plan of subdivision. (Water Corporation)
21. Suitable arrangements being made with the Water Corporation so that provision of a sewerage service will be available to the lot(s) shown on the approved plan of subdivision. (Water Corporation)

Notifications

22. A notification, pursuant to Section 165 of the *Planning and Development Act 2005* is to be placed on the certificates of title of the proposed lot(s) advising of the existence of a hazard or other factor. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows:

"This lot is in close proximity to known mosquito breeding areas. The predominant mosquito species is known to carry viruses and other diseases."
(Western Australian Planning Commission)

ADVICE:

1. Condition 5 has been imposed in accordance with *Better Urban Water Management Guidelines (WAPC 2008)*. Further guidance on the contents of urban water management plans is provided in *'Urban Water Management Plans: Guidelines for preparing and complying with subdivision conditions'* (Published by the then Department of Water 2008).
2. The landowner/applicant and the local government are advised to refer to the Institute of Public Works Engineering Australasia's *Local Government Guidelines for Subdivisional Development* (current edition). The guidelines set out the minimum best practice requirements recommended for subdivision construction and granting clearance of engineering conditions imposed.
3. The landowner/applicant is advised that the Department of Water and Environmental Regulation has prepared dust control guidelines for development sites, which, outline the procedures for the preparation of dust management plans.

The dust management plans are generally approved, and their implementation overseen, by the Local Government. Further information on the guidelines can be obtained from the Department of Water and Environmental Regulation's website www.dwer.wa.gov.au under air quality publications.
4. With regard to Conditions 12 to 15, the landowner/applicant is advised that the road reserves, including the constructed carriageways, laneways, truncations, footpaths/dual use paths and car embayment's, are to be generally consistent with the approved plan of subdivision.
5. With regard to Condition 13, the landowner/applicant is advised that to achieve the dark sky principles, new street lighting is to comply with a correlated colour temperature of 3,000 kelvins or less, shielded luminaires and in accordance with *AS4282:2010 - control of the obtrusive effects of lighting*.
6. With regard to Condition 17, the development is to include full earthworks, reticulation, grassing of key areas, and pathways that form part of the overall pedestrian and/or cycle network. The works are to be seamless with abutting public open space.
Any lighting within the public open space shall comply with the dark sky principles and *AS4282:2010 - control of the obtrusive effects of lighting*. Smart lighting should also be installed to ensure that lighting infrastructure is capable of remote operation and/or timing.
7. With regard to Condition 18, Western Power provides only one point of electricity supply per freehold (green title) lot.

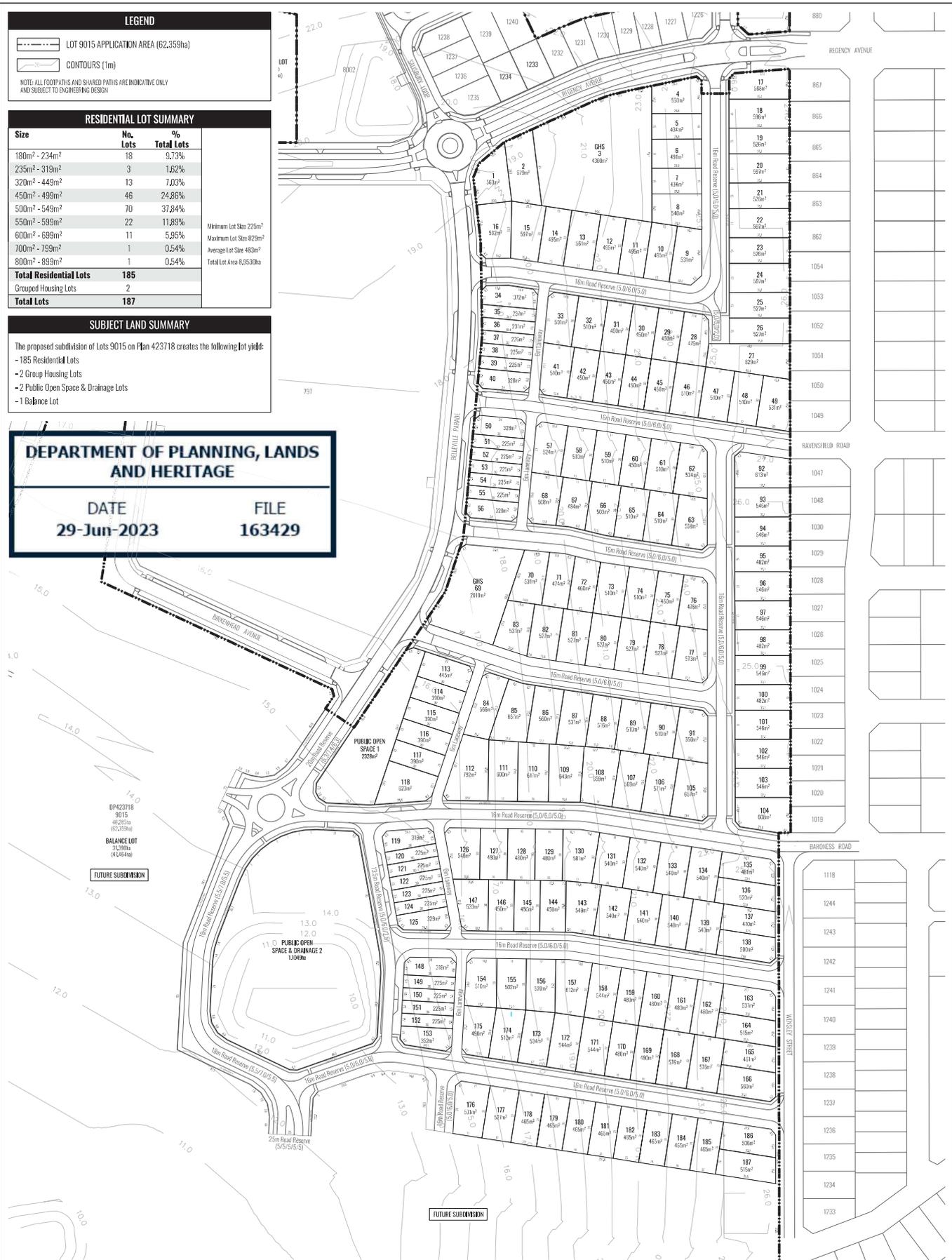


8. With regard to Conditions 20 to 21, the landowner/applicant shall make arrangements with the Water Corporation for the provision of the necessary services. On receipt of a request from the landowner/ applicant, a Land Development Agreement under Section 83 of the *Water Services Act 2012* will be prepared by the Water Corporation to document the specific requirements for the proposed subdivision.
9. The applicant/landowner is advised that pursuant to the *Commonwealth Telecommunications Act 1997* there will generally be a requirement for the installation of fibre-ready telecommunications infrastructure. Exemptions can be sought for certain types of development. Further information is available from the Australian Government Department of Infrastructure, Transport, Regional Development and Communications website at www.infrastructure.gov.au.
10. Prior to the commencement of subdivisional works, the landowner/applicant needs to be aware of their obligations under the *Aboriginal Cultural Heritage Act 2021*. The Aboriginal Cultural Heritage Management Code sets out the process for meeting those obligations.

A handwritten signature in black ink, appearing to read "S Fagan".

Ms Sam Fagan
Secretary
Western Australian Planning Commission
24 July 2023

Enquiries : Lisa Hall (Ph 9586 4690)



LEGEND

- LOT 9015 APPLICATION AREA (62.359ha)
- CONTOURS (1m)

NOTE: ALL FOOTPRINTS AND SHARED PATHS ARE INDICATIVE ONLY AND SUBJECT TO ENGINEERING DESIGN

RESIDENTIAL LOT SUMMARY

Size	No. Lots	% Total Lots
180m ² - 234m ²	18	9.73%
235m ² - 319m ²	3	1.62%
320m ² - 449m ²	13	7.03%
450m ² - 499m ²	46	24.86%
500m ² - 549m ²	70	37.84%
550m ² - 599m ²	22	11.89%
600m ² - 699m ²	11	5.95%
700m ² - 799m ²	1	0.54%
800m ² - 899m ²	1	0.54%
Total Residential Lots	185	
Group Housing Lots	2	
Total Lots	187	

Minimum Lot Size 225m²
 Maximum Lot Size 823m²
 Average Lot Size 493m²
 Total Lot Area 8,936,300ha

SUBJECT LAND SUMMARY

The proposed subdivision of Lots 9015 on Plan 423718 creates the following lot yield:

- 185 Residential Lots
- 2 Group Housing Lots
- 2 Public Open Space & Drainage Lots
- 1 Balance Lot

DEPARTMENT OF PLANNING, LANDS AND HERITAGE

DATE: 29-Jun-2023 FILE: 163429

DP423718
 9015
 462,359
 (62,359ha)

BALANCE LOT
 31,280m²
 (4,454ha)

FUTURE SUBDIVISION

PROPOSED FREEHOLD SUBDIVISION

Lot 9015 Nairn Drive, PARKLANDS HEIGHTS Page 1 of 2

A Rockingham Park Project

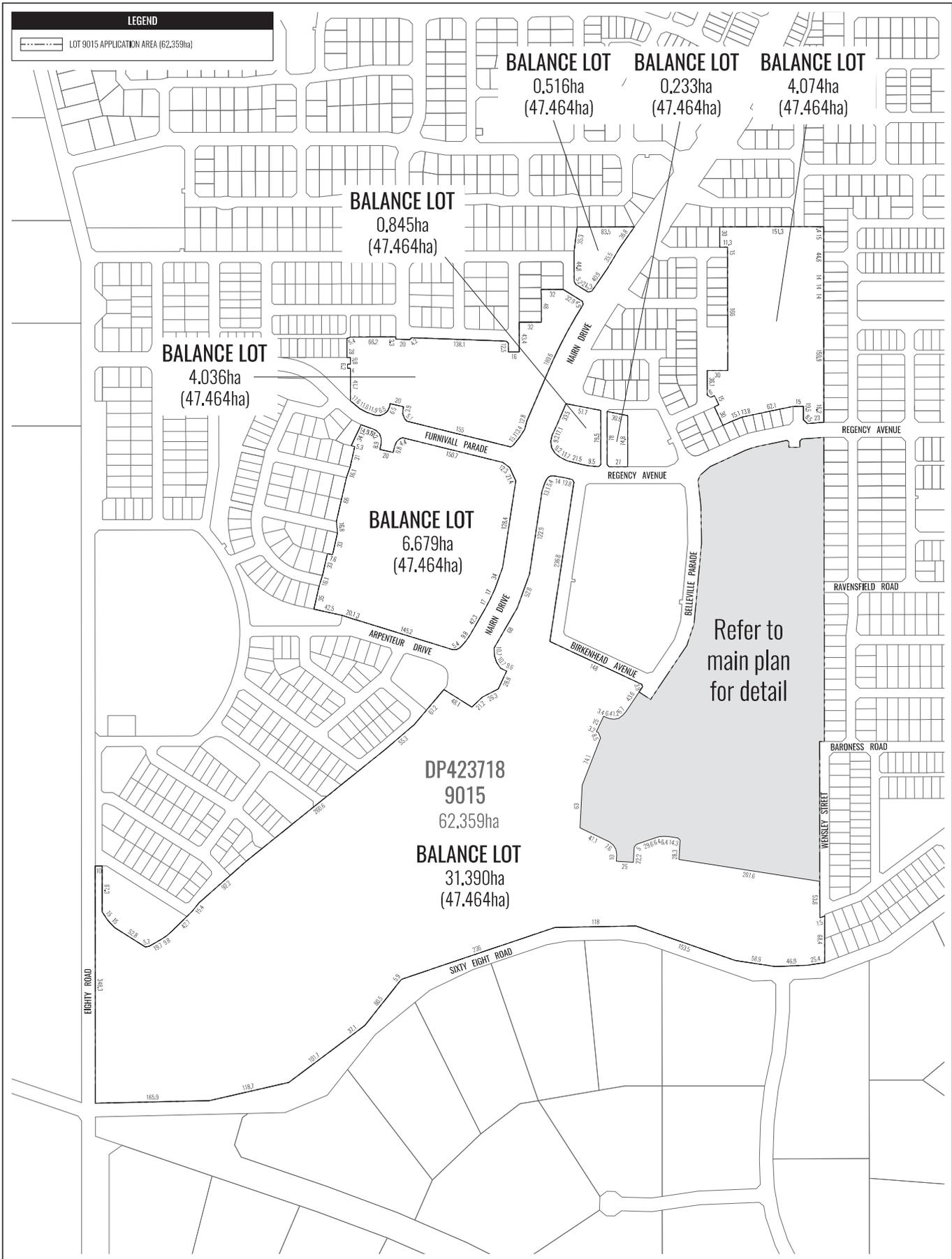
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PLN: RUPPH-2-011 REVISION: E
 DATE: 09/03/2023 DRAWN: JP
 PRODUCTION: PCD 94 PLANNER: CH
 DATUM: AHD CHECK: KB



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BALANCE LOT DETAIL

Lot 9015 Nairn Drive, PARKLANDS HEIGHTS Page 2 of 2

A Rockingham Park Project

Scale: 1:5000 @ A3

0 50 100 150m

PLAN: R10/PP1-3-011
 DATE: 09/03/2023
 PROJECTION: PGD 94
 DATUM: AHD

REVISION: E
 DRAWN: JP
 PLANNER: CH
 CHECK: KB



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LEGEND

- ZONES/RESERVES**
- RESIDENTIAL R15
 - RESIDENTIAL R20
 - RESIDENTIAL R25
 - RESIDENTIAL R30
 - RESIDENTIAL R40
 - RESIDENTIAL R60
 - COMMERCIAL
 - SPECIAL USE
 - EDUCATION
 - PUBLIC OPEN SPACE

- OTHER**
- LOCAL STRUCTURE PLAN BOUNDARY
 - 400m NEIGHBOURHOOD WALKABLE CATCHMENT
 - PUMP STATION ODOUR BUFFER
 - POWERLINE EASEMENT
 - ROAD WIDENING (SIXTY EIGHT ROAD)
 - PLANNED BUS ROUTE
 - VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
 - SEWER PUMP STATION (900m² - 1220m²)

NOTES

- 1 The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
- 2 The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
- 3 PDS Areas are indicative only and subject to further detailed design and drainage considerations.
- 4 All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-cal and final survey and may vary from figures shown.
- 5 Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
- 6 Sixty-Eight Road widening to accommodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.



Scale: 1:5000 @ A3

0 60 120 180m

PLAN: RHPH-2-001 REVISION:
 DATE: 20/11/2018 DRAWN: JP
 PROJECTION: PCS 94 PLANNER: BK
 DATUM: AHD CHECK: TV

CREATIVE
 CONSULTANTS

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LOCAL STRUCTURE PLAN MAP
 Lot 1507 Eighty Road, BALDIVIS
 A Rockingham Park Project

Our ref: EWP20132.001

Level 2, 27-31 Troode Street
West Perth WA 6005
T +61 8 9211 1111

Date: 12 November 2020

City of Rockingham
PO Box 2142
Rockingham DC WA 6967

Dear Sir/Madam,

Parkland Heights Lot 1507 Eighty Road Baldivis - addendum to the Local Water Management Strategy

This letter has been prepared as an addendum to the Parkland Heights Lot 1507 Eighty Road Baldivis Local Water Management Strategy (LWMS) (ENV Australia 2011) to support the submitted revised Local Structure Plan (LSP) (herein referred to as 'the site').

This addendum provides updated stormwater management to support the revised LSP and demonstrates that adequate flood management provisions will be provided. This addendum should be read in conjunction with the following documents:

- Proposed Local Structure Plan, Lot 1507 Eighty Road (Creative Design and Planning 2018) (Appendix A)
- Draft Subdivision Plan, Lot 9010 Nairn Drive (Creative Design and Planning 2019) (Appendix B)
- Amendment advice, Parklands Height Structure Plan (Western Australian Planning Commission 2019) (Appendix C)
- Approved Local Structure Plan, Lot 1507 Eighty Road (Creative Design and Planning 2017) (Appendix D)
- Local Water Management Strategy Parkland Heights Lot 1507 Eighty Road, Baldivis (ENV Australia 2011) (Appendix E)
- POS K Landscape Concept Plan, Parkland Height Lot 1507 Eighty Road, Baldivis (LD Total 2020) (Appendix F)
- Irrigation Schedule, Parkland Heights Lot 1507 Eighty Road, Baldivis (LD Total 2020) (Appendix G)
- Licence to take water (Department of Water and Environmental Regulation 2018) (Appendix H)
- Stormwater Management Plan – Nairn Drive Extension (Eco Logical Australia 2020) (Appendix I)
- Lot 9009 Sixty Eight Road Drainage Management Plan (Mortons Urban Solutions 2019) (Appendix J)
- Permeability Assessment of POS Areas and Median Strip, Parklands Heights Private Estate (Galt Geotechnics Solutions 2019) (Appendix K)
- Testing of Proposed Bio Retention Soil Filter Media, Parklands Heights Private Estate (Galt Geotechnics Solutions 2019) (Appendix L).

1 Background

The purpose of this LWMS addendum is to provide updated stormwater modelling details to address the proposed changes to the approved LSP, consistent with recommendations provided by the Western Australian Planning Commission (WAPC) and comments provided by the City of Rockingham (CoR) (Appendix C).

A LWMS for Parkland Heights was prepared by ENV Australia in 2011 (Appendix E) to support the submission of the original LSP for Lot 1507 Eighty Road, Baldivis (Appendix D). The LWMS received approval by the CoR and Department of Water and Environmental Regulation (DWER). A LWMS addendum report was prepared by Mortons Urban Solutions (2018) to assess the impact to downstream infrastructure of the proposed Neighbourhood Centre, located west of Nairn Drive. No change to the LWMS' overall drainage strategy was required.

A revised LSP was prepared by Creative Design and Planning in 2018 (Appendix A) with modifications to the layout within stages 13 and 14 (refer to Figure 1 and Figure 2). A draft subdivision plan for stages 13 and 14 has also been included as Appendix B and provides a breakdown of lot sizes.

The revised LSP shows land use types proposed within stages 13 and 14 will largely remain consistent with the approved LSP with the predominant land use consisting of R25, R15 and R40 residential lots, road reserve and a relatively large Public Open Space (POS) area which provides a drainage function. In addition to this, a group home (residential R60) is now proposed in the southwestern corner of stage 14 which was previously R40 residential lots.



Figure 1: Stages 13 and 14 of the approved LSP (Creative Design and Planning 2017)



Figure 2: Stages 13 and 14 of the revised LSP (Creative Design and Planning 2018)

2 Approved LWMS

2.1 Stormwater management summary

In the approved LWMS, all run-off generated on the eastern side of Nairn Drive drains into the Basin B1 within POS K where it is infiltrated (Figure 3). Run-off was assumed to only occur from road reserve areas and was calculated using the Rational method. The infiltration areas were estimated as 25% of POS and total road verge areas, with an infiltration rate of 3 m/day. Basin B1 design as detailed in the LWMS are provided in Table 1.



Figure 3: Approved LWMS catchment plan for stages 13 and 14 (ENV Australia 2011)

Table 1: LWMS Basin B1 design (ENV Australia 2011)

Storm event (ARI)	Inundation area (m ²)	Volume (m ³)
1 year	1,878	300
5 year	2,085	740
10 year	2,159	910
100 year	2,495	1,700

3 LWMS addendum

The stormwater drainage strategy for the revised LSP is proposed to be consistent with the approved LSP and LWMS with all run-off to be drained and infiltrated in Basin B1 located within POS K. The main changes to the revised LSP is the alignment of lots and roads, as well as a slight change in land use type (i.e. lot densities) within stages 13 and 14.

The following sub-sections provide context on the similarities and differences to the approved LWMS and results from recent investigations.

3.1 Water sustainability

3.1.1 Landscaping and irrigation strategy

The landscape concept plan and cross-section for POS K was prepared by LD Total in 2020 (Appendix F). Note that the landscape plan will be subject to further detailed design at the UWMP stage. All proposed turf and planting will be irrigated, and the dense tree planting will be temporarily irrigated.

The water use and irrigation schedule for POS K and all stages is shown in Appendix G. The Groundwater Licence (GWL164680(11)) was issued by the DWER for an annual water entitlement of 86,320 kL for dust suppression and irrigation of up to 5.8 ha of POS (Appendix H).

3.2 Stormwater management strategy for adjacent sites

3.2.1 Lot 9009 Sixty Eight Road, Baldivis

Stormwater management for Lot 9009 Sixty Eight Road, Baldivis (Primary School Site, stage 12) immediately south of the stages 13 and 14 is detailed in the Lot 9009 Sixty Eight Road Drainage Management Plan (Appendix J). The Primary School Site has four sub-catchments; Furnivall Parade, proposed Regency Avenue, Road 1 & 2, and School Site (Mortons Urban Solutions 2019).

Within the School Site, stormwater run-off will be captured, retained, and infiltrated for up to the critical 1% AEP storm event, whereby allowing stormwater to overflow and infiltrate through the school oval during major storm events.

Within the road reserves, stormwater run-off will be captured via a pit and pipe system, with 0.6 m traps and open bases to prompt at source infiltration. These systems will be designed to convey the 20% AEP storm event, with 0.3 m freeboard to the pit inlet levels. Furnivall Parade's run-off will be directed towards the existing pit and pipe system in stage 3, while run-off from Regency Avenue and Road 1 & 2 will be directed to temporary basins within the future POS K and POS L, respectively. Once Stage 9 is developed, this run-off will be connected to the POS M.

The temporary storage requirements in POS K from Regency Avenue for the 1% AEP storm event will be a volume of 115 m³. This will not significantly impact the POS K basin as at 1.2 m depth it will have greater than 115 m³ additional capacity in the 1% AEP event.

3.2.2 Nairn Drive extension

Stormwater management along Nairn Drive immediately west of the stages 13 and 14 is detailed in the Stormwater Management Plan - Nairn Drive Extension by Eco Logical Australia in 2020 (Appendix I). This includes the drainage sump located on Songlark Ct, which will be retained.

Run-off from Section 1 of Nairn Drive will discharge into swales which are designed to capture flows up to the 1% AEP, with a total catchment area of 1.43 ha. The swales will be 'V' shaped with side slopes designed at 1 in 6 batters with a maximum depth of 300 mm, providing a total storage capacity of 302 m³. The swales will be 6 m wide and will be located between the carriageway (including the bike lane) and the footpath, on both sides of Section 1. Stormwater will street flow from the road to the swale. No stormwater will be directed towards the median of Nairn Drive.

XPSWMM modelling of Section 1 Nairn Drive showed relatively minor run-off will discharge into Furnivall Parade. This flow will be conveyed via the roadside drainage network and discharged into Basin B1 and has been accounted for in the revised modelling for the site.

3.3 Stormwater management strategy for the site

3.3.1 Stormwater management

A summary of the stormwater management strategies for the site including modelling methodology and assumptions for sizing Basin B1 is detailed in the subsections below.

The layout and land use types proposed within stages 13 and 14 of the revised LSP were remodelled by RPS using XPSWMM. Additional run-off from lots greater than 300 m² in size was accounted for, as was run-off from the Cottonwood Drive Northern Catchment and minor overflow from Nairn Drive via Furnivall Parade. The infiltration rate within Basin B1 was increased from 3 m/day to 8 m/day, as advised by the City of Rockingham (S. Main pers. Comms. 09 August 2020). Basin B1 located within POS K was sized to accommodate the 1% AEP storm event.

The top area of Basin B1 was found to be approximately 2% larger than the size documented in the approved LWMS. As such the revised LSP has resulted in relatively minor changes to the approved LWMS' stormwater management strategy as all run-off from the site will still be contained and infiltrated within Basin B1.

3.3.2 Infiltration rate

A permeability assessment of the site's POS areas and median strip was undertaken by Galt Geotechnics in 2019 (Appendix K). To a depth of 0.9 m, the infiltration test results for POS K ranged from 3.4 m/day to >15 m/day. Based on these findings, the CoR advised to adopt a maximum infiltration rate under Basin B1 of 8 m/day (S Main 2019, personal communication, 9 August).

3.3.3 Phosphorus retention index

Testing of the in-situ soil in POS and a median strip within Parkland Heights was undertaken by Galt Geotechnics in 2019 (Appendix L). Soil samples were collected from POS K from a depth of 0 to 0.5 m below surface level and were found to have a phosphorus retention index of 6.8. Based on this finding, the CoR advised that the use of in-situ soils in POS K is suitable for use within Basin B1 in providing adequate water quality treatment and that bioretention treatment media is not required to be provided (S Main 2019, personal communication, 17 October).

3.3.4 Catchment plan

For the northern catchment two drainage sumps were constructed in 2006 in Lot 334 Songlark Court and Lot 309 Cottonwood Drive. Drainage modelling and assessment of the Songlark Court catchment was detailed in the Stormwater Management Plan - Nairn Drive Extension to support a subdivision application along Nairn Drive (Eco Logical Australia 2020). Run-off from the northern external catchment was proposed to be directly connected to the Songlark Court sump via Nairn Drive at the site boundary, as such run-off from this area was treated as being isolated from the site. Similarly, run-off from the Cottonwood Drive catchment was previously assumed to be contained within the sump and not considered to be draining into the site prior to this LWMS addendum.

The CoR have advised that these drainage sumps are temporary and that this LWMS addendum is required to integrate the run-off generated from the Songlark Court and Cottonwood Drive catchments (T. Fernandes 2020, personal communication, 28 August 2020). However, CoR have since advised in their response to comments on the LWMS addendum that as the Nairn Drive Stormwater Management plan incorporated the sump on Songlark Ct, this basin would be retained. A minor upgrade of the Nairn Drive drainage system has ensured that no run-off from up to and including the 1% AEP will enter Parkland Heights, No changes have been made to the Songlark Ct basin since the Eco Logical Australia report (2020). This sump has now been handed over to the CoR as Drainage Reserve.

Revised modelling of Basin B1 has assumed removal of the Cotton Wood Drive sump and has accounted for run-off from the northern catchment area including Cottonwood Drive catchment (Figure 4 and Figure 5).

The catchment and land use areas considered in the stormwater modelling are summarised in Table 2.

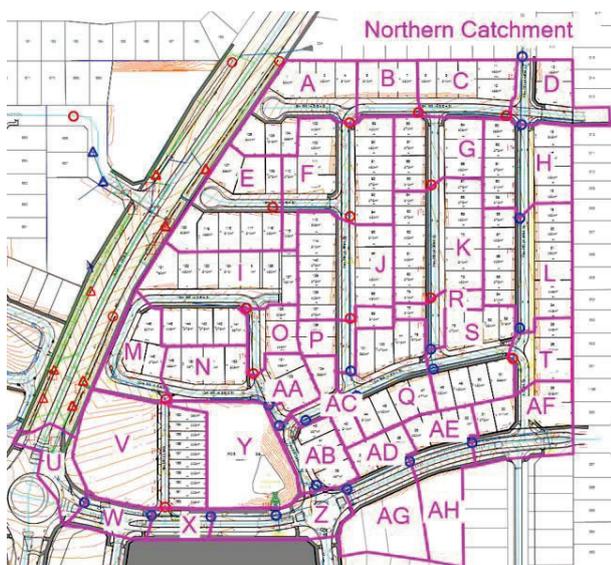


Figure 4: LWMS addendum catchment plan



Figure 5: Northern catchment

Table 2: Catchment and land use areas

Catchment ID	Land use areas included in the XPSWMM modelling						Additional 90% of >300 m ² lots not included in the model (ha)	Total area (ha)
	Road verge (ha)	Road impervious (ha)	10% of >300 m ² lot (ha)	<300 m ² lot (ha)	Group home (ha)	POS (ha)		
A	0.073	0.073	0.032	0	0	0	0.288	0.466
B	0.035	0.035	0.014	0	0	0	0.127	0.211
C	0.053	0.053	0.024	0	0	0	0.212	0.342
D	0.085	0.085	0.01	0	0	0	0.092	0.272
E	0.062	0.062	0.042	0	0	0	0.376	0.542
F	0.085	0.085	0.051	0	0	0	0.461	0.682
G	0.041	0.041	0.028	0	0	0	0.256	0.366
H	0.048	0.048	0.037	0	0	0	0.329	0.462
I	0.061	0.061	0.042	0	0	0	0.376	0.54
J	0.085	0.085	0.051	0	0	0	0.461	0.682
K	0.064	0.064	0.049	0	0	0	0.441	0.618
L	0.071	0.071	0.046	0	0	0	0.415	0.603
M	0.095	0.095	0.013	0	0	0	0.113	0.316
N	0.07	0.07	0.027	0	0	0	0.247	0.414
O	0.038	0.038	0.01	0	0	0	0.085	0.171
P	0.032	0.032	0.013	0	0	0	0.118	0.195
Q	0.058	0.058	0.038	0	0	0	0.337	0.491
R	0.032	0.032	0.008	0	0	0	0.068	0.14
S	0.053	0.053	0.035	0	0	0	0.316	0.457
T	0.037	0.037	0.015	0	0	0	0.132	0.221
U	0.103	0.103	0	0	0	0	0	0.206
V	0.037	0.037	0	0.233	0.503	0	0	0.81

Catchment ID	Land use areas included in the XPSWMM modelling						Additional 90% of >300 m ² lots not included in the model (ha)	Total area (ha)
	Road verge (ha)	Road impervious (ha)	10% of >300 m ² lot (ha)	<300 m ² lot (ha)	Group home (ha)	POS (ha)		
W	0.075	0.075	0	0	0	0	0	0.15
X	0.059	0.059	0	0	0	0	0	0.118
Y	0	0	0	0	0	0.529	0	0.529
Z	0.157	0.157	0	0	0	0	0	0.314
AA	0.013	0.013	0.005	0	0	0	0.041	0.072
AB	0.046	0.046	0.016	0	0	0	0.141	0.249
AC	0.033	0.033	0.011	0	0	0	0.099	0.176
AD	0.064	0.064	0.04	0	0	0	0.363	0.531
AE	0.058	0.058	0.035	0	0	0	0.315	0.466
AF	0.113	0.113	0.018	0	0	0	0.167	0.411
Northern Catchment	0.6	0.6	0.324	0	0	0	2.912	4.436

3.3.5 Modelling assumptions

Revised XPSWMM modelling was undertaken based on the revised LSP to determine the required flood storage area within Basin B1. The design assumptions of Basin B1 were kept generally consistent with the LWMS including 1 in 6 side slopes and a maximum depth of up to 1.2 m in the 1% AEP storm event.

An infiltration rate of 8 m/day was adopted within Basin B1 in line with advice received from the CoR (Section 3.3.2). This is supported by infiltration testing at the site which measured infiltration rates in excess of 15 m/day.

Additional inflows from the Northern Catchment and Nairn Drive via Furnivall Parade has also been accounted for in the modelling.

The modelling simulated current (Australian Rainfall and Run-off 2016) rainfall intensity-frequency-duration data and temporal patterns in line with best practice.

The run-off assumptions for all land uses are summarised below and in Table 3:

- Lots greater than 300 m² in size are assumed to have an effective impervious area of 10%, with run-off from this area assumed to discharge directly into the roadside drainage system. The remaining 90% of the lot area is assumed to be contained within the lot for infiltration via soak wells and garden areas.
- Lots less than 300 m² in size are assumed to be 100% effective impervious with all run-off discharging directly into the roadside drainage system as these lots are higher density and will not have soak wells.
- Group lots are assumed to retain the first 15 mm on site in soak wells with a 5 mm/ hour continuing loss. In large storm events excess run-off will drain into the roadside drainage.
- POS is provided as POS K. An initial loss of 20 mm and continuing loss of 5 mm/hour was initially adopted for this land use type, with additional 8 m/day infiltration occurring within Basin B1. This was further revised so that the initial and continuing losses only apply to the POS area outside of Basin B1. Basin B1 has been modelled to have an infiltration rate of 8 m/d with no initial or continuing losses.

Table 3: Run-off assumptions for different land use types

	Road verge area	Road impervious	10% of >300 m ² lots ¹	<300 m ² lot	Group home	POS ²
Impervious %	0	100	100	100	0	0
Initial loss (mm)	12	0	0	0	15	20
Continuing loss (mm/hour)	6	0	0	0	5	5

¹ Assumed lots over 300 m² have 10% effective impervious area.

² Excludes basin B1. This has been modelled has having an infiltration rate of 8 m/d as requested by CoR

Our ref: EWP20132.001

The modelling results are summarised in Table 4 with a basin top area in the 1% AEP event of 2,550 m², which is approximately 2% larger than that reported in the LWMS of 2,495 m².

Table 4: Basin B1 design based on RPS modelling of the revised LSP

	Depth (m)	Top Area (m ²)	Volume (m ³)	Peak storm duration (hrs)	Time to empty (hrs)
1 EY	0.17	1,580	254	0.5	3
20% AEP	0.40	1,180	636	1	4
10% AEP	0.57	1,950	960	3	5
1% AEP	1.12	2,580	2180	2	8

Basin B1’s plan and cross-section of the 1 Exceedances per Year (EY), 20%, 10% and 1% AEP ponding extents and depths are shown in Figure 6 and 7.

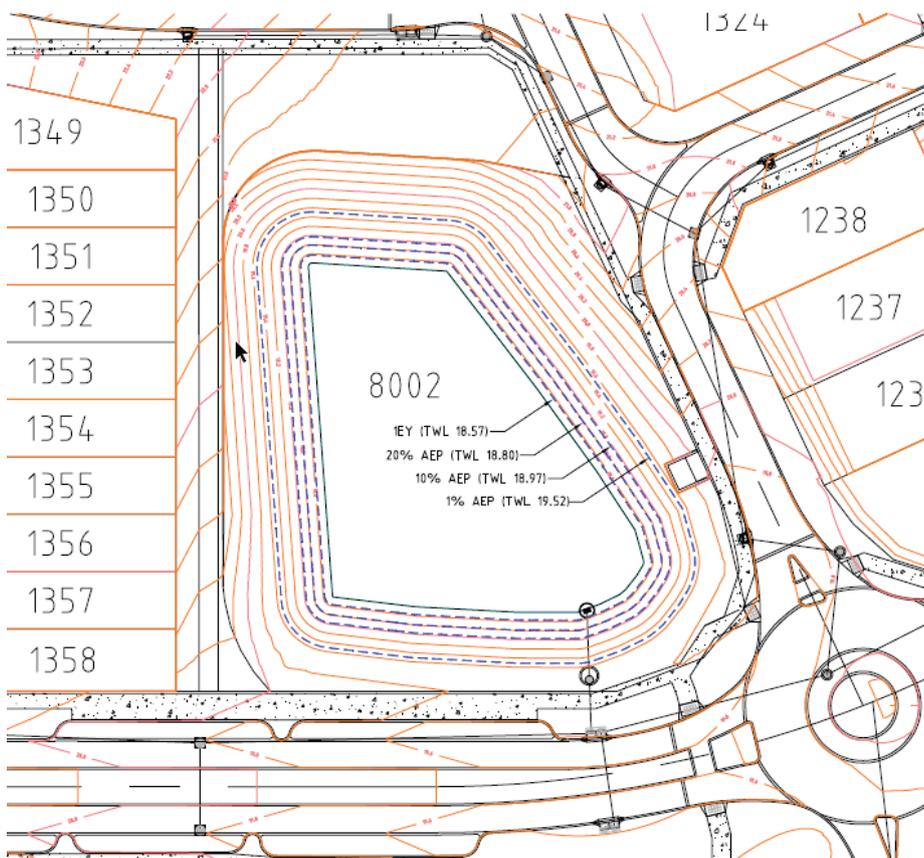


Figure 6: Basin B1 ponding extents and top water levels

Our ref: EWP20132.001

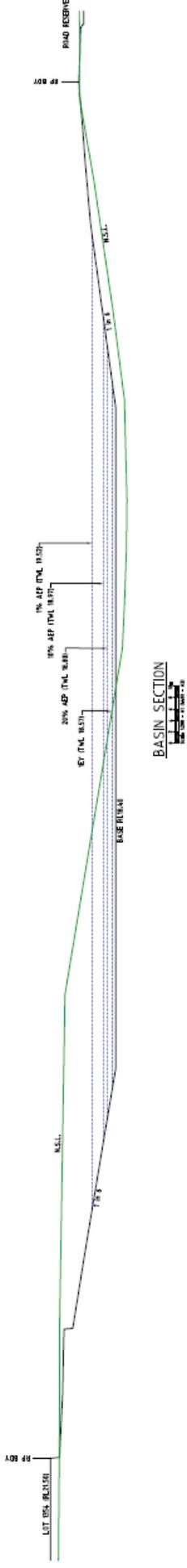


Figure 7: Basin B1 indicative cross-section and top water levels

4 Conclusion

The layout and land use types proposed within stages 13 and 14 of the revised LSP were remodelled using XPSWMM. Additional run-off from lots greater than 300 m² in size was accounted for, as was run-off from the Northern Catchment and inflow from Nairn Drive via Furnivall Parade. The infiltration rate within Basin B1 was increased from 3 m/day to 8 m/day. Basin B1 located within POS K was sized to accommodate the 1% AEP storm event.

The top area of Basin B1 was found to be approximately 2% larger than the size documented in the approved LWMS. As such the revised LSP has resulted in relatively minor changes to the approved LWMS' stormwater management strategy as all run-off from the site will still be contained and infiltrated within Basin B1.

Further water management details will be provided at detailed design stage and documented in the future Urban Water Management Plan to support subdivision application.

Yours sincerely,
for RPS Australia West Pty Ltd



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Senior Hydrologist
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enc: Appendix A: Proposed Local Structure Plan, Lot 1507 Eighty Road (Creative Design and Planning 2018)
Appendix B: Draft Subdivision Plan, Lot 9010 Nairn Drive (Creative Design and Planning 2019)
Appendix C: Amendment advice, Parklands Height Structure Plan (Western Australian Planning Commission 2019)
Appendix D: Approved Local Structure Plan, Lot 1507 Eighty Road (Creative Design and Planning 2017)
Appendix E: Local Water Management Strategy Parkland Heights Lot 1507 Eighty Road, Baldivis (ENV Australia 2011)
Appendix F: Parkland Heights Baldivis Landscape Concept Plan Amendment POS K (LD Total and Mortons Urban Solutions 2020)
Appendix G: Staged water use and irrigation schedule for POS K and Parkland Heights (LD Total 2020)
Appendix H: Licence to take water (Department of Water and Environmental Regulation 2018)
Appendix I: Stormwater Management Plan - Nairn Drive Extension (Eco Logical Australia 2020)
Appendix J: Lot 9009 Sixty Eight Road Drainage Management Plan (Mortons Urban Solutions 2019)
Appendix K: Permeability Assessment of POS Areas and Median Strip, Parklands Heights Private Estate Baldivis (Galt Geotechnics 2019)
Appendix L: Testing of Proposed Bio Retention Soil Filter Media, Parklands Heights Private Estate Baldivis (Galt Geotechnics 2019)

cc: Brett Dunn, Department of Water and Environmental Regulation
Jo Kempton, Western Australian Planning Commission

Appendix A
**Proposed local structure
plan, Lot 1507 Eighty Road**

LEGEND

- ZONES/RESERVES**
- RESIDENTIAL R15
 - RESIDENTIAL R20
 - RESIDENTIAL R25
 - RESIDENTIAL R30
 - RESIDENTIAL R40
 - RESIDENTIAL R60
 - COMMERCIAL
 - SPECIAL USE
 - EDUCATION
 - PUBLIC OPEN SPACE

- OTHER**
- LOCAL STRUCTURE PLAN BOUNDARY
 - 400m NEIGHBOURHOOD WALKABLE CATCHMENT
 - PUMP STATION ODOUR BUFFER
 - POWERLINE EASEMENT
 - ROAD WIDENING (SKY EIGHT ROAD)
 - PLANNED BUS ROUTE
 - VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
 - SEWER PUMP STATION (900m² - 1220m²)

NOTES

- 1 The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
- 2 The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
- 3 POS Areas are indicative only and subject to further detailed design and drainage considerations.
- 4 All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-call and final survey and may vary from figures shown.
- 5 Baseline attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS2959 - Construction in Bushfire Prone Areas.
- 6 Sky-Eight Road widening to accommodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.



Scale: 1:5000 @ A3

0 60 120 180m

PLANS: RHP42-2001 REVISION: DRAWING: P
 DATE: 20/11/2018 PROJECTION: PCS 84 PLANNERS: BK
 DRAFTER: AHD CHECKER: TV

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LOCAL STRUCTURE PLAN MAP

Lot 1507 Eighty Road, BALDVM

A Rockingham Park Project

Appendix B
Draft subdivision plan, Lot
9010 Nairn Drive

Appendix C
Amendment advice,
Parklands Height structure
plan



Your ref: LUP/866
Our ref: SPN/0423M-3
Enquiries: Kempton, Jo (Jo.Kempton@planning.wa.gov.au)

City of Rockingham
P O Box 2142
Rockingham Dc 6967 WA

transmission via electronic mail to: customer@rockingham.wa.gov.au; tamarav@creativdep.com.au

Dear Sir/Madam

**Request To Modify – Amendment 5 to Parkland Heights Structure Plan
SPN/0423M-3 Lodgement ID: 2019-213916**

Pursuant to Schedule 2, Clause 22(1)(b) of the *Planning and Development (Local Planning Schemes) Regulations 2015* (Regulations), the Western Australian Planning Commission (WAPC), requires Creative Design and Planning to modify and resubmit Amendment 5 to Parkland Heights Structure Plan in accordance with the attached Schedule of Modifications.

You are requested to undertake the required modifications to the Structure Plan and provide an updated copy of the Structure Plan to the WAPC. When submitting the modified document, please provide a complete modified Structure Plan (including spatial data in the format and manner specified in the Structure Plan Framework) as well as a separate document containing the updated Parts 1 and 2 only, to the WAPC for endorsement and publication in accordance with Schedule 2, Clause 26 of the Regulations.

The modified document can be lodged via the Department of Planning's online eLodgement portal by selecting the 'Modification' option and inputting the lodgement ID into the drop-down menu which will link to the following reference number: SPN/0423M-3. The portal can be accessed at the Department's website, or at: <https://elodgement.planning.wa.gov.au/>.

Yours sincerely,

A handwritten signature in black ink, appearing to read "S Fagan".

Ms Sam Fagan
Secretary
Western Australian Planning Commission

22/05/2019

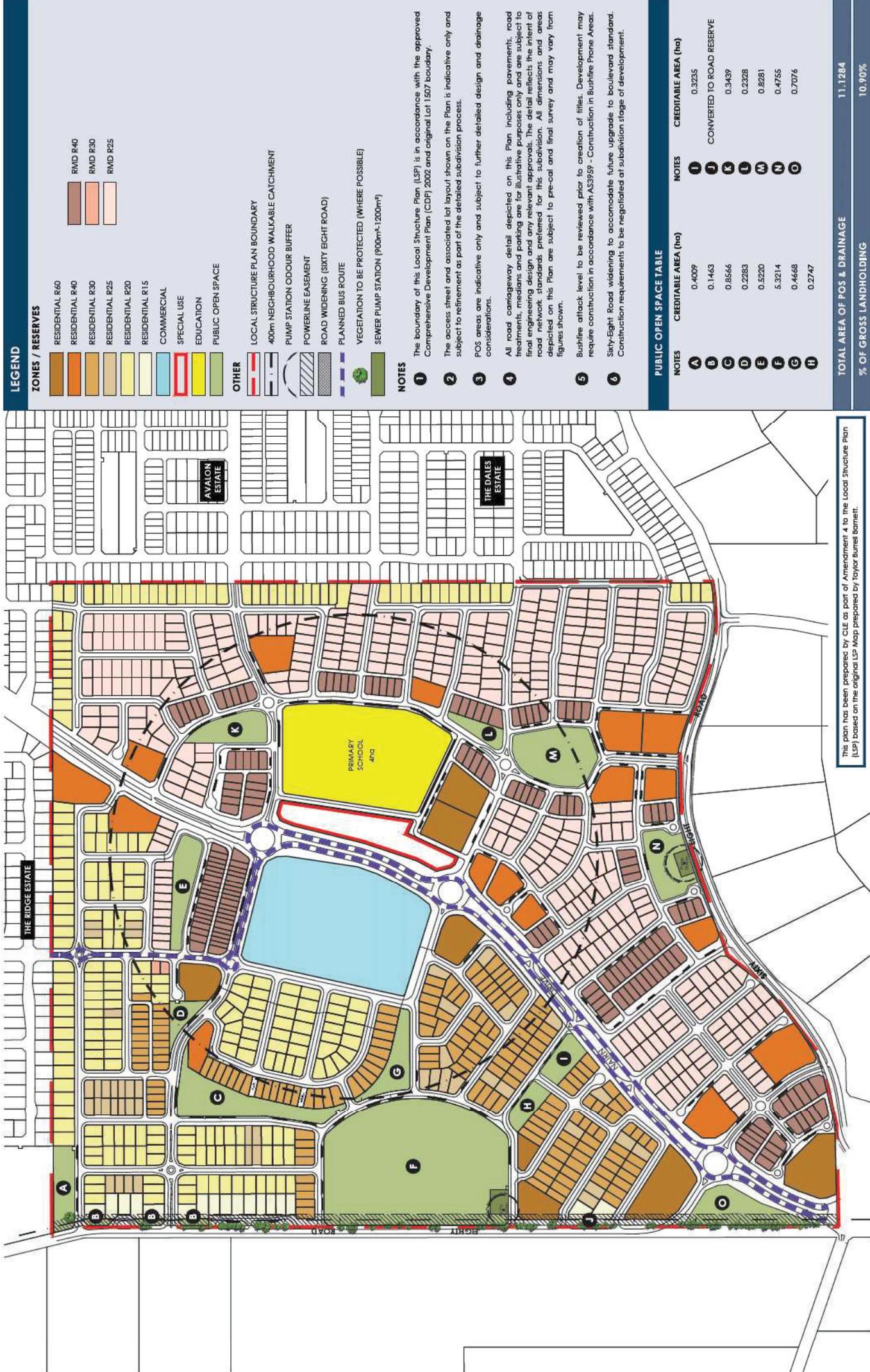


Attachment 4 - Track change document April 2019

Parkland Heights Structure Plans- Schedule of Modifications

1. Require Amendment 5 to the Parkland Heights Structure Plan be modified as follows:
 - (a) Update Part 1 in accordance with Attachment 4 – Track change document April 2019;
 - (b) Update the Local Water Management Strategy addendum in Part 2 to the specifications of the Local Government in consultation with the Department of Water and Environment Regulation
2. Require the modified structure plan to be resubmitted to the Western Australian Planning Commission for determination

Appendix D
**Approved local structure
plan, Lot 1507 Eighty Road**



LEGEND

ZONES / RESERVES

- RESIDENTIAL R60
- RESIDENTIAL R40
- RESIDENTIAL R30
- RESIDENTIAL R25
- RESIDENTIAL R20
- RESIDENTIAL R15
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE

- OTHER
- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m² x 1200m²)

NOTES

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- 3 POS areas are indicative only and subject to further detailed design and drainage considerations.
- 4 All road camberway detail depicted on this Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on this Plan are subject to pre- and final survey and may vary from figures shown.
- 5 Bushfire attack level to be reviewed prior to creation of fills. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
- 6 Sixty-Eight Road widening to accommodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

PUBLIC OPEN SPACE TABLE

NOTES	CREDITABLE AREA (ha)	NOTES	CREDITABLE AREA (ha)
A	0.4009	I	0.3235
B	0.1463	J	CONVERTED TO ROAD RESERVE
C	0.8566	K	0.3439
D	0.2283	L	0.2328
E	0.5220	M	0.8281
F	5.3214	N	0.4755
G	0.4668	O	0.7076
H	0.2747		

TOTAL AREA OF POS & DRAINAGE
11.1284
% OF GROSS LANDHOLDING
10.90%

This plan has been prepared by CLE as part of Amendment 4 to the Local Structure Plan (LSP) based on the original LSP Map prepared by Taylor Burnell Barnett.



Appendix E

**Local water management
strategy Parkland Heights
Lot 1507 Eighty Road,
Baldivis**



Lot 1507 Eighty Road, Baldivis
Local Structure Plan



APPENDIX J

LOCAL WATER MANAGEMENT STRATEGY



PARKLAND HEIGHTS

LOT 1507 EIGHTY ROAD BALDIVIS

LOCAL WATER MANAGEMENT STRATEGY



PARKLAND HEIGHTS

LOT 1507 EIGHTY ROAD BALDIVIS

LOCAL WATER MANAGEMENT STRATEGY

Prepared for:

Rockingham Park Pty Ltd

Prepared by:

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Job Number:	<i>J100378</i>
Report Number:	<i>10/174</i>
Prepared by:	<i>Halinka Lamparski & John Hunt</i>
Status:	<i>Final</i>
QA Review:	<i>Paul Zahra</i>
Technical Review:	<i>Karen Lane</i>
Content Review:	<i>Karen Lane</i>
Date:	<i>14 December 2011</i>

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STATEMENT OF LIMITATIONS

Scope of Services

This environmental site assessment report (“the report”) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and ENV. Australia Pty Ltd (ENV) (“scope of services”). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

Reliance on Data

In preparing the report, ENV has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report (“the data”). Except as otherwise stated in the report, ENV has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (“conclusions”) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. ENV will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to ENV.

Environmental Conclusions

In accordance with the scope of services, ENV has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

On all sites, varying degrees of non-uniformity of the vertical and horizontal soil or groundwater conditions are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of soil and/or groundwater conditions encountered. The conclusions are based upon the data and the environmental field monitoring and/or testing and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of contaminants or emissions. Also it should be recognised that site conditions, including the extent and concentration of contaminants, can change with time.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. ENV assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of ENV or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

ENV will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

EXECUTIVE SUMMARY

This report has been prepared by ENV. Australia Pty Ltd to support the submission of a revised version of a Local Structure Plan for the land located in Lot 1507 Eighty Rd, Baldivis. This site is owned by Rockingham Park Pty Ltd and is also known as Parkland Heights.

Under *Better Urban Water Management (BUWM)* (WAPC 2008a), a Local Water Management Strategy (LWMS) is required to support the Local Structure Plan prior to subdivision and development of land zoned Urban. The BUWM sets out the requirements for a LWMS, which must be approved by the Western Australian Planning Commission on advice of the Department of Water as part of the Local Structure Plan Approval.

The objective of the Local Water Management Strategy (LWMS) is to ensure that sustainable management of the total water cycle at Parkland Heights, Lot 1507 Eighty Rd, Baldivis occurs through Water Sensitive Urban Design. This includes water conservation, stormwater management and groundwater management. Rockingham Park Pty Ltd aims to manage these issues at the site through the following initiatives:

Water Conservation

- Participating in the Urban Development Institute of Australia’s EnviroDevelopment program to achieve a maximum potable water usage of 80 kL/person/year and meet the EnviroDevelopment target of a 20% reduction in scheme water use;
 1. Behaviour change of householders, encouraging water conservation through education packages and the construction of a Waterwise Display Village (The Behaviour Change Program).
 2. Providing waterwise front gardens to all homes in Parkland Heights
- Providing Waterwise landscaping for Public Open Space (POS) that includes waterwise plants, soil amendments to improve water and nutrient retention, minimising turf areas and water efficient irrigation; and
- Using groundwater to irrigate POS.

Stormwater Management

- Implementing a drainage design that ensures pre-development discharge rates in the event of a 1 in 100 year ARI event will be maintained through storage and infiltration on site; and
- Maximising infiltration by developing swales and rain gardens in road reserves where possible, planted with native vegetation to encourage nutrient and

suspended solids uptake and removal prior to infiltration. Open based manholes will also be used to maximise infiltration. Infiltration basins in Public Open Space will manage larger events.

Groundwater Management

- Recognising the issue of groundwater availability and planning low water use POS.

This LWMS demonstrates that Parkland Heights, Lot 1507 Eighty Rd, Baldivis can be developed without significant constraints. The outstanding issues can be resolved at the Urban Water Management Plan stage to create a development that meets the goals and ideals of *Better Urban Water Management*.

1 INTRODUCTION

This report has been prepared to support the submission of a Local Structure Plan for Lot 1507 Eighty Road, Baldivis. The study area is approximately 40 km kilometres south of Perth in the City of Rockingham (Figure 1). The site is situated on the Spearwood Dunes system on the Swan Coastal Plain. It was cleared in the 1960's and has since been operated as an agroforestry plantation (Figure 1). It is bound by existing and approved residential housing to the north and east of the site respectively, Eighty Road to the west and Sixty-Eight Road immediately south. The total area of the site is approximately 120 hectares.

Under *Better Urban Water Management* (BUWM) (WAPC, 2008a) and *Planning Bulletin 92* (WAPC, 2008b) a Local Water Management Strategy (LWMS) is required to support a Local Structure Plan (LSP). An amended LSP is being prepared to expand the area within the existing LSP at Lot 1507 Eighty Road to include land on the east side of Nairn Drive (Figure 2). The LWMS provides strategic information regarding the management of water in the development while outlining and demonstrating the feasibility of the proposed drainage design. This work is then refined and details confirmed at the Subdivision Stage through Urban Water Management Plans for each subdivision application area. *BUWM* and the document *Interim: Developing a Local Water Management Strategy* (DoW, 2008) set out the requirements for a LWMS. The agency responsible for the approval of the LWMS is the Western Australian Planning Commission (WAPC) on advice of the Department of Water (WAPC, 2008b).

1.1 Total Water Cycle Management – Principles and Objectives

The process of managing the total water cycle in an urban scenario is referred to as Water Sensitive Urban Design (WSUD). A Local Water Management Strategy seeks to support WSUD by assisting to design, develop and maintain urban water systems that are sensitive to the total water cycle. The principles of WSUD as outlined in the *Better Urban Water Management* (BUWM) (WAPC, 2008a) have been used here. These principles are to:

- Protect natural systems – protect and enhance natural water systems and their hydrological regimes in urban developments;
- Integrate stormwater treatment into the landscape – use stormwater in the landscape by incorporating multiple use corridors that maximise the visual and recreational amenity of developments;
- Protect water quality – protect the water quality draining from urban development and minimise outputs of phosphorus and nitrogen and other pollutants;
- Manage run-off and peak flows – reduce peak flows from urban developments by using local detention measures and minimising impervious areas; and

- Add value while minimising development costs – minimise the drainage infrastructure cost of development.

1.2 Planning Background

1.2.1 Metropolitan Region Scheme

The site is situated in the South-West Corridor of the Perth Metropolitan Region. The land is zoned Urban under the Metropolitan Region Scheme (MRS) and is included within Category A1 of the South West Corridors Structure Plan, being land assessed as having no constraints to urban development.

1.2.2 City of Rockingham District Zoning Scheme (Town Planning Scheme No. 2)

Under the City of Rockingham District Zoning Scheme (Town Planning Scheme No. 2) the site is zoned Development.

1.2.3 Baldivis South District Structure Plan

The Baldivis South District Structure Plan (DSP) was prepared for the site by the City of Rockingham in 2004. A District Water Management Strategy (DWMS) was not developed as part of the DSP.

1.3 Previous Studies

Previous studies into land and water management at the subject site include:

- Lot 1507 Eighty Road Baldivis, Geotechnical Investigation Report, Prepared for Summit Homes Group (Sinclair Knight Merz, 2009);
- Preliminary Acid Sulphate Soils Investigation Lot 1507 Sixty Eight Road, Baldivis WA, Prepared for Rockingham Park Pty Ltd (ENV, 2009a);
- Environmental Preliminary Site Investigation Lot 1507 Sixty Eight Road, Baldivis WA, Prepared for Rockingham Park Pty Ltd (ENV, 2009b);
- Flora and Vegetation of Lot 1507 Sixty-Eight and Eighty Roads, Baldivis, Prepared for Rockingham Park Pty Ltd (ENV, 2009c);
- Lot 1507 Sixty-Eight Road, Baldivis Black Cockatoo Assessment, Prepared for Rockingham Park Pty Ltd (ENV, 2010);
- Parkland Heights, Lot 1507 Sixty-Eight Road Baldivis, Environmental Assessment, Prepared for Rockingham Park Pty Ltd (ENV, 2011a); and
- Parkland Heights Acid Sulfate Soils Dewatering Management Plan, Prepared for Rockingham Park Pty Ltd (ENV, 2011b).

2 PROPOSED DEVELOPMENT

2.1 KEY POINTS OF STRUCTURE PLAN

The Local Structure Plan (LSP) presents a predominantly low and medium residential development forming a community with a range of densities (R15 – R60) including single and grouped dwellings. The site is divided east and west by Nairn Drive, a major road in the South Baldivis traffic network (Figure 2).

Within the residential areas, provisions have been made for 20 areas of Public Open Space (POS) for both drainage and amenity purposes. Provision has also been made for a primary school located in the area east of Nairn Drive. Community and recreation facilities and a local centre are also included within the LSP to enhance community amenity within the development (Figure 2). A staging plan is provided in Figure 7.

A focus on preserving and reinforcing existing positive site characteristics will be implemented through the proposed landscape treatment of the site. POS have been planned to incorporate significant existing trees along Eighty Road both pines and eucalypts) where possible. The existing vegetation will provide the foundation and structure for new tree planting, which will include eucalypts and pines, as well as deciduous trees in key areas to reference the semi-rural character of the area.

2.2 ENVIRONMENTAL REPORT AND MANAGEMENT PLAN

An Environmental Assessment of Lot 1507 Eighty Road, Baldivis was undertaken by ENV Australia and included in the Local Structure Plan (ENV, 2011a). The report is based on work done for the site in the preparation of the Local Structure Plan, including a desktop study, a flora and vegetation survey and an acid sulfate soils investigation, carried out by ENV Australia. The report presents opportunities and constraints for development of the site and recommendations for environmental management of the site related to the proposed development (ENV, 2011a).

3 DESIGN CRITERIA

The principles, design objectives and criteria shown here are from *Better Urban Water Management (BUWM)* (WAPC, 2008a). Quotes from BUWM are shown in italics.

3.1 WATER CONSERVATION - AND EFFICIENCY

Principle

No potable water should be used outside of homes and buildings with the use of water to be as efficient as possible (WAPC, 2008a).

Design Objectives

Consumption target of 100 kL/person/year (State Water Plan Target).

Site Response

The development will aim to achieve the target of a maximum scheme water usage of 80 kL/person/year through Rockingham Park's participation in the UDIA EnviroDevelopment program and the expected uptake of groundwater for POS and residential irrigation. The Water Corporation's latest potable water use study 'Perth's Residential Water Use Study 2008/2009' (Water Corporation, 2010) found that the average potable water consumption rate was 106 kL/person/year. Water efficiency programs will be developed to target behaviour change of householders and promote the use of non-potable water sources to minimise potable water use both in-house and ex-house. This will be modelled in the display village. All homes will have water wise front garden landscapes in order to assist in meeting the EnviroDevelopment target of a 20% reduction in potable water use.

3.2 WATER QUANTITY MANAGEMENT

Principle

Post-development annual discharge volume and peak flows will be maintained relative to pre-development conditions, unless otherwise established through determination of Ecological Water Requirements for sensitive environments (WAPC, 2008a).

Criteria

Ecological Protection - For the critical one-year average recurrence interval (ARI) event, the post-development discharge volume and peak flow rates shall be maintained relative to pre-development conditions in all parts of the catchment. Where there are identified impacts on significant ecosystems, maintain or restore desirable environmental flows and/or hydrological cycles as specified by the DoW.

Flood Management - Manage the catchment run-off for up to the 1 in 100 year ARI event in the development area to pre-development peak flows, unless otherwise indicated in

an approved strategy or as negotiated with the relevant drainage service provider (WAPC 2008a).

Site Response

The drainage strategy for the site is based on detention of stormwater on-site to maintain pre-development discharge rates in events up to the 1 in 100 year ARI. Run-off from 1 in 1 year ARI events will be infiltrated on site.

3.3 WATER QUALITY MANAGEMENT

These are intended to apply to run-off from impervious areas and should be met in addition to the groundwater design objectives.

Principle

Maintain surface and groundwater quality at pre-development levels (winter concentrations) and, if possible, improve the quality of water leaving the development area to maintain and restore ecological systems in the sub-catchment in which the development is located (WAPC, 2008a).

Criteria

Contaminated Sites – *To be managed in accordance with the Contaminated Sites Act 2003.*

All other Land – *If the pollutant outputs from the development (measured or modelled concentrations) exceed catchment ambient conditions, the proponent shall achieve water quality improvements in the development area or, alternatively, arrange equivalent water quality improvement offsets inside the catchment. If these conditions have not been determined, the development should meet relevant water quality guidelines stipulated in the National Water Quality Management Strategy (ARMCANZ & ANZECC, 2000) (WAPC, 2008a).*

Site Response/Commitment

The development proposes to use Best Management Practices in line with the Stormwater Management Manual (DoW, 2004-2007) to manage water quality on the site, predominantly nutrients. The site is considered to be unlikely to be contaminated based on the land use history of being largely vegetated (ENV, 2008b). As such, contaminated sites guidelines do not apply.

Bio-retention structures with an area equivalent to 2% of the directly connected constructed impervious area will be provided as close to source as possible and practical.

3.4 STORMWATER MODELLING CRITERIA

Principle

If it is proposed to use a stormwater modelling tool to demonstrate compliance with design objectives, the following design modelling parameters are recommended.

As compared to a development that does not actively manage stormwater quality:

- *At least 80% reduction in the average annual load of total suspended solids;*
- *At least 60% reduction in the average annual load of total phosphorus;*
- *At least 45% reduction in the average annual load of total nitrogen; and*
- *At least 70% reduction in the average annual load of gross pollutants (WAPC, 2008a).*

Site Response/Commitment

Stormwater quality modelling is not proposed for the site at this stage because currently there is no commercially available tool in Western Australia approved by the DoW to undertake such modelling.

3.5 DISEASE VECTOR AND NUISANCE INSECT MANAGEMENT

Principle:

To reduce health risks from mosquitoes, retention and detention treatments should be designed to ensure that between the months of November and May, detained immobile stormwater is fully infiltrated in a time period not exceeding 96 hours.

Permanent water bodies are discouraged, but where accepted by DoW, must be designed to maximise predation of mosquito larvae by native fauna to the satisfaction of the local government on advice of the Departments of Water and Health (WAPC, 2008a).

Site Response/Commitment

The system has been designed to ensure that detained immobile stormwater is fully infiltrated in a time period not exceeding 96 hours.

Permanent water bodies are not proposed for this site.

4 PRE-DEVELOPMENT ENVIRONMENT

4.1 TOPOGRAPHY

The site is composed of remnant bushland and pine plantation and is situated at an elevation of 4 - 42 m AHD (Figure 3). The site is undulating, but generally slopes overall from the south-east to north-west, with the lowest point of the site on the western border. There are also two lower points in the centre of the site with heights of 10 – 11 m AHD (Figure 3).

4.2 SOILS AND GEOLOGY

Regional geological information was obtained from the Geological Survey of WA 1:50,000 Environmental Geology Series which describes the geology at and surrounding the site (Gozzard, 1986) (Figure 4). Only one geological unit was identified at the site:

- S7 SAND – (Sand derived from Tamala limestone) pale yellowish brown, medium to coarse-grained, sub-angular to well-rounded quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin.

This soil unit is also known as ‘Spearwood Sand’. This classification is generally consistent with the geotechnical work undertaken by SKM (2009). ENV (2009a) also recorded the presence of a layer of clayey sand at a depth of 1.7 m at groundwater bore MW1 located in the north-western corner of the site (Figure 8, Appendix C of ENV, 2009a). As this layer was not reported in any other surveys, it is assumed that this layer is isolated to a small area near this bore only.

The physical properties of the site geology are described as follows (GSWA, 1980):

- High permeability;
- Low to medium slope stability; and
- Moderate ease of excavation.

A geotechnical report of the site (SKM, 2009) summaries permeability testing and geological results obtained at three test pits across the site (Figure 3). Soils within the site were found to consist predominantly of sand with a hydraulic conductivity between 4.3 – 5.9 m/day and of moderate to good drainage characteristics (SKM, 2009).

4.2.1 Acid Sulfate Soils

An Acid Sulfate Soils (ASS) Investigation was undertaken on the site by ENV in 2009 (ENV, 2009a). The investigation indicated that the site was generally at a low risk of ASS, in line with the ASS risk mapping of the site (Figure 4). Only one soil sample showed evidence of ASS. This was found at MW1 in the north-west of the site at a

depth of 2.25 m (Figure 8, Appendix C of ENV, 2009a). This may be due to its proximity to a high risk ASS area associated with an adjacent wetland (identified in Section 4.3).

Should future excavation works involve the disturbance of soil at or near the water table and groundwater in the north-western vicinity of the site, further localised investigation is recommended and it may trigger some management specific to this corner of the site.

4.2.2 Phosphorus Retention Index

Phosphorus Retention Index (PRI) was measured at four groundwater bores at the site during installation. The PRI results are presented in Table 1 below.

Table 1: Phosphorus Retention Index Test Results

Location	PRI
MW1	0
MW2	4.2
MW4	1.1
MW5	6

According to Allen and Jeffery (1990), soils with PRIs of less than 2 may be classified as very weakly adsorbing or desorbing of phosphorus and PRIs between 2-5 as weakly adsorbing of phosphorus. This indicates that the soils at the site have a low natural nutrient retention property with respect to phosphorus.

With the exception of soil at bore MW5 (PRI = 6), the PRI results are generally below the usual range expected for a Spearwood Sand of 5 -20 (Allen and Jeffrey, 1990). This may be due in part to the use of the site as a pine plantation, which may have enhanced leaching of the surface soils. Observations of adjacent sites indicate that the soils become a darker yellow or orange colour at depth, suggesting that more iron oxides are present at depth. This may imply an increase in PRI with depth (Bolland, Allen and Barrow, 2003).

4.2.3 Contaminated Sites Assessment

ENV has undertaken an Environmental Preliminary Site Investigation (PSI) of the site (ENV, 2009b). Searches indicated that the site was not subject to any specific land use prior to 1963 (ENV, 2009b). Aerial photographs of the site before 1963 confirm this and show surrounding areas consist entirely of bushland (ENV, 2009b). Early stages of land cultivation to the east and west of the site are observable in aerial photographs taken in

1963 (ENV, 2009b). The site was cultivated for forestry product purposes at some stage between 1963 and 1974 (ENV, 2009b). There is no indication that the site was utilised for any other land use between 1973 and 2000 (ENV, 2009b). The Forest Products Commission began harvesting the pine trees at the site between 2001 and 2004 (ENV, 2009b).

No record of the site was found on the Department of Environment and Conservation Contaminated Sites Database at the time of the investigation (ENV, 2009b). It was therefore considered that a Detailed Site Investigation (DSI) was not required (ENV, 2009b).

4.3 SURFACE WATER QUANTITY AND QUALITY

The site is located within the Peel-Harvey catchment. There are no ephemeral or permanent surface water bodies located within the site. The nearest wetlands to the site are Outridge Swamp, located 80 m west of the site and Lake Walyungup, located 1.7 km north-west of the site.

There are no drainage lines within the site due to the high permeability of the Spearwood Sands at the site, as described in Section 3.2. The site is therefore dominated by infiltration with little to no surface run-off except during extreme storm events.

4.4 GROUNDWATER QUANTITY AND QUALITY

ENV installed five groundwater monitoring bores at the site using air and mud rotary methods in October 2009 (Appendix A). Four Department of Water (DoW) groundwater bores have also been included in the groundwater monitoring program at the site (Table 2). ENV undertook pre-development groundwater level and quality monitoring for the period of October 2009 to March 2011. Groundwater levels have currently been measured during 12 events and five sets of water samples have been collected and analysed.

4.4.1 Groundwater Levels

The five ENV bores and four DoW bores located on or near the site have been monitored monthly since 28 October 2009 until most recently on 11 November 2010 (Figure 6). The groundwater levels measured in the DoW bores since installation in 1975 were also reviewed to provide maximum and minimum groundwater levels (Appendix B). Groundwater levels have been measured for at least two winters in 2009 and 2010.

The Annual Average Maximum Groundwater Levels (AAMGLs) on the site were calculated from levels measured in October 2009 and varied from 2.41 mAHD in MW1 in the north-west to 1.50 mAHD at MW5 in the south. Depth to AAMGLs varied between

8.65 m Below Ground Level (BGL) at MW4 in the south-west, to 1.67 mBGL at MW3 in the west (Table 2). MW3 is located in one of the lowest areas of the site. On many areas of the site the depth to AAMGLs exceeds 20 m (Figure 6). Groundwater contour mapping is presented in Figure 6.

The minimum groundwater levels measured on-site varied from 1.6 mAHD (January 2010) at MW1 in the north-east to 0.35 mAHD (May 2010) at MW5 in the south of the site. Full monitoring records may be found in Appendix C.

The regional flow direction shown in the Second Edition of the Perth Groundwater Atlas (DoE, 2004) is south-west towards Lake Walyungup. This direction is consistent with groundwater levels measured by ENV, which indicate a clear south-westerly flow direction towards Lake Walyungup, as well as a general southerly direction (Figure 6).

Table 2: AAMGLs at or near Lot 1507 Eighty Rd, Baldivis Groundwater Bores

Bore	Annual Average Maximum Groundwater Levels (mAHD)	Depth to AAMGLs (mBGL)
MW1	2.41	1.87
MW2	2.38	5.81
MW3	2.35	1.67
MW4	2.34	8.65
MW5	1.50	5.46
DoW 3011	2.25	4.51
DoW 3012	2.23	4.53
DoW 3033	2.35	8.37
DoW 3034	2.35	11.51

Figure 6 also shows bores F and G. These bores were initially installed to record upstream groundwater levels and quality at the site. These bores however were dry at 21m and advise from the DoW in 2009 was that they therefore did not need to be monitored.

4.4.2 Groundwater Quality

The groundwater quality monitoring program included the measurements of physical parameters of acidity and electrical conductivity, measurements of total and components of nitrogen and phosphorus and a suite of heavy metals, detailed below. No groundwater quality data is available for bore MW2 because it has been blocked since October 2009, thus not allowing bailers to reach groundwater for sampling. The

thinner water level probes were still able to move freely through the bore however, and measure water levels at MW2.

Physical parameter measurements were taken using hand-held water quality meters in collected groundwater samples. Groundwater samples were purged and collected using bailers and analysed at National Association of Testing Authorities (NATA)-accredited laboratory MPL Laboratories, Myaree.

Physical Parameters

pH was found to be generally stable and neutral in all bores located within the site (Table 3 and Figure 6). Electrical conductivity (EC) levels measured in groundwater were found to be similar and of freshwater quality in all bores. Full physical parameter results may be found in Appendix C.

Table 3: Groundwater Physical Parameter Results

Bore	pH			Mean EC (mS/cm)	Calculated TDS (mg/L) ¹
	Mean	Minimum	Maximum		
MW1	5.53	5.35	5.7	0.67	335
MW3	6.37	6.16	6.68	0.45	227
MW4	7.52	7.39	7.66	0.75	377
MW5	6.43	6.13	6.82	0.58	288

¹TDS (Total Dissolved Solids) calculated from EC assuming pure NaCl and conversion factor of 500

Nutrient Concentrations

Groundwater at the site was generally found to have levels of Total Phosphorus (TP) exceeding the Long Term Swan-Canning Cleanup Program (SCCP) target of 0.1 mg/L (SRT, 1999) with mean TP concentrations varying between 0.11 and 0.48 mg/L (Table 4 and Figure 6). However, PO₄ concentrations at all bores were negligible and only bore MW4 was found to minimally exceed detection limits, which suggests that phosphorus in groundwater at the site exists predominantly in a particulate form.

Total Nitrogen (TN) concentrations exceeded the long-term SCCP target of 1 mg/L at all bores except for MW5. TN concentrations in MW1 were also found to equal or exceed the ANZECC Fresh Water Quality guidelines level of 1.2 mg/L (Table 4 and Figure 6). Full nutrient results may be found in Appendix C. Given a breakdown of nitrogen in groundwater in Table 4, the predominant form is organic (Kjeldahl) nitrogen (TKN).

Table 4: Mean Groundwater Nutrient Results

Monitoring Location	Total P mg/L	PO4 mg/L	Total N mg/L	NO3-N mg/L	NH3-N mg/L	TKN mg/L
MW1	0.22	<0.005	3.35	0.13	0.46	3.25
MW3	0.48	<0.005	1.09	0.01	0.16	1.09
MW4	0.24	0.0058	1.00	0.20	0.04	0.79
MW5	0.11	<0.005	0.93	0.13	0.05	0.79
SCCP long-term Target ¹	0.1	-	1	-	-	-
ANZECC Guidelines ²	0.065	0.04	1.2	0.15	-	-

¹SRT (2003)

²ANZECC & ARMCANZ (2000). Guidelines are for slightly disturbed ecosystems in south-west Australia.

Heavy Metal Concentrations

Groundwater samples were analysed for a suite of heavy metals listed in Table 5 below. Mean Chromium (Cr), Copper (Cu) and Zinc (Zn) concentrations exceeded ANZECC Fresh Water Quality guidelines levels (95% level of protection) in bores. Mean Cadmium (Cd) concentrations exceeded ANZECC Fresh Water Quality guidelines (95% level of protection) in all bores except MW1, however, MW1 was also the only bore where mean Arsenic (As) and Nickel (Ni) concentrations did exceed the guidelines. Mean Lead (Pb) concentrations exceeded ANZECC Fresh Water Quality guidelines (95% level of protection) in two of the four bores sampled, MW1 and MW5.

Given that the detection limit for Mercury (Hg) analysis (<0.0001 mg/L) was greater than the ANZECC guideline level (0.00006 mg/L), it is not possible to determine whether the ANZECC guideline level (95% level of protection) was exceeded. However, Hg mean concentrations were found to be below detection limits in all bores sampled.

Table 5: Mean Groundwater Metals Results

Bore	As (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Pb (mg/L)	Ni (mg/L)	Zn (mg/L)	Hg (mg/L)
MW1	0.024	0.0001	0.046	0.01	0.01	0.02	0.07	<0.0001
MW3	0.015	0.0008 6	0.024	0.003	0.0026	0.003 2	0.032	<0.0001
MW4	0.002	0.0008 6	0.003	0.0046	0.0016	0.004 2	0.024	<0.0001
MW5	0.01	0.0008 6	0.038	0.006	0.0078	0.004 2	0.13	<0.0001
ANZECC Guideline ¹ (mg/L)	0.024	0.0002	0.001	0.0014	0.0034	0.011	0.008	0.00006

¹ANZECC & ARMCANZ (2000). Guidelines are trigger values for freshwater with 95% level of protection.

4.5 ENVIRONMENTAL ASSETS

This section represents a brief summary of the environmental assets and water dependent ecosystems on the site. Further information on the species and management of flora and fauna on the site can be found in *Flora and Vegetation of Lot 1507 Sixty-Eight and Eighty Roads, Baldivis* (ENV, 2009c), which also accompanies the Local Structure Plan.

4.5.1 Vegetation Type and Condition

The site does not appear to be constrained in terms of floristic attributes. The vegetation over most of the site is cleared with no good quality remnant vegetation of significance.

Twenty-two families, 35 genera and 40 taxa (18 of which were introduced) were found during the survey. None of these are listed as significant species.

The site contains one main vegetation unit - Open Woodland of *Eucalyptus gomphocephala*, *Eucalyptus marginata* and **Pinus pinaster* over *Acacia saligna*, *Jacksonia furcellata* and *Xanthorrhoea preissii* over weeds. There are no flora species or vegetation communities of significance on the site. There are no areas of vegetation or particular trees that should be retained in planning urban development for the site and no particular requirements for management have been identified.

4.5.2 Water Dependant Ecosystems

There are no wetlands, springs or other water dependant ecosystems located within the site. A Conservation Category Wetland (CCW) and Multiple Use Wetland (UFI 6394),

Outridge Swamp, is located approximately 80 m to the west of the site (Figure 5). Another CCW Wetland (UFI 13083), Stakehill Swamp, is located further west, approximately 600 m of the site. The local groundwater flow direction at the site is partially south-west and may have some influence on the wetlands located directly west of the site.

5 WATER SUSTAINABILITY

5.1 INTRODUCTION

This section provides a summary of water conservation measures that will be undertaken at Lot 1507 Eighty Road, Baldivis. Water conservation criteria for Water Sensitive Urban Design (WSUD) in BUWM (WAPC, 2008) provide a consumption target of 100 kL/person/year. At a minimum, the development at Lot 1507 Eighty Road, Baldivis aims to meet the State Water Plan target of 100 kL/person/year. However, a greater goal of achieving a 20% reduction in potable water use will be implemented through Rockingham Park's participation in the UDIA EnviroDevelopment program. Additional savings will be achieved through use of residential bores for garden irrigation and commercial bores for POS irrigation.

The Water Corporation's latest potable water use study 'Perth's Residential Water Use Study 2008/2009' (Water Corporation, 2010) found that the average potable water consumption rate was 106 kL/person/year whereas the State Water Plan states a target of 100kL/p/a. Therefore, to meet the EnviroDevelopment potable water reduction target of 20%, a maximum usage of 80 kL/person/year of potable water is required. The water sustainability initiatives to meet this target are addressed below.

This section also addresses the provision of water for the irrigation within the development of areas of Public Open Space (POS), the proposed primary school and the servicing of potable water and wastewater supplies and sources. Water conservation issues are summarised and matters to be addressed at subdivision are presented.

5.2 WATER CONSERVATION STRATEGY

Rockingham Park Pty Ltd is seeking certification of sustainability initiatives undertaken at its Lot 1507 Eighty Rd development through the UDIA EnviroDevelopment program, including those specifically targeting water conservation under the Water Element of the program.

The EnviroDevelopment program seeks to raise the level of sustainable urban land development in WA and provides awards across six elements where it can be verified that sustainability benchmarks will be achieved. These elements include water conservation through the reduction of potable water consumption, as well as protecting ecosystems, reducing waste and increasing recycling, reducing energy use, using environmentally responsible materials in development and encouraging sustainable community amenities and behaviour.

To achieve water conservation at Lot 1507 Eighty Rd, the following EnviroDevelopment principles will be implemented:

- Reduction of overall potable water use by more than 20% through water efficiency measures; and

- Use of alternate water sources.

Support will also be provided to residents to educate them on how to minimise their water use. Sustainability Information Packages (SIPs) will be provided by Rockingham Park to homeowners as an educational tool on water conservation, reducing fertiliser use and other sustainability initiatives, as well as stipulating requirements on the built form of each lot. Education will also be promoted through the construction of a Waterwise Display Village designed to display and endorse waterwise practices both inside and outside the house. In addition to participating in the EnviroDevelopment program, Rockingham Park Pty Ltd is also investigating a Waterwise Land Development accreditation from the Water Corporation to demonstrate their commitment to water conservation.

The Water Corporation Waterwise criteria to be investigated for Lot 1507 Eighty Rd include:

- Addressing water efficiency and water conservation within the Entry Statement and Public Open Spaces;
- Addressing water efficiency and water conservation through innovation in all major buildings within the development;
- Including specific clauses that reflect water efficiency and water conservation within the general conditions of sale, in relation to both private and public buildings and building of display villages; and
- Educating the community on water efficiency and water conservation.

5.2.1 Water Efficiency Measures

Approximately half of all household water use is for maintaining gardens, therefore minimising water demand for landscaping is an essential water conservation measure for residential areas (Water Corporation, 2010). Ex-house irrigation controls can be easily implemented through the developer provided landscaping packages.

Rockingham Park will commit to implementing its goal of reducing overall potable water use by more than 20% through offering waterwise front garden landscaping to all homes in the development. In addition programs will be implemented to support residents to use less water through behavioural changes.

Note that residential bore water use has not been included in these calculations and the uptake off this alternate water source would reduce the scheme water use significantly further.

In addition to these options, it will be incentivised through the associated rebate packages to plumb homes for provisional connection to rainwater and grey water reuse schemes (as per the earlier proposed Five Star Plus Stage Two program).

It is intended that waterwise landscaping packages through Waterwise landscaping incentive packages by Planet Landscapes will be provided by Rockingham Park as part of each lot sale. These packages will include the use of soil amendments (such as mulch or clayey/loamy soils to improve water and nutrient retention), waterwise plants (with native options), paving or mulched surfaces and minimising turf areas, based upon individual garden requirements of the landowner.

In addition to these water efficiency measures aimed at the household scale, waterwise landscape design will also be undertaken for all POS and streetscapes. POS and streetscape design will also include the use of soil amendments, waterwise plants with native options, paving or mulched surfaces and minimal turf areas where practical.

5.2.2 Potential Alternate Water Sources

Rockingham Park will also commit to implementing its goal of reducing overall potable water use through the provision of a combination of the following water efficiency measures implemented in POS, as well as in-house and ex-house in individual houses:

- The use of **groundwater** for irrigation of POS and streetscapes.
- Consideration of the use of **grey water**: home grey water reuse systems on all 'traditional' lots (R20 and R40) and group housing lots (from bathrooms only) for irrigation of perennial garden beds, where garden areas are large enough to meet Department of Health standards.
- Consideration of the use of **rainwater**: rainwater harvesting tanks (minimum of 2000L) on all houses where roof areas are large enough to be plumbed in to supplement toilets and laundry water use. These systems will be promoted for use from the Stage 1 Display Village.

A preliminary water balance (Appendix F) has been completed for each of these individual options to determine how much water will be saved at the development if any of these are implemented. The cost-benefit aspects of these alternative water source options will also be considered at the subdivision stage of the development.

5.2.3 Education Strategies

Marketing and educational tools are important in encouraging the behaviour change of future landowners. The installation of waterwise fittings by landowners, further to those required for Stage 1 of the Five Star Plus scheme, may reduce water usage by up to 25% (Water Corporation, 2008). Sustainability Information Packages (SIPs) provided by Rockingham Park will be designed to ensure that landowners are aware of all

possible water conservation measures and how best to apply them. The packages will be distributed individually and will be supported by free community workshops and householder consultations on waterwise design.

SIPs will comprise information on, but will not be limited to, advice on the following:

- Changing personal and family water use behaviour, both in-house and ex-house;
- Using Water Efficiency Labelling and Standards (WELS) to choose fixtures with greater than four stars for tap fittings and three stars for shower heads, as well as advice about choosing flow regulators, low flow dual flush toilet, washing machines and relevant rebates available from the State Government;
- Water efficiency measures for ex-house use, including how to operate waterwise irrigation systems, frequency and timing of irrigation, landscaping packages and timing and the use of pool covers;
- Rainwater tanks, requirements, information about installation of tanks, switching systems and plumbing to toilets and/or laundry and relevant rebates; and
- Greywater systems, including requirements, approved products, regulatory approvals, installation of infrastructure for irrigation and relevant rebates.

Rockingham Park Pty Ltd plans to build a Waterwise Display Village that meets Water Corporation standard (Water Corporation, 2007) for viewing by potential and new landowners. The Display Village will be designed to display and promote waterwise practices both inside and outside the house. Sustainability Information Packages (SIP) and tours of the Display Village will be provided to explain waterwise measures, such as waterwise fittings, appliances, landscaping and irrigation. Features are expected to include rainwater tanks and connections, water efficient taps and shower heads in kitchens and bathrooms and mulching, waterwise plants, turf, soil amendments and irrigation controllers in the garden.

Rockingham Park Pty Ltd is investigating obtaining a Waterwise Land Development accreditation from the Water Corporation to demonstrate their commitment to water conservation. This accreditation is obtained by submitting an application to the Water Corporation specifying that water conservation targets have been met for POS, water efficient methods have been addressed in public and private buildings (including the display village) and that the community will be educated on water conservation via methods such as literature (SIPs).

5.3 PROJECTED POTABLE WATER CONSUMPTION

- The 80 kL/person/year EnviroDevelopment target (Section 5.1) can be achieved as shown in Appendix F. These calculations are determined from the current water yields calculated from given lot yields, based on Water Corporation Waterwise

Calculator assumptions, take-up rates of water efficiency packages and dwelling statistics. It is estimated that a typical resident living in Lot 1507 Eight Road, Baldivis will potentially use less than 80 kL/year on average of scheme water.

The water sustainability initiatives will save 26% volume of scheme water, based on current Water Corporation figures, and meet BUWM design criteria. It will also meet EnviroDevelopment criteria for the Water Element of a 20% reduction of potable water. Full potable demand calculations may be found in Appendix F.

5.4 PUBLIC OPEN SPACE (POS) IRRIGATION

Rockingham Park Pty Ltd has been issued groundwater allocations by the Department of Water (DoW) to irrigate POS and verge streetscapes at a rate of 7,500 kL/ha/year, as required by the DoW (WAWA, 1990). This irrigation rate requires a total allocation of 97 ML/year. A licence for 37 ML/year from the Leederville aquifer and 60 ML/year from the superficial aquifer has been acquired by Rockingham Park (Appendix G) and comes from an 80ML/year allocation that is shared with Lot 1507 Eighty Rd and another site owned by Rockingham Park. This will need to be amended in the future.

Rockingham Park Pty Ltd recognises the importance of conserving groundwater resources in the Jandakot area and has planned for the use of a water minimising landscape design. The groundwater allocation will be sufficient to ensure the irrigation of POS within the Lot 1507 Eighty Rd, Baldivis development through the use of minimal turf, soil amendments, waterwise plants and water-efficient irrigation. Appendix D contains information demonstrating the breakdown of water use for the POS areas until 2025.

5.5 PRIMARY SCHOOL IRRIGATION

A site for a primary school has been identified in the Local Structure Plan (Figure 2) with an approximate area of 4Ha. Of this area 1Ha will be used as a sports oval requiring non-potable water for irrigation of the turf. The DoW's recommended irrigation application rate for active POS is 10000 kL/ha/a. Therefore the required water to irrigate just the oval is 10000 kL/a. Additional irrigable areas of the school grounds will require additional water. As the ground water in this sub area is fully allocated, a groundwater licence to irrigate the primary school grounds cannot be given at this time. Options to source the required irrigation water for the Primary School shall be investigated as part of the Urban Water Management Plan (UWMP) and will include:

- Purchasing or leasing of a ground water allocation from a third party if available. This may be a private or public entity;
- Applying for a groundwater allocation from the DoW that may become available from recouped water entitlements;

- Using recycled water whether it be an onsite system, sewer mining, grey water reuse or a combination of these;
- Supplementing of any of the above systems with rainwater or stormwater harvesting;
- A combination of the above.

The UWMP shall present a feasibility study of the proposed options and identify the proposed supply option or options.

5.6 WATER BALANCE

An increase in recharge volume of approximately 270% is estimated post-development as shown in Appendix E. The pre-development recharge is estimated at 113 ML/year. Water balance calculations indicate that approximately 306 ML/yr additional recharge will occur on site once developed (Appendix E).

5.7 POTABLE WATER SERVICING

The site falls within the Tamworth tank water reticulation area. Water supply to the eastern part of the site is currently limited until the existing DN500 water distribution main in Nairn Drive has been extended south to the existing DN250 reticulation main at The Ridge Boulevard. This work is currently under way. The DN400 water main is proposed to be progressively extended southwards along Nairn Drive as a Water Corporation pre-funded capital works item as the development front moves southwards along Nairn Drive.

There is an existing DN300 water main located on the eastern side of Eighty Road that will also need to be extended southwards as a Water Corporation pre-funded capital works item along the front of the site to service the site from the west. The distribution mains in Nairn Drive and Eighty Road will be linked by reticulation-sized mains through the development road network as the development front moves ahead.

The Water Corporation has advised that land above the 30 metre contour is unable to be supplied by the Corporation and local boosting of water supply may be required. As shown in the Preliminary Earthworks Plan (Appendix H), none of the landholding will fall above the RL30 contour.

5.8 WASTEWATER SERVICING

Water Corporation waste water planning shows two future Waste Water Pump Stations (WWPSs) and Pressure Mains (PMs) located within the site: Baldivis WWPS “K” and Baldivis South WWPS “N”.

The initial stages of the development are proposed in the north-west corner of the site fronting Eighty Road. The Baldivis South WWPS “K” would need to be constructed as

part of any first stage of development for the landholding as the Water Corporation policy is not to allow tankering. No details of the sewerage outfall could be confirmed at the time of writing this report. It is expected that the outfall would be, at least in the short-term, into an existing 225 mm gravity sewer located to the north, near the intersection of Nairn Drive and Territory Crescent.

The Water Corporation waste water planning shows 2 Waste Water Pumping Stations (WWPS) and Pressure Mains (PMs), being Baldivis South WWPS “K” and Baldivis South WWPS “N” located within the landholding.

The initial stages of the development are proposed in the northwest corner of the landholding fronting Eighty Road. The Baldivis South WWPS “K” would need to be constructed as part of any first stage of development for the landholding as the Water Corporation policy is not to allow tankering. The WWPS is a Type 40 permanent station and will be located on the eastern side of Eighty Road next to a future POS area. The outfall is to be as per Option B (Refer Appendix J) and eventually moving into the ultimate as Option C.

The WWPS, and the ultimate pressure main (PM) if it forms part of the ultimate sewerage infrastructure, are capital works items for the Water Corporation, and as such the costs are funded by the developer and reimbursed by the Water Corporation according to a formula based on the number of lots titled compared to the number of lots calculated by the Water Corporation to justify the capital works expenditure. The agreement is formalised through a Customer Constructed Works Agreement (CCWA). Only permanent infrastructure falls within the CCWA as being reimbursable by the Water Corporation to the Developer.

It is expected that the initial pressure main construction (Option B and C) will not be capital works items.

If the WWPS and the PM form part of the ultimate sewerage infrastructure, then they will be capital works items owned by the Water Corporation. In this case the costs are funded by the developer and reimbursed by the Water Corporation according to a formula based on the number of lots titled compared to the number of lots calculated by the Water Corporation to justify the capital works expenditure. The agreement is formalised through a Customer Constructed Works Agreement (CCWA). Only permanent infrastructure falls within the CCWA as being reimbursable by the Water Corporation to the developer.

It is recommended that the CCWA takes into account an agreed discharge factor from an agreed percentage of individual household grey water reuse systems to be permanently implemented and operated. It is expected that this will be less than the actual number installed due to a lack of maintenance, shutdown and failure to replace systems by some householders at the end of their useful life.

5.9 MATTERS TO BE ADDRESSED AT THE SUBDIVISION STAGE

Matters to be addressed at the subdivision stage in the Urban Water Management Plan(s) (UWMPs) where relevant are:

- Finalise details of landscaping design in terms of confirmed groundwater allocation;
- Undertake subdivision level water balances based on the groundwater allocation;
- Final decision on water sustainability initiatives to be implemented at the site based on current investigations;
- Refine expected percentage uptake of rainwater and greywater reuse systems to be implemented and include at UWMP level water balance calculations;
- Finalise details to be included in the Sustainability Information Package; and
- Provide relevant design detail for the primary school irrigation water source including demonstration that any required licences for groundwater supply (if this is the preferred option) are substantially progressed.

6 STORMWATER MANAGEMENT STRATEGY

The stormwater management strategy for the site is based on infiltration of stormwater to maintain pre-development flows, while maintaining water quality. A variety of structural and non-structural Best Management Practices (BMPs) are proposed to achieve this, including swales and rain gardens in road reserves and POS, side entry and other drainage pits with open bases and infiltration basins. Swales, rather than pipes, may be used for conveyance where possible.

A Drainage Concept Plan for the site developed by Serling Consulting engineers is included in Appendix I.

6.1 STORMWATER QUANTITY

6.1.1 Stormwater Management in Road Reserves

Stormwater within road reserves will be collected via swales or conventional gully pits depending on the steepness of the landform and adjacent land uses. The pits will have open bases to increase soakage from the system. Swales, rain gardens and underground soakage systems will be used where feasible to manage more frequent rainfall events and increase infiltration through the drainage network.

Swales and road reserve rain gardens will be installed in median strips on the major road, Nairn Drive, and in road reserves adjacent to Public Open Space where space is available, as shown in the Drainage Concept Plans in Appendix I. These structures will generally contain native vegetation, although grass may be used on the edges of Public Open Space where this is more appropriate to the development. Where feasible, the use of swales rather than pipes for conveyance will be considered.

Swales are generally only suitable for areas where the slope is less than about 4% (Engineers Australia, 2006). Road reserve widths are also a potential constraint for the use of swales and rain gardens. Road reserves that may be appropriate for the use of swales have been identified and are shown on the Drainage Concept Plan (Appendix I).

Intermittent rain gardens within the widened road reserve of Nairn Drive may also be utilised. These will be designed to retain nutrients while infiltrating stormwater and use appropriate native vegetation. An example of a rain garden is shown in Plate 1. Potential rain garden locations are presented in Appendix I.

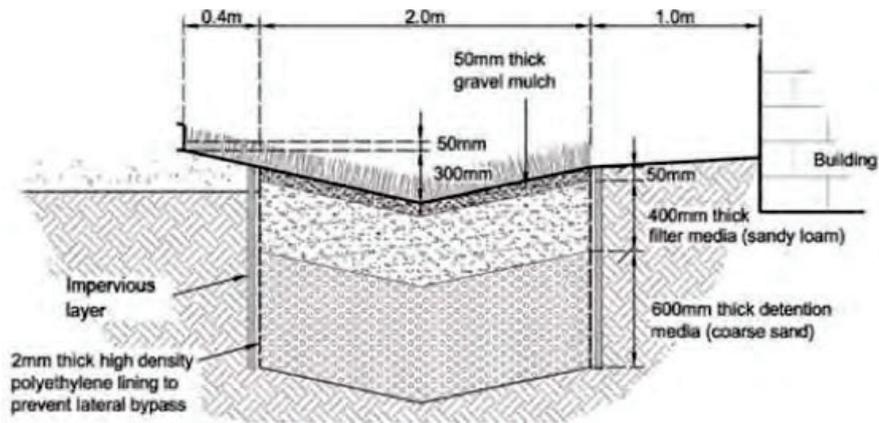


Plate 1: Example of a rain garden design (from DoW, 2008). Note that the rain gardens will not be located adjacent to buildings.

The site will utilise open-based drainage pits to increase infiltration throughout the drainage network. Soakage pits may be used in road verges where road reserve widths and service alignments permit.

The use of permeable paving will be considered for rear lane access in addition to parking areas and within the activity centres. The City of Rockingham will be consulted to determine suitability of permeable paving. Consideration will be given to non-central road alignments for better facilitation of swales and rain gardens, and to appropriate road reserve widths for infiltration within road reserves at a UWMP stage.

Major flow paths will be provided along road reserves for the 1 in 100 year flow (Appendix I). Peak flows for the 1 in 100 year ARI event will discharge the site by overland flow in the north-western corner of the site.

6.1.2 Flood Management in Public Open Space

The development has been divided into ten catchments for flood management purposes (Appendix I and Table 6) based on approximate topographic catchments. The catchment areas vary from 1.10 ha to 6.32 ha (Table 6). Areas of Public Open Space have been allocated for drainage in each catchment. The basins have been designed to cater for the 1 in 100 year ARI events and to allow approximately 12340m³ of storage in all of the ten catchments. The basin areas have been designed upon the basis that a maximum area of 25% of POS is inundated during a 1 in 10 year ARI storm event, as per City of Rockingham standards. The infiltration rate upon which the drainage concept plan is based is 3 m/day.

Table 6: Catchment areas for 1 in 100 year ARI peak volumes and approximate basin areas for each catchment at Parkland Heights

Catchment No.	Catchment Area (ha)	Impervious Area (ha)	1 in 100 year ARI Peak Volume (m ³)	Basin Area (m ²) (based on the base area requirement for 1 in 100 Year ARI event)			
				1 in 100 Year ARI	1 in 10 Year ARI	1 in 5 Year ARI	1 in 1 Year ARI
B1	3.77	3.39	1,700	2,495	2,159	2,085	1,878
B2	6.32	5.69	2,350	3,365	2,977	2,893	2,654
B3	5.09	4.58	2,100	2,227	1,839	1,755	1,508
B4	2.06	1.85	1,050	1,546	1,265	1,206	1,043
B5	3.03	2.48	1,290	2,095	1759	1,673	1,414
B6	1.27	1.14	860	2,119	1,840	1,795	1,732
B7	1.89	1.7	380	935	902	878	798
B8	1.1	0.99	310	942	836	810	750
B9	3.43	3.09	1,480	2,501	2,180	2,112	1,924
B10	2.12	1.91	820	1,245	1,012	961	814

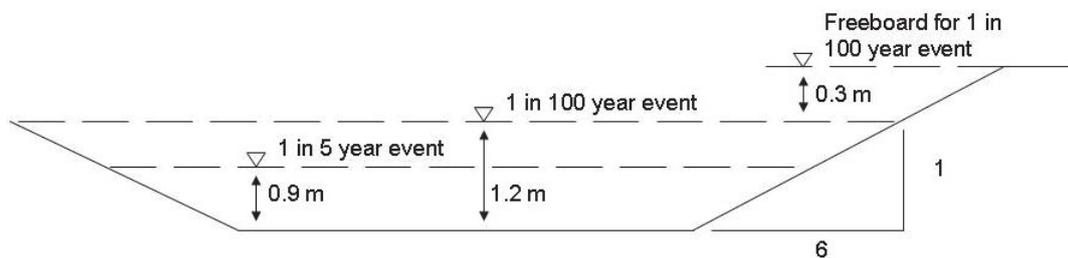


Plate 2: Conceptual design of drainage structure. Design will be optimised and improved at subdivision stage to decrease area of inundation in smaller events and maximise POS useability. Base area will depend on volume required.

The total area of inundation in a 1 in 5 year ARI event is 1.62 ha within Public Open Space. This area represents the storage for the whole 1 in 5 year event, without allowances for losses through drainage pits and swales. This is seen as a maximum allowable area for inundation and efforts will be made to reduce this area by maximising infiltration within the road reserve.

The area of inundation in a 1 in 100 year ARI event is estimated at 1.95 ha. This area is outlined in Appendix I. The areas are shown to indicate the total area of inundation. The basins themselves shall be shaped and located to maximise the useability of the Public Open Space while maintaining acceptable depths of inundation.

6.1.3 Lot Stormwater Management

The drainage from lots will be managed on the lots through the use of soakwells or similar structures. Soils within the site consist predominantly of sand with a given hydraulic conductivity between 4.3 – 5.9 m/day and of moderate to good drainage characteristics (SKM, 2009), which is considered suitable.

Lots will not be provided with a direct connection to the road drainage system.

A minimum freeboard of 0.3 m will be provided between the 1 in 100 year water level and minimum habitable floor levels.

6.2 STORMWATER QUALITY

The development will use a mixture of structural and non-structural controls to manage stormwater quality, in line with the DoW's *Stormwater Management Manual (2004-7)*.

Stormwater quality on the site will be maintained through the use of Best Management Practices including swales, rain gardens and infiltrating basins to remove nutrients and sediments. These structures will be planted with native vegetation to encourage nutrient and suspended solids uptake and removal prior to infiltration. The structures will be sized to meet the DoW requirement that an equivalent of 2% of the effective impervious area will be bioretention structures to maintain water quality (DoW, 2008c). Gross pollutant traps will also be used prior to discharge to basins or Public Open Space.

A package of information provided to landowners at settlement of their property will include information on reducing fertiliser use and other water conservation and environmental management measures.

6.3 IMPACT ON WATER DEPENDANT ECOSYSTEMS

There are no water dependant ecosystems (WDEs) within the site. The closest wetland, Outridge Swamp, is 80 m to the west of the site and the associated 50 m buffer zone is still 30 m away from the site.

6.4 MATTERS TO BE ADDRESSED AT THE SUBDIVISION STAGE

Matters to be addressed at the subdivision stage in the Urban Water Management Plan(s) (UWMPs) are:

- Provision of a detailed drainage design and planning for the subdivision area including underground soakage systems, swales and rain gardens and confirmation of sizing and location of structures, road alignments and road reserves; and
- Details of landscaping for swales, rain gardens and basins.

7 GROUNDWATER MANAGEMENT STRATEGY

7.1 GROUNDWATER QUANTITY

Because of the significant depth to groundwater over the site, depth to groundwater is not considered to be a significant constraint to development on this site. Subsoil drainage is not proposed on this site.

Fill will not be required on this site to manage groundwater levels, except possibly in isolated areas around POS and other low points.

7.2 IMPACT ON WATER DEPENDANT ECOSYSTEMS

There are no wetlands or groundwater dependent vegetation within the site as outlined in Section 4.5.2. The closest wetland, Outridge Swamp, is 80 m to the west of the site. Groundwater flow direction at the site is partially due south-west and not directly in the path of the wetland. Any changes to the groundwater regime will be managed to ensure there is minimal impact upon this wetland.

7.3 GROUNDWATER QUALITY

Nutrient concentrations entering groundwater will be reduced through the use of a mixture of structural and non-structural Best Management Practices including:

- Swales, rain gardens and basins with native vegetation in frequently inundated areas and amended fill to strip nutrients prior to infiltration;
- Soil amendments in all POS and landscaping packages to retain phosphorus and water;
- Limiting the use of fertilisers in POS through householder education and control of POS; and
- Provision of education to householders on fertilise wise gardening through Sustainability Information Packages.

7.4 MATTERS TO BE ADDRESSED AT THE SUBDIVISION STAGE

Matters to be addressed at the subdivision stage in the Urban Water Management Plan(s) (UWMPs) are:

- Confirmation of finished lot levels; and
- Further details of landscaping and Sustainability Information Packages to be provided to householders.

8 MATTERS TO BE ADDRESSED AT THE SUBDIVISION STAGE

The following section summarises all matters presented in this report that have to be addressed at the subdivision stage in the Urban Water Management Plan(s) (UWMPs).

These are:

- Finalise details of landscaping design in terms of confirmed groundwater allocation;
- Undertake subdivision level water balances based on the groundwater allocation;
- Finalise decisions on water sustainability initiatives to be implemented at the site based on current investigations;
- Undertake cost-benefit analyses of alternate water source options;
- Determine expected percentage uptake of rainwater and greywater reuse systems to be implemented and include at UWMP level water balance calculations;
- Provision of a detailed drainage design and planning for the subdivision area including underground soakage systems, swales and rain gardens and confirmation of sizing and location of structures, road alignments and road reserves;
- Provision of details of landscaping for swales, rain gardens and basins;
- Confirmation of finished lot levels; and
- Finalise details of landscaping and Sustainability Information Packages to be provided to householders.

9 MONITORING

9.1 PROGRAM FOR UWMP PREPARATION

Eighteen months of groundwater monitoring has been completed at Lot 1507 Eighty Rd, Baldivis. The full set of monitoring data acquired will be used to provide a baseline for post-development groundwater quality and levels.

This information will be provided as part of the first UWMP.

9.2 POST-DEVELOPMENT MONITORING

A detailed post-development monitoring program and contingency plan should be developed for the subdivision by the developer and submitted to the City of Rockingham before any works are commenced. These programs should be inline with the LWMS.

Post-development monitoring for each stage will include monthly measurements of ground water and surface water levels (where surface water is present) and quarterly sampling for pH, electrical conductivity, redox potential, total nitrogen, ammonia, heavy metals, Kjeldahl nitrogen, nitrate/nitrite, total phosphorus and phosphate in groundwater for which trigger levels and resulting actions are outlined in Table 7. This monitoring will be undertaken for two years following the practical completion of each stage.

Monitoring shall be undertaken at the pre-development bores (Figure 6) excepting bores F and G. Where pre-development bores are destroyed during construction, replacement bores of a similar depth shall be installed and monitored after development.

Table 7: Parameters, Tests and Actions Associated with Monitoring

Parameter	Test	Trigger	Action
Groundwater Levels and Quality	Groundwater level and water quality from pre-development bores, sampled quarterly	Increase in Total Phosphorus and Total Nitrogen concentration compared to pre-development baseline for two successive events (refer Table 1). Increase in groundwater level over two successive winters from predevelopment levels.	Responsible body to investigate reasons for any change. If intervention is required, this shall be undertaken prior to the following winter.

The contingency response to the monitoring program will be detailed in each UWMP. It will likely include trigger levels and action levels in the groundwater levels and wetlands that will require investigation and responsive actions. There will also be water quality criteria to be addressed.

10 IMPLEMENTATION

10.1 ROLES AND RESPONSIBILITIES

Item	Scheme Development	Interim Maintenance (Minimum of two years)	Long-term Maintenance
Waterwise Efficiency Packages	Developer	Residents and strata companies.	Residents and strata companies.
Sustainability Information packages	Developer	Developer	Council
Swales, raingardens and drainage system	Developer	Developer for at least 2 years as per Council requirements	Council
Public Open Space	Developer	Developer for at least 2 years as per Council requirements	Council
Monitoring of the development	Developer	Developer for three years post-development, including one year following the completion of the majority (80%) of the development	Developer for monitoring in compliance with groundwater licensing conditions. Council for other items.

10.2 FUNDING

No external funding is being sought for this project.

10.3 REVIEW

Rockingham Park Pty Ltd expects that development of Lot 1507 Eighty Rd, Baldivis will occur over a number of years. Water management ‘best practice’ procedures will likely vary during the development timeframe. If there is a need to change, then proposed practices may need to be modified in the future to comply with improvements in understanding or design. Rockingham Park Pty Ltd proposes to address any identified and agreed modifications through the preparation and implementation of UWMPs.

11 CONCLUSIONS

The objective of the Local Water Management Strategy (LWMS) is to ensure that sustainable management of the total water cycle at Parkland Heights, Lot 1507 Eighty Rd, Baldivis occurs through Water Sensitive Urban Design. This includes water conservation, stormwater management and groundwater management. Rockingham Park Pty Ltd aims to manage these issues at the site through the following initiatives:

Water Conservation

- Participating in the EnviroDevelopment program to achieve a maximum potable water usage of 80 kL/per/year and meet both the State Water Target and EnviroDevelopment target of a 20% reduction in scheme water use;
- Providing Waterwise landscaping for Public Open Space (POS) that includes waterwise plants, soil amendments to improve water and nutrient retention, minimising turf areas and water efficient irrigation;
- Investigating the possibility of using an alternative water source to irrigate POS;

Stormwater Management

- Implementing a drainage design that ensures pre-development discharge rates in the event of a 1 in 100 year ARI event will be maintained through storage and infiltration on site; and
- Maximising infiltration by developing swales and rain gardens in road reserves where possible, planted with native vegetation to encourage nutrient and suspended solids uptake and removal prior to infiltration. Open based manholes will also be used to maximise infiltration. Infiltration basins in Public Open Space will manage larger events.

Groundwater Management

- Recognising the issue of groundwater availability and planning low water use POS.

This LWMS demonstrates that Parkland Heights, Lot 1507 Eighty Rd, Baldivis can be developed without significant constraints. The outstanding issues can be resolved at the Urban Water Management Plan stage to create a development that meets the goals and ideals of *Better Urban Water Management*.

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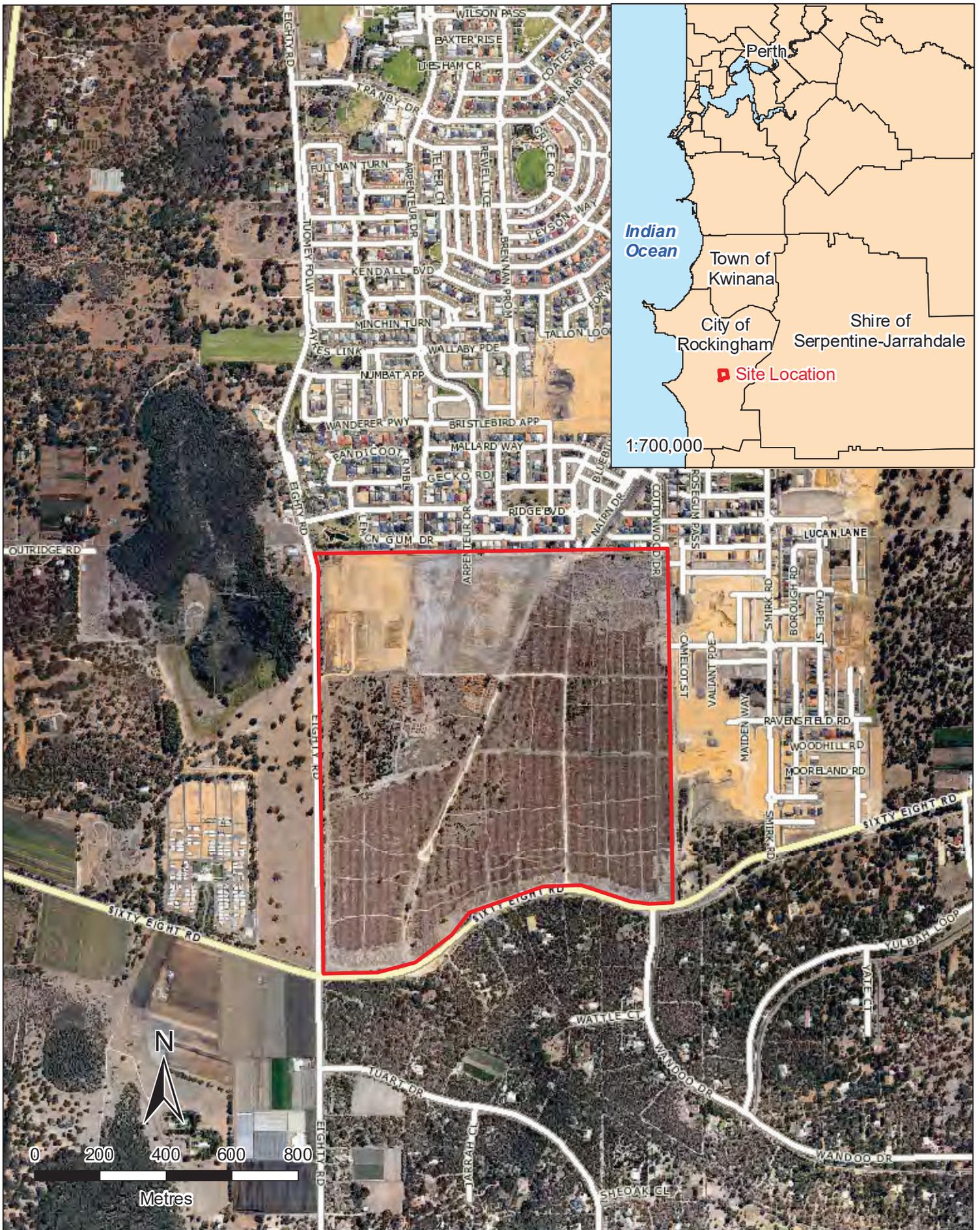
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FIGURES



CLIENT	Rockingham Park	
AUTHOR:	DRAWN	
J Hunt	T Ellis	
SCALE	PROJECTION	
1:15,000@A4	GDA94 MGA50	

JOB NO.	J100378
DATE	6-12-2011

Site Context Plan

Lot 1507 Eighty Road, Baldvis
 Local Water
 Mangement Strategy

FIGURE 1



CLIENT
Rockingham Park

AUTHOR: J Hunt **DRAWN:** T Ellis

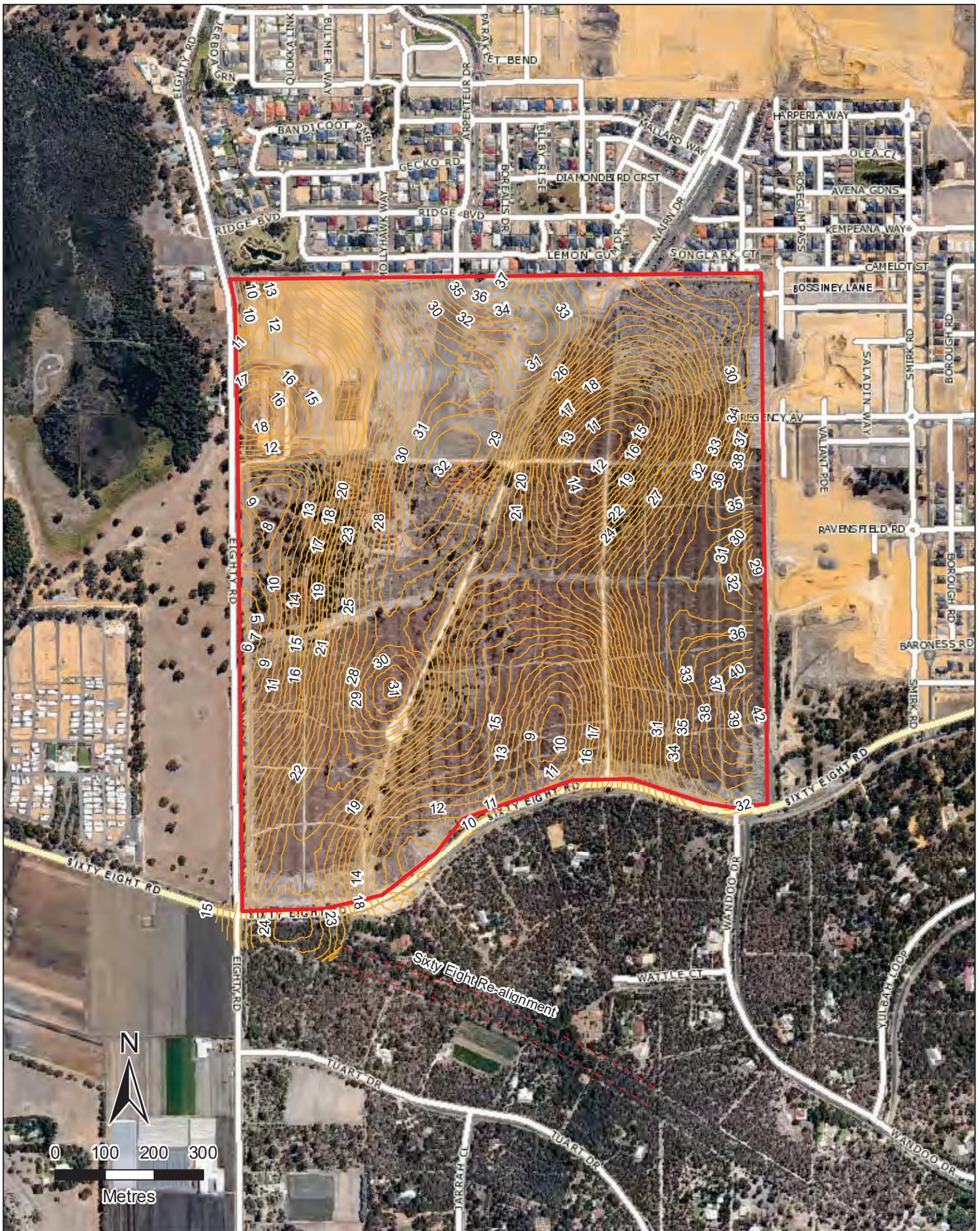
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JOB NO.
J100378

DATE
6-12-2011

Site Structure Plan

Lot 1507 Eighty Road, Baldvis
Local Water
Mangement Strategy



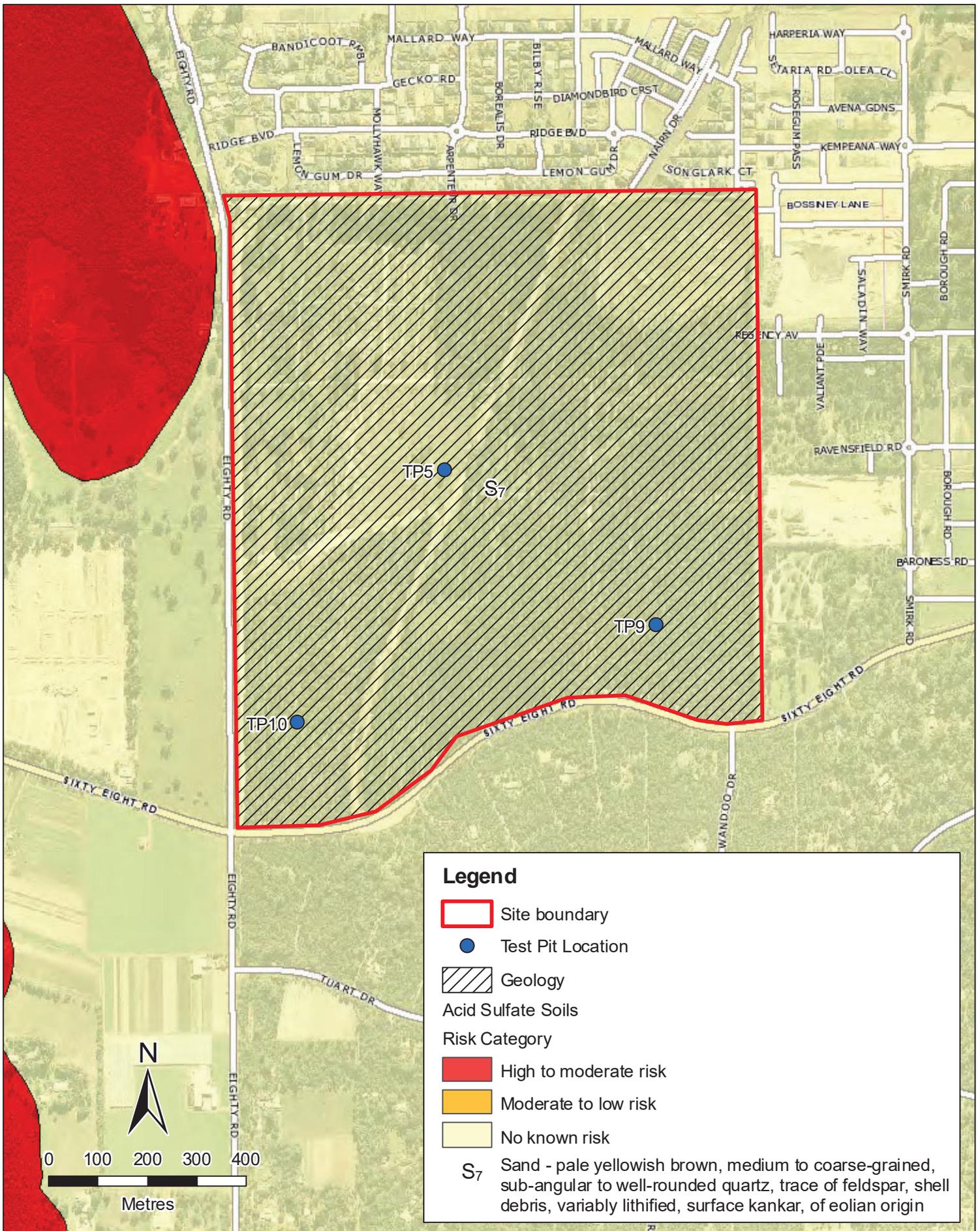
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AUTHOR:
 J Hunt
SCALE
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JOB NO.
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DATE
 6-12-2011

DRAWN
 T Ellis
PROJECTION

Site Condition Plan

Lot 1507 Eighty Road, Baldvis
 Local Water
 Mangement Strategy

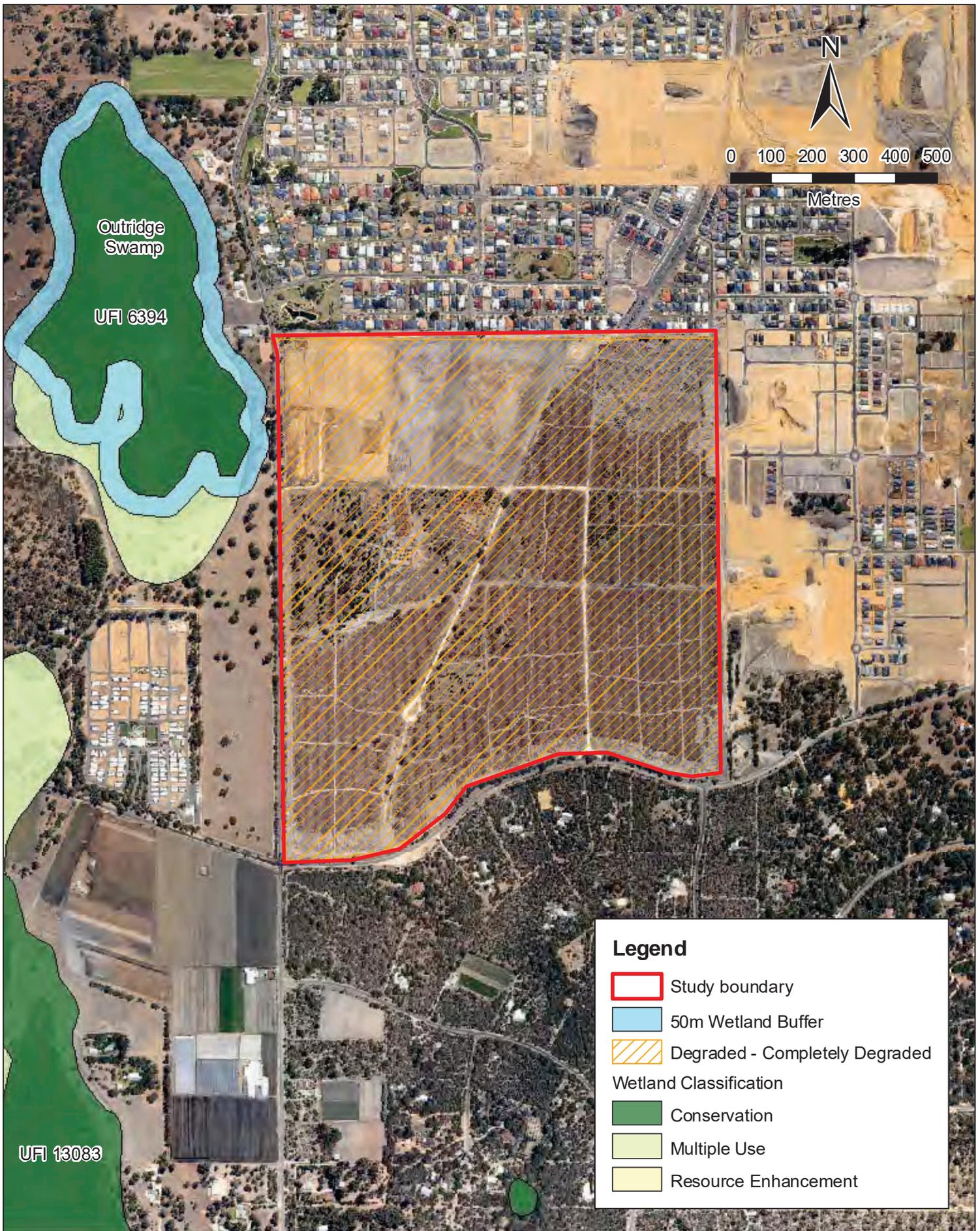


CLIENT
 Rockingham Park
AUTHOR: J Hunt
SCALE 1:10,000@ A4 GDA 94 MGA 50
DRAWN T Ellis
PROJECTION

JOB NO.
 J100378
DATE
 6-12-2011

Geotechnical Plan

Lot 1507 Eighty Road, Baldvis
 Local Water
 Mangement Strategy



Legend

- Study boundary
- 50m Wetland Buffer
- Degraded - Completely Degraded

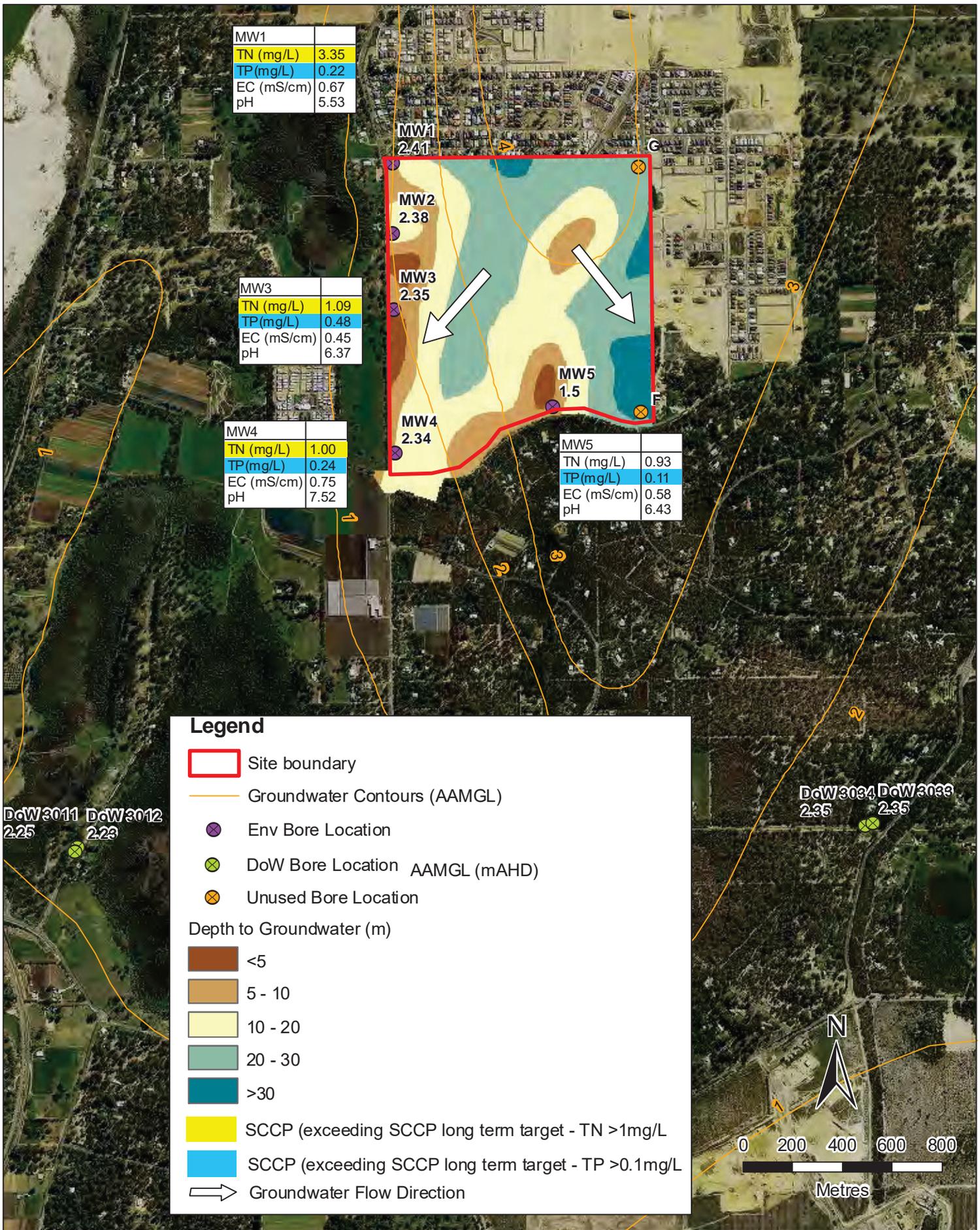
Wetland Classification

- Conservation
- Multiple Use
- Resource Enhancement

UFI 13083

	<u>CLIENT</u>	<u>JOB NO.</u>	
	Rockingham Park	J100378	
	<u>AUTHOR:</u>	<u>DRAWN</u>	<u>DATE</u>
	J Hunt	T Ellis	6-12-2011
	<u>SCALE</u>	<u>PROJECTION</u>	
	1:12,000@ A4	GDA 94 MGA 50	

Environmental Plan
 Lot 1507 Eighty Road, Baldvis
 Local Water
 Mangement Strategy



CLIENT
Rockingham Park

AUTHOR: J Hunt **DRAWN:** T Ellis

SCALE 1:20,000@A4 **PROJECTION** GDA94 MGA50

JOB NO. J100378

DATE 6-12-2011

Groundwater Plan
Lot 1507 Eighty Road, Baldvis
Local Water
Mangement Strategy



Indicative Staging Plan
 LOT 1507, BALDIVIS
 A ROCKINGHAM PARK PTY LTD PROJECT

plan: 010075/0328 date: 22/11/2011 scale: PCG 94	prepared: DR checked: SDM date: BR	scale: 1:2000(S/A1) 1:2000(S/A0) 0 50 100m	Taylor Burne Barnett Town Planning & Design 187 Roberts Road, Solihull, Western Australia 4038 p: (08) 9382 2911 f: (08) 9382 4556 e: admin@tbbtownplanning.com.au <small>© copyright Taylor Burne Barnett Town Planning & Design. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage and retrieval system, without the prior written permission of Taylor Burne Barnett Town Planning & Design.</small>
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APPENDIX A

BORE LOGS

Client: Rockingham Park
 Logged By: PA
 Drilled By: Landcare Drilling
 Monitoring Bore No: MW1

Project: Parkland Heights
 Job No: 09.207
 Date Logged: 21-Oct-09
 Installation Method: Air Rotary

386986E, 6419561N

Depth BGL (m)	Sample Taken	Monitor Well Log	Profile	Lithology	Field Rank	Observations (PID in ppm _v , VOC)
				Blue riser		
			0 - 0.25	SAND & ORGANIC MATTER, brown/grey, medium grain size, poorly sorted, dry		
			0.25 - 0.7	SAND, brown, medium grain size, moderately sorted, dry		Quartz sand, limestone fragments elements
			0.7 - 0.75	SAND, cream/grey, medium grain size, moderately sorted dry		
1.0			0.75 - 1.25	SAND, brown/cream/grey, medium grain size, moderately sorted, dry		
			1.25 - 1.7	SAND, cream/grey, medium grain size, moderately sorted		damp uniform colour all the way down, tan speckles
2.0			1.7 - 2.25	CLAYEY SAND, brown, medium grain size, moderately sorted,		Saturated WL: 1.75mbgl
			2.25 - 2.75	CLAYEY SAND, brown/grey, medium grain size moderately sorted		Saturated Quartz sand
3.0			2.75 - 5	CLAYEY SAND, dark brown/grey, medium grain size, moderately sorted, saturated		becoming darker with depth
4.0						
5.0						
				EoH @ 5 mbgl		

NOTE:

-  Monitor Well Screen
-  Gravel Pack
-  Bentonite Layer
-  Sand Fill
-  Cement Grout

Initial water table at time drilling



ENV. Australia
 Level 7
 182 St Georges Terrace
 Perth, WA, 6000.

Client: Rockingham Park
 Logged By: PA
 Drilled By: Landcare Drilling
 Monitoring Bore No: MB2

Project: Parkland Heights
 Job No: 09.207
 Date Logged: 21-Oct-09
 Installation Method: Air Core

386985E, 6419281N

Depth BGL (m)	Sample Taken	Monitor Well Log	Profile	Lithology	Field Rank	Observations (PID in ppm _v , VOC)
				blue riser		
			0 - 0.25	TOPSOIL - SAND, black		organic matter
			0.25 - 0.5	SAND, tan brown, medium grain size, poorly sorted		dry
			0.5 - 1	SAND, brown, medium grain size, moderately sorted		dry quartz sand light tan parts
1.0			1 - 2.5	SAND, yellow/orange, medium grain size, moderately sorted		dry white quartz elements, very orange colour
2.0						
			2.5 - 6	SAND, yellow/orange, medium grain size, moderately sorted		damp very slight clay stain
3.0						
4.0						
5.0						
						slightly lighter at 5.4 mbgl

NOTE:

-  Monitor Well Screen
-  Gravel Pack
-  Bentonite Layer
-  Sand Fill
-  Cement Grout

Initial water table at time drilling



ENV. Australia
 Level 7
 182 St Georges Terrace
 Perth, WA, 6000.

Client: Rockingham Park
 Logged By: PA
 Drilled By: Landcare Drilling
 Monitoring Bore No: MB3

Project: Parkland Heights
 Job No: 09.207
 Date Logged: 21-Oct-09
 Installation Method: Air core, mud rotary

386998E, 6418987N

Depth BGL (m)	Sample Taken	Monitor Well Log	Profile	Lithology	Field Rank	Observations (PID in ppm _v , VOC)
Steel riser						
0-0.15			0-0.25	TOPSOIL - SAND, black		
			0.25 - 1.5	SAND, cream/tan, medium grain size, poorly sorted		dry
1.0						
			1.5 - 5.5	SAND, yellow/orange, medium grain size, poorly sorted		saturated
2.0						WL: 2.5 mbgl
3.0						
4.0						
5.0						
				EOH @ 5.5 mbgl		

NOTE:

-  Monitor Well Screen
-  Gravel Pack
-  Bentonite Layer
-  Sand Fill
-  Cement Grout

Initial water table at time drilling



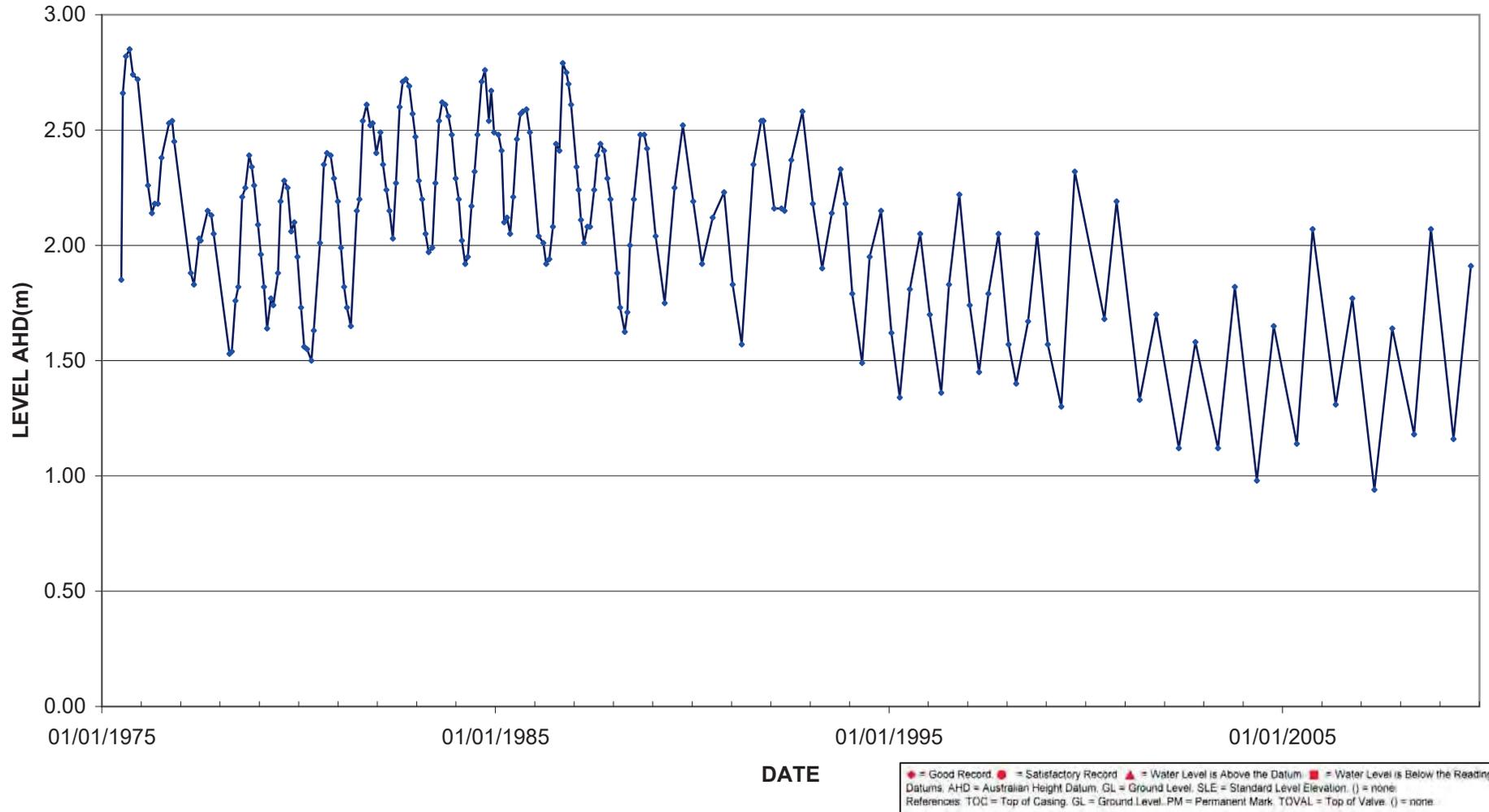
ENV. Australia
 Level 7
 182 St Georges Terrace
 Perth, WA, 6000.

APPENDIX B

DOW GROUNDWATER DATA

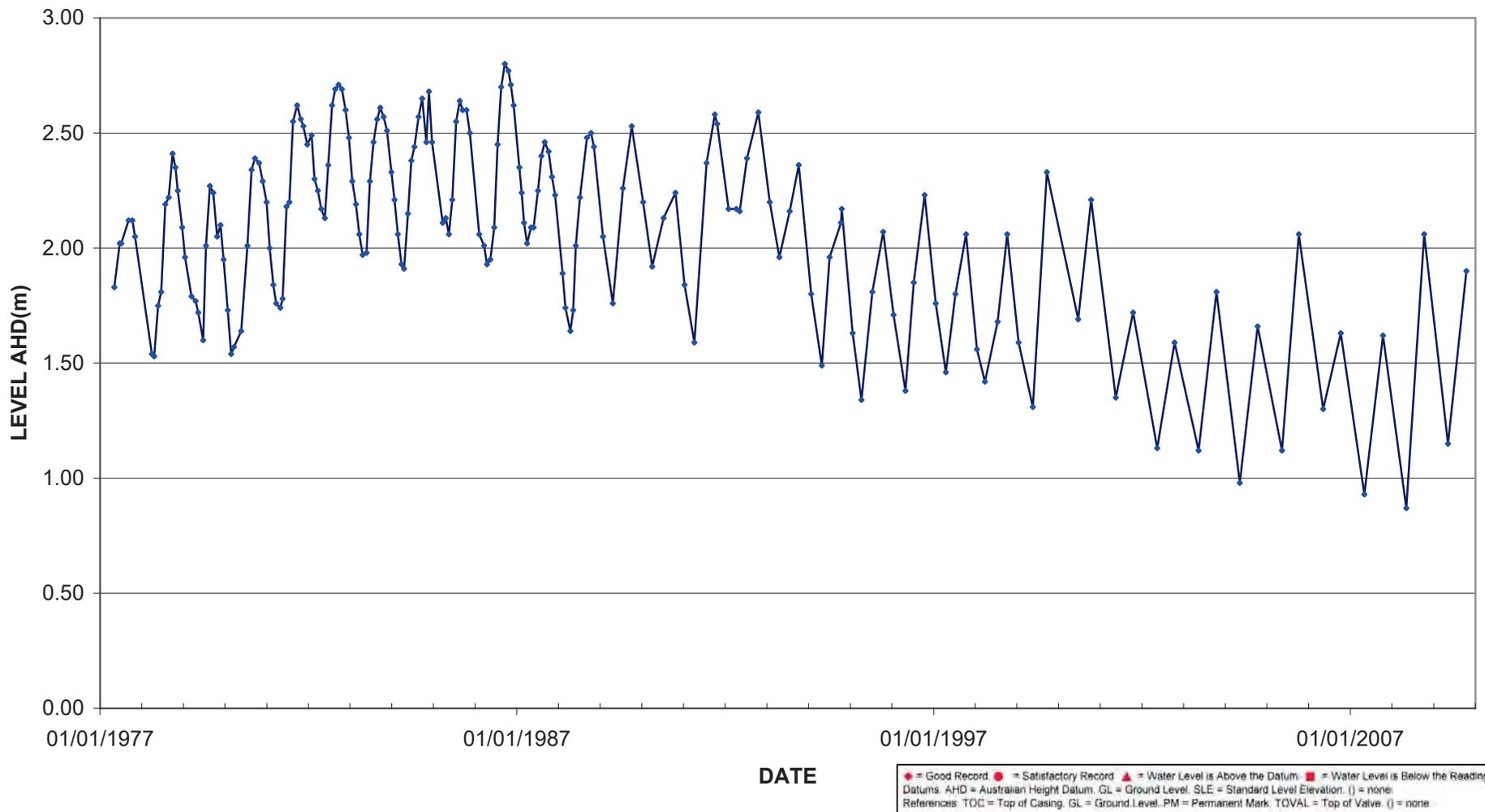
61410049 LAKE THOMSON T430 (O)

Easting = 385714.00 Northing = 6416781.00 Zone = 50 TOC = 7.17m AHD WIN SITE ID = 3011



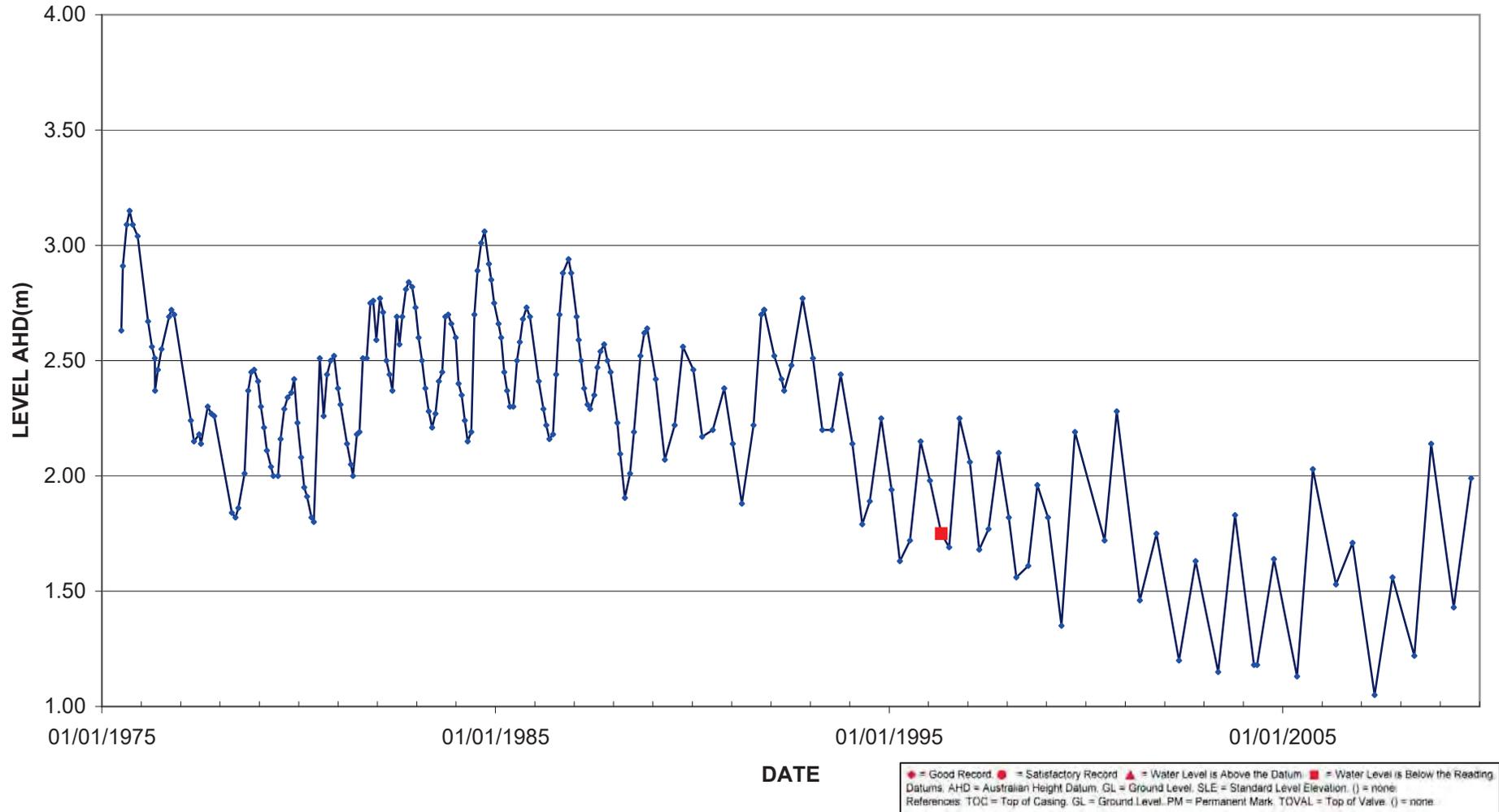
61410050 LAKE THOMSON T430 (I)

Easting = 385704.00 Northing = 6416765.00 Zone = 50 TOC = 7.46mAHD WIN SITE ID = 3012



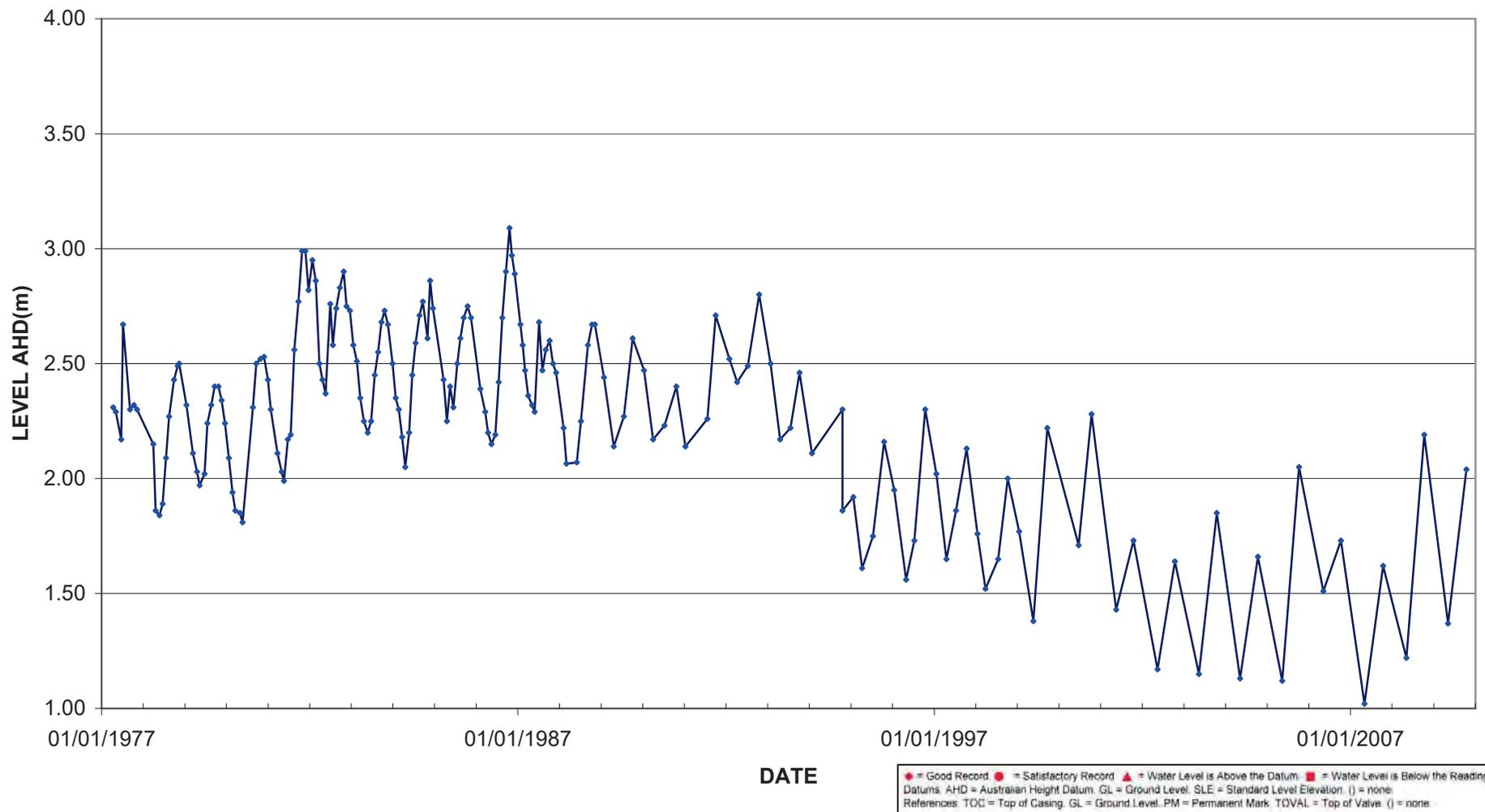
61410071 LAKE THOMSON T440

Easting = 388918.00 Northing = 6416879.00 Zone = 50 TOC = 10.9mAHD WIN SITE ID = 3033



61410072 LAKE THOMSON T441

Easting = 388889.00 Northing = 6416870.00 Zone = 50 TOC = 14.15m AHD WIN SITE ID = 3034



APPENDIX C

MONITORING RECORDS

Parkland Heights - Lot 1507 Eighty Road - Baldivis

pH						
	28/10/2009	21/01/2010	21/04/2010	7/07/2010	11/10/2010	MEAN
MB1	5.7	5.35	dry	dry	dry	5.53
MB2	blocked					
MB3	6.68	6.5	6.16	6.29	6.22	6.37
MB4	7.66	7.5	7.5	7.39	7.56	7.52
MB5	6.82	6.16	6.13	6.61	6.45	6.43

EC (mS)						
	28/10/2009	21/01/2010	21/04/2010	7/07/2010	11/10/2010	MEAN
MB1	0.71	0.63	dry	dry	dry	0.67
MB2	Blocked					
MB3	0.47	0.46	0.47	0.45	0.42	0.45
MB4	1.13	0.73	0.67	0.71	0.53	0.75
MB5	0.61	0.52	0.61	0.69	0.45	0.58

Parkland Heights - Lot 1507 Eighty Road - Baldvins

Date	Bore ID	pH	EC mS/cm	Total P mg/L	PO4-P mg/L	Total N mg/L	NOX-N mg/L	NH3-N mg/L	TKN mg/L	Dissolved Metals							
										Arsenic mg/L	Cadmium mg/L	Chromium mg/L	Copper mg/L	Lead mg/L	Nickel mg/L	Zinc mg/L	Mercury mg/L
28/10/2009	MB1	4.55	0.77	0.32	<0.005	3.4	0.24	0.55	3.2	<0.001	0.0001	<0.001	0.006	0.004	0.028	0.042	<0.0001
21/01/2010		5.4	0.6	0.11	<0.005	3.3	0.011	0.37	3.3	0.047	<0.0001	0.09	0.004	0.016	0.007	0.092	<0.0001
AVERAGE		4.98	0.69	0.22	<0.005	3.35	0.13	0.46	3.25	0.024	0.0001	0.0455	0.01	0.01	0.02	0.07	<0.0001
28/10/2009	MB3	6.9	0.45	0.08	<0.005	0.86	0.008	0.1	0.85	<0.001	<0.0001	<0.001	0.002	<0.001	0.002	0.008	<0.0001
21/01/2010		6.55	0.45	<0.01	<0.005	1.5	<0.005	0.15	1.5	0.029	<0.0001	0.11	0.002	0.009	0.003	0.094	<0.0001
21/04/2010		6.9	0.47	2	<0.005	0.71	<0.005	0.23	0.71	0.017	<0.0001	0.001	0.001	<0.001	<0.001	0.037	<0.0001
7/07/2010		7.6	0.44	0.21	<0.005	1.4	0.005	0.21	1.4	0.013	<0.002	<0.005	<0.005	<0.005	<0.005	<0.01	<0.0001
11/10/2010	8.3	0.44	0.08	<0.005	1	0.03	0.093	0.97	0.97	0.014	<0.002	<0.005	<0.005	<0.001	<0.005	<0.01	<0.0001
AVERAGE		7.25	0.45	0.48	<0.005	1.09	0.01	0.16	1.09	0.0148	0.00086	0.0244	0.003	0.0026	0.0032	0.0318	<0.0001
28/10/2009	MB4	7.8	1.2	<0.01	<0.005	0.88	0.78	0.01	0.1	0.002	<0.0001	<0.001	0.002	<0.001	0.004	0.027	<0.0001
21/01/2010		7.65	0.74	<0.01	<0.005	0.4	0.026	0.037	0.37	0.003	0.0001	0.003	0.004	0.004	0.005	0.067	<0.0001
21/04/2010		7.7	0.69	0.55	<0.005	0.5	0.015	0.089	0.48	0.003	<0.0001	0.001	0.005	0.001	0.002	0.007	<0.0001
7/07/2010		8	0.61	0.17	<0.005	1.8	0.11	0.047	1.7	0.002	<0.002	<0.005	<0.005	<0.005	<0.005	<0.01	<0.0001
11/10/2010	8.1	0.6	0.46	0.009	1.4	0.084	0.025	1.3	0.001	<0.002	<0.005	0.007	<0.001	<0.005	<0.01	<0.0001	
AVERAGE		7.85	0.768	0.24	0.0058	1.00	0.20	0.04	0.79	0.002	0.00086	0.003	0.0046	0.0016	0.0042	0.0242	<0.0001
28/10/2009	MB5	7.1	0.64	0.1	<0.005	1.1	0.22	<0.005	0.85	0.002	<0.0001	<0.001	0.002	<0.001	0.001	0.016	<0.0001
21/01/2010		6.55	0.51	<0.01	<0.005	0.92	0.16	0.056	0.76	0.005	<0.0001	0.14	0.017	0.035	0.009	0.47	<0.0001
21/04/2010		6.5	0.57	0.12	<0.005	0.5	0.14	0.12	0.36	0.017	<0.0001	nt	0.001	<0.001	<0.001	nt	nt
7/07/2010		8.2	0.54	0.16	<0.005	0.75	0.07	0.031	0.68	0.002	<0.002	<0.005	<0.005	<0.005	<0.005	0.02	<0.0001
11/10/2010	8.1	0.48	0.17	<0.005	1.4	0.065	0.057	1.3	0.004	<0.002	<0.005	<0.005	<0.005	<0.005	<0.01	<0.0001	
AVERAGE		7.29	0.55	0.11	<0.005	0.93	0.13	0.05	0.79	0.01	0.00086	0.03775	0.006	0.0078	0.0042	0.129	<0.0001
SCCP Long Term				0.1		1					0.0002	0.001	0.0014	0.0034	0.011	0.008	0.00006
SCCP Short Term Target				0.2		2											
ANZECC Drinking						11.3											

Fresh Waters Guideline
given as Dissolved; only indicative comparison)

(Concentrations)

DoW Bore 3012

Levels in mAHD		observed WL (mAHD)	calculated AAMGL (mAHD)	GL (mAHD)	GL - AAMGL (m)
12:00:00 05/05/1977	1.830				
12:00:00 21/06/1977	2.020				
12:00:00 06/07/1977	2.020				
12:00:00 08/09/1977	2.120				
12:00:00 12/10/1977	2.120				
12:00:00 04/11/1977	2.050				
	2.120				
12:00:00 30/03/1978	1.540				
12:00:00 20/04/1978	1.530				
12:00:00 24/05/1978	1.750				
12:00:00 19/06/1978	1.810				
12:00:00 26/07/1978	2.190				
12:00:00 24/08/1978	2.220				
12:00:00 29/09/1978	2.410				
12:00:00 23/10/1978	2.350				
12:00:00 13/11/1978	2.250				
12:00:00 20/12/1978	2.090				
	2.410				
12:00:00 15/01/1979	1.960				
12:00:00 13/03/1979	1.790				
12:00:00 18/04/1979	1.770				
12:00:00 10/05/1979	1.720				
12:00:00 22/06/1979	1.600				
12:00:00 17/07/1979	2.010				
12:00:00 21/08/1979	2.270				
12:00:00 19/09/1979	2.240				
12:00:00 23/10/1979	2.050				
12:00:00 22/11/1979	2.100				
12:00:00 20/12/1979	1.950				
	2.270				
12:00:00 24/01/1980	1.730				
12:00:00 22/02/1980	1.540				
12:00:00 19/03/1980	1.570				
12:00:00 21/05/1980	1.640				
12:00:00 16/07/1980	2.010				
12:00:00 21/08/1980	2.340				
12:00:00 19/09/1980	2.390				
12:00:00 24/10/1980	2.370				
12:00:00 25/11/1980	2.290				
12:00:00 29/12/1980	2.200				
	2.390				
12:00:00 27/01/1981	2.000				
12:00:00 26/02/1981	1.840				
12:00:00 24/03/1981	1.760				
12:00:00 30/04/1981	1.740				
12:00:00 19/05/1981	1.780				
12:00:00 23/06/1981	2.180				
12:00:00 17/07/1981	2.200				
12:00:00 19/08/1981	2.550				
12:00:00 24/09/1981	2.620				
12:00:00 26/10/1981	2.560				
12:00:00 17/11/1981	2.530				
12:00:00 21/12/1981	2.450				
	2.620				
12:00:00 29/01/1982	2.490				
12:00:00 23/02/1982	2.300				
12:00:00 25/03/1982	2.250				
12:00:00 22/04/1982	2.170				
12:00:00 24/05/1982	2.130				
12:00:00 23/06/1982	2.360				
12:00:00 27/07/1982	2.620				
12:00:00 23/08/1982	2.690				
12:00:00 22/09/1982	2.710				
12:00:00 22/10/1982	2.690				
12:00:00 23/11/1982	2.600				
12:00:00 21/12/1982	2.480				
	2.710				
12:00:00 20/01/1983	2.290				
12:00:00 21/02/1983	2.190				
12:00:00 23/03/1983	2.060				

	28/10/2009				
MW1	2.009	2.412	4.281	1.869	
MW2	1.98	2.383	8.195	5.812	
MW3	1.942	2.345	4.012	1.667	
MW4	1.938	2.341	10.988	8.647	
MW5	1.094	1.497	6.954	5.457	
DoW 3011	1.845	2.248	6.76	4.512	
DoW 3033					
DoW 3034					
DoW 3012	1.83	2.233	6.76	4.527	
	Max		2.412		
	Min		1.497		
		0.403			
	difference between observed & calculated				

12:00:00	22/04/1983	1.970	
12:00:00	25/05/1983	1.980	
12:00:00	24/06/1983	2.290	
12:00:00	26/07/1983	2.460	
12:00:00	25/08/1983	2.560	
12:00:00	23/09/1983	2.610	
12:00:00	21/10/1983	2.570	
12:00:00	21/11/1983	2.510	
12:00:00	29/12/1983	2.330	2.610
12:00:00	25/01/1984	2.210	
12:00:00	23/02/1984	2.060	
12:00:00	26/03/1984	1.930	
12:00:00	18/04/1984	1.910	
12:00:00	22/05/1984	2.150	
12:00:00	20/06/1984	2.380	
12:00:00	18/07/1984	2.440	
12:00:00	24/08/1984	2.570	
12:00:00	24/09/1984	2.650	
12:00:00	31/10/1984	2.460	
12:00:00	21/11/1984	2.680	
12:00:00	19/12/1984	2.460	2.680
12:00:00	22/03/1985	2.110	
12:00:00	18/04/1985	2.130	
12:00:00	16/05/1985	2.060	
12:00:00	14/06/1985	2.210	
12:00:00	18/07/1985	2.550	
12:00:00	20/08/1985	2.640	
12:00:00	12/09/1985	2.600	
12:00:00	16/10/1985	2.600	
12:00:00	15/11/1985	2.500	2.640
15:06:00	05/02/1986	2.060	
10:44:00	20/03/1986	2.010	
10:31:00	15/04/1986	1.930	
10:12:00	14/05/1986	1.950	
11:07:00	18/06/1986	2.090	
10:23:00	16/07/1986	2.450	
10:41:00	18/08/1986	2.700	
10:03:00	18/09/1986	2.800	
10:24:00	20/10/1986	2.770	
09:27:00	10/11/1986	2.710	
09:35:00	03/12/1986	2.620	2.800
09:18:00	23/01/1987	2.350	
09:47:00	12/02/1987	2.240	
10:26:00	04/03/1987	2.110	
09:36:00	02/04/1987	2.020	
09:21:00	05/05/1987	2.090	
09:43:00	28/05/1987	2.090	
08:58:00	06/07/1987	2.250	
09:38:00	04/08/1987	2.400	
09:11:00	02/09/1987	2.460	
13:24:00	06/10/1987	2.420	
09:15:00	05/11/1987	2.310	
11:13:00	03/12/1987	2.230	2.460
09:34:00	05/02/1988	1.890	
09:40:00	03/03/1988	1.740	
10:01:00	15/04/1988	1.640	
09:27:00	09/05/1988	1.730	
09:06:00	01/06/1988	2.010	
09:40:00	07/07/1988	2.220	
09:33:00	06/09/1988	2.480	
09:41:00	12/10/1988	2.500	
09:47:00	07/11/1988	2.440	2.500
09:36:00	25/01/1989	2.050	
09:59:00	21/04/1989	1.760	
11:32:00	20/07/1989	2.260	
10:00:00	05/10/1989	2.530	2.530
13:04:00	11/01/1990	2.200	
10:49:00	02/04/1990	1.920	
13:01:00	10/07/1990	2.130	
11:46:00	23/10/1990	2.240	2.240

10:52:00	10/01/1991	1.840	
10:24:00	06/04/1991	1.590	
10:01:00	23/07/1991	2.370	
10:41:00	02/10/1991	2.580	
14:43:00	23/10/1991	2.540	2.580
14:34:00	31/01/1992	2.170	
10:17:00	07/04/1992	2.170	
14:07:00	07/05/1992	2.160	
12:12:00	09/07/1992	2.390	
12:13:00	19/10/1992	2.590	2.590
11:30:00	25/01/1993	2.200	
11:28:00	20/04/1993	1.960	
09:27:00	19/07/1993	2.160	
10:15:00	08/10/1993	2.360	2.360
10:33:00	24/01/1994	1.800	
12:39:00	27/04/1994	1.490	
10:16:00	05/07/1994	1.960	
15:45:00	11/10/1994	2.110	
12:37:00	18/10/1994	2.170	2.170
11:22:00	23/01/1995	1.630	
09:50:00	10/04/1995	1.340	
13:15:00	14/07/1995	1.810	
11:47:00	17/10/1995	2.070	2.070
09:17:00	15/01/1996	1.710	
10:17:00	30/04/1996	1.380	
11:17:00	11/07/1996	1.850	
09:57:00	14/10/1996	2.230	2.230
10:50:00	20/01/1997	1.760	
08:49:00	17/04/1997	1.460	
09:23:00	11/07/1997	1.800	
09:35:00	13/10/1997	2.060	2.060
09:22:00	15/01/1998	1.560	
09:10:00	26/03/1998	1.420	
11:14:00	15/07/1998	1.680	
10:53:00	07/10/1998	2.060	2.060
09:30:00	15/01/1999	1.590	
10:19:00	20/05/1999	1.310	
09:37:00	21/09/1999	2.330	2.330
10:18:00	21/06/2000	1.690	
09:33:00	12/10/2000	2.210	2.210
09:22:00	16/05/2001	1.350	
09:06:00	16/10/2001	1.720	1.720
09:17:00	13/05/2002	1.130	
09:13:00	14/10/2002	1.590	1.590
09:06:00	13/05/2003	1.120	
13:15:00	15/10/2003	1.810	1.810
10:44:00	07/05/2004	0.980	
09:53:00	11/10/2004	1.660	1.660
10:22:00	13/05/2005	1.120	
09:18:00	06/10/2005	2.060	2.060
09:35:00	08/05/2006	1.300	
09:29:00	09/10/2006	1.630	1.630
08:59:00	03/05/2007	0.930	
09:14:00	15/10/2007	1.620	1.620
10:24:00	06/05/2008	0.870	
09:12:00	09/10/2008	2.060	2.060
09:49:00	06/05/2009	1.150	
12:27:00	15/10/2009	1.900	1.900

Average = 2.233

DoW Bore 3011

Levels in mAHD		observed WL (mAHD)	calculated AAMGL (mAHD)	GL (mAHD)	GL - AAMGL (m)
00:00:00	30/06/1975	1.850			
12:00:00	14/07/1975	2.660			
12:00:00	13/08/1975	2.820			
12:00:00	15/09/1975	2.850			
12:00:00	17/10/1975	2.740			
12:00:00	28/11/1975	2.720			
		2.850			
12:00:00	05/03/1976	2.260			
12:00:00	08/04/1976	2.140			
12:00:00	05/05/1976	2.180			
12:00:00	04/06/1976	2.180			
12:00:00	07/07/1976	2.380			
12:00:00	15/09/1976	2.530			
12:00:00	13/10/1976	2.540			
12:00:00	02/11/1976	2.450			
		2.540			
12:00:00	05/04/1977	1.880			
12:00:00	05/05/1977	1.830			
12:00:00	21/06/1977	2.030			
12:00:00	06/07/1977	2.020			
12:00:00	08/09/1977	2.150			
12:00:00	12/10/1977	2.130			
12:00:00	04/11/1977	2.050			
		2.150			
12:00:00	30/03/1978	1.530			
12:00:00	20/04/1978	1.540			
12:00:00	24/05/1978	1.760			
12:00:00	19/06/1978	1.820			
12:00:00	26/07/1978	2.210			
12:00:00	24/08/1978	2.250			
12:00:00	29/09/1978	2.390			
12:00:00	23/10/1978	2.340			
12:00:00	13/11/1978	2.260			
12:00:00	20/12/1978	2.090			
		2.390			
12:00:00	15/01/1979	1.960			
12:00:00	14/02/1979	1.820			
12:00:00	13/03/1979	1.640			
12:00:00	18/04/1979	1.770			
12:00:00	10/05/1979	1.740			
12:00:00	22/06/1979	1.880			
12:00:00	17/07/1979	2.190			
12:00:00	21/08/1979	2.280			
12:00:00	19/09/1979	2.250			
12:00:00	23/10/1979	2.060			
12:00:00	22/11/1979	2.100			
12:00:00	20/12/1979	1.950			
		2.280			
12:00:00	24/01/1980	1.730			
12:00:00	22/02/1980	1.560			
12:00:00	19/03/1980	1.550			
12:00:00	28/04/1980	1.500			
12:00:00	21/05/1980	1.630			
12:00:00	16/07/1980	2.010			
12:00:00	21/08/1980	2.350			
12:00:00	19/09/1980	2.400			
12:00:00	24/10/1980	2.390			
12:00:00	25/11/1980	2.290			
12:00:00	29/12/1980	2.190			
		2.400			
12:00:00	27/01/1981	1.990			
12:00:00	26/02/1981	1.820			
12:00:00	24/03/1981	1.730			
12:00:00	30/04/1981	1.650			
12:00:00	23/06/1981	2.150			
12:00:00	17/07/1981	2.200			
12:00:00	19/08/1981	2.540			
12:00:00	24/09/1981	2.610			
12:00:00	26/10/1981	2.520			
12:00:00	17/11/1981	2.530			
12:00:00	21/12/1981	2.400			
		2.610			
12:00:00	29/01/1982	2.490			
12:00:00	23/02/1982	2.350			
12:00:00	25/03/1982	2.240			

	observed WL (mAHD)	calculated AAMGL (mAHD)	GL (mAHD)	GL - AAMGL (m)
	28/10/2009			
MW1	2.009	2.423	4.281	1.858
MW2	1.98	2.394	8.195	5.801
MW3	1.942	2.356	4.012	1.656
MW4	1.938	2.352	10.988	8.636
MW5	1.094	1.508	6.954	5.446
DoW 3011	1.845	2.259	6.76	4.501
Max			2.423	
Min			1.508	
		0.414		
	difference between observed & calculated			

12:00:00	22/04/1982	2.150	
12:00:00	24/05/1982	2.030	
12:00:00	23/06/1982	2.270	
12:00:00	27/07/1982	2.600	
12:00:00	23/08/1982	2.710	
12:00:00	22/09/1982	2.720	
12:00:00	22/10/1982	2.690	
12:00:00	23/11/1982	2.570	
12:00:00	21/12/1982	2.470	2.720
12:00:00	20/01/1983	2.280	
12:00:00	21/02/1983	2.200	
12:00:00	23/03/1983	2.050	
12:00:00	22/04/1983	1.970	
12:00:00	25/05/1983	1.990	
12:00:00	24/06/1983	2.270	
12:00:00	26/07/1983	2.540	
12:00:00	25/08/1983	2.620	
12:00:00	23/09/1983	2.610	
12:00:00	21/10/1983	2.560	
12:00:00	21/11/1983	2.480	
12:00:00	29/12/1983	2.290	2.620
12:00:00	25/01/1984	2.200	
12:00:00	23/02/1984	2.020	
12:00:00	26/03/1984	1.920	
12:00:00	18/04/1984	1.950	
12:00:00	22/05/1984	2.170	
12:00:00	20/06/1984	2.320	
12:00:00	18/07/1984	2.480	
12:00:00	24/08/1984	2.710	
12:00:00	24/09/1984	2.760	
12:00:00	31/10/1984	2.540	
12:00:00	21/11/1984	2.670	
12:00:00	19/12/1984	2.490	2.760
12:00:00	29/01/1985	2.480	
12:00:00	25/02/1985	2.410	
12:00:00	22/03/1985	2.100	
12:00:00	18/04/1985	2.120	
12:00:00	16/05/1985	2.050	
12:00:00	14/06/1985	2.210	
12:00:00	18/07/1985	2.460	
12:00:00	20/08/1985	2.570	
12:00:00	12/09/1985	2.580	
12:00:00	16/10/1985	2.590	
12:00:00	15/11/1985	2.490	2.590
15:09:00	05/02/1986	2.040	
10:47:00	20/03/1986	2.010	
10:38:00	15/04/1986	1.920	
10:16:00	14/05/1986	1.940	
11:13:00	18/06/1986	2.080	
10:27:00	16/07/1986	2.440	
10:36:00	18/08/1986	2.410	
10:08:00	18/09/1986	2.790	
10:28:00	20/10/1986	2.750	
09:31:00	10/11/1986	2.700	
09:38:00	03/12/1986	2.610	2.790
09:20:00	23/01/1987	2.340	
09:45:00	12/02/1987	2.240	
10:30:00	04/03/1987	2.110	
09:39:00	02/04/1987	2.010	
09:23:00	05/05/1987	2.080	
09:55:00	28/05/1987	2.080	
09:01:00	06/07/1987	2.240	
09:41:00	04/08/1987	2.390	
09:13:00	02/09/1987	2.440	
13:28:00	06/10/1987	2.410	
09:18:00	05/11/1987	2.290	
11:09:00	03/12/1987	2.200	2.440
09:37:00	05/02/1988	1.880	
09:42:00	03/03/1988	1.730	
10:04:00	15/04/1988	1.625	
09:30:00	09/05/1988	1.710	
09:08:00	01/06/1988	2.000	
09:42:00	07/07/1988	2.200	
09:36:00	06/09/1988	2.480	

09:48:00	12/10/1988	2.480	
09:50:00	07/11/1988	2.420	2.480
09:38:00	25/01/1989	2.040	
10:01:00	21/04/1989	1.750	
11:34:00	20/07/1989	2.250	
10:08:00	05/10/1989	2.520	2.520
12:50:00	11/01/1990	2.190	
10:46:00	02/04/1990	1.920	
13:06:00	10/07/1990	2.120	
11:23:00	23/10/1990	2.230	2.230
10:56:00	10/01/1991	1.830	
10:27:00	06/04/1991	1.570	
09:59:00	23/07/1991	2.350	
10:32:00	02/10/1991	2.540	
12:33:00	23/10/1991	2.540	
13:10:00	23/10/1991	2.540	2.540
14:28:00	31/01/1992	2.160	
10:14:00	07/04/1992	2.160	
14:42:00	07/05/1992	2.150	
12:17:00	09/07/1992	2.370	
12:08:00	19/10/1992	2.580	2.580
11:24:00	25/01/1993	2.180	
11:26:00	20/04/1993	1.900	
09:32:00	19/07/1993	2.140	
10:18:00	08/10/1993	2.330	
00:00:00	24/11/1993	2.180	2.330
10:35:00	24/01/1994	1.790	
12:44:00	27/04/1994	1.490	
10:19:00	05/07/1994	1.950	
12:35:00	18/10/1994	2.150	2.150
11:20:00	23/01/1995	1.620	
09:45:00	10/04/1995	1.340	
13:10:00	14/07/1995	1.810	
11:45:00	17/10/1995	2.050	2.050
09:15:00	15/01/1996	1.700	
10:15:00	30/04/1996	1.360	
11:15:00	11/07/1996	1.830	
09:55:00	14/10/1996	2.220	2.220
10:52:00	20/01/1997	1.740	
08:45:00	17/04/1997	1.450	
09:20:00	11/07/1997	1.790	
09:30:00	13/10/1997	2.050	2.050
09:20:00	15/01/1998	1.570	
09:08:00	26/03/1998	1.400	
11:12:00	15/07/1998	1.670	
10:51:00	07/10/1998	2.050	2.050
09:28:00	15/01/1999	1.570	
10:17:00	20/05/1999	1.300	
09:34:00	21/09/1999	2.320	2.320
10:16:00	21/06/2000	1.680	
09:31:00	12/10/2000	2.190	2.190
09:20:00	16/05/2001	1.330	
09:03:00	16/10/2001	1.700	1.700
09:15:00	13/05/2002	1.120	
09:11:00	14/10/2002	1.580	1.580
09:04:00	13/05/2003	1.120	
13:11:00	15/10/2003	1.820	1.820
10:42:00	07/05/2004	0.980	
09:51:00	11/10/2004	1.650	1.650
10:20:00	13/05/2005	1.140	
09:16:00	06/10/2005	2.070	2.070
09:33:00	08/05/2006	1.310	
09:27:00	09/10/2006	1.770	1.770
08:57:00	03/05/2007	0.940	
09:11:00	15/10/2007	1.640	1.640
10:21:00	06/05/2008	1.180	
09:09:00	09/10/2008	2.070	2.070
08:47:00	06/05/2009	1.160	
12:22:00	15/10/2009	1.910	1.910

Average = 2.259

12:00:00 22/04/1982	2.440	
12:00:00 20/05/1982	2.370	
12:00:00 30/06/1982	2.690	
12:00:00 23/07/1982	2.570	
12:00:00 19/08/1982	2.690	
12:00:00 21/09/1982	2.810	
12:00:00 19/10/1982	2.840	
12:00:00 19/11/1982	2.820	
12:00:00 20/12/1982	2.730	2.840
12:00:00 17/01/1983	2.600	
12:00:00 18/02/1983	2.500	
12:00:00 21/03/1983	2.380	
12:00:00 21/04/1983	2.280	
12:00:00 24/05/1983	2.210	
12:00:00 23/06/1983	2.270	
12:00:00 25/07/1983	2.410	
12:00:00 24/08/1983	2.450	
12:00:00 22/09/1983	2.690	
12:00:00 20/10/1983	2.700	
12:00:00 18/11/1983	2.660	
12:00:00 28/12/1983	2.600	2.700
12:00:00 24/01/1984	2.400	
12:00:00 22/02/1984	2.350	
12:00:00 22/03/1984	2.240	
12:00:00 17/04/1984	2.150	
12:00:00 21/05/1984	2.190	
12:00:00 19/06/1984	2.700	
12:00:00 17/07/1984	2.890	
12:00:00 21/08/1984	3.010	
12:00:00 20/09/1984	3.060	
12:00:00 31/10/1984	2.920	
12:00:00 21/11/1984	2.850	
12:00:00 18/12/1984	2.750	3.060
12:00:00 29/01/1985	2.660	
12:00:00 21/02/1985	2.600	
12:00:00 21/03/1985	2.450	
12:00:00 18/04/1985	2.370	
12:00:00 15/05/1985	2.300	
12:00:00 14/06/1985	2.300	
12:00:00 18/07/1985	2.500	
12:00:00 14/08/1985	2.580	
12:00:00 12/09/1985	2.680	
12:00:00 16/10/1985	2.730	
12:00:00 15/11/1985	2.690	2.730
14:47:00 05/02/1986	2.410	
11:22:00 20/03/1986	2.290	
11:42:00 15/04/1986	2.220	
10:59:00 14/05/1986	2.160	
12:32:00 18/06/1986	2.180	
11:06:00 16/07/1986	2.440	
11:20:00 18/08/1986	2.700	
10:54:00 18/09/1986	2.880	
10:35:00 10/11/1986	2.940	
10:11:00 03/12/1986	2.880	2.940
09:57:00 23/01/1987	2.690	
10:20:00 12/02/1987	2.590	
11:13:00 04/03/1987	2.500	
10:17:00 02/04/1987	2.380	
10:00:00 05/05/1987	2.310	
10:28:00 28/05/1987	2.290	
10:15:00 06/07/1987	2.350	
10:16:00 04/08/1987	2.470	
09:44:00 02/09/1987	2.540	
14:06:00 06/10/1987	2.570	
10:05:00 05/11/1987	2.500	
13:30:00 03/12/1987	2.450	2.690
10:09:00 05/02/1988	2.230	
10:20:00 03/03/1988	2.095	
10:49:00 15/04/1988	1.905	
09:51:00 01/06/1988	2.010	
10:28:00 07/07/1988	2.190	
10:22:00 06/09/1988	2.520	
10:42:00 12/10/1988	2.620	

10:22:00 07/11/1988	2.640	2.640
10:09:00 25/01/1989	2.420	
10:42:00 21/04/1989	2.070	
12:05:00 20/07/1989	2.220	
11:05:00 05/10/1989	2.560	2.560
13:58:00 11/01/1990	2.460	
11:33:00 02/04/1990	2.170	
13:51:00 10/07/1990	2.200	
12:48:00 23/10/1990	2.380	2.460
11:29:00 10/01/1991	2.140	
11:03:00 06/04/1991	1.880	
10:56:00 23/07/1991	2.220	
11:15:00 02/10/1991	2.700	
12:21:00 29/10/1991	2.720	
13:29:00 29/10/1991	2.720	
13:36:00 31/01/1992	2.520	
11:30:00 08/04/1992	2.420	
14:05:00 01/05/1992	2.370	
13:42:00 09/07/1992	2.480	
12:53:00 19/10/1992	2.770	2.770
12:55:00 25/01/1993	2.510	
12:12:00 20/04/1993	2.200	
10:30:00 19/07/1993	2.200	
10:57:00 08/10/1993	2.440	2.510
11:15:00 24/01/1994	2.140	
13:24:00 27/04/1994	1.790	
11:40:00 05/07/1994	1.890	
13:08:00 18/10/1994	2.250	2.250
12:43:00 23/01/1995	1.940	
11:00:00 10/04/1995	1.630	
14:10:00 14/07/1995	1.720	
09:22:00 19/10/1995	2.150	2.150
09:55:00 15/01/1996	1.980	
10:52:00 30/04/1996	1.750	
11:50:00 11/07/1996	1.690	
10:37:00 14/10/1996	2.250	2.250
11:20:00 20/01/1997	2.060	
09:50:00 17/04/1997	1.680	
09:50:00 11/07/1997	1.770	
10:30:00 13/10/1997	2.100	2.100
09:55:00 15/01/1998	1.820	
09:53:00 26/03/1998	1.560	
11:42:00 15/07/1998	1.610	
10:27:00 07/10/1998	1.960	1.960
10:00:00 15/01/1999	1.820	
11:05:00 20/05/1999	1.350	
10:30:00 21/09/1999	2.190	2.190
10:54:00 21/06/2000	1.720	
10:00:00 12/10/2000	2.280	2.280
10:00:00 16/05/2001	1.460	
09:44:00 16/10/2001	1.750	1.750
09:50:00 13/05/2002	1.200	
09:43:00 14/10/2002	1.630	1.630
09:40:00 13/05/2003	1.150	
13:54:00 15/10/2003	1.830	1.830
09:24:00 07/04/2004	1.180	
11:22:00 07/05/2004	1.180	
10:43:00 11/10/2004	1.640	1.640
10:53:00 13/05/2005	1.130	
09:50:00 06/10/2005	2.030	2.030
10:22:00 08/05/2006	1.530	
10:16:00 09/10/2006	1.710	1.710
09:28:00 03/05/2007	1.050	
09:40:00 15/10/2007	1.560	1.560
10:46:00 06/05/2008	1.220	
09:37:00 09/10/2008	2.140	2.140
09:12:00 06/05/2009	1.430	
13:01:00 15/10/2009	1.990	1.990

Average = 2.344

DoW Bore 3034

Levels in mAHD		observed WL (mAHD)	calculated AAMGL (mAHD)	GL (mAHD)	GL - AAMGL (m)
12:00:00	13/04/1977				
12:00:00	05/05/1977				
12:00:00	21/06/1977				
12:00:00	07/07/1977				
12:00:00	08/09/1977				
12:00:00	12/10/1977				
12:00:00	07/11/1977				
			25/11/2009		
		MW1	1.941	2.354	1.927
		MW2	1.895	2.308	5.887
		MW3	1.87	2.283	1.729
		MW4	1.85	2.263	8.725
		MW5	1.036	1.449	5.505
		DoW 3034	1.945	2.358	4.402
		Max		2.354	
		Min		1.449	
				0.413	
				difference between observed & calculated	
12:00:00	30/03/1978				
12:00:00	20/04/1978				
12:00:00	24/05/1978				
12:00:00	19/06/1978				
12:00:00	20/07/1978				
12:00:00	16/08/1978				
12:00:00	29/09/1978				
12:00:00	29/10/1978				
12:00:00	13/11/1978				
					2.670
12:00:00	15/01/1979				
12:00:00	13/03/1979				
12:00:00	18/04/1979				
12:00:00	11/05/1979				
12:00:00	22/06/1979				
12:00:00	17/07/1979				
12:00:00	21/08/1979				
12:00:00	19/09/1979				
12:00:00	23/10/1979				
12:00:00	19/11/1979				
12:00:00	20/12/1979				
					2.500
12:00:00	23/01/1980				
12:00:00	22/02/1980				
12:00:00	19/03/1980				
12:00:00	28/04/1980				
12:00:00	21/05/1980				
12:00:00	20/08/1980				
12:00:00	19/09/1980				
12:00:00	24/10/1980				
12:00:00	25/11/1980				
12:00:00	29/12/1980				
					2.400
12:00:00	23/01/1981				
12:00:00	24/03/1981				
12:00:00	30/04/1981				
12:00:00	19/05/1981				
12:00:00	23/06/1981				
12:00:00	17/07/1981				
12:00:00	19/08/1981				
12:00:00	23/09/1981				
12:00:00	26/10/1981				
12:00:00	23/11/1981				
12:00:00	21/12/1981				
					2.530
12:00:00	25/01/1982				
12:00:00	22/02/1982				
12:00:00	26/03/1982				
12:00:00	22/04/1982				
12:00:00	20/05/1982				
12:00:00	30/06/1982				
12:00:00	23/07/1982				
12:00:00	20/08/1982				
12:00:00	21/09/1982				
12:00:00	25/10/1982				
12:00:00	19/11/1982				
12:00:00	20/12/1982				
					2.990
12:00:00	17/01/1983				
12:00:00	18/02/1983				
12:00:00	21/03/1983				
12:00:00	21/04/1983				
12:00:00	24/05/1983				
12:00:00	23/06/1983				
					2.950

12:00:00	25/07/1983	2.450	
12:00:00	24/08/1983	2.550	
12:00:00	22/09/1983	2.680	
12:00:00	20/10/1983	2.730	
12:00:00	18/11/1983	2.670	
12:00:00	28/12/1983	2.500	2.730
12:00:00	24/01/1984	2.350	
12:00:00	22/02/1984	2.300	
12:00:00	22/03/1984	2.180	
12:00:00	17/04/1984	2.050	
12:00:00	21/05/1984	2.200	
12:00:00	19/06/1984	2.450	
12:00:00	17/07/1984	2.590	
12:00:00	21/08/1984	2.710	
12:00:00	20/09/1984	2.770	
12:00:00	31/10/1984	2.610	
12:00:00	21/11/1984	2.860	
12:00:00	18/12/1984	2.740	2.860
12:00:00	21/03/1985	2.430	
12:00:00	18/04/1985	2.250	
12:00:00	15/05/1985	2.400	
12:00:00	14/06/1985	2.310	
12:00:00	18/07/1985	2.500	
12:00:00	14/08/1985	2.610	
12:00:00	12/09/1985	2.700	
12:00:00	16/10/1985	2.750	
12:00:00	15/11/1985	2.700	2.750
14:45:00	05/02/1986	2.390	
11:18:00	20/03/1986	2.290	
11:52:00	15/04/1986	2.200	
10:55:00	14/05/1986	2.150	
12:44:00	18/06/1986	2.190	
11:11:00	16/07/1986	2.420	
11:27:00	18/08/1986	2.700	
10:50:00	18/09/1986	2.900	
10:54:00	20/10/1986	3.090	
10:30:00	10/11/1986	2.970	
10:08:00	03/12/1986	2.890	3.090
09:54:00	23/01/1987	2.670	
10:18:00	12/02/1987	2.580	
11:16:00	04/03/1987	2.470	
10:20:00	02/04/1987	2.360	
10:05:00	05/05/1987	2.320	
10:31:00	28/05/1987	2.290	
10:18:00	06/07/1987	2.680	
10:19:00	04/08/1987	2.470	
09:46:00	02/09/1987	2.560	
14:12:00	06/10/1987	2.600	
10:09:00	05/11/1987	2.500	
13:33:00	03/12/1987	2.460	2.680
10:11:00	05/02/1988	2.220	
10:15:00	03/03/1988	2.065	
09:59:00	01/06/1988	2.070	
10:23:00	07/07/1988	2.250	
10:20:00	06/09/1988	2.580	
10:49:00	12/10/1988	2.670	
10:26:00	07/11/1988	2.670	2.670
10:13:00	25/01/1989	2.440	
10:45:00	21/04/1989	2.140	
12:09:00	20/07/1989	2.270	
11:14:00	05/10/1989	2.610	2.610
13:40:00	11/01/1990	2.470	
11:29:00	02/04/1990	2.170	
13:55:00	10/07/1990	2.230	
12:41:00	23/10/1990	2.400	2.470
11:43:00	10/01/1991	2.140	
10:51:00	23/07/1991	2.260	
11:17:00	02/10/1991	2.710	2.710
13:27:00	31/01/1992	2.520	
11:34:00	08/04/1992	2.420	
13:48:00	09/07/1992	2.490	
12:47:00	19/10/1992	2.800	2.800

13:00:00	25/01/1993	2.500	
12:15:00	20/04/1993	2.170	
10:23:00	19/07/1993	2.220	
10:53:00	08/10/1993	2.460	2.500
11:17:00	24/01/1994	2.110	
13:04:00	18/10/1994	2.300	
15:30:00	19/10/1994	1.860	2.300
12:45:00	23/01/1995	1.920	
10:55:00	10/04/1995	1.610	
14:05:00	14/07/1995	1.750	
09:20:00	19/10/1995	2.160	2.160
09:50:00	15/01/1996	1.950	
10:50:00	30/04/1996	1.560	
11:52:00	11/07/1996	1.730	
10:35:00	14/10/1996	2.300	2.300
11:15:00	20/01/1997	2.020	
09:35:00	17/04/1997	1.650	
09:55:00	11/07/1997	1.860	
10:25:00	13/10/1997	2.130	2.130
09:50:00	15/01/1998	1.760	
09:50:00	26/03/1998	1.520	
11:40:00	15/07/1998	1.650	
10:25:00	07/10/1998	2.000	2.000
09:58:00	15/01/1999	1.770	
10:59:00	20/05/1999	1.380	
10:26:00	21/09/1999	2.220	2.220
10:50:00	21/06/2000	1.710	
09:58:00	12/10/2000	2.280	2.280
09:57:00	16/05/2001	1.430	
09:40:00	16/10/2001	1.730	1.730
09:47:00	13/05/2002	1.170	
09:49:00	14/10/2002	1.640	1.640
09:37:00	13/05/2003	1.150	
13:57:00	15/10/2003	1.850	1.850
11:25:00	07/05/2004	1.130	
10:39:00	11/10/2004	1.660	1.660
10:50:00	13/05/2005	1.120	
09:48:00	06/10/2005	2.050	2.050
10:19:00	08/05/2006	1.510	
10:13:00	09/10/2006	1.730	1.730
09:25:00	03/05/2007	1.020	
09:45:00	15/10/2007	1.620	1.620
10:49:00	06/05/2008	1.220	
09:35:00	09/10/2008	2.190	2.190
09:09:00	06/05/2009	1.370	
13:01:00	15/10/2009	2.040	2.040

Average = 2.358

APPENDIX D

GROUND WATER USAGE

Date: 15/06/2011

Project: Lot 1507 Parkland Heights					
Year	Construction Stage	Approximate Stage Finish Date	Water Usage	Required Construction Water (kL)	Required Irrigation Water (kL)
2011	1	September	Construction Water/ Irrigation	30,000	6,500
2012	2	August	Construction Water/ Irrigation	30,000	13,000
2013	3	August	Construction Water/ Irrigation	40,000	55,000
2014	Sand Mining	Continuous	Construction Water/ Irrigation	40,000	55,000
2015	4	February	Construction Water/ Irrigation	40,000	56,000
2016	5	February	Construction Water/ Irrigation	60,000	56,000
2017	6	June	Construction Water/ Irrigation	60,000	56,000
2018	7	June	Construction Water/ Irrigation	40,000	62,000
2019	Sand Mining	Continuous	Construction Water/ Irrigation	40,000	62,000
2020	8	June	Construction Water/ Irrigation	40,000	67,000
2021	9A	June	Construction Water/ Irrigation	50,000	70,000
2022	9B	June	Construction Water/ Irrigation	50,000	70,000
2023	10A	June	Construction Water/ Irrigation	50,000	75,000
2024	10B	June	Construction Water/ Irrigation	50,000	77,000
2025	11	June	Construction Water/ Irrigation	30,000	77,000

Project: Heritage Park					
Year	Construction Stage	Approximate Stage Finish Date	Water Usage	Required Construction Water (kL)	Required Irrigation Water (kL)
2011	5A	July	Construction Water/ Irrigation	20000	23,000
2012	5B & 1B	July	Construction Water/ Irrigation	25000	23,000
2013	POS Only		Irrigation	-	23,000
2014	POS Only		Irrigation	-	23,000
2015	POS Only		Irrigation	-	23,000
2016	POS Only		Irrigation	-	23,000
2017	POS Only		Irrigation	-	23,000
2018	POS Only		Irrigation	-	23,000
2019	POS Only		Irrigation	-	23,000
2020	POS Only		Irrigation	-	23,000
2021	POS Only		Irrigation	-	23,000
2022	POS Only		Irrigation	-	23,000
2023	POS Only		Irrigation	-	23,000
2024	POS Only		Irrigation	-	23,000
2025	POS Only		Irrigation	-	23,000

Summary: Parkland Heights & Heritage Park		
Year	Total Required Construction Water (kL)	Total Required Irrigation Water (kL)
2011	50,000	29,500
2012	55,000	36,000
2013	40,000	78,000
2014	40,000	78,000
2015	40,000	79,000
2016	60,000	79,000
2017	60,000	79,000
2018	40,000	85,000
2019	40,000	85,000
2020	40,000	90,000
2021	50,000	93,000
2022	50,000	93,000
2023	50,000	98,000
2024	50,000	100,000

APPENDIX E

WATER BALANCE CALCULATIONS

Appendix E - Pre-post LD Water Balance

Parkland Heights LWMS

Pre-Development	Drainage and Infiltration (ML/yr)
Pre Development	112.83

Post-Development	Drainage and Infiltration (ML/yr)
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Groundwater Input	
R15 Houses	5.71
R20 Houses	191.64
R25 Houses	6.94
R30 Houses	55.91
R40 Houses	26.34
R50 Houses	0.00
R60 Houses	19.27
Non Residential recharge from rainfall & irrigation	48.60
POS recharge from rainfall & irrigation	19.36
Drainage areas and roads	164.54
Total Input	538.31

Groundwater Extraction	
R15 Houses	-1.20
R20 Houses	-46.36
R25 Houses	-1.19
R30 Houses	-12.37
R40 Houses	0.00
R50 Houses	0.00
R60 Houses	0.00
Groundwater for non-residential irrigation	-14.70
Groundwater for POS irrigation	-44.39
Total Extraction	-120.21

Total recharge to groundwater and drainage leaving site	418.10
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Extra volume recharge/outflow	305.28
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% increase of recharge/outflow	271%
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APPENDIX F

POTABLE DEMAND CALCULATIONS

Appendix F - Potable Calculator

Standard Water Use data		R15	R20	R25	R30	R40	R60	Total
Number of dwellings		19	696	27	302	170	190	1404
Number of people/hh		4	3	3	2	1.5	1.5	2.41
Number of people		76	2088	81	604	255	285	3389
Irrigable area/ lot	m2	280	208	208	110	50	35	
Irrigation rates	kl/ha/a	7500	7500	7500	7500	7500	7500	
Irrigation rates	kl/m2/a	0.75	0.75	0.75	0.75	0.75	0.75	
Indoor	kl/hh/a	224	168	168	112	84	84	
Outdoor	kl/hh/a	210	156	156	82.5	37.5	26.3	
Total Water use	kl/hh/a	434	324	324	194.5	121.5	110	244
Total Water use	kl/zone/a	8246	22504	8748	58739	20655	20948	342840
Total Water use	kl/p/a	109	108	108	97	81	74	101

Residential bore takeup rate		%	20%	20%	20%	0%	0%	0%
Total Savings								
		kl/dev/a	kl/hh/a	%				
P1	Eco water saver- Rainwater indoors							
	Package takeup rate		1%	1%	1%	0%	0%	0%
	Savings	kl/hh/a	26	21	21	16	15	15
	Total package savings	kl/zone/a	4.94	146.16	5.67	0	0	0
							157	0.1
								0%
P2	Eco water recycler - Greywater + ww garden (backyard)							
	Package takeup rate (not including those in P3)		0%	0%	0%	0%	0%	0%
	% of total homes with both bore and package		0%	0%	0%	0%	0%	0%
	Greywater							
	Greywater produced	kl/hh/a	0	0	0	0	0	0
	Required Greywater area (35mm/wk)	m2	0.0	0.0	0.0	0.0	0.0	0.0
	Scheme water saved	kl/hh/a	0.0	0.0	0.0	0.0	0.0	0.0
	Scheme water saved	kl/zone/a	0	0	0	0	0	0
	Waterwise garden usage							
	Waterwise garden savings	kl/hh/a	42.0	31.2	31.2	16.5	7.5	5.3
	Waterwise garden savings	kl/zone/a	0.0	0.0	0.0	0.0	0.0	0.0
	Total package savings	kl/zone/a	0	0	0	0	0	0
	Savings from bore	kl/zone/a	798	21715	842	0	0	0
	Savings from bore & package	kl/zone/a	798	21715	842	0	0	0
							0	0.0
							23356	17
							23356	16.6
								0.0%
								6.8%
								6.8%
P3	Eco waterwise landscape (frontyard)							
	Package takeup rate (not including those with P2)		100%	100%	100%	100%	0%	0%
	% of total homes with both bore and package		0%	0%	0%	0%	0%	0%
	Scheme water savings	kl/hh/a	42	31.2	31.2	16.5	7.5	5.25
	Total package scheme water savings	kl/zone/a	798	21715	842	4983	0	0
	Savings from bore	kl/zone/a	798	21715	842	0	0	0
	Savings from bore & package	kl/zone/a	1596	43430	1685	4983	0	0
							28339	20.2
							23356	16.6
							51694	36.8
								8.3%
								6.8%
								15.1%
P4	Indoor Eco water saver (Internal appliance upgrade)							
	Package takeup rate		0%	0%	0%	0%	0%	0%
	Savings	kl/hh/a	46.6	35.0	35.0	23.3	17.5	17.5
	Total package savings	kl/zone/a	0	0	0	0	0	0
							0	0.0
							0	0.0
								0.0%
P5	Behaviour change program							
	Package takeup rate		30%	30%	30%	30%	30%	30%
	Savings	kl/hh/a	65.1	48.6	48.6	29.2	18.2	16.5
	Total package savings	kl/zone/a	371	10148	394	2643	929	943
							15428	11.0
								4.5%

Total packages savings		kl/zone/a	1174	32009	1242	7626	929	943
							43923	31.3
								12.8%
Total Residential Bore savings		kl/zone/a	1596	43430	1685	0	0	0
							46711	33.3
								13.6%

	kl/hh/a	L/hh/d	kl/p/a	L/p/d
Standard Total Water Use	247	677	102.3	280
Estimated Total Water Savings from Packages	31.3	86	13.0	36
Estimated Total Water Savings from Bore	33.3	91	13.8	38
Expected Total Water Scheme Water Use	182	500	75.6	207
% reduction	26%	26%	26%	26%

Packages Summary (averaged over whole development)

	Total saving			
	kl/hh/a	kl/p/a	%	
Eco water saver- Rainwater indoors	0.1	0.0	0%	toilet and w/m only assuming a 3star w/m assumes WW garden saves 40% of rear garden use assumes WW garden saves 40% of front garden use 4.5/3 toilet, 7.5L/min shower, tap restrictors Assumes 15% reduction
Eco water recycler - Greywater + ww garden	0.0	0.0	0%	
Eco waterwise landscape	20.2	8.4	8%	
Indoor Eco water saver (Internal appliance upgrade)	0.0	0.0	0%	
Behaviour change program	11.0	4.6	5%	
Residential bore water savings	33.3	4.6	14%	
Total	31	13	26%	

APPENDIX G

GROUNDWATER LICENCES



Your ref: GWL 169700 (3)
Our ref: RF 7769
Enquiries: Lorna Aylward 9550 4217

Rockingham Park Pty Ltd
PO Box 7197
CLOISTERS SQUARE WA 6850

Dear Licensee

Re: Issue of a Licence to Take Water – GWL 169700 (3)
Property: Lot 9002 on Plan 61888-Volume/Folio 2715/142- Lot 9002 Baldivis-Heritage Park
Lot 182 on Plan 55259 on Plan 55259-Volume/Folio Lr3147/627-Lot 182 Baldivis-Heritage Park

Please find enclosed your *Licence to Take Water*, issued under section 5C of the *Rights in Water and Irrigation Act 1914*. This licence entitles you to take water, subject to certain terms, conditions or restrictions. It does not absolve the licensee from responsibility for compliance with the requirements of all Commonwealth and State legislation.

It is important that you read the conditions of your licence carefully. If you do not understand your licence, please contact the Department as soon as possible, as there are penalties for failing to comply with all of your licence conditions.

Under Section 26GG(2) of the *Rights in Water and Irrigation Act 1914*, you have a right to apply to the State Administrative Tribunal to request a written statement of reasons for the period for which the licence is granted or for a review of any term, condition or restriction included in the licence. You have 28 days from the date you received this letter to request that the decision be reviewed

For further information please contact the State Administrative Tribunal:

State Administrative Tribunal
12 St Georges Terrace
PERTH WA 6000

GPO Box U1991
PERTH WA 6845

Telephone: (08) 9219 3111
Toll-free: 1300 306 017
Facsimile: (08) 9325 5099
www.sat.justice.wa.gov.au

If you wish to continue taking water after this *Licence to Take Water* expires, it is your responsibility to apply to the Department of Water for its renewal. If this licence expires and you have not applied to renew it, then the taking of water must cease, or you will be in breach of *the Rights in Water and Irrigation Act 1914*. It is suggested that an application for renewal be made at least one month in advance of the *Licence to Take Water* expiry date.

Should legal access to the land cease, for example you decide to sell your property, before the *Licence to Take Water* expiry date, you are required to inform the Department using Form 6 - Notice that Licence Holder is not or may not be Eligible to Hold a Licence and return the enclosed licence within 30 days. Failure to comply is a breach of the *Rights in Water and Irrigation Act 1914*.

You may apply to amend or transfer the *Licence to Take Water* at any time. The Department may also amend, suspend or cancel this licence in certain circumstances. For further information, please refer to the Frequently Asked Questions (FAQ's) on the Departments website <http://www.water.wa.gov.au>

Please note that the Department maintains a 'Water Register' containing information on Western Australia's water availability and licensing details. An extract of this licence has been placed on the register and can be viewed online at; <http://www.water.wa.gov.au>.

If you have any queries relating to the above matter, please contact me on 9550 4217

Yours faithfully



Lorna Aylward
Natural Resource Management Officer
Department of Water
Kwinana Peel Regional office

24 August 2011

Encl. GWL 169700 (3)



LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Rockingham Park Pty Ltd		
Description of Water Resource	Stakehill Perth - Superficial Swan	Annual Water Entitlement	27450 kL
Location of Water Source	Lot 182 On Plan 55259 - Volume/Folio Lr3147/627 - Lot 182 Baldivis - Heritage Park		
Authorised Activities	Taking of water for	Location of Activity	
	Irrigation of up to 0 ha of public open space	Lot 9002 On Plan 61888 - Volume/Folio 2715/142 - Lot 9002 Baldivis - Heritage Park	
	Irrigation of up to 6.87 ha of public open space	Lot 182 On Plan 55259 - Volume/Folio Lr3147/627 - Lot 182 Baldivis - Heritage Park	
Duration of Licence	From 18 August 2011 to 18 July 2013		

This Licence is subject to the following terms, conditions and restrictions:

- 1 Approval by the Department of Water is to be obtained prior to the construction of additional and replacement wells and the modification or refurbishment of existing wells.
- 2 That should the licensee's draw adversely affect the aquifer or other users in the area, the Department of Water may reduce the amount that may be drawn.
- 3 The licensee shall not use water for public open space between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.
- 4 The annual water year for water taken under this licence is defined as 12:00 pm at 1 July to 12:00 pm at 1 July twelve months later.
- 5 The licensee must take and record the reading from each meter required under this licence at the beginning and another at the end of the water year defined on this licence.
- 6 In addition to taking and recording the reading(s) at the beginning and the end of the water year, the licensee must, as close as practicable to the end of each month (other than the month in which the water year ends), take and record the reading from each meter required under this licence.
- 7 All meter readings must be recorded on the "Meter Water Use Card".
- 8 The completed Meter Water Use Card must be returned to the Department of Water by 14 July.
- 9 The licensee must not, in any water year, take more water than the annual water entitlement specified in this licence.
- 10 The licensee must notify the Department of Water in writing of any water meter malfunction within seven days of the malfunction being noticed.
- 11 That the licensee shall have the irrigation project completed by 27 August 2011.

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000



LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

This Licence is subject to the following terms, conditions and restrictions:

- 12 The licensee must obtain authorisation from the Department of Water before removing, replacing or interfering with any meter required under this licence.
- 13 The licensee must ensure the installed meter(s) accuracy is maintained to within plus or minus 5% of the volume metered, in field conditions.
- 14 Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.

End of terms, conditions and restrictions



Your ref: GWL 164680 (4)

Our ref: RF7769

Enquiries: Lorna Aylward (08) 9550 4217

Neil Teo
Dynamic Planning & Developments
PO Box 525
NORTH PERTH WA 6906

On behalf of Rockingham Park Pty Ltd

Dear Mr Teo

Re: Issue of a Licence to Take Water – GWL 164680 (4)
Property: Lot 1507 on Plan 194627-Volume/Folio Lr3115/948-Lot 1507 Baldivis-Parkland Estate
Lot 9003 on Plan 61899-Volume/Folio 2748/284-Lot 9003 Baldivis –Heritage Park

Please find enclosed your *Licence to Take Water*, issued under section 5C of the *Rights in Water and Irrigation Act 1914*. This licence entitles you to take water, subject to certain terms, conditions or restrictions. It does not absolve the licensee from responsibility for compliance with the requirements of all Commonwealth and State legislation.

It is important that you read the conditions of your licence carefully. If you do not understand your licence, please contact the Department as soon as possible, as there are penalties for failing to comply with all of your licence conditions.

Under Section 26GG(2) of the *Rights in Water and Irrigation Act 1914*, you have a right to apply to the State Administrative Tribunal to request a written statement of reasons for the period for which the licence is granted or for a review of any term, condition or restriction included in the licence. You have 28 days from the date you received this letter to request that the decision be reviewed

For further information please contact the State Administrative Tribunal:

State Administrative Tribunal
12 St Georges Terrace
PERTH WA 6000

GPO Box U1991
PERTH WA 6845

Telephone: (08) 9219 3111
Toll-free: 1300 306 017
Facsimile: (08) 9325 5099
www.sat.justice.wa.gov.au

This licence is due to expire on 25 August 2013. If you wish to continue taking water after this *Licence to Take Water* expires, it is your responsibility to apply to the Department of Water for its renewal. If this licence expires and you have not applied to renew it, then the taking of water must cease, or you will be in breach of *the Rights in Water and Irrigation Act 1914*. It is suggested that an application for renewal be made at least one month in advance of the *Licence to Take Water* expiry date.

Should legal access to the land cease, for example you decide to sell your property, before the *Licence to Take Water* expiry date, you are required to inform the Department using Form 6 - Notice that Licence Holder is not or may not be Eligible to Hold a Licence and return the enclosed licence within 30 days. Failure to comply is a breach of the *Rights in Water and Irrigation Act 1914*.

You may apply to amend or transfer the *Licence to Take Water* at any time. The Department may also amend, suspend or cancel this licence in certain circumstances. For further information, please refer to the Frequently Asked Questions (FAQ's) on the Departments website <http://www.water.wa.gov.au>

The Department of Water would like to inform you that your licence has been re-issued for a 1 year period only, it includes a development condition stating that you must have at least 50% of the irrigation project completed within the term of the licence otherwise the water entitlement will be reduced in line with the Department of Water's Statewide policy on unused water entitlements.

Please note that the Department maintains a 'Water Register' containing information on Western Australia's water availability and licensing details. An extract of this licence has been placed on the register and can be viewed online at; <http://www.water.wa.gov.au>.

If you have any queries relating to the above matter, please contact me on (08) 9550 4217

Yours sincerely



Lorna Aylward
Natural Resource Management Officer
Department of Water
Kwinana Peel Region

31 August 2011

Encl. GWL 164680 (4)



LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Rockingham Park Pty Ltd		
Description of Water Resource	Stakehill Perth - Superficial Swan	Annual Water Entitlement	80000 kL
Location of Water Source	Lot 1507 On Plan 194627 - Volume/Folio Lr3115/948 - Lot 1507 Baldivis - Parkland Heights Lot 9003 On Plan 61899 - Volume/Folio 2748/284 - Lot 9003 Baldivis - Heritage Park		
Authorised Activities	Taking of water for	Location of Activity	
	Dust suppression for earthworks and construction purposes	Lot 1507 On Plan 194627 - Volume/Folio Lr3115/948 - Lot 1507 Baldivis - Parkland Heights	
	Earthwork and construction purposes		
	Dust suppression for earthworks and construction purposes	Lot 9003 On Plan 61899 - Volume/Folio 2748/284 - Lot 9003 Baldivis - Heritage Park	
	Earthwork and construction purposes		
Duration of Licence	From 26 August 2011 to 25 August 2013		

This Licence is subject to the following terms, conditions and restrictions:

- 1 That should the licensee's draw adversely affect the aquifer or other users in the area, the Department of Water may reduce the amount that may be drawn.
- 2 Approval by the Department of Water is to be obtained prior to the construction of additional and replacement wells and the modification or refurbishment of existing wells.
- 3 The annual water year for water taken under this licence is defined as 12:00 pm at 1 July to 12:00 pm at 30 June twelve months later.
- 4 The licensee must take and record the reading from each meter required under this licence at the beginning and another at the end of the water year defined on this licence.
- 5 In addition to taking and recording the reading(s) at the beginning and the end of the water year, the licensee must, as close as practicable to the end of each month (other than the month in which the water year ends), take and record the reading from each meter required under this licence.
- 6 All meter readings must be recorded on the "Meter Water Use Card".
- 7 The licensee must not, in any water year, take more water than the annual water entitlement specified in this licence.
- 8 The licensee must ensure the installed meter(s) accuracy is maintained to within plus or minus 5% of the volume metered, in field conditions.

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000



LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

This Licence is subject to the following terms, conditions and restrictions:

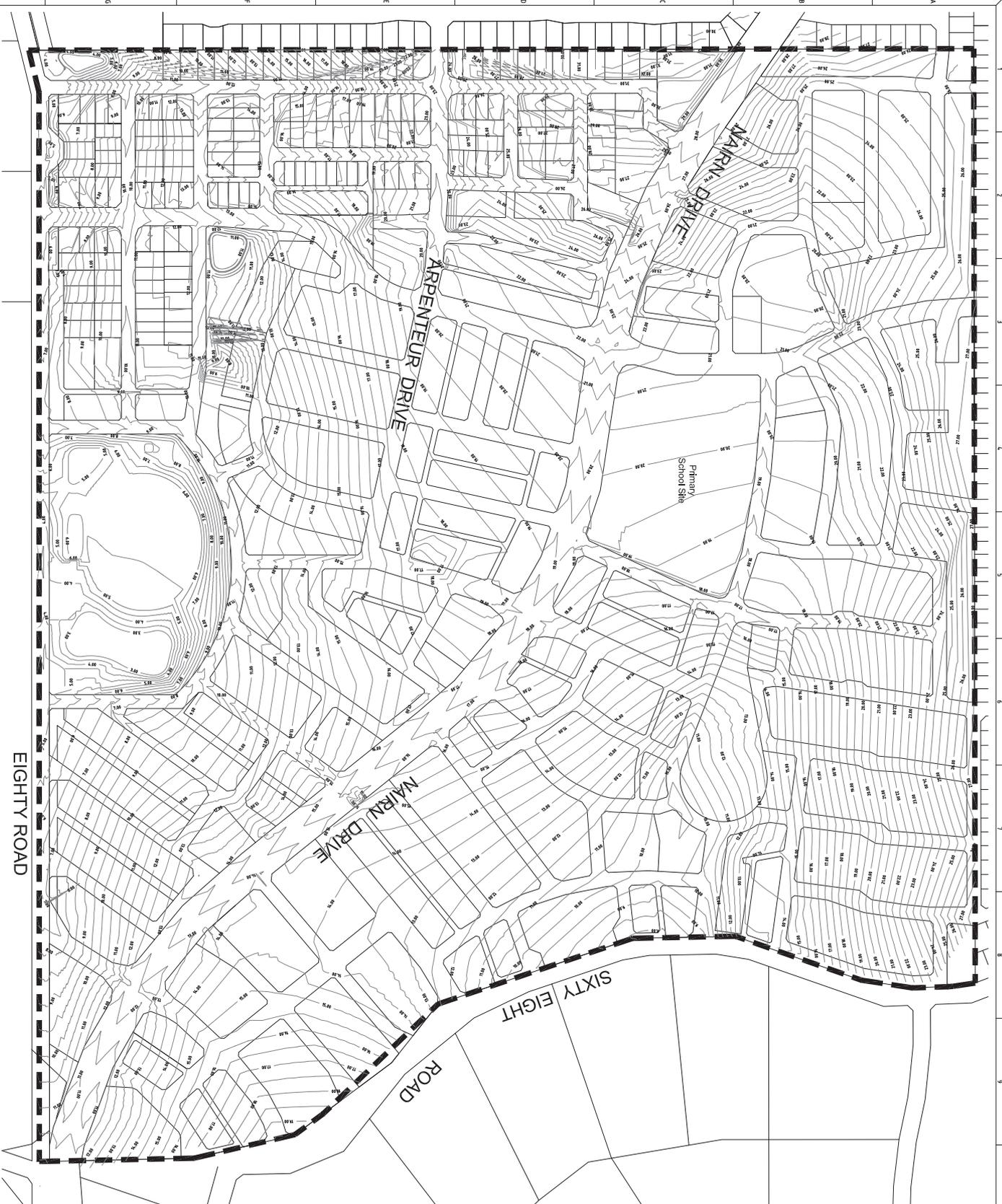
- 9 The licensee must notify the Department of Water in writing of any water meter malfunction within seven days of the malfunction being noticed.
- 10 The licensee must submit to the Department of Water the recorded meter readings and the volume of water taken within the water year by 14 July.
- 11 The licensee must install a cumulative water meter of a type approved under the Rights in Water and Irrigation (Approved Meters) Order 2009 to each water draw point under this licence.

End of terms, conditions and restrictions

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000

APPENDIX H

PRELIMINARY EARTHWORKS PLAN



EIGHTY ROAD

MAIRIN DRIVE

ARPENTEUR DRIVE

MAIRIN DRIVE

Primary School Site

SIXTY EIGHT ROAD

NOTES
 1. DRAWING FOR INFORMATION ONLY. FOR DETAILED DESIGN INFORMATION REFER TO STAGE SPECIFIC DRAWINGS AND SPECIFICATION.

LEGEND
 - - - - - PRELIMINARY DESIGN FINISHED SURFACE CONTOUR (1.0m INTERVAL)
 - - - - - LIMIT OF WORKS BOUNDARY

PRELIMINARY AND UNCHECKED

CHECK PRINT
 Apr 20, 2011

DRAFTING CHECK
 DESIGN CHECK
 CLIENT REVIEW
 APPROVED BY
 DESIGN

NO.	DATE	CHECK	REVISION	FIGS.	APPROVED
B	25/05/11				
CONTENTS UPDATED RE. SIGNED FOR INFORMATION					
ISSUED FOR INFORMATION ONLY					

NO.	DATE	CHECK	REVISION	FIGS.	APPROVED
CONTENTS UPDATED RE. SIGNED FOR INFORMATION					
ISSUED FOR INFORMATION ONLY					

SPRING CONSULTING
 INNOVATIVE ENGINEERING SOLUTIONS

Unit 10/200 Condonia Parkway, Mt Pleasant
 Telephone: (08) 8222 8244
 Fax: (08) 8222 8245
 Email: info@springconsulting.com.au
 www.springconsulting.com.au

CLIENT	ROCKINGHAM PARK
PROJECT	LOT 1507 - BALDWIN'S - PARKLAND HEIGHTS
DRAWN	RJE JMG
CHECKED	RJE JMG
DESIGNED	RJE JMG
REVIEWED	RJE JMG
PROJECT MANAGER	
APPROVED	
PROJECT DIRECTOR	

TITLE			
PRELIMINARY OVERALL EARTHWORKS PLAN			
SHEET	DRAWN	WORK NO.	PROJECT NO.
A1	A.H.L.	1080	SC00102.010
	SCALE		DRAWING NO.
			C010
			VERSION
			B

* - INDICATES A COPY OF AN ORIGINAL SIGNED DRAWING

APPENDIX I

DRAINAGE CONCEPT PLANS



OVERLAND FLOW FOR 1 IN 100 YEAR STORM EVENT

EIGHTY ROAD

ROAD

SIXTY EIGHT ROAD

ARPENTEUR DRIVE

MAIN DRIVE

MARY STREET

Primary School Site

DESIGN ASSUMPTIONS

- WHERE SUBDIVISION LAYOUT NOT AVAILABLE IMPERVIOUS AREA EQUALS 25% OF TOTAL CATCHMENT AREA.
- INFILTRATION AREA IS ESTIMATED AT 29% OF ALL POS / ROAD / MEDIAN AREA WITHIN CATCHMENT BELOW GROUND INFILTRATION NETWORK AREA

LEGEND

- GENERALISED DRAINAGE FLOW DIRECTION
- EXTENT OF SITE CATCHMENT BOUNDARY
- DRAINAGE SUB CATCHMENT BOUNDARY
- PROPOSED SURFACE CONTOUR
- PROPOSED PUBLIC OPEN SPACE
- PROPOSED SWALES / BELOW GROUND INFILTRATION SYSTEM
- DENOTES DRAINAGE INFILTRATION BASIN, SHAPE TO BE DETERMINED AT DETAIL DESIGN
- DENOTES 1 in 5 STORM TWL
- DENOTES 1 in 10 STORM TWL
- DENOTES 1 in 100 STORM TWL

AREAS AND STORAGE 1 IN 100 STORM

SWALE CATCHMENT	IMPERVIOUS AREA	INFILTRATION RATE	SWALE AREA	STORM VOLUME
1	1.33 ha	3.0m/DAY	546m ²	70m ³
2	1.89 ha	3.0m/DAY	902m ²	110m ³
3	2.17 ha	3.0m/DAY	800m ²	150m ³
4	1.73 ha	3.0m/DAY	551m ²	100m ³
5	0.99 ha	3.0m/DAY	462m ²	50m ³

BASIN CATCHMENT	IMPERVIOUS AREA	INFILTRATION RATE	BASIN AREA	STORM VOLUME
B1	3.77 ha	3.0m/DAY	1878m ²	300m ³
B2	6.32 ha	3.0m/DAY	2654m ²	470m ³
B3	5.09 ha	3.0m/DAY	1508m ²	560m ³
B4	2.06 ha	3.0m/DAY	1043m ²	170m ³
B5	2.75 ha	3.0m/DAY	1416m ²	140m ³
B6	1.27 ha	3.0m/DAY	1732m ²	10m ³
B7	1.89 ha	3.0m/DAY	798m ²	14.0m ³
B8	1.10 ha	3.0m/DAY	750m ²	60m ³
B9	3.43 ha	3.0m/DAY	1924m ²	260m ³
B10	2.12 ha	3.0m/DAY	814m ²	200m ³

09.078



PARKLAND HEIGHTS
 LOT 1507 EIGHTY ROAD, BALDIYS
 LOCAL WATER MANAGEMENT STRATEGY
 DRAINAGE CATCHMENT PLAN - 1 IN 100 YEAR STORM EVENT
 FIGURE 1



AUSTRALIA



OVERLAND FLOW FOR 1 IN 100 YEAR STORM EVENT

EIGHTY ROAD

ROAD SIXTY EIGHT

09.078

Spring Consulting Pty Ltd
 10/110 Spring Street, Suite 101, Parkland Heights, NSW 2146
 Phone: (02) 9638 8800
 Fax: (02) 9638 8801
 Email: info@springconsulting.com.au
 Website: www.springconsulting.com.au



DESIGN ASSUMPTIONS

- WHERE SUBDIVISION LAYOUT NOT AVAILABLE IMPERVIOUS AREA EQUALS 25% OF TOTAL CATCHMENT AREA.
- INFILTRATION AREA IS ESTIMATED AT 29% OF ALL POS / ROAD / MEDIAN AREA WITHIN CATCHMENT BELOW GROUND INFILTRATION NETWORK AREA

LEGEND

- GENERALISED DRAINAGE FLOW DIRECTION
- EXTENT OF SITE CATCHMENT BOUNDARY
- DRAINAGE SUB CATCHMENT BOUNDARY
- PROPOSED SURFACE CONTOUR
- PROPOSED PUBLIC OPEN SPACE
- PROPOSED BELOW GROUND INFILTRATION STORAGE
- DENOTES DRAINAGE INFILTRATION BASIN, SHAPE TO BE DETERMINED AT DETAIL DESIGN
- DENOTES 1 in 1 STORM TWL
- DENOTES 1 in 5 STORM TWL
- DENOTES 1 in 10 STORM TWL
- DENOTES 1 in 100 STORM TWL

AREAS AND STORAGE 1 IN 5 STORM

SWALE	CATCHMENT AREA	IMPERVIOUS AREA	INFILTRATION RATE	SWALE AREA	STORM VOLUME
1	1.33 ha	1.20 ha	3.0m/DAV	69m ²	120m ³
2	1.89 ha	1.70 ha	3.0m/DAV	1232m ²	190m ³
3	2.17 ha	1.95 ha	3.0m/DAV	1000m ²	250m ³
4	1.73 ha	1.56 ha	3.0m/DAV	755m ²	180m ³
5	0.99 ha	0.99 ha	3.0m/DAV	573m ²	80m ³

BASIN	CATCHMENT AREA	IMPERVIOUS AREA	INFILTRATION RATE	BASIN AREA	STORM VOLUME
B1	3.17 ha	3.39 ha	3.0m/DAV	2085m ²	740m ³
B2	6.32 ha	5.69 ha	3.0m/DAV	2892m ²	1070m ³
B3	5.09 ha	4.58 ha	3.0m/DAV	1755m ²	1050m ³
B4	2.06 ha	1.85 ha	3.0m/DAV	1206m ²	430m ³
B5	2.75 ha	2.48 ha	3.0m/DAV	1673m ²	440m ³
B6	1.27 ha	1.14 ha	3.0m/DAV	1795m ²	140m ³
B7	1.89 ha	1.70 ha	3.0m/DAV	878m ²	270m ³
B8	1.10 ha	0.99 ha	3.0m/DAV	810m ²	130m ³
B9	3.43 ha	3.09 ha	3.0m/DAV	2172m ²	650m ³
B10	2.12 ha	1.91 ha	3.0m/DAV	961m ²	440m ³

PARKLAND HEIGHTS
 LOT 1507 EIGHTY ROAD, BALDYS
 LOCAL WATER MANAGEMENT STRATEGY
 DRAINAGE CATCHMENT PLAN - 1 IN 5YR STORM EVENT
 FIGURE 2



AUSITALLIA



OVERLAND FLOW FOR 1 IN 100 YEAR STORM EVENT

EIGHTY ROAD

SIXTY EIGHT ROAD

09.078

Spring Consulting Pty Ltd
 10/110 Spring Street, Suite 101, Parkland Heights, QLD 4074
 Phone: (07) 5522 8744
 Fax: (07) 5522 8744
 Email: info@springconsulting.com.au
 Website: www.springconsulting.com.au

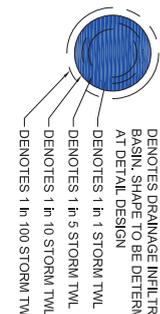


PARKLAND HEIGHTS
 LOT 1507 EIGHTY ROAD, BALDIYS
 LOCAL WATER MANAGEMENT STRATEGY
 DRAINAGE CATCHMENT PLAN - 1 IN 10YR STORM EVENT
 FIGURE 3



- DESIGN ASSUMPTIONS**
- WHERE SUBDIVISION LAYOUT NOT AVAILABLE IMPERVIOUS AREA EQUALS 25% OF TOTAL CATCHMENT AREA.
 - INFILTRATION AREA IS ESTIMATED AT 29% OF ALL POS / MEDIAN AREA WITHIN CATCHMENT
 - ROAD / MEDIAN AREA WITHIN CATCHMENT BELOW GROUND INFILTRATION NETWORK AREA

- LEGEND**
- GENERALISED DRAINAGE FLOW DIRECTION
 - EXTENT OF SITE CATCHMENT BOUNDARY
 - DRAINAGE SUB CATCHMENT BOUNDARY
 - PROPOSED SURFACE CONTOUR
 - PROPOSED PUBLIC OPEN SPACE
 - PROPOSED BELOW GROUND INFILTRATION STORAGE



AREAS AND STORAGE 1 IN 10 STORM

SWALE	CATCHMENT AREA	IMPERVIOUS AREA	INFILTRATION RATE	SCALE AREA	STORM VOLUME
1	1.33 ha	1.20 ha	3.0m/DAY	737m ²	190m ³
2	1.89 ha	1.70 ha	3.0m/DAY	1335m ²	220m ³
3	2.17 ha	1.95 ha	3.0m/DAY	1060m ²	280m ³
4	1.73 ha	1.56 ha	3.0m/DAY	819m ²	210m ³
5	0.99 ha	0.89 ha	3.0m/DAY	607m ²	90m ³

BASIN	CATCHMENT AREA	IMPERVIOUS AREA	INFILTRATION RATE	BASIN AREA	STORM VOLUME
B1	3.77 ha	3.39 ha	3.0m/DAY	2759m ²	910m ³
B2	6.32 ha	5.69 ha	3.0m/DAY	2977m ²	1290m ³
B3	5.09 ha	4.58 ha	3.0m/DAY	1839m ²	1230m ³
B4	2.06 ha	1.85 ha	3.0m/DAY	1265m ²	530m ³
B5	2.75 ha	2.48 ha	3.0m/DAY	1759m ²	570m ³
B6	1.27 ha	1.14 ha	3.0m/DAY	840m ²	230m ³
B7	1.89 ha	1.70 ha	3.0m/DAY	902m ²	320m ³
B8	1.10 ha	0.99 ha	3.0m/DAY	836m ²	170m ³
B9	3.43 ha	3.09 ha	3.0m/DAY	2180m ²	790m ³
B10	2.12 ha	1.91 ha	3.0m/DAY	1012m ²	480m ³

APPENDIX J

SEWER SERVICING OPTION

Serling Consulting (WA) Pty Ltd
Unit 210 Westpoint Centre
396 Scarborough Beach Road
Osborne Park WA 6017 Australia

Tel: +61 8 9202 8740
Fax: +61 8 92028749
Email: admin@serling.co.au
Web: www.serlingconsulting.com.au

Mr John Giacchetta
Development Services Branch
Water Corporation
PO Box 100
LEEDERVILLE, WA 6902



*L01 WdT WaterCorporation WWPS options 110203
SC00102.011*

3 February 2011

Dear John,

**LOT 1507: BALDIVIS SOUTH WWPS K
WAPC No.: 143012 / 139379**

WWPS Pressure Main Options Evaluation

Following a number of meetings towards the end of last year, we would like to confirm the status of our assessment for the proposed Type 40 Wastewater Pumping Station (WWPS) requirements and investigation of the proposed options for the temporary pressure main discharge path and location.

Background

Serling Consulting (WA) Pty Ltd (Serling) has used current Water Corporation Sewer planning and current development structure plan for the project to investigate options for the WWPS and pressure main.

The WWPS is a Type 40 permanent station with catchment as discussed below. It will be located on the eastern side of Eighty Road next to a future POS area.

Previous meetings confirmed that the pressure main options for this WWPS are all temporary and our assessment indicates that there are significant hydraulic, operations and construction cost differences between the possible options. We have evaluated these options for comments and direction before we can finalise the actual pumping station report. Pump duties and details for example will vary significantly depending on the option taken.

This options evaluation includes detail calculations for every option and these will be discussed in the following sections.

Catchment Plan

The catchment plan is attached as Annexure 1, Plan 1-1.

Calculations for the temporary pressure main have been based on an initial gross catchment area of 38 ha (19.1 + 4.75 + 14.7) which will cover the first 4 – 5 stages of the proposed Parkland Heights development (equal to at least 4 – 5 years construction timeframe depending on the number of lots developed per year) and it also includes the existing aged care group housing site, that is currently discharging into AC 5638 via a private pressure main.

The 38 ha is about 30% of the ultimate catchment area for this WWPS.

WWPS Site Layout

The proposed pumping station is located within a future POS, south of stage 1, with the access road to the station being constructed off a future internal road within the development. The attached site plan, see Annexure 2, demonstrates the turning movement and site boundary required to cater for the Type 40 arrangement and 3 hours of emergency storage pipe network.

The total area of the pump station site is approximately 40.5m x 22.5m and consideration for a combination of lot & easement boundaries are being reviewed.

Option A: Discharge into existing AC 5638 in Eighty Road – Preferred

Plan 1-2 showing the proposed layout and long section, as well as detail calculations, are included in Annexure 3.

This option will result in cutting into the existing 70mm private sewer pressure main in Eighty Road and redirect into a new discharge that gravity feeds into the proposed WWPS. The proposed pressure main from the pump station will then be installed along Eighty Road (915m) to discharge into the existing discharge chamber AC 5638 with the pipework between AC5638 & AB4398 to be upgraded to DN225. Key issues to note about this option are the following: (Refer to the calculation table in Annexure 3 for details)

1. In principle it will increase an existing discharge arrangement currently with the private pumping station from existing pumping rate of 3 l/sec to 11 l/sec (approximately peak flow of 8.3l/s)
2. Minimum temporary infrastructure required.
3. Much lower pump head requirements when compared to the other options, resulting in a more efficient and lower maintenance pump system.
4. Pressure main can be 100P-12 and further reduction in Duty Head Required if approval to use PE pipe. (Refer calculations for both the PVC and PE options in Annexure 3)
5. Construction along existing road reserve within the design parameters of 1.0m to 2.5m cover as specified in the Manual.
6. Redirects existing private station flows into the ultimate pumping station minimising future works in upgrades.

Option B: Discharge into existing pressure main at existing AC 5694

Plan 1-3 showing the proposed layout and long section, as well as detail calculations, are included in Annexure 4.

For this option, sewer will be pumped from the proposed pumping station through a 1,360m pressure main to an existing Water Corporation pressure main in the Nairn Drive area that discharges into existing access chamber AB5694. The pumping system will have to be synchronised with the Cottonwood Drive temporary pumping station. Key issues to note about this option are the following: (Refer to the calculation table in Annexure 4 for details)

1. Pump head requirements are relatively high as a result of the static head requirements.
2. Most of the route not subdivided or earthworked, so risk with alignment and levels. Excavations of over 6.0m for a pressure main to accommodate the ultimate future design levels.
3. A 150mm pressure main is required to reduce the pump head requirements and the minimum pumping rate required is 15l/s to provide the minimum velocity acceptable.
4. Due to the higher pumping rate and the low initial expected peak flows from the catchment, septic sewer is likely to occur within the station and the pressure main not being turned sufficiently.

Option C: Discharge into existing AC5237 – DN300 gravity main

Plan 1-4 showing the proposed layout, as well as detail calculations, are included in Annexure 5.

This option is along the same route as Option B, but discharges 2,150m from the pumping station into an existing DN300 (AC 5237) gravity main. Key issues to note about this option are the following: (Also refer to the calculation table in Annexure 5).

1. Pump head requirements are relatively high as a result of the static head requirements.
2. Most of the route not subdivided or earthworked, so risk with alignment and levels. Excavations of over 6.0m for a pressure main to accommodate the ultimate future design levels.
3. The pressure main & gravity main route also crosses unplanned private land with uncertainty about approvals and conditions or finished surface levels.
4. A significant section is along an existing, recently constructed road, which will require to be bored in order to not impact on the road and footpaths.
5. A 150mm pressure main is required to reduce the pump head requirements, and the minimum pumping rate required is 15l/s to provide the minimum velocity acceptable.
6. This option involves the construction of over 2km of temporary sewer pressure main and 350m of DN225 gravity main installed at steep grades (approximately 1 in 20) in order to connect into the existing DN300 invert levels.
7. Due to the higher **pumping** rate and the low initial expected peak flows from the catchment, septic sewer is likely to occur within the station and the pressure main not being turned sufficiently

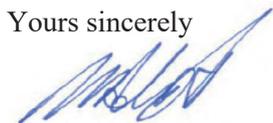
Further important issues are the following:

- The Developer will install the permanent rising main as stages develop, so there will be no issue with installation of sewer in new subdivision areas.
- Should the temporary system down Eighty Road be used (Option A) and in the event that the permanent pumping outlet to the East along Sixty Eight Road is not available when the temporary system reaches capacity, there is still the option to construct Options B or C with less risk, as the road reserves and levels will be established by that time.

Based on the comparison of options, we propose to use Option A as the most efficient and cost effective solution when considering maintenance and capital cost. It also provides flexibility should the permanent solution not be in place 5 or more years in the future. It will be appreciated if Water Corporation can investigate the downstream capacities and alternatives for Option A.

Your earliest attention to this application would be appreciated. Should you have any queries, please contact the undersigned.

Yours sincerely



WILLEM DU TOIT

Executive Engineer

Phone: 08 9202 8743

Fax: 08 9202 8701

Mobile: 0438 966 086

E-mail: wdutoit@serling.com.au

ANNEXURE 1

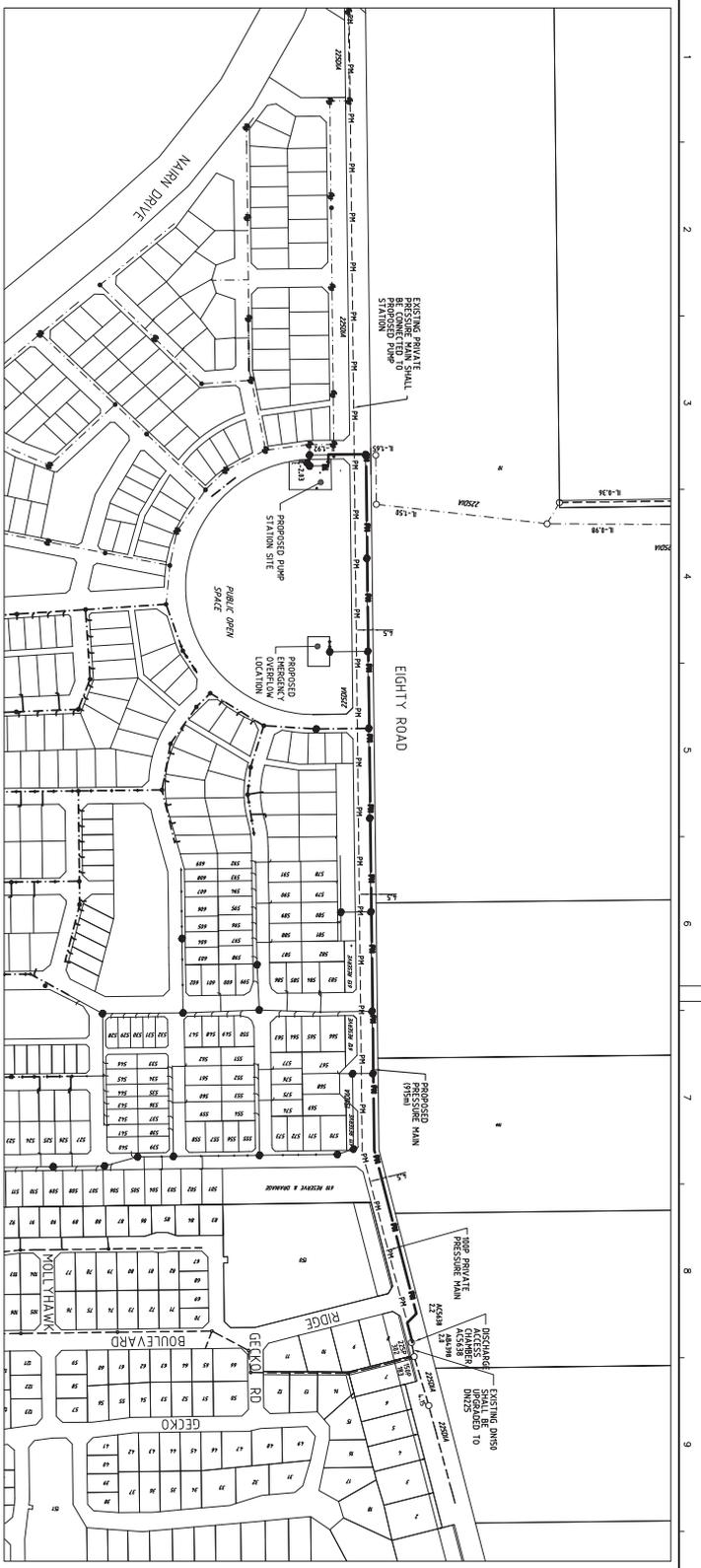
Catchment Plan

ANNEXURE 2

Preliminary Site Plan

ANNEXURE 3

Option A Layout and calculations



PIPE GRADE DATUM RL - 8.0	FINISHED SURFACE LEVEL	DEPTH TO PIPE INVERT	PRESSURE MAIN PIPE INVERT	PRESSURE MAIN CHAINAGE
0.000	3.150	-1.098	4.249	
10.232	3.114	-1.492	4.605	
20.000	3.078	-1.531	4.469	
40.000	3.006	-1.236	4.242	
43.029	2.995	-1.184	4.179	
60.000	2.934	-1.177	4.111	
80.000	2.862	-1.217	4.079	
100.000	2.790	-1.126	3.915	
120.000	2.718	-1.119	3.837	
140.000	2.646	-1.243	3.889	
160.000	2.574	-1.221	3.844	
180.000	2.502	-1.299	3.800	
200.000	2.429	-1.490	3.919	
210.661	2.391	-1.603	3.994	
220.000	2.590	-1.472	4.062	
240.000	3.017	-1.985	5.002	
260.000	3.443	-2.102	5.545	
280.000	3.870	-2.251	6.121	
300.000	4.297	-2.434	6.731	
320.000	4.723	-2.434	7.157	
340.000	5.150	-1.352	7.302	
360.000	4.890	-2.403	7.293	
380.000	4.630	-2.448	7.098	
400.000	4.370	-2.304	6.674	
420.000	4.110	-2.148	6.259	
440.000	3.850	-2.121	5.971	
460.000	3.590	-1.779	5.369	
473.948	3.409	-1.895	5.304	
480.000	3.389	-1.858	5.247	
500.000	3.323	-1.865	5.188	
520.000	3.257	-1.778	5.035	
540.000	3.191	-1.934	5.125	
560.000	3.125	-1.501	4.625	
580.000	3.058	-1.268	4.326	
600.000	2.992	-1.283	4.275	
620.000	2.926	-1.251	4.177	
640.000	2.860	-1.199	4.059	
660.000	2.794	-1.251	4.045	
680.000	2.728	-1.290	4.018	
700.000	2.662	-1.338	4.000	
719.526	2.597	-1.450	4.047	
720.000	2.596	-1.433	4.028	
740.000	2.529	-1.471	4.000	
760.000	2.463	-1.537	4.000	
780.000	2.397	-1.659	4.056	
799.007	2.334	-1.666	4.000	
800.000	2.352	-1.648	4.000	
820.000	2.706	-1.610	4.316	
824.515	2.786	-1.527	4.314	
837.357	3.013	-1.453	4.467	
840.000	3.060	-1.443	4.503	
860.000	3.414	-1.289	4.704	
880.000	3.769	-1.181	4.950	
900.000	4.123	-1.695	5.818	
915.650	4.400	-1.675	6.075	
915.652			6.076	

PRESSURE MAIN PROFILE - OPTION A
 SCALE HORIZ 1:2500 METRES
 VERT 1:250 METRES

ISSUE	DATE	GRID	REVISION	BY	CHKD	APPD
95						
96						
97						

SIGNATURE	BRAND	VERTICAL DATUM	DESIGN DATE	DESIGNER	DATE	SCALE
		AND				
COMPOSITE STA	DESIGN DATE	DESIGNER	DATE	SCALE		
DESIGNER	DATE	SCALE				
DESIGNER	DATE	SCALE				
DESIGNER	DATE	SCALE				

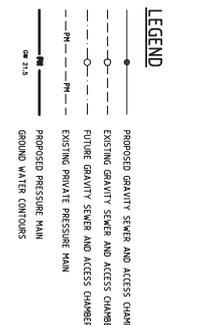
VERTICAL DATUM: DESIGNED TO: DESIGNED BY: DATE: SCALE:

ORTH POINT: [Diagram]

SPRING CONSULTING ENGINEERING SOLUTIONS

Spring Consulting (Pty) Ltd
 Unit 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000

- NOTES**
- LOCAL AUTHORITY - CITY OF ROBINSON
 - EXISTING GROUND WATER LEVEL REFER AMBL CONTOURS
 - THIS RETICULATION AREA IS CLASSIFIED 'WET & DRY' IN ACCORDANCE WITH THE RETICULATION DESIGN MANUAL, VOL. 1 UNLESS NOTED OTHERWISE.
 - EXISTING SURFACE LEVELS DETERMINED FROM MAPS, AERIAL AND GROUND SURVEYS.
 - ALL PIPE SIZES IN MILLIMETRES UNLESS NOTED OTHERWISE.
 - CONCEPTUAL ENGINEERING DESIGN FROM MAPS, AERIAL, GROUND SURVEYS AND PLANNERS INFORMATION WHICH MAY BE SUBJECT TO FURTHER CHANGES.



SC - REVISION RECORD

NO	DATE	DESCRIPTION	BY	CHKD	APPD
A1					

SC DRG. No. WC090004-PS-1-2

METROPOLITAN WASTEWATER - WACC - BALDWIN SOUTH PUMPING STATION - PRELIMINARY PRESSURE MAIN ALIGNMENT - OPTION A

FILE: PLAN 1-2

ORIGINAL SHEET SIZE: A1

SPRING CONSULTING ENGINEERING SOLUTIONS

Spring Consulting (Pty) Ltd
 Unit 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 6

Option A - Eighty Road Existing AC 5638 - PVC Pressure Main

	<i>Initial</i>	<i>Ultimate</i>	
Max PUMP HEAD	29.8	44.5	m
PIPE DIAMETER	100	225	mm
Friction Head	20.0	11.4	m
Pumping Rate	11.1	39.8	L/s
Start of Pressure Main Level	3.15	3.15	RL
Internal Pump Station Pipework Diameter	200	200	mm
Internal Pump Station Pipework Length	62	62	m
Internal Pump Equivalent length Factor	0.0	2.5	
Pressure Main Nominal Diameter	100	225	mm
• Pipe Class to AS1477	12	12	
• Pipe Internal Diameter	108.5	233.7	mm
• Pipe Length Actual	915	2200	m
• Pipe Velocity	1.20	0.93	m/s
Equivalent Length	915.0	2354.4	m
Colebrook-White k =	0.6 , f	0.0322	0.0259
Hydraulic Gradient	0.022	0.005	m/m
Max Static Head	9.8	33.1	m
Min Static Head	2.6	25.9	m
Pump Duty Cut-out Level	-4.05	-4.05	RL
IL Discharge / Pressure Main Highest Point	5.65	29.00	RL
Emergency Overflow Level	3.10	3.10	RL

Option A - Eighty Road Existing AC 5638 - PE Pressure Main

	<i>PE140</i>	<i>PE160</i>	
Max PUMP HEAD	22.9	16.3	m
PIPE DIAMETER	140	160	mm
Friction Head	13.1	6.5	m
Pumping Rate	11.1	11.1	L/s
Start of Pressure Main Level	3.15	3.15	RL
Internal Pump Station Pipework Diameter	200	200	mm
Internal Pump Station Pipework Length	62	62	m
Internal Pump Equivalent length Factor	1.0	1.0	
Pressure Main Nominal Diameter	140	160	mm
• Pipe Class	12.5	12.5	
• Pipe Internal Diameter	119	136	mm
• Pipe Length Actual	915	915	m
• Pipe Velocity	1.00	0.77	m/s
Equivalent Length	976.8	976.8	m
Colebrook-White k =	0.6 , f	0.0315	0.0305
Hydraulic Gradient	0.013	0.007	m/m
Max Static Head	9.8	9.8	m
Min Static Head	2.6	2.6	m
Pump Duty Cut-out Level	-4.05	-4.05	RL
IL Discharge / Pressure Main Highest Point	5.65	5.65	RL
Emergency Overflow Level	3.10	3.10	RL

Serling Consulting (WA) Pty Ltd

Unit 210, Westpoint Centre, 396 Scarborough Beach Road, Osborne Park WA 6017 Australia

Parkland Heights Lot 1507 WWPS

03 February 2011

ANNEXURE 4

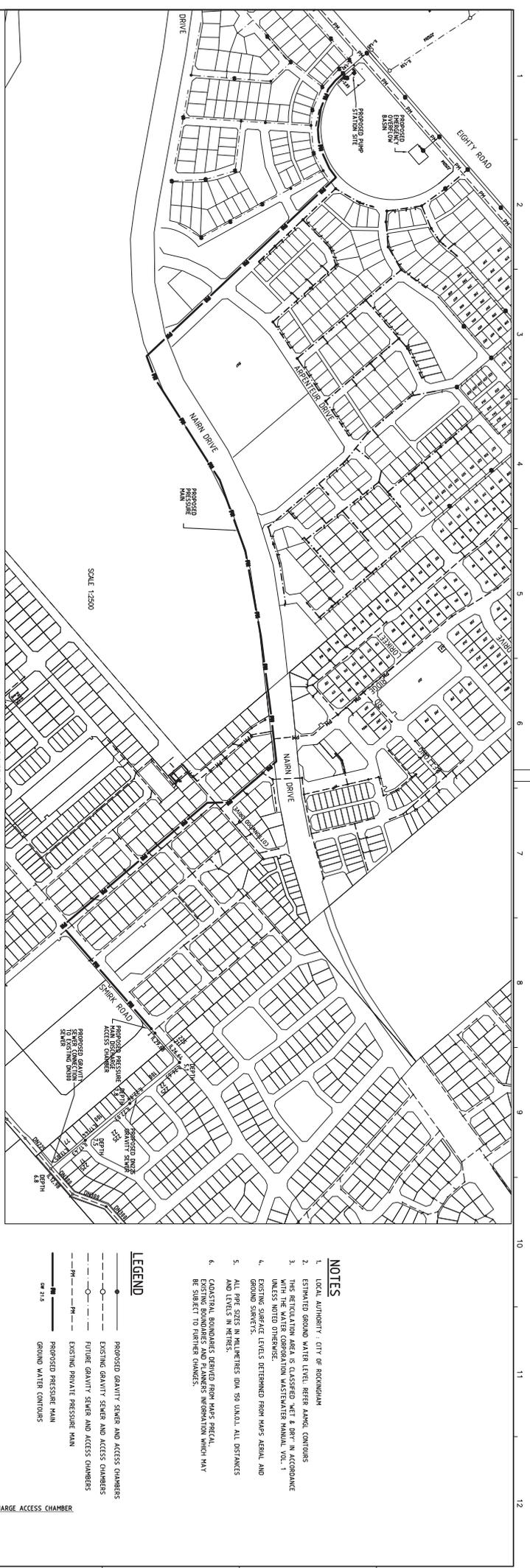
Option B Layout and calculations

Option B - Discharge into existing PM & Existing AB5694

	<i>Initial</i>	<i>Ultimate</i>	
Max PUMP HEAD	59.1	44.5	m
PIPE DIAMETER	150	225	mm
Friction Head	20.0	11.4	m
Pumping Rate % Ratio		100.00%	
Pumping Rate	15.1	39.8	L/s
Start of Pressure Main Level	3.15	3.15	RL
Internal Pump Station Pipework Diameter	200	200	mm
Internal Pump Station Pipework Length	62	62	m
Internal Pump Equivalent length Factor	1.0	2.5	
Pressure Main Nominal Diameter	150	225	mm
• Pipe Class to AS1477	12	12	
• Pipe Internal Diameter	158	234	mm
• Pipe Length Actual	1360	2200	m
• Pipe Velocity	0.77	0.93	m/s
Equivalent Length	1421.8	2354.4	m
Colebrook-White k = 0.6 , f	0.0291	0.0259	
Hydraulic Gradient	0.006	0.005	m/m
Pressure Main Nominal Diameter - Existing	100		mm
• Pipe Class to AS1477	12		
• Pipe Internal Diameter	108.5		mm
• Pipe Length Actual	300		m
• Pipe Velocity	1.63		m/s
Colebrook-White k = 0.6 , f	0.0320		
Hydraulic Gradient	0.040		m/m
Max Static Head	39.1	33.1	m
Min Static Head	31.9	25.9	m
Pump Duty Cut-out Level	-4.05	-4.05	RL
IL Discharge / Pressure Main Highest Point	35.00	29.00	RL
Emergency Overflow Level	3.10	3.10	RL

ANNEXURE 5

Option C Layout and calculations



PRESSURE MAIN PROFILE - OPTION C

SCALE HORIZ 1:3000 METERS
VERT 1:300 METERS

PIPE GRADE DATUM R.L. -10.0	FINISHED SURFACE LEVEL	DEPTH TO PIPE INVERT	PRESSURE MAIN PIPE INVERT	PRESSURE MAIN CHAINAGE
0.000	4.605	-2.605	2.000	0.000
20.000	5.190	-3.052	2.138	20.000
39.448	5.590	-3.318	2.273	39.448
40.000	5.602	-3.326	2.277	40.000
59.494	5.848	-3.436	2.411	59.494
60.000	5.859	-3.451	2.415	60.000
80.000	6.377	-3.824	2.553	80.000
94.336	6.503	-3.851	2.652	94.336
100.000	6.775	-4.084	2.691	100.000
120.000	6.896	-4.666	2.830	120.000
131.300	6.753	-3.848	2.908	131.300
140.000	6.653	-3.685	2.968	140.000
149.205	6.312	-3.281	3.031	149.205
160.000	6.311	-3.205	3.106	160.000
166.848	6.127	-2.973	3.153	166.848
180.000	6.154	-2.970	3.244	180.000
200.000	6.003	-2.603	3.283	200.000
203.308	6.000	-2.594	3.405	203.308
206.000	5.975	-2.551	3.424	206.000
220.000	5.876	-1.444	4.381	220.000
222.102	5.802	-1.277	4.325	222.102
240.000	5.308	-0.560	5.748	240.000
260.000	7.533	-0.438	7.115	260.000
280.000	8.998	-0.516	8.482	280.000
300.000	10.663	-0.814	9.849	300.000
320.000	12.224	-1.008	11.216	320.000
340.000	13.641	-1.057	12.583	340.000
360.000	14.936	-0.986	13.950	360.000
380.000	16.420	-1.103	15.317	380.000
400.000	17.904	-1.221	16.684	400.000
420.000	19.389	-1.338	18.051	420.000
440.000	21.101	-1.687	19.418	440.000
460.000	22.358	-1.573	20.785	460.000
475.000	23.722	-1.912	21.810	475.000
480.000	24.093	-2.485	21.608	480.000
500.000	24.932	-0.134	20.798	500.000
520.000	24.286	-1.298	19.988	520.000
540.000	23.287	-1.404	19.178	540.000
560.000	22.513	-1.744	18.369	560.000
580.000	21.744	-1.485	17.559	580.000
594.395	21.190	-1.214	16.976	594.395
600.000	21.332	-4.583	16.749	600.000
620.000	20.564	-4.625	15.939	620.000
640.000	19.064	-3.879	15.129	640.000
660.000	19.023	-3.072	15.950	660.000
660.000	19.066	-2.832	16.234	660.000
671.711	19.918	-3.517	16.401	671.711
680.000	20.243	-3.725	16.519	680.000
700.000	20.468	-2.658	16.803	700.000
714.589	20.615	-3.605	17.010	714.589
720.000	20.786	-3.699	17.087	720.000
735.000	21.307	-4.007	17.300	735.000
740.000	21.498	-4.122	17.376	740.000
760.000	22.139	-4.760	17.678	760.000
780.000	23.234	-2.251	17.981	780.000
800.000	20.421	-2.137	18.283	800.000
820.000	20.609	-2.023	18.586	820.000
840.000	20.799	-1.911	18.888	840.000
860.000	21.077	-1.886	19.191	860.000
880.000	21.500	-2.007	19.494	880.000
900.000	21.964	-2.568	19.796	900.000
920.000	22.414	-2.315	20.099	920.000
921.391	22.445	-2.325	20.120	921.391
940.000	22.934	-2.523	20.401	940.000
960.000	23.463	-2.744	20.704	960.000
980.000	24.000	-4.457	21.006	980.000
1000.000	25.497	-4.188	21.309	1000.000
1020.000	25.660	-4.049	21.612	1020.000
1040.000	25.350	-3.436	21.914	1040.000
1052.003	25.686	-3.591	22.096	1052.003
1060.000	24.838	-2.621	22.217	1060.000
1080.000	24.254	-1.735	22.519	1080.000
1100.000	24.264	-1.443	22.822	1100.000
1120.000	24.299	-1.174	23.124	1120.000
1140.000	25.108	-1.681	23.427	1140.000
1160.000	25.712	-1.983	23.729	1160.000
1180.000	26.277	-4.245	24.032	1180.000
1200.000	26.362	-4.027	24.335	1200.000
1202.757	26.373	-3.997	24.376	1202.757
1220.000	26.464	-3.827	24.637	1220.000
1240.000	26.510	-3.600	24.940	1240.000
1260.000	26.675	-3.433	25.242	1260.000
1280.000	26.781	-3.236	25.545	1280.000
1300.000	26.887	-3.039	25.847	1300.000
1320.000	26.992	-2.842	26.150	1320.000
1340.000	26.007	-2.954	26.453	1340.000
1341.361	26.009	-2.536	26.473	1341.361
1360.000	26.059	-2.304	26.755	1360.000
1380.000	26.559	-2.501	27.058	1380.000
1400.000	26.654	-2.294	27.360	1400.000
1420.000	26.731	-2.069	27.663	1420.000
1421.262	26.746	-2.064	27.682	1421.262
1437.000	26.857	-1.977	27.920	1437.000
1440.000	26.900	-1.811	27.800	1440.000
1460.000	26.724	-2.033	27.691	1460.000
1480.000	26.915	-1.622	27.492	1480.000
1500.000	26.013	-1.720	27.293	1500.000
1520.000	26.892	-1.798	27.094	1520.000
1531.255	26.843	-1.662	26.983	1531.255
1540.000	26.523	-1.628	26.895	1540.000
1541.073	26.546	-1.662	26.884	1541.073
1560.000	26.480	-1.784	26.696	1560.000
1566.819	26.435	-1.807	26.628	1566.819
1586.186	26.442	-1.827	26.615	1586.186
1580.000	26.911	-1.967	26.824	1580.000
1600.000	26.022	-1.844	27.178	1600.000
1620.000	26.783	-2.250	27.533	1620.000
1639.564	26.967	-2.087	27.879	1639.564
1640.000	26.968	-2.087	27.881	1640.000
1660.000	27.005	-3.051	27.955	1660.000
1680.000	27.000	-2.972	28.028	1680.000
1700.000	26.933	-2.831	28.102	1700.000
1720.000	26.920	-2.745	28.175	1720.000
1740.000	26.086	-2.837	28.249	1740.000
1760.000	26.147	-2.891	28.322	1760.000
1780.000	26.167	-2.871	28.396	1780.000
1800.000	26.178	-3.009	28.470	1800.000
1820.000	26.180	-2.937	28.543	1820.000
1840.000	26.180	-2.617	28.617	1840.000
1860.000	26.690	-2.890	28.690	1860.000
1860.614	26.692	-2.892	28.692	1860.614
1880.000	26.800	-2.740	28.740	1880.000
1885.335	26.800	-2.820	28.820	1885.335
1900.000	26.810	-2.993	28.837	1900.000
1917.641	26.810	-2.902	28.902	1917.641
1920.000	26.811	-2.911	28.911	1920.000
1940.000	26.946	-2.946	28.946	1940.000
1950.000	26.984	-2.984	28.984	1950.000
1980.000	26.984	-2.984	29.132	1980.000
2000.000	26.984	-2.984	29.205	2000.000
2020.000	26.984	-2.984	29.279	2020.000
2040.000	26.984	-2.984	29.352	2040.000
2060.000	26.984	-1.704	29.426	2060.000
2080.000	26.984	-2.984	29.499	2080.000
2100.000	26.984	-2.984	29.573	2100.000
2120.000	26.984	-2.984	29.646	2120.000
2129.128	26.984	-2.984	29.680	2129.128

SC - REVISION RECORD

NO.	DATE	DESCRIPTION	BY	CHKD
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SPRING CONSULTING SOLUTIONS

2000 Highway 100, Suite 100, Mississauga, ON L4V 1L7
 Tel: (905) 875-8888 Fax: (905) 875-8889
 www.springconsulting.com

WATER CORPORATION

1000 Lakeshore Blvd. W., Suite 1000, Mississauga, ON L4Y 1G7
 Tel: (905) 875-8888 Fax: (905) 875-8889
 www.watercorp.com

PROJECT: BATHURST WASTEWATER - WAPC - BATHURST SOUTH PUMP STATION - OPTION C
PRELIMINARY PRESSURE MAIN LAYOUT - OPTION C

SCALE: HORIZ 1:3000 METERS
 VERT 1:300 METERS

DATE: 2010-05-10
PROJECT NO.: WC090004-PS-1-2

DESIGNER: [Signature]
CHECKED: [Signature]
APPROVED: [Signature]

CONSULTANT PROJECT DIRECTOR: [Signature]

RECOMMENDED CONSULTANT PROJECT MANAGER: [Signature]

FILE: [Blank]
PROJECT: [Blank]

SCALE: 1-4

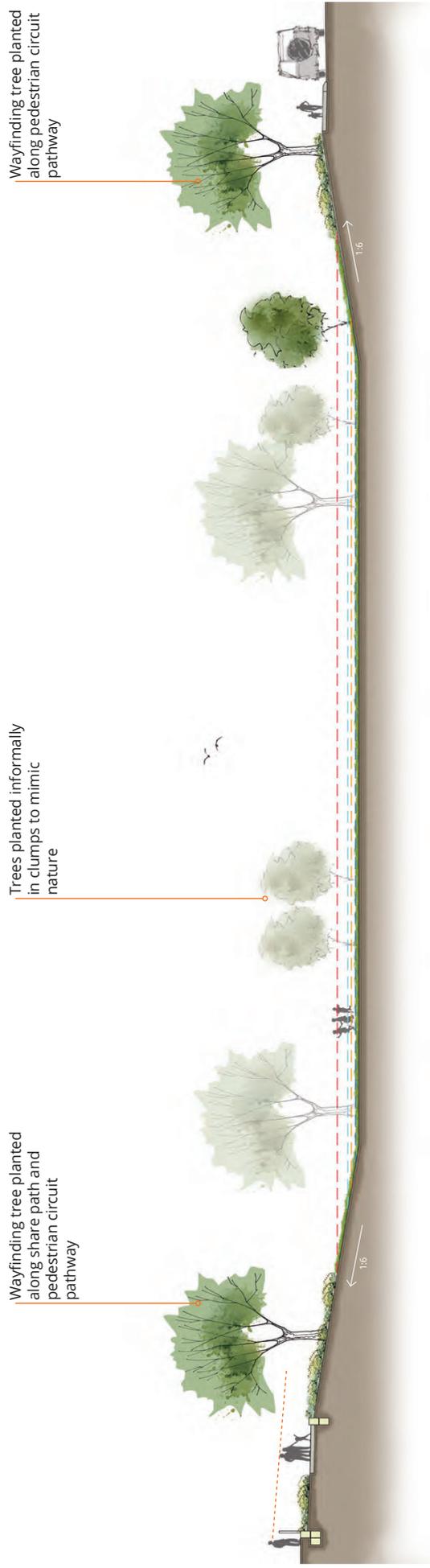
DATE: 2010-05-10
ISSUE: A1

ORIGINAL SHEET SIZE: A1

Option C - Discharge into Existing AC5237 - DN300 Gravity Main

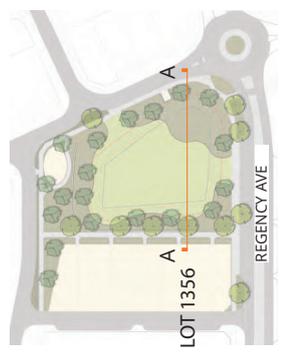
	<i>Initial</i>	<i>Ultimate</i>	
Max PUMP HEAD	60.0	44.5	m
PIPE DIAMETER	150	225	mm
Friction Head	24.4	11.4	m
Pumping Rate % Ratio		100.00%	
Pumping Rate	15.1	39.8	L/s
Start of Pressure Main Level	3.15	3.15	RL
Internal Pump Station Pipework Diameter	200	200	mm
Internal Pump Station Pipework Length	62	62	m
Internal Pump Equivalent length Factor	1.0	2.5	
Pressure Main Nominal Diameter	150	225	mm
• Pipe Class to AS1477	12	12	
• Pipe Internal Diameter	158	234	mm
• Pipe Length Actual	2150	2200	m
• Pipe Velocity	0.77	0.93	m/s
Equivalent Length	2211.8	2354.4	m
Colebrook-White k = 0.6 , f	0.0291	0.0259	
Hydraulic Gradient	0.006	0.005	m/m
Pressure Main Nominal Diameter - Existing	100		mm
• Pipe Class to AS1477	12		
• Pipe Internal Diameter	108.5		mm
• Pipe Length Actual	300		m
• Pipe Velocity	1.63		m/s
Colebrook-White k = 0.6 , f	0.0320		
Hydraulic Gradient	0.040		m/m
Max Static Head	35.6	33.1	m
Min Static Head	28.4	25.9	m
Pump Duty Cut-out Level	-4.05	-4.05	RL
IL Discharge / Pressure Main Highest Point	31.50	29.00	RL
Emergency Overflow Level	3.10	3.10	RL

Appendix F
**Parkland Heights Baldivis
landscape concept plan
amendment POS K**



Lot | Planting 2.5m | 2.0m | Street
 | buffer | share | path |
 | to lots | path |
 Basin slopes are
 1:6 or less and planted
 with native species
 Informal active use grassed area
 Basin slopes are
 1:6 or less
 and planted
 with native
 species

indicative SECTION A A



KEY PLAN

**THIS IS A CONCEPT DESIGN ONLY AND
 SUBJECT TO FUTURE DETAIL DESIGN
 AT URBAN WATER MANAGEMENT PLAN
 PHASE.**

DRAINAGE BASIN

- 1EY Area 1,580m² Depth 0.17m
- 20% AEP Area 1,800m² Depth 0.40m
- 10% AEP Area 1,950m² Depth 0.57m
- 1% AEP Area 2,580m² Depth 1.12m



Appendix G
Staged water use and
irrigation schedule for
POS K and Parkland
Heights

Annual Water Entitlement 86,320kL

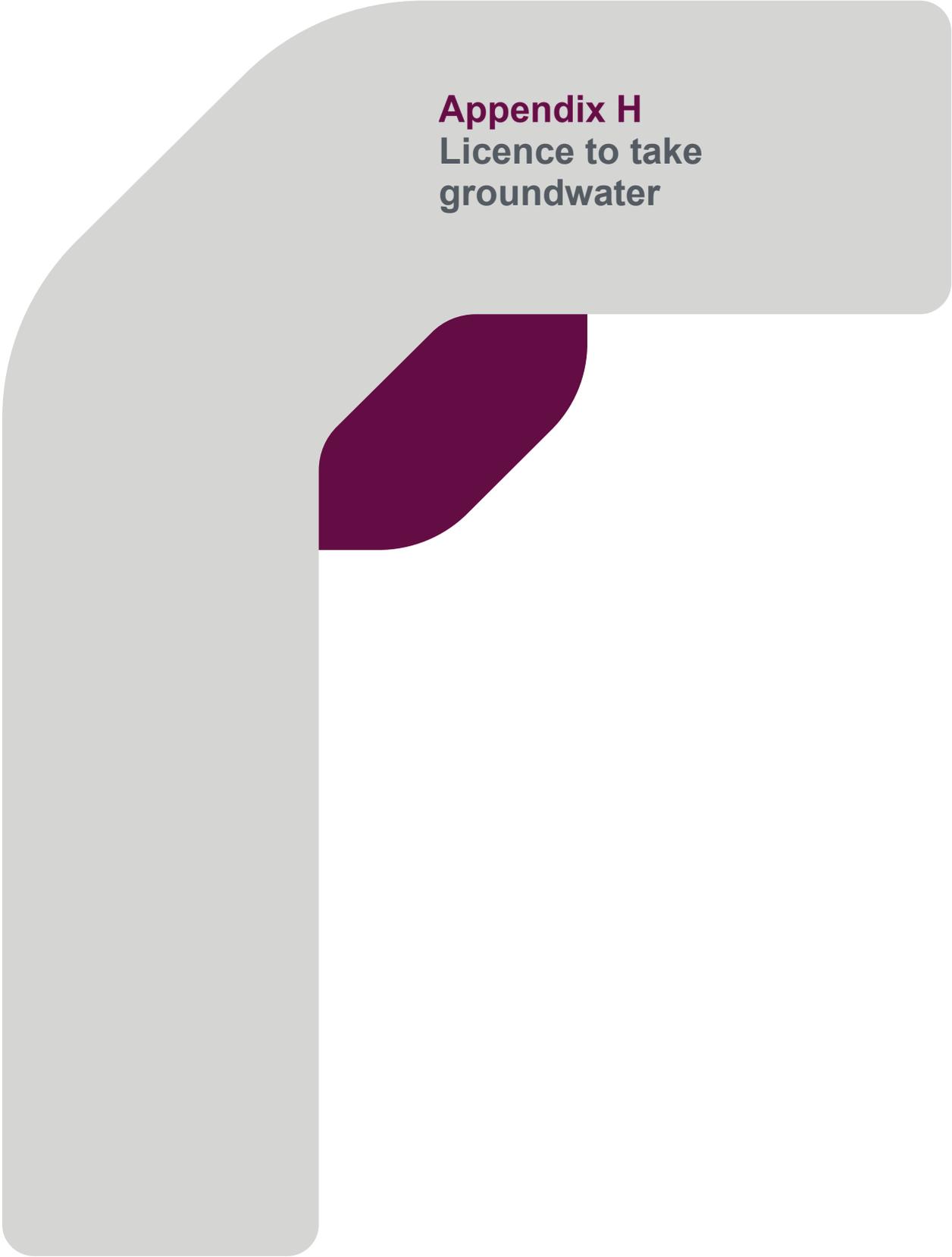
GWL164680(11) -INSTRUMENT REPOR~al-Rockingham Park Pty Ltd



PARKLAND HEIGHTS
STAGED WATER USE AND IRRIGATION SCHEDULE
27th Oct 2020

7,500kL/ha 9,000kL/ha - DOS	Total POS & Streetscape area m2	Irrigated Area (m2)	Irrigated turf area %	Irrigated Turf area (m ²)	Volumes - Turf (kL/yr)	Irrigated Planting %	Irrigated Planting area (m ²)	Volumes - Planting (kL/yr) Non - Irrigated Areas (m2)	TOTAL VOLUME Volume - Planting & Turf (kL/yr)
Stage 3									
POS Part B	0	0	0	0	0	0	0	0	0
POS C	11,920	8,702	33%	3,934	2,950	40%	4,768	3,278	6,526
POS D	2,754	2,010	33%	908	682	40%	1,102	826	1,508
Total for Stage	14,674								
Stage 4 - Feb 16 - June '18									
POS G - Feb 16 - Jun 16	6,105	5,709	75%	4,608	3,456	18%	1,101	826	4,282
DOS F - Jul 15 - Nov 15	57,736	49,059	84%	48,549	43,894	1%	510	459	44,153
Total for Stage	63,841								48,635
Stage 5 - Jan 18 - April 18									
POS H - Jan 18 - April 18	3,131	2,956	53%	1,650	1,228	30%	936	702	1,940
POS I - Jan 18 - April 18	3,784	3,256	60%	2,277	1,708	26%	979	734	2,442
Total for Stage	6,915			3,927	2,945		1,915	1,436	4,382
Stage 6									
POS E	5,680	5,570	67%	3,859	2,897	31%	1,761	1,521	4,178
Furnival Parade - Median & RAB	515	515	0%	0	0	100%	515	386	386
Total for Stage	6,195			3,859	2,897		2,276	1,707	4,964
Main Drive									
Section 1 + 2	13,320	13,010	66%	8,794	6,595	32%	4,230	3,173	9,768
Section 3	11,293	10,155	40%	4,513	3,395	50%	5,642	4,231	7,616
Total for Stage	24,613			13,293	9,970		9,872	7,404	17,374
Stage 7 & 8 - SOLE									
POS O	11,054	9,396	50%	5,527	4,145	35%	3,869	2,902	7,047
Greenlinks - Median	155	155	0%	0	0	100%	155	116	116
Total for Stage	11,209			5,527	4,145		4,024	3,018	7,163
Stage 8									
POS N	7,508	6,362	50%	3,754	2,816	35%	2,628	1,971	4,786
Greenlinks - Verges	950	950	0%	0	0	100%	950	713	713
Total for Stage	8,458			3,754	2,816		3,578	2,683	5,499
Stage 9									
POS M	12,394	10,501	50%	6,177	4,633	39%	4,324	3,243	7,876
Greenlinks - Median + RAB	950	950	0%	0	0	100%	950	713	713
Total for Stage	13,304			6,177	4,633		5,274	3,955	8,589
Stage 11									
POS L	2,863	2,290	50%	1,432	1,074	30%	859	644	1,718
Main Streets - Median + RAB	2,942	2,942	0%	0	0	100%	2,942	2,207	2,207
Total for Stage	5,805			1,432	1,074		3,801	2,851	3,924
Stage 12									
Regency Avenue - Median + RAB	710	710	0%	0	0	100%	710	533	533
Total for Stage	710			0	0		2,942	2,207	0
Stage 13									
Regency Avenue - Median	455	455	0%	0	0	100%	455	341	341
Total for Stage	455			0	0		710	533	0
Stage 14 - SOLE									
POS K	5,950	4,750	54%	3,200	2,400	26%	1,550	1,163	3,563
Total for Stage	5,950			3,200	2,400		1,550	1,163	3,563
Slavy Eight Rd Upgrade									
Slavy Eight Rd - Verges + RAB	11,500	8,050	40%	4,600	3,450	30%	3,450	2,588	6,038
Total for Stage	11,500			4,600	3,450		3,450	2,588	6,038
TOTALS FOR ESTATE				4,600	3,450		3,450	2,588	57,586

PH + HP TOTAL PROPOSED IRR	75,222
PH + HP REMAINING ALLOCATION FOR IRR	11,099



Appendix H
Licence to take
groundwater



Rockingham Park Pty Ltd
PO BOX 4376
MYAREE BUSINESS CENTRE WA 6960

Dear Licensee

Issue of a licence under the *Rights in Water and Irrigation Act 1914*

Properties: Parkland Heights and Heritage Park, Baldivis

Thank you for your application, dated 12/08/2020 for the transfer of a portion (15,000 kilolitres) of the annual water entitlement from your licence to take water GWL164680 to the Department of Education. Your application has been approved and your new annual water entitlement is now 86,320 kilolitres.

Please find enclosed the following:

- Your licence to take water **GWL164680(11)**
- Brochure *Your licence to take water*
- Brochure *Metering your water use*
- *Metering Regulations* – fact sheet

Take time to read these documents as they contain important information about your rights and responsibilities.

The *Rights in Water and Irrigation Regulations 2000* apply to this licence. We have removed the conditions on your licence that require you to meter your water use and submit meter readings, as these requirements are now statutory. Please note you must report meter readings to the department within 30 days after the end of your water year referred to in **Condition 1** of your licence.

Please read the enclosed information. If you are unsure if you meet the requirements of the new Regulations, you should review your current licence(s) and the requirements of the new legislation to work out if there is anything you need to do.

You can find out more about how the changes affect you by accessing the FAQs on our website at www.dwer.wa.gov.au Go to Water > Licensing > Metering and measurement, where you can also access a copy of the measurement policy.

Furthermore, the department has no records on the submission of the monthly meter readings for this licence for the 2019 water year which were due on 31 January 2020. Meter readings must be submitted via the department's Water Online portal, unless otherwise approved by the department.

Please be advised, that failure to comply with these requirements is an offence and attracts a penalty of \$2000 and daily penalty of \$200 under prosecution. The department may elect to deal with the offence by way of a modified penalty (i.e. issue an infringement) of \$400.

In addition, please update the drawpoints and meters registered in the Water Online portal, as some may have been handed over to the City of Rockingham.

Under provisions of the *Rights in Water and Irrigation Act 1914*, you have a right to apply to the State Administrative Tribunal for a review of our decision within 28 days from the date of this letter.

For further information please contact the State Administrative Tribunal:

In person: State Administrative Tribunal
Level 6, 565 Hay Street PERTH WA 6000

In writing: State Administrative Tribunal
GPO Box U1991
PERTH WA 6845

By telephone: Metro: (08) 9219 3111
Regional: 1300 306 017 (for the cost of a local call)

By fax: (08) 9325 5099

Website: <http://www.sat.justice.wa.gov.au/>

You can now use online services to manage all of your licensing and metering needs. Water Online provides the easiest, fastest and most efficient way to:

- Apply for a new licence or permit
- Apply to amend, renew or transfer an existing licence
- Submit meter readings in accordance with a licence; and
- Manage your account details.

Register for Water Online at www.water.wa.gov.au by clicking on the Water Online Login icon.

The instructions for registering, checking your details and updating them where required can be found by selecting the Quick Reference Guides link on the water online home page.

Please check your details to ensure that they are correct. If they are not correct please contact the department's online business support unit on 1800 508 885 (select option 2).

If you have any queries about this or any other water licensing matter please contact Oliver Krumholz by telephone on 9550 4210 or email oliver.krumholz@dwer.wa.gov.au

Yours faithfully,

A handwritten signature in black ink, appearing to read 'Carlie Slodecki', written in a cursive style.

Carlie Slodecki
District/Program Manager
Peel Region
09 September 2020



LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Rockingham Park Pty Ltd		
Description of Water Resource	Stakehill Perth - Superficial Swan	Annual Water Entitlement	86,320kL
Location of Water Source	LOT 954 ON PLAN 407830 - Lot 954 BALDIVIS - POS H - Parkland Heights		

Authorised Activities	Taking of water for	Location of Activity
	Dust suppression for earthworks and construction purposes	LOT 9011 ON PLAN 417866 - Volume/Folio 2982/250 - Lot 9011 Lot 986 On Plan 202758 - Volume/Folio 2128/381 - Lot 986 Baldivis Rd Baldivis - Heritage Park Lot 993 On Plan 202758 - Volume/Folio 2125/382 - Lot 993 Baldivis Rd Baldivis - Heritage Park Road Reserve - PIN11754540 - Heritage Park
	Irrigation of up to 5.8 ha of public open space	LOT 9011 ON PLAN 417866 - Volume/Folio 2982/250 - Lot 9011 Lot 986 On Plan 202758 - Volume/Folio 2128/381 - Lot 986 Baldivis Rd Baldivis - Heritage Park Lot 993 On Plan 202758 - Volume/Folio 2125/382 - Lot 993 Baldivis Rd Baldivis - Heritage Park Road Reserve - PIN11754540 - Heritage Park
Duration of Licence	From 9 September 2020 to 3 February 2024	

This Licence is subject to the following terms, conditions and restrictions:

- The annual water year for water taken under this licence is defined as 1 Jan to 31 Dec.
- The licensee shall not use water for sprinkler irrigation between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.
- Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.

End of terms, conditions and restrictions



Your licence to take water

Important
information.
Please read.

Please carefully read this information. It explains your licence and responsibilities as a licensee.

Carefully read your licence. You may commit an offence if you take or use water in any way that is not authorised.

Keep your licence in a safe place.

You must inform the department if

- the details on your licence seem in any way incorrect
- you do not understand your licence terms, conditions and restrictions
- you believe you may not be able to comply with your licence terms, conditions and restrictions
- for any reason you no longer have lawful access to the part of the property from which you take water e.g. you sell or lease your property or your lease expires. You must tell the department **within 30 days** if this occurs
- you want to use some or all of your water entitlement on a different property
- someone else is using the water, either temporarily or permanently, or you are planning to lease your property to somebody else and they plan to use water
- you plan to drill new wells, excavate new soaks or construct new dams, or alter existing infrastructure. You may need to apply for a licence or permit to do this
- you plan to change your water-use activities.

Your licence

File and instrument numbers

The file number (top left) refers to the department's records of your licence(s) and the applications you have made. The instrument number (top right) is your licence number. You may be asked to quote these numbers if you make an enquiry about your licence.

Licensee(s)

The licensee(s) is responsible for the use of water as authorised by the licence. If there is more than one name on the licence, all named parties share joint responsibility.

Water resource

This is the name of the groundwater area and aquifer, or the surface water area and

branch/tributary, you are authorised to take water from, based on the information you have given the department in your application about the depth and location of your bores, wells, dams, soaks or pumps.

Annual water entitlement

This is how much water you can take within a 12 month period, in kilolitres (kL).

Location of water source

This is the only property from which water is to be taken.

Authorised activities

This part of your licence lists what activities you can use the water for. Using water for other purposes or at any other location may be an offence. If your water use is not measured with a meter, your 'authorised activities' are an important way for the department to calculate your water-use.

Duration of licence

The licence is valid for this period.

Terms, conditions and restrictions

This section lists any other terms, conditions or restrictions that apply to your licence. It is a breach of the Rights in Water and Irrigation Act 1914 if you do not comply with these conditions.

Other things you should know

Annual water entitlement

There is no guarantee this volume of water is available at all times or is of a suitable quality for your purposes.

Licence expiry

You should apply to renew your licence before your licence expires. It is an offence if you continue to take water after the expiry date, unless you have applied to renew the licence. The department recommends you submit an application at least one month before the expiry date. You can apply online at www.online.water.wa.gov.au.

Copy of licence

You may request a certified copy of your licence. A fee applies.

Water year

On some licences, the water year is defined in the terms, conditions and restrictions. If the water year is not defined on your licence, the water year begins on the date your licence is issued (see duration of licence). For example, if the licence was issued on 15 May 2012, the water year would be from 15 May to 14 May the following year. Unused water in any year does not carry over to the next water year.

Licence transfer

If you are planning to move premises and would like to be able to use your current water entitlement on a new property, you can apply to transfer the water entitlement.

If the property is sold or leased, the new owner or tenant does not automatically have rights to take water under this licence, **even if the water entitlement has been included in the contract of sale or lease agreement**. Contact the department for more information.

Water efficiency

Water in WA is a precious resource. All water users are encouraged to keep up with new technologies and operate the most efficient systems possible.

Other laws

This licence does not give you any rights except to take and use water from a given point(s). You must still comply with Commonwealth and state legislation, and local by-laws.

Our rights

The Department of Water and Environmental Regulation (on behalf of the Minister for Water), can take action it believes is necessary to manage and protect the state's water resources, and to protect the rights of other water users. The department may, for example:

- require you to fit a water meter
- access your property for routine inspection purposes
- access your property to determine if an offence has been committed (under the *Rights in Water and Irrigation Act 1914*)
- direct you to reduce the amount of water you take or change the rate at which water is pumped, or direct the purpose for which it is taken
- direct you to close a well, if water is being wasted or improperly used
- refuse to renew your licence if it believes you will not comply with licence conditions
- cancel or suspend your licence
- add, remove or change the terms, conditions and restrictions of your licence.

This includes reducing your water entitlement if you cannot demonstrate that you are legitimately using water for the purpose for which it was intended.

In all but an exceptional circumstance, you would be given notice of these actions and, in some cases, you would have a right to comment or apply for a review of the decision.

The Water Register

The general public has access to a register which contains some of the details of your licence, including the licensee name(s) and postal address, annual water entitlement and duration of licence.

The Water Register is available at the department's website, www.dwer.wa.gov.au.

Definitions

Well Any opening in the ground made or used to obtain access to underground water. This includes bores and 'soaks' or other excavations that intercept groundwater.

Water year The 12 month period during which you can use your annual water entitlement.

Ha (hectare) A measure of land area. One hectare is equal to 10 000 square metres, which is approximately 2.5 acres.

kL (kilolitre) A measure of water volume. One kilolitre is 1000 litres or one cubic metre (m³).

Take water To remove or reduce the flow of water in a watercourse, wetland or from underground. This includes pumping or siphoning water; stopping, impeding or diverting the flow of water; releasing water from a wetland; allowing water to flow under natural pressure from a well; or allowing stock to drink from a watercourse or wetland. It also includes storing water that has been drawn by these means.

For further information

Please refer to 'Responsibilities of licence and permit holders' at the department's website

www.dwer.wa.gov.au

or contact your local regional office.



Metering your water use

For online licensees

Please carefully read this information. It will help you to understand your responsibilities as a licensee. You may commit an offence if you do not correctly meter your water use.

As a metered water user you must:

- Install an approved meter (or meters). This is a meter that complies with the Rights in Water and Irrigation (Approved Meters) Order 2009.
- Maintain your meter and take all reasonable steps, including regular servicing, to ensure it is accurately measuring all water use.
- Record and report readings, as required by your licence conditions. If you cannot read the meter at the required time, you will need to arrange for someone else to do this for you.
- Not deliberately damage or alter a meter, or associated fittings or pipework, such that the meter does not accurately measure all of the water being taken.

Failure to comply with these requirements may attract a penalty

To ensure you are compliant with your obligations you should:

- Inform the Department of Water and Environmental Regulation in writing within 30 days of installing the meter, the date of installation, meter location, make, size, type and serial number of the meter, and the meter reading after installation.
- Provide the department with a photograph(s) and/or diagram(s) of the meter, shown fitted to the pipe work.
- Familiarise yourself with your meter and how to read the instrument. Not all meters are the same. See the department's *Reading your meter* fact sheet and ask your installer for a demonstration.

You need to contact the department immediately if:

- You think you may not be able to fit a meter within the timeframe specified in your licence (notify the department **before** the installation deadline).
- You are unable to read your meter or report the meter readings by the due date, for any reason.
- You think your meter may not be accurately recording water use. For example, if the meter is not registering water flow when the pump is

switched on, or if water use is higher or lower than expected.

- A meter is damaged, or if for any reason you think that your meter may have malfunctioned.
- A meter must be removed for a period of time for maintenance or repair or any other reason.
- A meter is replaced for any reason.

Installation

You should ask your local irrigation systems supplier to recommend a fit-for-purpose water meter that complies with the Rights in Water and Irrigation (Approved Meters) Order 2009. The supplier may also be able to recommend a competent installer.

The department's *Guidelines for water meter installation 2009* provides you with details of the technical, maintenance and installation requirements for new water meters, and the upgrade or replacement of existing water meters. If a meter installation does not comply with the department's requirements, you will be required to ensure alterations are made to the meter or the pipework to address this issue. The department will advise you in writing of the required changes or it may elect to issue you with a formal direction. Failure to comply with a direction is also an offence and may attract a penalty.

Maintenance

Over time, a meter may lose accuracy and incorrectly measure water use. The accuracy of a meter is affected by its age, and by the volume and quality of the water passing through the instrument. Corrosion, iron bacteria, exposure to coarse sediment and intermittent patterns of water use may affect meter performance and longevity.

Meters must therefore be maintained properly to ensure they continue to accurately measure water use over time. The department accepts a margin of error of up to five per cent, on an installed meter.

The department may inspect a meter at any time and may require a meter be tested if the department believes the instrument is not accurate. The department may estimate your water use if it believes your water use has not been measured accurately, because the meter was not installed

correctly, was removed for maintenance or repair, or the meter was tested and found to be inaccurate. For more information about meter-testing please refer to the department's *Guidelines for water meter installation 2009*.

Records

Taking regular meter readings will help you manage your water use and ensure you comply with your annual licensed entitlement, and may be a condition of your water licence.

For monthly readings, you should set aside a specific day during the last week of each month to read your meter. It may be useful to set yourself a reminder in your diary, calendar or on your mobile phone. If a reading is required for the beginning of your water year, it should be taken during the first week of that year. A reading required to be taken at the end of your water year should be taken during the last week of that year.

If your licence requires you to record readings on a *Meter water use card*, readings submitted electronically through Water Online at www.online.water.wa.gov.au will be accepted as completed *Meter water use cards*.

Meter removal

If a meter that is required under your licence must be replaced or removed for any reason, you should notify the department as soon as possible, by providing the following information:

- your name and/or the licensee's name and licence details
- location of the draw-point
- serial number of the meter
- date and time of removal and replacement
- meter reading at the time of removal
- details of the new meter fitted, if applicable
- reasons for meter removal.

Servicing

Servicing should be carried out by an irrigation specialist, ideally during a period of low water use. Regular servicing helps maintain meter accuracy and reduces the risk of a malfunction which may affect your water supply. Meters should be serviced more frequently if the water in your area has high levels of iron or sediment. Brown stains on hard surfaces and build-ups of deposits on sprinkler heads are common signs of high iron levels. In some cases it may be more economical to schedule regular meter replacement. You should consult your irrigation specialist about your meter maintenance options.

You can expect a routine service to include:

- **inspection** of the outer casing of the meter and the register (dial), and the removal and examination of the internal parts. The technician

may identify corrosion or iron build-up, or structural damage to the turbine, paddle or impeller caused by exposure to coarse sediment

- **servicing** which may include cleaning and restoration of the internal measurement elements, cleaning of the meter register housing, repair of any obvious damage or faults and the application of a bore-cleaning solution

- **testing** of the meter once reassembled. A service certificate should be provided for your records.

Why meter water use?

The state's water resources are under increasing pressure. Precise information about how much water is being used in a particular area helps the department to understand the real impacts of our water use.

The information supports sustainable water resource management and planning by helping us to set allocation limits, improve modelling and forecasting for the future, and improving equity for all water users by ensuring licensees' take no more water than they are entitled to.

Metering also benefits water users, for example, by helping you to understand your water needs to support business planning and development, optimising water efficiency, allowing you to monitor the performance of pump and irrigation systems, identifying opportunities to trade surplus entitlements.

Definitions

Draw-point a point at which water is accessed and drawn.

Rights in Water and Irrigation (Approved Meters) Order 2009 legislation published in the *Western Australian Government Gazette* on 5 May 2009. It requires that a meter complies with the Australian standard, or is tested and verified to be accurate by an accredited laboratory and installed according to manufacturer's specifications. Refer to the department's *Guidelines for water meter installation 2009*.

For further information

For more information about your responsibilities as a licence holder, please see the department's brochure *Your licence to take water*, contact your local regional office or see Responsibilities of Licence and Permit holders at the department's website.

www.dwer.wa.gov.au

The department's *Guidelines for water meter installation 2009* are available from your local regional office or from the department's website.



Metering regulations

The *Rights in Water and Irrigation Amendment Regulations 2018*, enacted on 18 February 2018, relate primarily to the Rights in Water and Irrigation Regulations 2000 Part 4A – Meters.

The regulations

Under the new regulations, certain licensees must:

- Install a meter on each water draw-point.
- Ensure the meter and installation complies with the Rights in Water and Irrigation (Approved meters) Order 2009.
- Provide the following details of the installation (within 30 days):
 - Coordinate references relating to the location of the meter or another approved description of its location
 - Date of installation
 - Meter reading at the time of installation
 - Make, size, type and serial number of the meter.

After the meter is installed drawings or annotated photographs of the meter should be taken and must show:

- the length of pipe connecting the draw-point to the upstream flange of the meter
- the length of pipe between the downstream flange of the meter and the first-bend or take-off
- the direction of the water flow through the meter.

A copy of the manufacturer's specifications for installation of the meter or written advice from the person who installed the meter that it complies with the manufacturer's specifications for installation must also be provided.

Licensees are to ensure the meter is maintained, in good working order and operating within a range of plus or minus five per cent of the quantity of water that actually passes through it, when tested in field conditions.

Under the Rights in Water and Irrigation Regulations 2000 it is an offence to damage a meter; or install, or alter, a meter or any associated fittings so that the meter does not accurately measure the quantity of water being taken from a well.

Licensees are required to:

- Record the meter reading at the end of each month
- Report meter readings to the department within 30 days after the end of the relevant water year (unless approved to provide an annual abstraction volume)
- Notify the department within seven days of detecting a malfunction of the meter.

Meter readings must be submitted via the department's Water Online metering portal, unless otherwise approved by the department. To enable the online submission of meter readings, meters must first be registered in the metering portal against the relevant water licence by entering some key meter installation details.

When do the requirements apply?

The new metering regulations will affect licences issued under Section 5C of the *Rights in Water and Irrigation Act 1914*, with an annual water entitlement of -

500,000 kL or more	from 31 March 2018
50,000 kL to 499,000 kL	from 31 December 2018
10,000 kL to 49,999 kL in the Gnamara groundwater plan area	from 31 December 2019
10,000 kL to 49,999 kL In all other areas	from 31 December 2020

The regulations **do not** apply if

- the licence is issued for less than 12 months
- the licence relates to a single user dam
- the department has approved an alternative method for measuring the take of water, or
- the licence is exempt from all forms of measurement.

Alternative measurement

The department may approve alternative forms of measurement, for example, for in-stream dams (where metering may not be practical) and in situations where the licensed water take requires more comprehensive monitoring (most likely in addition to metering). This will be assessed on a case by case basis.

Alternative forms of measurement approved for surface water may include but not be limited to dam surveys, installation of staff gauges, or monitoring of water levels.

Exemptions

In some cases, where measurement will provide minimal benefit to water resource management, licensees may be exempt from measuring their water take. A licensee may be exempt from the requirement to measure the quantity of water taken under a licence if the department is satisfied on reasonable grounds that it is impracticable to fit a meter and it is also inappropriate to use an alternative measurement method for measuring the quantity of water taken.

Penalties

Failure to comply with these requirements is an offence and attracts a penalty of \$2000 and daily penalty of \$200 under prosecution. The department may elect to deal with the offence by way of a modified penalty (i.e. issue an infringement) of \$400.

If a licensee fails to comply with the regulations, the department also may formally direct a licensee to comply. The licensee commits an offence if they do not comply with the direction within the specified time-frame and the department may do all or part of whatever the direction requires to be done (such as fitting a meter), and recover the costs from the licensee.

More information

For more information about your responsibilities see our brochure '[Metering your water use](#)' and answers to Frequently Asked Questions on our website at www.dwer.wa.gov.au. Go to Water > Licensing > Metering and measurement.

You can see a full transcript of the regulations and the *Rights in Water and Irrigation Act 1914* at the State Law Publisher's website at www.slp.wa.gov.au/legislation/statutes.

You can use our online services to manage all of your licensing and metering needs. Register for water online at www.dwer.wa.gov.au >Water> Home > Water Online.

Appendix I
**Stormwater management
plan - Nairn Drive
extension**

STORMWATER MANAGEMENT PLAN - NAIRN DRIVE EXTENSION

BACKGROUND AND AREA COVERED BY THIS PLAN

The intention of this Stormwater Management Plan (SMP) is to support the progression of a subdivision application to create a portion of road reserve, being the extension of Nairn Drive within the Parkland Heights Estate (the site). This subdivision will enable the construction of Nairn Drive from the northern boundary of the site to just south of the proposed roundabout to be constructed at the intersection of Arpenteur Drive and Nairn Drive.

This SMP covers Section 1 and 2 of Nairn Drive and a small unconstructed section of Pymmes Junction, as illustrated in Attachment A (the subdivision area) and Attachment B (drainage catchment extents). The Pymmes Junction catchment is included on 28601-NAIRN- SK008(D) of Attachment B.

This SMP responds to a request from the City of Rockingham (CoR) for the purpose of demonstrating the drainage requirements and proposed water management of Section 1 and 2 of Nairn Drive plus a small section of Pymmes Junction. This statement will clarify the stormwater volumes generated by Sections 1 and 2 Nairn Drive and the small section of Pymmes Junction. It will also demonstrate the proposed engineering design and treatment of this stormwater to be implemented within the Nairn Drive road reserve Section 1 and Pymmes Junction and provision of a temporary basin for Section 2.

Parts of the subdivision area drain to Furnivall Parade and Arpenteur Drive (see Attachment B 28601-NAIRN-SK008 and 28601-NAIRN-SK009). These sub-catchment areas are in accordance with the approved Stage 4, 5 and 6 Urban Water Management Plan and are not discussed further.

An indicative staging plan for the site is provided as Attachment C and illustrates the location of each stage. This staging plan should be considered indicative as this a working document which is subject to change but is useful to provide overall context of the development.

Construction of Nairn Drive is a project priority. Therefore, approvals (planning, engineering and landscaping) are being progressed to facilitate civil construction commencing mid 2020. This SMP forms part of this work and is consistent with the currently approved Parkland Heights LWMS.

An LWMS Addendum update will also be developed, relating to the Structure Plan amendment resulting from minor changes to the Stage 13 & 14 subdivision layout. As agreed with the city, this LWMS Addendum will be limited to, and address (1) upstream catchment (2) runoff from lots within Stage 13 & 14 to POSK; and (3) limited commentary on Nairn Drive Section 1 and 2, consistent with this SMP.

DESIGN DETAIL

The following assumptions were used to inform stormwater infrastructure design.

- The *Laurenson Routing Method* was used for modelling runoff of each sub-catchment.
- The XPSWMM Hydraulic model was used for modelling of pit and pipes, swales, basins, and surface conveyance (eg kerb side).

Table 1 Impervious area assumptions

Post-development land use	Percentage as impervious area
Road Reserve	80%
Pymmes Junction Catchment	70%

Table 2 Loss model assumptions

	Initial Loss*	Continuing Loss
Impervious Area	2 mm	Nil
Pervious Area	30 mm	7 mm per hour*

*Pervious area continuing loss as accepted by CoR.

The initial and continuing loss values adopted are based on other sandy sites and are recommended by the CoR for Nairn Drive. As agreed with the CoR in recent meetings, these values shall be re-assessed for future Parkland Heights stages, including POSK in Stage 14.

The Pymmes Junction catchment was modelled as 1.31 ha in size, with approximately 70% impervious and 30% pervious areas. The initial and continuing loss rates adopted for pervious areas are consistent with the rates used along Nairn Drive.

Table 3 Mean-Max Design Storms for Nairn Drive sub-catchments

Design Storm	Nairn Drive Sub-Catchments
1% AEP	30min Storm 6
10% AEP	1 hour Storm 3
20% AEP	30min Storm 3
63% AEP (Bio Retention)	1 hour Storm 5

GROUNDWATER LEVELS AND QUALITY

Based on the recent geotechnical investigation of the Parkland Heights Estate, no groundwater was observed within boreholes drilled to depths of up to 2.5 m below surface level.

In addition, as part of Parkland Heights Draft Stage 6 UWMP, the estimated AAMGL underlying Nairn Drive is 4.5 m to 4.95 m AHD. The main proposed levels and the estimated depth to AAMGL is summarised in Table 4 below. Given the significant depth to groundwater, ranging from 10 m to 25 m, groundwater does not present as a constraint to the management of drainage within the Nairn Drive road reserve or surrounding development.

Table 4 Proposed development levels separation to AAMGL

	Proposed Levels (m AHD)	Estimated Depth to AAMGL (m)	Estimated AAMGL (m)
Section 1	22.5 to 29	17.5 to 24	5
Section 2	14.5 to 20	10 to 15.5	4.5
Section 3	29 to 30	24 to 25	5

INFRASTRUCTURE OVERVIEW- UPSTREAM CATCHMENT

The main external catchment from the Ridge Estate to the north is illustrated in 28601-NAIRN-SK007 (C) of Attachment B. It has an area of 9.3 ha and is directed to a storage basin in Lot 334 currently owned by

Rockingham Park Pty Ltd. It was agreed that this site would remain the storage basin for this catchment and that ownership would be transferred to the CoR. The basin has been surveyed and it has a storage volume of 1,852 m³ which is more than adequate to store the 1% AEP of 1,748 m³.

To ensure runoff is diverted to this basin, side entry pits adequate for the 1% AEP and 525/750 diameter pipes directly connected to this basin at the Nairn Drive boundary of Parkland Heights have been incorporated into the design. The upstream Ridge Estate runoff is therefore isolated from Nairn Drive within Parkland Heights.

Additional detailed information relating to this upstream catchment will be included in the Parkland Heights Local Water Management Strategy Addendum (LWMS) as discussed above. This LWMS is currently being updated as part of the Parkland Heights Structure Plan amendment (minor) resulting from minor design changes to proposed Stages 13 and 14.

INFRASTRUCTURE OVERVIEW - SECTION 1 NAIRN DRIVE

Catchment details of Section 1 of Nairn Drive are shown in 28601-NAIRN-008 (D). Drainage generated by Section 1 of Nairn Drive will be managed through a roadside drainage swale that will be located within both the eastern and western verges of the northern portion of Nairn Drive. The location and size of the swales are detailed in 28601-NAIRN-100 (D), 101 (D),-102 (C), with typical cross sections detailed in 28601-NAIRN-128 (B), Attachment D.

The swales are designed to capture all flows up to the 1% AEP, with a total catchment area of 1.43 ha. The swales will be 'V' shaped with side slopes designed at 1 in 6 batters with a maximum depth of 300 mm, providing a total storage capacity of 302 m³. The swales will be 6 m wide and will be located between the carriageway (including the bike lane) and the footpath, on both sides of Section 1. Stormwater will streetflow from the road to the swale. No stormwater will be directed towards the median of Nairn Drive.

INFRASTRUCTURE OVERVIEW - SECTION 2 NAIRN DRIVE

Stormwater runoff for Section 2 of Nairn Drive adjoining the Neighbourhood Centre will be captured via a pit and pipe system which will ultimately connect and discharge to the future POS M via the future Arpenteur Drive (east of Nairn Drive). Catchment details of the Section 2 system are illustrated in 28601-NAIRN-SK009 (C) of Attachment B. Detailed design of the pit and pipe system was included in the amended engineering package previously provided to the CoR on the 28 April 2020.

As an interim measure, the Section 2 of Nairn Drive pit and pipe system will discharge into a temporary basin located to the south east of the Nairn Drive /Arpenteur Drive roundabout (refer 28601-NAIRN-SK009(C) and 28601-NAIRN-603 (B) of Attachment B for the temporary basin location and design details. The temporary basin allows for 1% AEP / 1:100 year event.

Temporary basin design details, a cross-section details were included in the amended engineering package previously provided to the CoR on the 28 April 2020. The basin will include side batters at a slope of no more than 1:4 and the temporary basin will be fenced to ensure access is restricted. No landscaping of the temporary basin is proposed to be undertaken as the basin will be relocated when future Stage 9 is developed, and POS M is installed.

INFRASTRUCTURE OVERVIEW - PYMMES JUNCTION

The Pymmes Junction catchment contains an area of 1.31 ha and will be constructed as part of the Nairn Drive extension works. Details of this catchment and runoff are included in 28601-NAIRN-SK008(D) of Attachment B. Runoff from Pymmes Junction catchment has been included as part of Nairn Drive Section 1 catchment calculations, and will be managed within the series of roadside swales provided within Section 1 of Nairn Drive as indicated in Attachment B.

RESPONSIBILITIES AND MANAGEMENT ARRANGEMENTS

Construction and management of all infrastructure described will be the responsibility of the developer until such time as handover to the CoR. Prior to handover of the temporary basin, on implementation of subdivision for adjacent Stage 9, the temporary basin described for Section 2 will be decommissioned and completely removed.

LANDSCAPING

A preliminary landscape design concept for Nairn Drive is detailed in Attachment E.

Attachment E illustrates a combination of planted and turfed swales for the extent of the Section 1 design. Please note this Landscape Plan is conceptual only and detailed design and documentation will be finalised for City of Rockingham approval following approval of the engineering drawings.

The proposed treatments for Section 1 of Nairn Drive for the verge and median will include two specifications detailed below:

- Verges, 600 mm mulch only offset and planting with native trees at 10 m spacings to drainage swale area and footpath; or
- Verges, turf with native trees at 10 m spacings to drainage swale area and footpath.
- Median will be kerbed with turf with *Eucalyptus gomphocephala* (Tuart) trees at 15 m spacings.

The proposed treatments for Section 2 of Nairn Drive for the verge and median will include:

- Verges with a kerb, turf with native trees at 10m spacings and footpath
- Median with a kerb, 600mm paving offset with mulch and planting including *Araucaria heterophylla* (Norfolk Pine) at 15m spacings

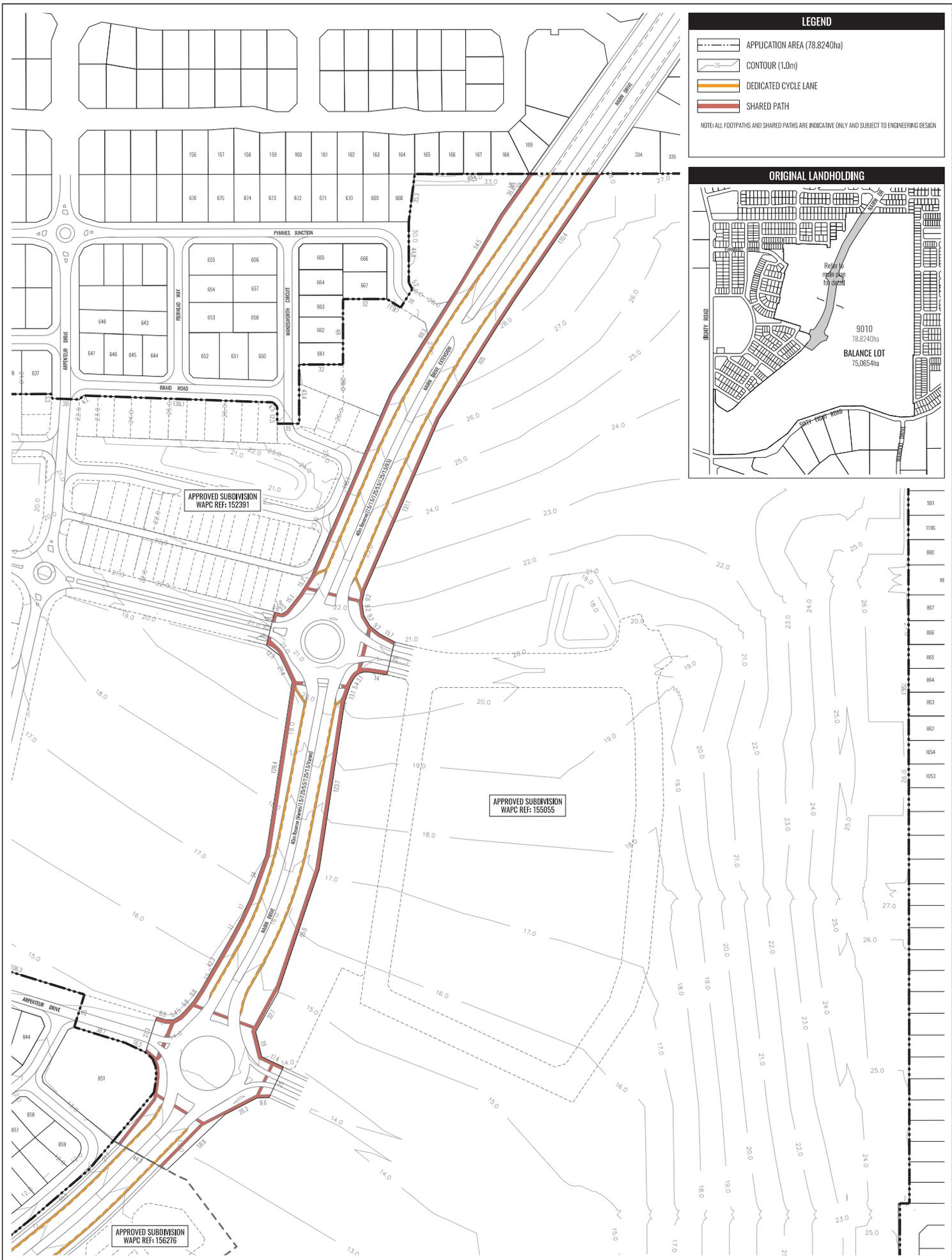
The proposed tree species to be utilised in the verges of Nairn Drive (both Section 1 and 2) will be confirmed by CoR, as per suggestions in Concept Document Attachment D and issued on 18th Dec 2019 by LD Total.

WATER RESOURCING

Groundwater Licence GWL164680(10) (Attachment F) applies to both Parkland Heights and Heritage Park and provides for a total annual allocation of 101,320 kL from the Stakehill Perth-Superficial Swan aquifer. A balance of 52,579 kL/annum is available for the Parkland Heights estate; of this it is estimated the entire Nairn Drive area will require approximately 10,000 - 15,000 kL (max) per annum for irrigation purposes. Table 5 below illustrates the use of the of the allocation within the estate more broadly and demonstrates the availability of this volume for use in the Nairn Drive sections.

ATTACHMENT A

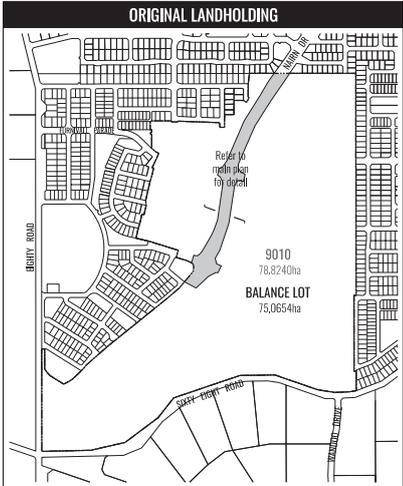
Proposed subdivision



LEGEND

- APPLICATION AREA (78.8240ha)
- CONTOUR (1.0m)
- DEDICATED CYCLE LANE
- SHARED PATH

NOTE: ALL FOOTPATHS AND SHARED PATHS ARE INDICATIVE ONLY AND SUBJECT TO ENGINEERING DESIGN



APPROVED SUBDIVISION
WAPC REF: 152391

APPROVED SUBDIVISION
WAPC REF: 155055

APPROVED SUBDIVISION
WAPC REF: 156276



PROPOSED SUBDIVISION

Lot 9010 Nairn Drive, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:2500 @ A3

0 25 50 75m

PLAN: RHPFH-3-005B REVISION: B
DATE: 03/10/2019 DRAWN: RV
PROJECTION: PCG 94 PLANNER: TV
DATUM: AHJD CHECK: TV

Creative
DESIGN + PLANNING

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ATTACHMENT B

Drainage catchment extents

PROJECT NAME



PARKLAND HEIGHTS

NAIRN DRIVE

CLIENT

Rockingham Park Pty Ltd



0 20 40 60 80 100m
Scale 1:2000 - A1(14,000 - A3)

ISSUES DATE

TENDER

WATER CORPORATION

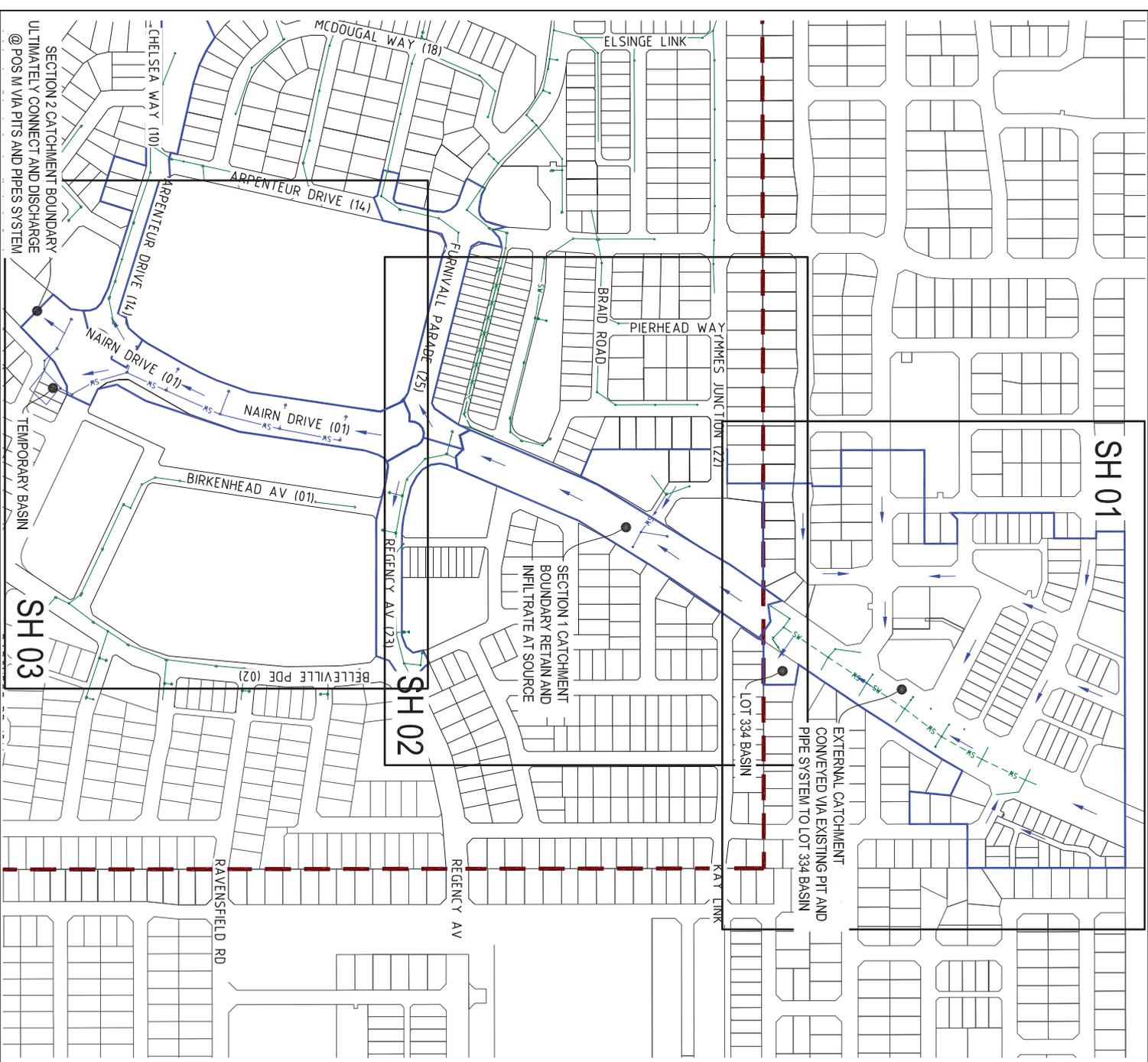
CONSTRUCTION

SH 01

SH 02

SH 03

- LEGEND**
- SM - - - - - EXISTING STORMWATER
 - EXISTING KERB (L/UP)
 - EXISTING PROPERTY LINE
 - PROPOSED SITE BOUNDARY
 - PROPOSED PROPERTY LINE
 - WORKS CATCHMENT BOUNDARY
 - STORMWATER FLOW
 - SM - - - - - PROPOSED STORMWATER



MORTONS
Urban solutions
Civil Engineering
Project Coordination

MUE Pty Ltd, 17/45
Horseshoe Solutions
ASN 39 16 315 965
Email: services@mortonsurban.com.au
Web: www.mortonsurban.com.au
Tel: 08 9380 9700

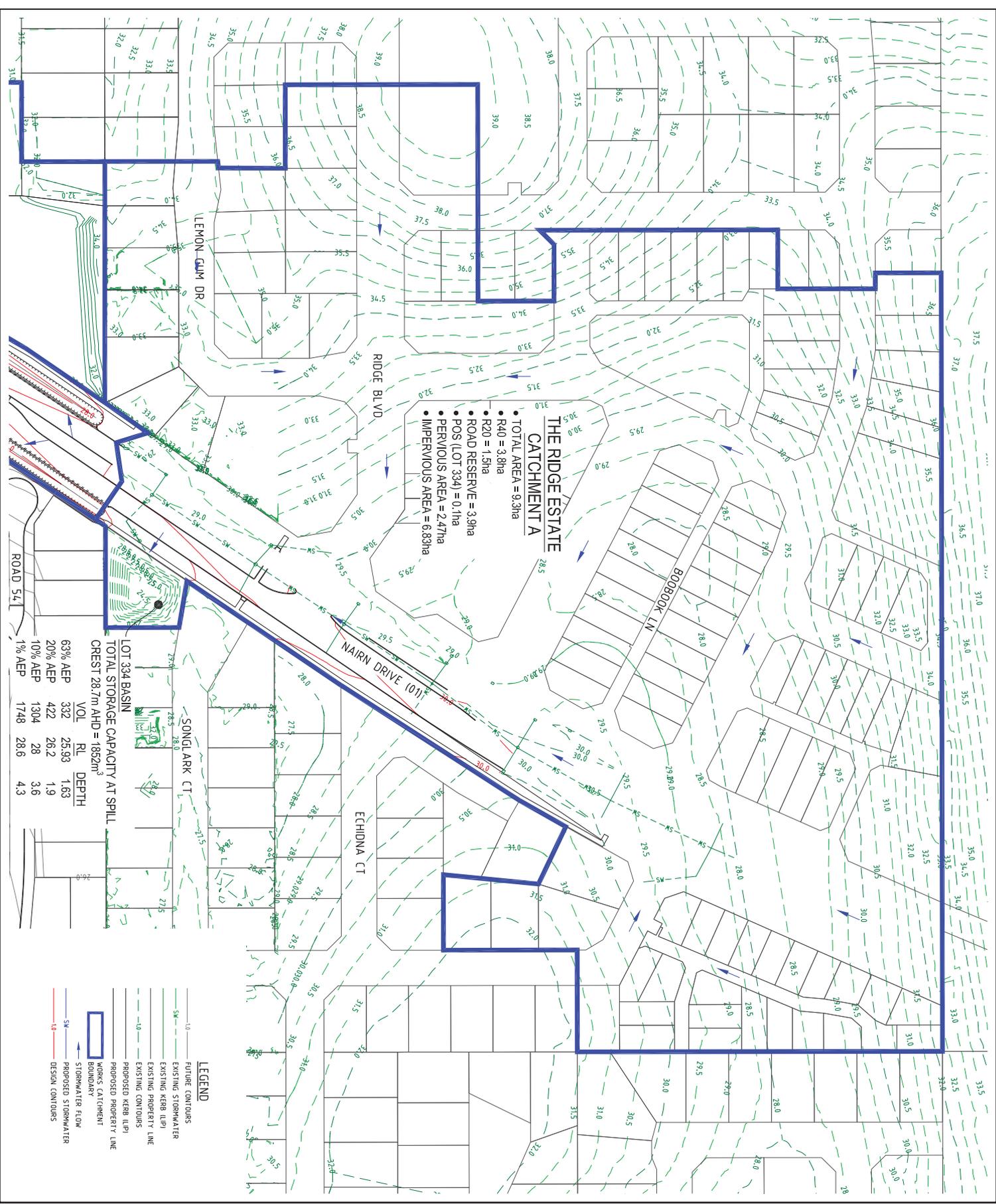
Postal Address
100 Railway Road
Suburb 6008

Perth Office
100 Railway Road
Suburb 6008

DRAINAGE CATCHMENTS KEY PLAN

DRAWING NUMBER: 28601-NAIRN-SK006

DATE: B



THE RIDGE ESTATE CATCHMENT A

- TOTAL AREA = 8.3ha
- R40 = 3.8ha
- R20 = 1.5ha
- ROAD RESERVE = 3.9ha
- POS (LOT 394) = 0.1ha
- PERVIOUS AREA = 2.47ha
- IMPERVIOUS AREA = 6.83ha

LOT 394 BASIN

TOTAL STORAGE CAPACITY AT SPILL

CREST 28.7m AHD = 1852m³

AEP	VOL	RL	DEPTH
63% AEP	332	25.93	1.63
20% AEP	422	26.2	1.9
10% AEP	1304	28	3.6
1% AEP	1748	28.6	4.3

LEGEND

- 10- FUTURE CONTOURS
- 10- EXISTING STORMWATER
- 10- EXISTING KERB (LIP)
- 10- EXISTING PROPERTY LINE
- 10- EXISTING CONTOURS
- 10- PROPOSED KERB (LIP)
- 10- PROPOSED PROPERTY LINE
- 10- STORMWATER FLOW
- 10- PROPOSED STORMWATER
- 10- DESIGN CONTOURS



PROJECT NAME
PARKLAND HEIGHTS
NAIRN DRIVE

CLIENT
Rockingham Park Pty Ltd



ISSUES	DATE
TENDER	
COUNCIL	
WATER CORPORATION	
CONSTRUCTION	

DESIGNED BY: MORTONS URBAN SOLUTIONS AND PARTNERS
 DRAWN BY: MORTONS URBAN SOLUTIONS
 CHECKED BY: MORTONS URBAN SOLUTIONS
 APPROVED BY: MORTONS URBAN SOLUTIONS
 DATE: 15/03/2017
 PROJECT: AMENDMENT

CONSULTANT: MORTONS URBAN SOLUTIONS AND PARTNERS
 100 WATSON ROAD, SUITE 101, WATSON WA 6105
 TEL: 08 9380 9700
 WWW.MORTONSURBANSOLUTIONS.COM.AU

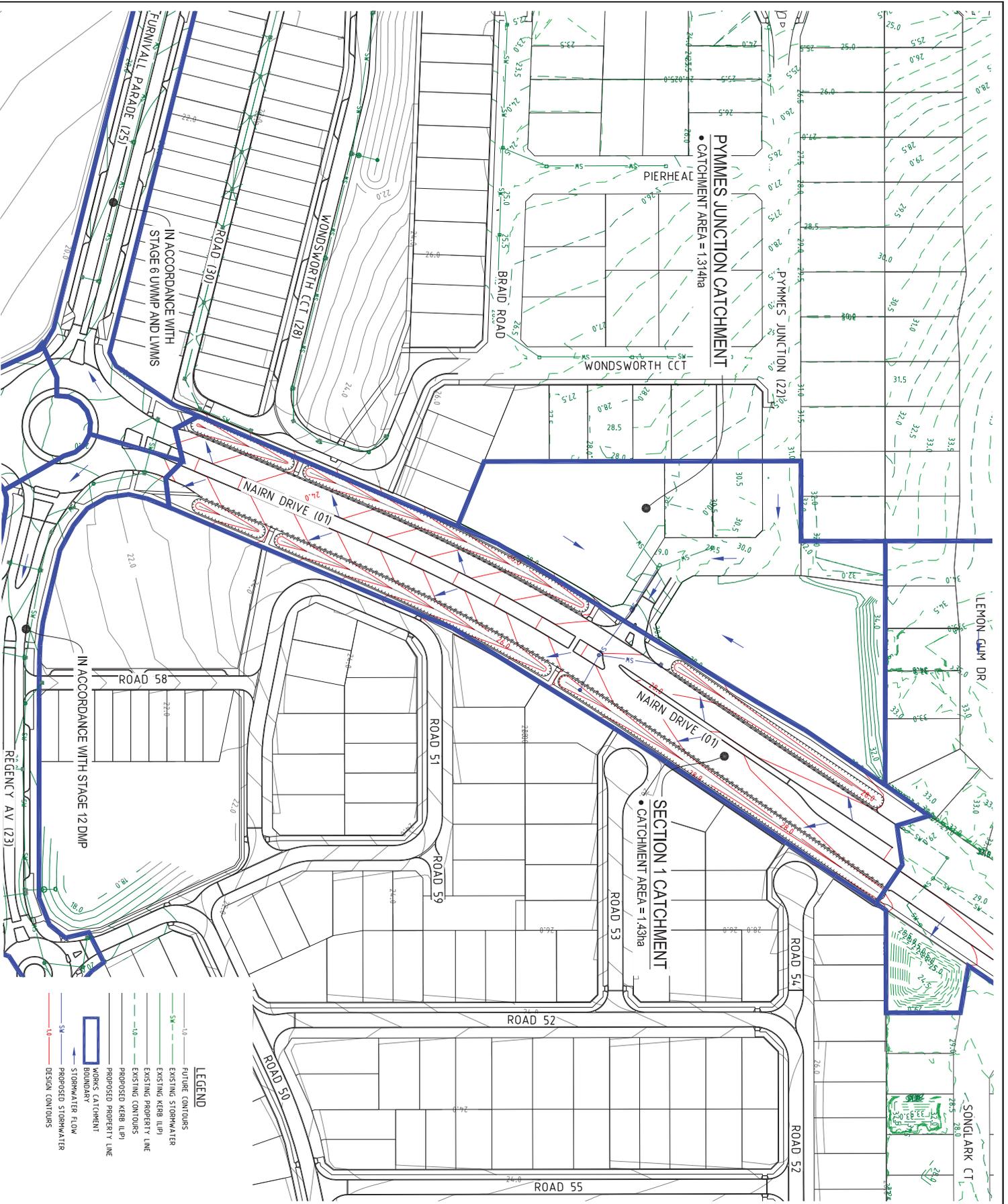
DRAWING TITLE
NAIRN DRIVE
DRAINAGE CATCHMENTS
SHEET 01

MORTONS Urban Solutions
 Civil Engineering
 Project Coordination

M/S Pty Ltd, 174/6
 North-south Solutions
 4th Floor, 100 Railway Road
 Subiaco 6008
 WA 6008
 Tel: 08 9380 9700
 www.mortonsurbansolutions.com.au

PAUL MORTON
 PROJECT MANAGER

28601-NAIRN-SK007



PROJECT NAME



PARKLAND HEIGHTS
NAIRN DRIVE

CLIENT

Rockingham Park Pty Ltd



0 75 15 225 30 375m
Scale 1:750 - A1 (1:500 - A3)

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TENDER	
COUNCIL	
WATER CORPORATION	
CONSTRUCTION	

NO	REVISION	DATE	BY	CHKD
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COMPILED & CHECKED BY: MORTONS URBAN SOLUTIONS AND CONSULTANTS
DATE: 15/08/2018
SCALE: AS SHOWN
DO NOT SCALE FROM THIS DRAWING.

ASSOCIATED CONSULTANTS

DRAWING TITLE

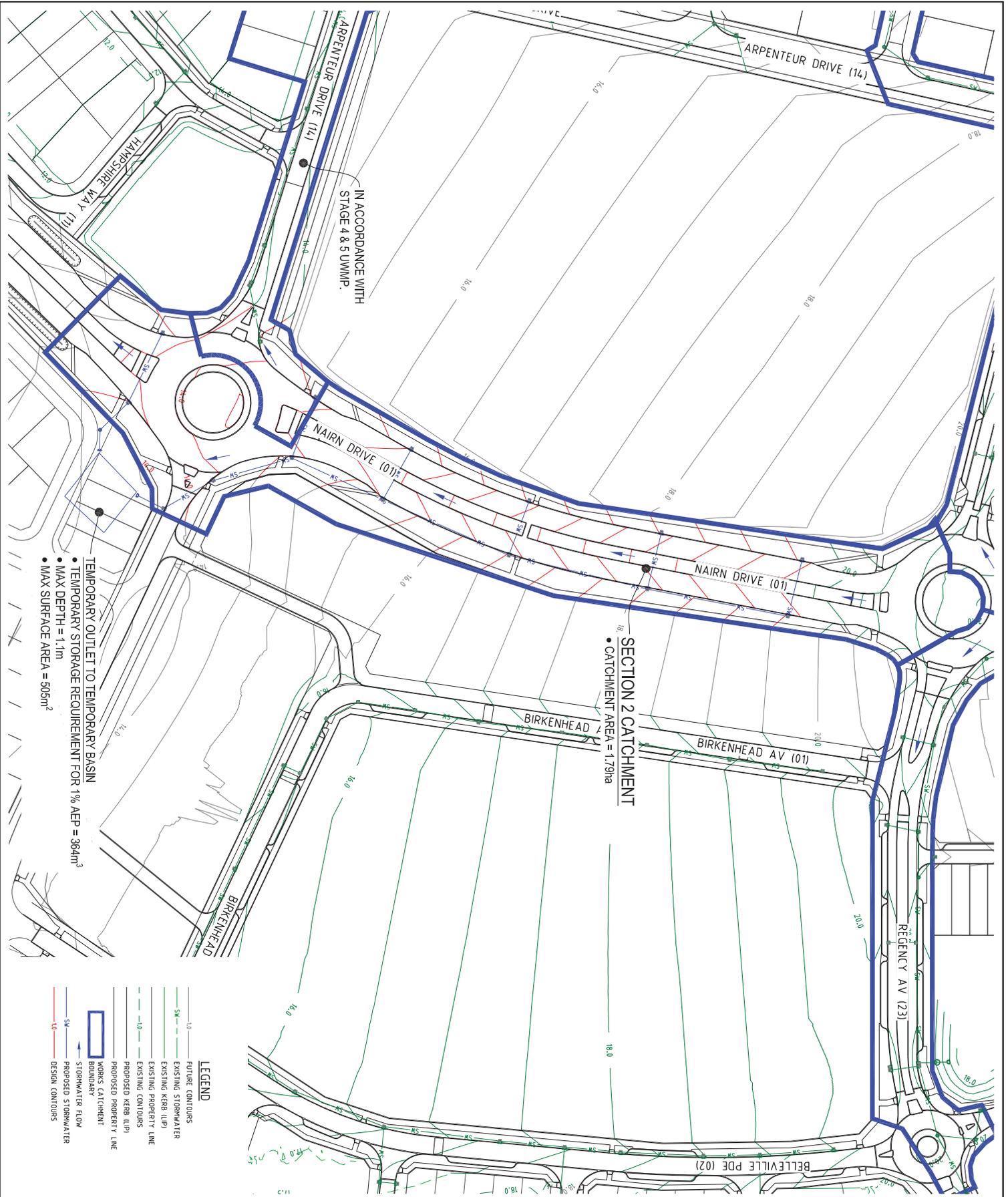
**NAIRN DRIVE
DRAINAGE CATCHMENTS
SHEET 02**

MORTONS
Urban Solutions
Civil Engineering
Project Coordination

MIS Pty Ltd 17/46
Horrocks Street
A/N 91 316 315 935
Website www.mortonsurbansolutions.com.au
Tel 08 9380 9700

Postal Address
Unit 100 Railway Road
Suburb 6008
Perth Office
Unit 100 Railway Road
Suburb 6008

DRAWING NUMBER: 28601-NAIRN-SK008
DATE: 15/08/2018
SCALE: AS SHOWN



- TEMPORARY OUTLET TO TEMPORARY BASIN
- TEMPORARY STORAGE REQUIREMENT FOR 1% AEP = 364m³
- MAX DEPTH = 1.1m
- MAX SURFACE AREA = 605m²

SECTION 2 CATCHMENT
 • CATCHMENT AREA = 1.79ha

LEGEND

-1.0	FUTURE CONTOURS
SW	EXISTING STORMWATER
---	EXISTING KERB (LIP)
---	EXISTING PROPERTY LINE
-1.0	EXISTING CONTOURS
---	PROPOSED KERB (LIP)
---	PROPOSED PROPERTY LINE
---	PROPOSED CATCHMENT
---	WORKS CATCHMENT
---	BOUNDARY
---	STORMWATER FLOW
---	PROPOSED STORMWATER
---	DESIGN CONTOURS

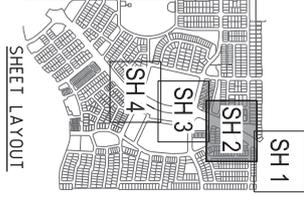
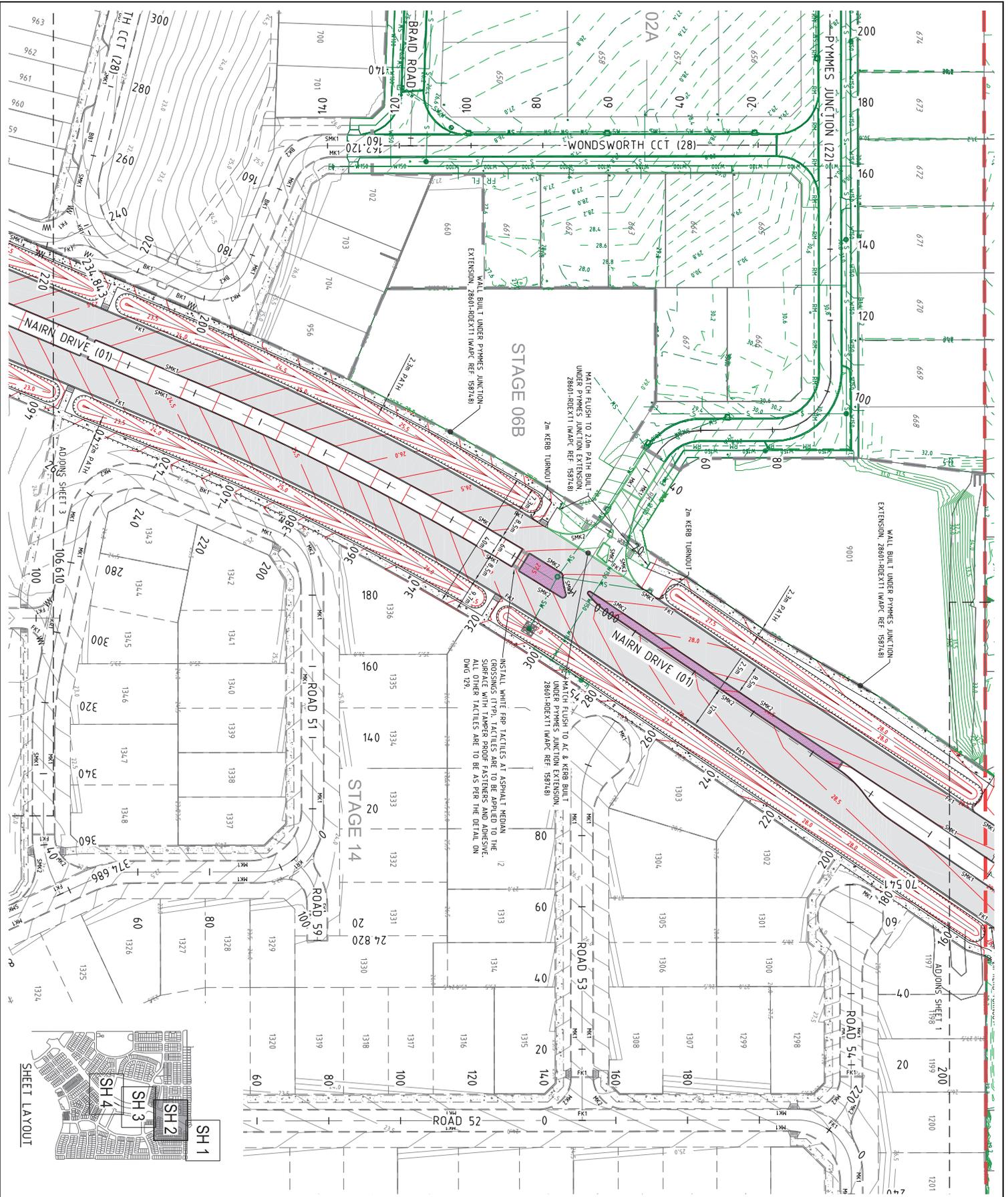
 MORTONS Urban Solutions Civil Engineering Project Coordination	Rockingham Park Pty Ltd CLIENT	PARKLAND HEIGHTS NAIRN DRIVE CLIENT	PROJECT NAME PARKLAND HEIGHTS NAIRN DRIVE CLIENT	DRAWING NUMBER 28601-NAIRN-SK009	DRAWING TITLE NAIRN DRIVE DRAINAGE CATCHMENTS SHEET 03																				
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ASSOCIATED CONSULTANTS																									

ATTACHMENT C

Indicative staging plan

ATTACHMENT D

Swale design detail



PROJECT NAME



PARKLAND HEIGHTS

NAIRN DRIVE, SECTIONS 1, 2 & 3

CLIENT

Rockingham Park Pty Ltd



Scale 1:500 - A1 (1:1000 - A3)

ISSUES	DATE
TENDER	28-04-20
CONSTRUCTION	24-01-20

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WAPC REF: 158851

ASSOCIATED CONSULTANTS



DRAWING TITLE

ROADWORKS PLAN
SHEET 02

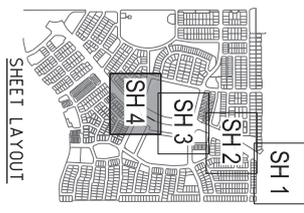
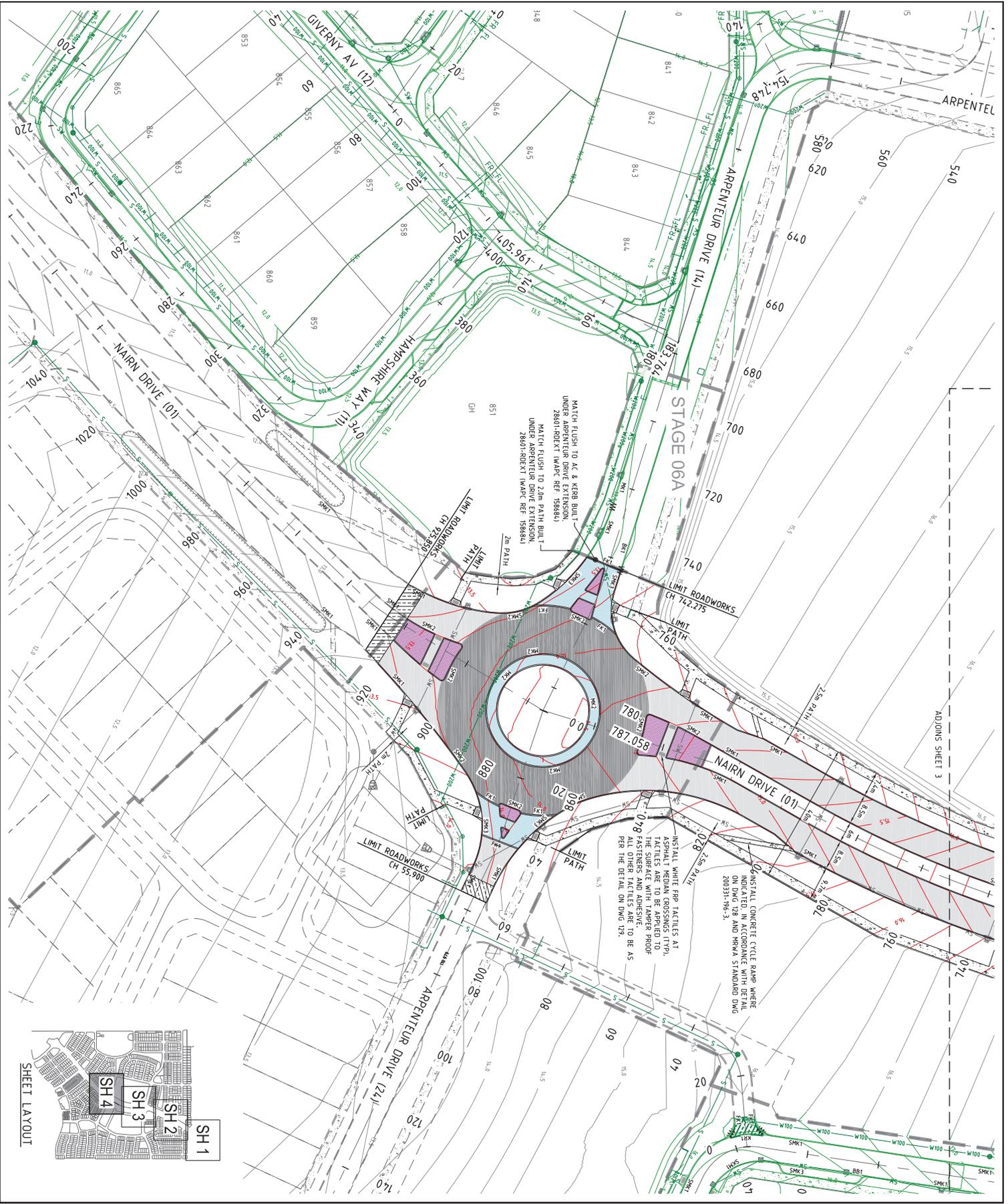
MORTONS
Urban Solutions
Civil Engineering
Project Coordination

MUE Pty Ltd
 1/147-148
 Northmead NSW 2151
 Phone: 02 9380 9700
 Email: info@mortonsurban.com.au
 Website: www.mortonsurban.com.au

Postal Address
 Suite 6008
 100 Railway Road
 Sydney NSW 2008
 Australia

NO	DATE	DESCRIPTION
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2	24-01-20	CONSTRUCTION

DRAWING NO: 28601-NAIRN-101
 SCALE: 1:500
 DATE: 28-04-20
 DRAWN BY: D



PROJECT NAME



PARKLAND HEIGHTS

NAIRN DRIVE, SECTIONS 1, 2 & 3

CLIENT

Rockingham Park Pty Ltd



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Scale 1:500 - A1 (11000 - A3)

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CONTRACT	24-01-20

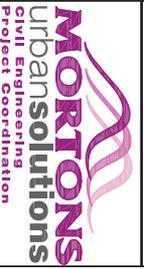
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WAPC REF: 158851



ASSOCIATED CONSULTANTS

ROADWORKS PLAN
SHEET 04



MORTONS Urban solutions
Civil Engineering
Project Coordination

M/S Pty Ltd
Mortons-urban solutions
ASN 39 16 315 965
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Website: www.mortonsurban.com.au
Tel: 08 9380 9700

Postal Address
UL 100 Railway Road
Suburb 6008
UL 100 Railway Road
Suburb 6008

APPROVED: [Signature] DATE: 24-01-20
DRAWING NUMBER: 28601-NAIRN-103



ISSUES	DATE
TENDER	30-04-20
CONCL.	24-01-20
CONSTRUCTION	

REV	DATE	DESCRIPTION
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WAPC REF: 158851

ASSOCIATED CONSULTANTS



Electrical Engineering Excellence

DRAWING TITLE

ROADWORKS & DRAINAGE

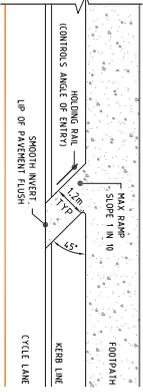
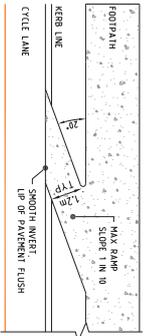
DETAILS

SHEET 09

MORTONS
Urban solutions
Civil Engineering
Project Coordination

MUS Pty Ltd
Mortons-Urban solutions
ABN 39 16 315 965
Perth Office
1st Floor, 100 Railway Road
Subiaco 6008
WA 6008
Perth Office
1st Floor, 100 Railway Road
Subiaco 6008
WA 6008

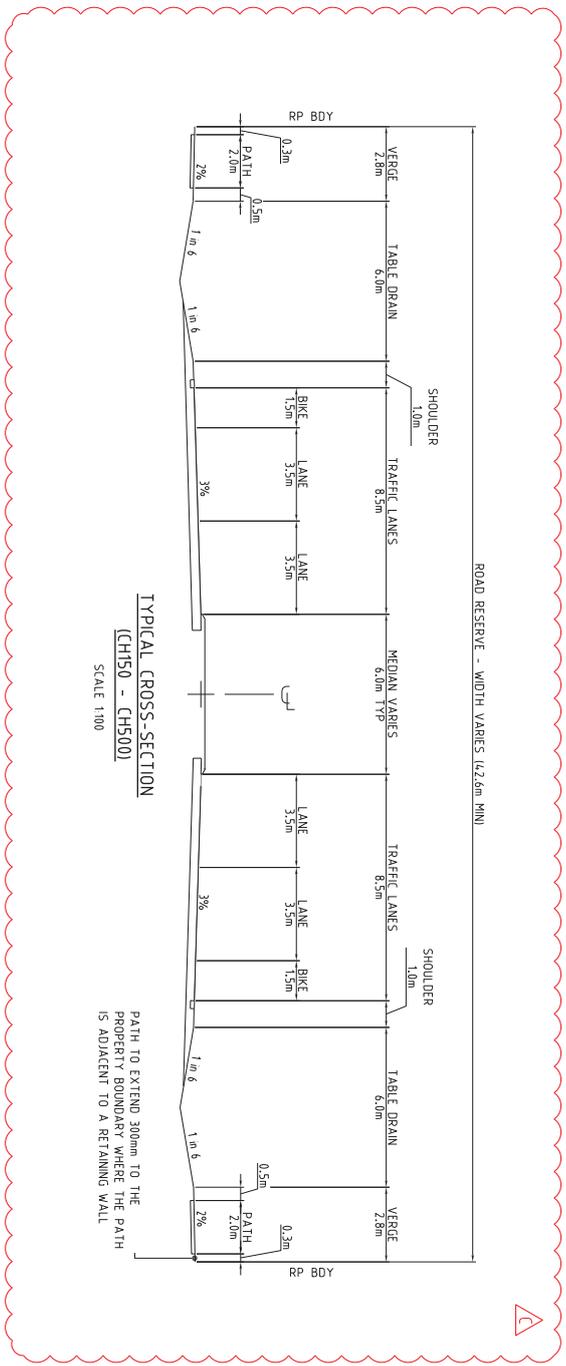
DRAWING NUMBER
28601-NAIRN-128
REVISIONS
DATE
BY
APPROVED
DATE
BY



ENTRY RAMP

LOW SPEED CYCLE RAMP

NOT TO SCALE
GENERALLY IN ACCORDANCE WITH AUSTRALASIAN ROAD DESIGN GUIDE TO ROAD DESIGN PART 3 GEOMETRIC DESIGN



TYPICAL CROSS-SECTION
(CH50 - CH500)
SCALE 1:100

PATH TO EXTEND 30m TO THE
PROPERTY BOUNDARY WHERE THE PATH
IS ADJACENT TO A REMAINING WALL

ATTACHMENT E

Landscape design concept plan

PARKLAND HEIGHTS

Nairn Drive Concept Design



9th Jan 2020 - Rev C



**PARKLAND
HEIGHTS**

NAIRN DRIVE - PARKLAND HEIGHTS CONCEPT PLAN

Note:
Design is subject to detailed design, budget and water allocation. LDT reserve
Copy Rights over this work and the right to change the design. Road reserve
boundary and design to follow approved civil drawings.



LEGEND

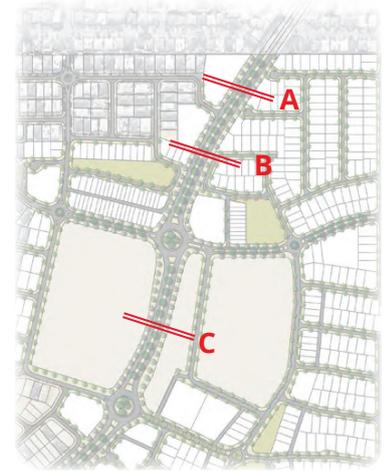
- MEDIAN TREES @15M SPACINGS
- VERGE TREES - @10M SPACINGS
- TURF AREAS
- PLANTING AREAS
- TREE WITH MEDIAN TURF - 600MM HARD EDGE BY CIVIL
- TREE WITH MEDIAN PLANTING - 600MM HARD EDGE BY CIVIL
- FOOTPATH TO VERGES BY CIVIL
- PLANTED SWALE TO VERGE SECTION 1 AREA
- TURF SWALE TO VERGE - SECTION 1 AREA
- TURF WITH NO SWALE TO VERGE - SECTION 2 AREA
- ROUNDABOUT FEATURE SCULPTURE
- NAIRN DRIVE SECTION 1 AREA
- NAIRN DRIVE SECTION 2 AREA - NEIGHBOURHOOD CENTRE

NAIRN DRIVE - PARKLAND HEIGHTS

LANDSCAPE TREE SPECIES SECTION AND CROSS-SECTIONS

Note:
 Design is subject to detailed design, budget and water allocation. LDT reserve
 Copy Rights over this work and the right to change the design. Road reserve
 boundary and design to follow approved civil drawings.

Angophora costata



LOCATION KEY sections NTS

TREE TO MEDIANS

SECTION 1



Eucalyptus gomphocephala

SECTION 2



Araucaria heterophylla

NATIVE TREES TO VERGE AREAS



Cupaniopsis anacardioides



Eucalyptus leucoxylo



Eucalyptus sideroxylo

ROUNDBABOUT SCULPTURES - INDICATIVE IMAGERY ONLY

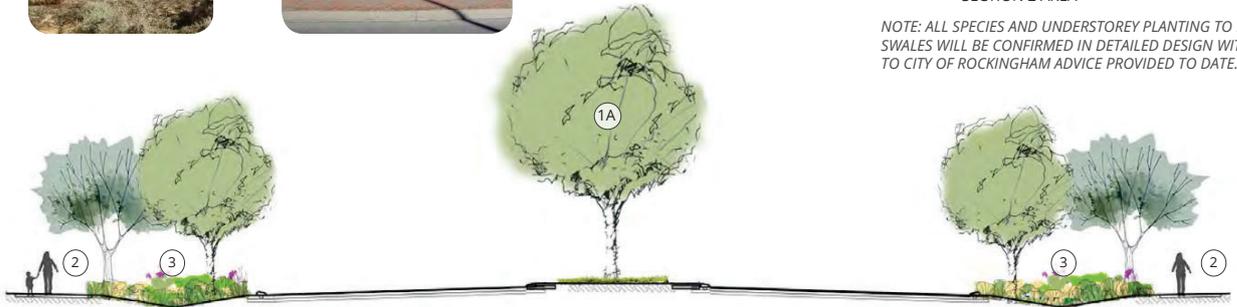


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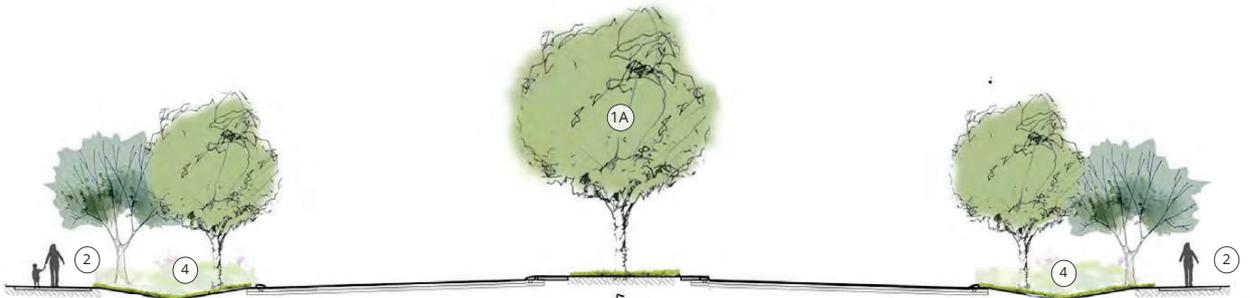
- ①A TREE AND TURF - 600MM HARD EDGE BY CIVIL
- ①B TREE AND PLANTING - 600MM HARD EDGE BY CIVIL
- ② FOOTPATH TO VERGES BY CIVIL
- ③ PLANTED SWALE TO VERGE - SECTION 1 AREA
- ④ TURF SWALE TO VERGE - SECTION 1 AREA
- ⑤ TURF WITH NO SWALE TO VERGE - SECTION 2 AREA

NOTE: ALL SPECIES AND UNDERSTOREY PLANTING TO MEDIAN AND SWALES WILL BE CONFIRMED IN DETAILED DESIGN WITH REFERENCE TO CITY OF ROCKINGHAM ADVICE PROVIDED TO DATE.

SECTION A



SECTION B



SECTION C



**NAIRN DRIVE - PARKLAND HEIGHTS
CONCEPT PLAN - TREE SPECIES**

NATIVE TREES TO ALL VERGE
- 10M SPACING
SPECIES SUGGESTIONS

Angophora costata
known as smooth-barked
apple, rose gum, etc



Eucalyptus leucoxylon
known as Yellow gum



Eucalyptus sideroxylon
known as mugga, red
ironbark or mugga



MEDIAN TREE
~15M SPACING
SECTION 1



Eucalyptus gomphocephala,
known as tuart

MEDIAN
WILL BE TURF
VERGE
WILL BE PLANTING
+ TURF

MEDIAN TREE
~15M SPACING
NEIGHBOURHOOD
CENTRE



Araucaria heterophylla
known as Norfolk Pine

MEDIAN
WILL BE PLANTING
VERGE
WILL BE TURF

ATTACHMENT F

Groundwater Licence



LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Rockingham Park Pty Ltd		
Description of Water Resource	Stakehill Perth - Superficial Swan	Annual Water Entitlement	101,320kL
Location of Water Source	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights LOT 954 ON PLAN 407830 - Lot 954 BALDIVIS - POS H - Parkland Heights		

Authorised Activities	Taking of water for	Location of Activity
	Dust suppression for earthworks and construction purposes	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights Lot 986 On Plan 202758 - Volume/Folio 2128/381 - Lot 986 Baldivis Rd Baldivis - Heritage Park Lot 993 On Plan 202758 - Volume/Folio 2125/382 - Lot 993 Baldivis Rd Baldivis - Heritage Park Road Reserve - PIN11754540 - Heritage Park
	Irrigation of up to 2ha ovals and playing fields	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights
	Irrigation of up to 5.8 ha of public open space	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights LOT 954 ON PLAN 407830 - Lot 954 BALDIVIS - POS H - Parkland Heights LOT 955 ON PLAN 407830 - Lot 955 BALDIVIS - POS I - Parkland Heights Lot 986 On Plan 202758 - Volume/Folio 2128/381 - Lot 986 Baldivis Rd Baldivis - Heritage Park Lot 993 On Plan 202758 - Volume/Folio 2125/382 - Lot 993 Baldivis Rd Baldivis - Heritage Park Road Reserve - PIN11754540 - Heritage Park
Duration of Licence	From 18 October 2018 to 4 February 2024	

This Licence is subject to the following terms, conditions and restrictions:

- The licensee shall not use water for sprinkler irrigation between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.
- Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.
- The volume of all water taken under this licence must be metered using an approved meter fitted to each drawpoint.
- The annual water year for water taken under this licence is defined as 1 January to 31 December.
- Unless otherwise approved by the Department of Water and Environmental Regulation, all meter readings must be recorded monthly via the Department of Water and Environmental Regulation's 'Water Online Portal' or on an approved Department of Water and Environmental Regulation 'Meter Water Use Card'. The meter readings must be reported via the 'Water Online Portal' or submitted via a completed 'Meter Water Use Card' to the Department of Water and Environmental Regulation every 12 Months, commencing 30/01/2019.

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000.



LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

This Licence is subject to the following terms, conditions and restrictions:

6. The licensee must ensure the installed meter(s) accuracy is maintained to within plus or minus 5% of the volume metered, in field conditions.
7. The licensee must notify the Department of Water and Environmental Regulation in writing of any water meter malfunction within seven days of the malfunction being noticed.
8. The licensee must obtain authorisation from the Department of Water and Environmental Regulation before removing, replacing or interfering with any meter required under this licence.

End of terms, conditions and restrictions

Appendix J
Lot 9009 Sixty Eight Road
drainage management
plan

PARKLAND HEIGHTS ESTATE

Lot 9009 Sixty Eight Road

Drainage Management Plan

Lot 9009 Sixty Eight Road DRAINAGE MANAGEMENT PLAN

Address: Furnivall Parade, Baldivis

Lot & RP Description: (part) of Lot 9010 DP407830

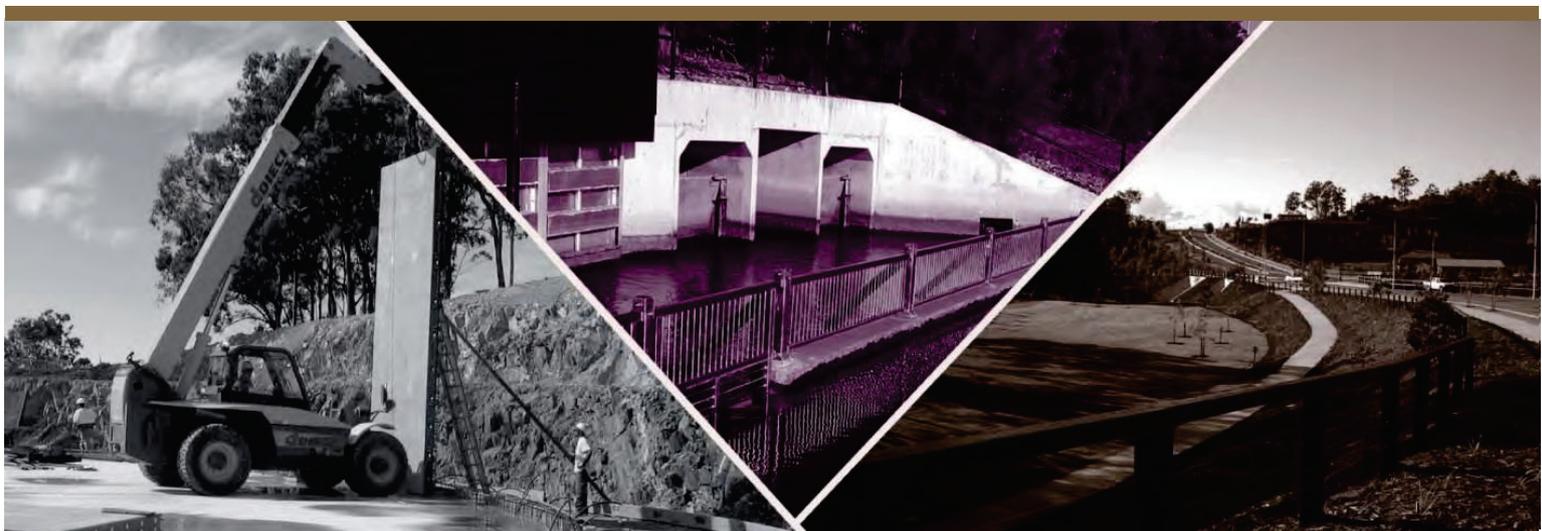
Local Government: City of Rockingham

Prepared for: Rockingham Park Pty Ltd

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DATE: JULY 2019



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Prepared for:



**PARKLAND
HEIGHTS**

Property Address:
Furnivall Parade, Baldivis

Real Property Description/s:
(part) Lot 9010 DP407830

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1.0 INTRODUCTION

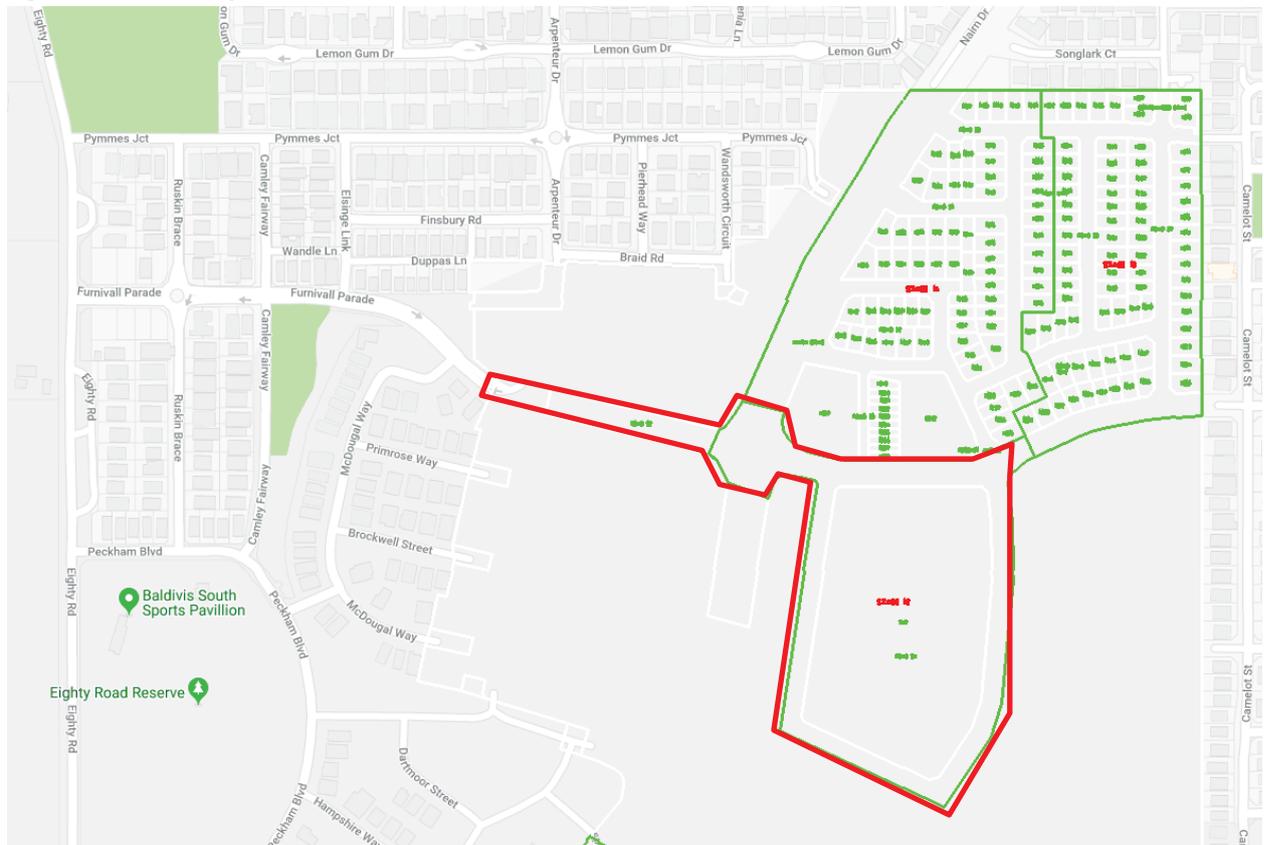
This report has been prepared to comply with Condition 2, Western Australian Planning Commission (WAPC) application number 155055, which applies to Parkland Heights Estate Stage 12 (Primary School Site). The site is located adjacent to the proposed intersection of Furnivall Parade, Nairn Drive, and Regency Avenue.

As per WAPC Advice Note 2, to facilitate Department of Education’s proposed school opening date of January 2021, City of Rockingham is supportive of a Drainage Management Plan and agrees that a full UWMP is not required for this proposed subdivision application. Future UWMP’s for the adjacent subdivisional stages will include the respective catchment areas of the School Site and the surrounding roads.

2.0 THE SITE AND ITS CONTEXT

The total subdividable area is approximately 7.03ha, comprising 1 Primary School Site (4.0316ha) and the essential access roads. The site is located approximately 40km south of Perth in the City of Rockingham. Preliminary bulk earthworks have been completed over this area.

Figure 1.0: Locality Plan



Source: www.mngaccess.com.au

3.0 DESIGN OBJECTIVES

The principles design objectives and criteria shown here are from BUWM (WAPC 2008).

3.1 Water Conservation and Efficiency

The Parkland Heights development will aim to achieve a maximum 100kL/person/year scheme water usage through a range of water efficiency measures, as per the LWMS and previously approved UWMP (e.g. Stage 1 to 6).

3.2 Stormwater Quantity Management

Stormwater quantity management has been designed and modelled in accordance with AR&R 2016 and CoR's Planning Policy 3.4.3.

The drainage strategy for Parkland Heights Estate is based on infiltration of stormwater onsite, furthermore, at source infiltration are prompted. Therefore, the school site shall retain up to the critical 1% AEP Median Maximum event, whereby allowing stormwater to overflow and infiltrate through the school oval during major storm events. This strategy is also in accordance with DoE's School Design Guidelines.

For stormwater runoff within road reserve areas, all drainage pits (where possible) have been designed with a 600mm deep trap and an oversized weephole which allows at source stormwater retention and infiltration.

A total of 360 storm ensembles were modelled for the 63%, 20%, 10% and 1% AEP Storm Events, and the Median Max Flow Storm Ensembles have been utilised in our calculation and hydraulic modelling and design.

3.3 Stormwater Quality Management

Bio-retention systems (swales, tree pits, rain gardens) designed to contain the first 15mm of runoff from the connected impervious catchment area will be implemented. This is the design criteria outlined in the DWER's Decision Process for Stormwater Management in WA (2017) which the City of Rockingham has adopted in Planning Policy 3.4.3.

Prior to the development of POS areas and the designated basins, the stormwater pit and pipe system have been designed to discharge into temporary drainage basins, which are sized to capture up to the 10% AEP Median Max storm event. For greater storm events above the 10% AEP, stormwater can overflow to the adjacent undeveloped area (within the developer's site) and infiltrate through the sandy soil. This is consistent with the previous approved strategy and management practise in previous stages and nearby subdivisional developments.

3.4 Stormwater Quality Modelling Criteria

Stormwater quality modelling is not proposed for this estate at this stage as currently there is no commercially available tool in Western Australia approved by the DWER to undertake such modelling.

3.5 Disease Vector and Nuisance Insect Management

The stormwater retention system has been designed to ensure that stormwater is fully infiltrated in a time period not exceeding 96 hours. The basin's emptying time is reported as part of MUS' calculation.

4.0 SITE CHARACTERISTICS

4.1 Site Conditions

The site has been cleared in preparation for construction. The pre-development elevation of the site ranges from approximately 16 m Australian Height Datum (AHD) along the western boundary to 32.7 m AHD towards the northeast area of the site.

4.2 Geotechnical Characteristics

The Rockingham 1:50,000 Environmental Geology sheet suggests that natural subsurface conditions at the site comprise of sand derived from Tamala Limestone (Spearwood Sand).

The Perth Groundwater Atlas (2004) indicates that the groundwater level was approximately between RL 3 m and 4 m AHD, i.e. more than 15 m below the surface levels at the site.

Acid sulphate soil risk mapping indicates that the Sand derived from Tamala Limestone in the area has no known risk of acid sulphate soil occurring within the top 3 m. It should be noted that bulk earthworks have occurred within this area over the past 10 years, comprising of cuts ranging between 0.5m to 7m.

The most recent geotechnical field works were undertaken by Douglas Partners in April 2019, and provided the following summary of the ground conditions encountered:

- **FILL (SAND, SP and SP-SM)** – well compacted, brown and grey sand with silt or trace silt, was observed at each test location except for Bore 13, from the surface to depths of between 0.05 m and borehole termination depth of 1.5 m.
- **SAND (SM)** – generally dense, yellow-brown and orange-brown, fine to medium grained sand with trace silt, underlying the fill and from the surface at Bore 13 to borehole termination depths of up to 2.5 m.

4.3 Contaminated Sites Assessment

As accepted in the approved LWMS, a Detailed Site Investigation (DSI) for this site is not required, as there was no record of any development according to the Department of Environment Regulation (DER) Contaminated Sites Database, besides from some evidence of forestry use at some stage between 1963 and 1974 by the Forest Products Commission.

4.4 Water Dependiant Ecosystem

There are no wetlands, springs or other water-dependent ecosystems located within 'the site'.

4.5 Surface Water Quantity and Quality

There are no ephemeral or permanent surface water bodies located within the site. There are no drainage lines within the site due to the high permeability of the Spearwood Sands present as described in Section 4.2. 'The site' is therefore dominated by infiltration with little to no surface run-off except during extreme storm events.

4.6 Groundwater Levels and Quality

Based on the recent investigation by Douglas Partners, no groundwater was observed within boreholes drilled to depths of up to 2.5 m below surface level.

According to ENV investigation as part of Parkland Heights Stage 6 UWMP, the estimated AAMGL underlying Stage 12 School Site Development is 4.9m AHD. The main proposed levels and the estimated depth to AAMGL are summarised in **Table 1** below. Given the significant depth to groundwater, ranging from 5.1m to 15.1m, groundwater does not present as a constraint to the development of the site.

	Proposed Levels (m AHD)	Estimated Depth to AAMGL (m)
School Site Lot	15.5 to 20	10.6 to 15.1
POS K Temporary Basin	18	13.1
Road 1 & 2 Temporary Basin	13	8.1
POS M Future Basin	10	5.1

4.7 Landscape Design

Landscape Design for POS K and POS M will be designed and submitted as part of Stage 13 & 14 UWMP, and Stage 9 to 11 UWMP, respectively.

The School Site Landscaping including the adjacent verge treatment will be designed and lodged as part of the Development Application for the School Site's built-form works.

The Parkland Heights development shares a licence with the Heritage Park development by the same developer, located approximately 2 km away. Both developments are located in the same proclaimed groundwater area (Stakehill). Irrigation of the POS areas is from groundwater licence GWL164680(10).

It is estimated that Heritage Park will require approximately 22,239 kL/yr for long term irrigation. The total for both Heritage Park and Parkland Heights is therefore estimated to be 59,226 kL/yr with the approved licence being 101,320kL/annum as of 19 October 2018. The updated water licence takes into account transfers associated with POS: B, C, D & G at Parkland Heights, and POS 5 at Heritage Park. The District Open Space at Parkland Heights (POS F) was a separate Water Licence which has been transferred to the CoR. The water licence on 2 January 2018 was 83,030kL and being reduced to 71,795kL following the handover of POS B, C, D – Parkland Heights – 1.498 ha of 11,235 kL. Additional water was secured resulting in the current allocation for the School Site and Dust Suppression.

Therefore sufficient groundwater is available within the groundwater licences to meet the long term irrigation demands and with sufficient remaining to meet short term irrigation and construction demands for both developments.

The Groundwater Licence includes 15,000kL allocation to irrigate 2Ha of ovals and playing fields for the proposed school. This water allocation is to be transferred to the DoE when construction of the proposed primary school is due to commence.

Appendix E contains the latest Irrigation Schedule dated 15 July 2019, and the latest Groundwater Licence, this is also reflected in the water register website.

5.0 WATER SUSTAINABILITY INITIATIVES

The Water Corporation's latest potable water use study 'Perth's Residential Water Use Study 2008/2009' (Water Corporation, 2010) found that the average potable water consumption rate was 106 kL/person/year whereas the State Water Plan states a target of 100 kL/person/year. The water sustainability initiatives to meet this target are addressed below.

This section also addresses the servicing of potable water and wastewater supplies including water conservation measures and sources.

The School Site Water Sensitive Urban Design (WSUD) initiatives will be as per the Department of Education's (DoE) typical development criteria for a primary school site and the City of Rockingham's inputs, typically detailed at the Development Application phase for the School Site's internal works.

The following Water Sensitive Urban Design (WSUD) initiatives are proposed for the adjacent residential lots:

- Free water-wise landscaping for all residential front yards including drought-tolerant lawn areas with improved soils, efficient drip irrigation system (where applicable);
- Access to free, voluntary information sessions about how to be Water Smart to reduce water bills; and
- Behaviour change of households, encouraging water conservation through sustainability information packages.

6.0 STORMWATER MANAGEMENT STRATEGY

The stormwater management strategy for the site is based on infiltration of stormwater to maintain predevelopment flows, while maintaining water quality.

A variety of structural and non-structural BMPs are proposed to achieve this.

As part of the Stage 12 School Site Development, the following will be constructed:

- Trapped Stormwater Drainage Pits, with 600mm traps and open bases;

- Gross Pollutant Trap (GPT) prior to discharge into future POS K; and
- Temporary Sandy Drainage Basins at future POS K and L, which are commonly accepted as interim measures in this area.

Ultimately, as part of Stage 9 and 14 development, vegetated bio-retention swales and grass-lined infiltration basin will be constructed in accordance with the approved UWMP and Landscape Plan.

Stormwater Drainage Plans including a Catchment Plan for 'the site', developed by Mortons Urban Solutions, are included in **Appendix B and Figures 2 to 6**.

6.1 Stormwater Quantity

6.1.1 Stormwater Management in School Site

Stormwater runoff within the School Site shall be captured, retained, and infiltrated on site for all events up to and including the Median Maximum 1% AEP storm event.

For minor events, stormwater can be collected via conventional pits and pipes and infiltrated via soak-wells or underground drainage cells.

For major events, stormwater should be allowed to overflow and infiltrate, through the School's ovals or other low-lying open space areas.

As per Department of Education's Consultant Brief for the Primary School Site (Document No. 5.4, November 2018), an internal stormwater management plan will be prepared and must be approved by the local authority as part of the built form development application (DA).

6.1.2 Stormwater Management in Road Reserve and POS

Stormwater within road reserves will be collected via conventional pits and pipes system. The pits will have 600mm traps and have open bases to increase soakage from the system and prompt at source infiltration.

Pit and pipe networks have been designed to convey the Median Max 20% AEP event with 300mm freeboard from pit inlet levels, with the exception for pit and pipe network within Nairn Drive. MUS has designed this system to convey the Median Max 10% AEP storm event. Although this was not specified in the LWMS, we believe this is desirable considering that Nairn Drive higher order in term of road hierarchy.

The proposed pit and pipe system has been designed to convey runoff from all future upstream catchment areas within the approved Structure Plan.

Runoff from Furnivall Parade, west of the Nairn Drive roundabout, will be connected into the existing Parkland Heights Stage 3 pit and pipe system, in accordance with the approved Stage 6 UWMP. Runoff from Regency Avenue will discharge into a temporary drainage basin within the future POS K area. Runoff from Road 1 & 2, south of Regency Ave, will discharge into a temporary basin located approximately within the future POS L area. Ultimately, this drainage will be extended to discharge into POS M in accordance with the LWMS.

In accordance with the City of Rockingham Planning Policy 3.4.1 – Public Open Space, MUS' modelling has checked for compliance with the following conditions at the ultimate discharge location for the proposed pit and pipe system:

- A maximum of 25% site area of any parcel of POS may be covered by any body of water, not exceeding a frequency of inundation of 1 in 10 years.
- The base of the detention basin shall be a minimum of 0.5m above the post-development groundwater level.
- A flood depth of 1.2m maximum for storms up to the critical 100-Year event.

6.1.3 Lot Stormwater Management

Development of residential Lots is not proposed as part of this development.

6.2 Stormwater Quality

Gross pollutant traps (GPTs) will be used prior to discharge to basins or Public Open Space and will remove rubbish, hydrocarbons through traps and some nutrients. This forms a treatment train of GPTs and infiltration structures, in line with the concepts of the Stormwater Management Manual (DoW, 2004-2007) and BUWM (WAPC, 2008).

The bio-retention swale will be sized to handle storm events up to Median Max 63% AEP 1 hour Storm Event (formerly referred to as 1 Year 1 Hour ARI). The bio-retention basin design will be included on the landscape drawings submitted separately for approval. The Bio-Filter composition will be as per City of Rockingham standard specification.

The City of Rockingham has expressed the desire to incorporate Bio-Retention Swale in the Central Median of Nairn Drive. The design of the proposed central bio-retention swale shall be investigated at the UWMP Phase for Stage 13 & 14 and will be subject to the City's review and approval.

7.0 MANAGING SUBDIVISION WORKS

There is no requirement for ASS and Dewatering Management for this site.

Water required for dust suppression during subdivision works will be sourced from an existing bore in POS N.

Semi-Permanent Wind Fencing will be constructed around the entire Limit of Works boundary as shown on the engineering drawings. Dust Management within the proposed Stage 12 School Site Subdivision will be managed by the successful contractor, and the balance bulk earthworks area will continue to be managed by Urban Resources under the extension of the existing Bulk Earthworks contract and approval.

8.0 MONITORING & MAINTENANCE PROGRAM

The developer will be responsible for monitoring and maintaining all temporary drainage basins, including cleaning and removal of Gross Pollutant, Erosion Control, and general maintenance.

The developer recognises that this is only an interim arrangement, the final POS & Basin Design is still subjected to Engineering, Landscaping, and UWMP Approval.

9.0 IMPLEMENTATION PLAN

9.1 Roles and Responsibility

Roles and responsibilities for Stage 12 Primary School Site are outlined in **Table 2**.

Table 2 - Roles and responsibilities for Stage 12 Primary School Site			
Item	Scheme Development	Interim Maintenance	Long-Term Maintenance
Best Management Practices	Developer	Maintain all BMP's to ensure effective operation.	City of Rockingham
Lot 797 (School Site) - Drainage Management & System	Developer	Department of Education	Department of Education
Interim Drainage System	Developer	Developer until the ultimate drainage system is completed.	Not Applicable
Ultimate Drainage System	Developer	Developer for 12months as per City of Rockingham standard defects liability period for civil works.	City of Rockingham
Monitoring of the development	Developer	Developer for three years post-development, including one year following the completion of the majority (80%) of the development.	Developer for monitoring in compliance with groundwater licensing conditions. City of Rockingham for other items.
Public Open Spaces	Developer/ Developer's Contractor	Establishment of POS areas including landscaping, irrigation and maintenance by the developer's contractor for a period of 2 years. Handover to City of Rockingham subject to satisfactory practical completion.	City of Rockingham

9.2 Management of the stormwater system

The stormwater system will be maintained by the developer until handover to the City of Rockingham as per the City of Rockingham's standard defects liability period for civil works. Until this time, the developer will maintain the stormwater system to ensure it is operating effectively. The following recommended maintenance practices are adapted from the Stormwater Management Manual (DoW, 2007).

- Identify pollutant 'hot spots', where relatively large quantities of pollutants of concern regularly accumulate in the drainage system.
- Focus on those parts of the stormwater drainage network with relatively flat grades or low flows, as pollutants tend to accumulate in these areas.
- Undertake regular inspections of 'hot spots' to assess whether pollutants are accumulating.
- Inspect all stormwater drains and detention basins at least once a year, preferably immediately prior to the wet season. Typical maintenance frequencies for assets in Perth are defined in the Water Corporation's Drainage Maintenance Standards (2004).
- Adjust the maintenance frequency of the drainage network to suit pollutant accumulation rates and seasonal conditions (flexibility of the maintenance regime is required given the uncertainty with accumulation rates and rainfall patterns).
- Prepare an inspection program, if required, that assigns inspection tasks, frequencies and responsibilities.
- All Best Management Practices will be maintained by the developer to ensure effective operation until handover to the City of Rockingham. The stormwater system will be inspected and cleaned as necessary, including flushing of pipes and sucking of pits before handover to the City of Rockingham.

9.3 Funding

No external funding is being sought for this project.

10.0 DRAINAGE CALCULATIONS & MODELLING

Detailed surface water modelling of the temporary and ultimate drainage system was undertaken using the stormwater modelling software XPSWMM to provide details of the required retention volumes for all interconnecting sub-catchment areas east of and including Nairn Drive. Design storms are 63% AEP, 20% AEP, 10% AEP, and 1% AEP, and the storm durations investigated varied between 10 minutes and 168 hours.

A total of 320 storm ensembles were assessed as part of MUS' modelling to determine critical design Median Max Storm for each catchment and design storm.

The detailed modelling also considers the conveyance system, and information such as water level, flow, velocity, and velocity depth factor, typical to that of UWMP level of assessment.

10.1 Design Rainfall Data System (2016)

In accordance with AR&R 2019, Design Rainfall Data System 2016 and AR&R Storm Ensembles were used as part of MUS' calculation and modelling, instead of the outgoing ARR 87 IFDs.

Links to the source of this information are detailed below:

<http://www.bom.gov.au/water/designRainfalls/revised-ifd/>
<http://data.arr-software.org/>

A copy of the design rainfall data system is attached in **Appendix C**.

10.2 Catchment Areas

Stage 12 Primary School Site is divided into 4 sub-catchments, as described in Section 6.1.2.

- Sub-catchment 1: Furnivall Parade, west of Nairn Drive, draining west towards Stage 3’s POS C as per the approved LWMS and Stage 6 UWMP.
- Sub-catchment 2: Proposed Regency Ave, drains towards future POS K, in accordance with the approved LWMS and LWMS addendum report.
- Sub-catchment 3: Road 1 & 2, drains south towards POS M, in accordance with the approved LWMS.
- Sub-catchment 4: School Site, stormwater will be managed and infiltrate at source.

All future contributing catchment areas have also been considered in our calculations and modelling, in accordance with the current approved Structure Plan and Subdivision Plans.

10.3 Runoff

The following assumptions are in accordance with the approved LWMS Addendum Report, dated February 2018.

To convert the region’s rainfall pattern and the tabled rainfall intensity into a runoff hydrograph for proposed post development catchments, the following assumptions were made. The runoff models were determined based on the following assumptions of impervious area percentage for 5 types of Land-use.

Table 3 – Post Development Land-use, Percentage of Impervious Area	
Road Reserve	80%
POS	20%
School Site	35%*

**Indicative only, this based on MUS estimate from other established school sites. This is to be determined as detailed in Section 6.1.1.*

Based on our estimates, we believe the Road Reserve percentage of impervious area is approximately 64% to 70%. However, an impervious percentage of 80% has been adopted as this is commonly used within the industry, stemming from the Rational Method Runoff Coefficient for Road Reserves.

The lot percentage of impervious area is based on measurements of the constructed lots through Parkland Heights. It is recognized that the Impervious Area within Lots is connected to other pervious and soakage areas, such as soakwells and garden beds. Therefore, a separate loss model was created for lot impervious areas, as it is different to all other impervious areas which are assumed to be directly connected to the street storm-water conveyance system.

In accordance with the latest AR&R Guidelines, we've assumed that the catchment area has been receiving rainfall throughout the winter period, prior to the arrival of the storm event of interest. Therefore, 20% of the POS area was assumed to be impervious which consists of 10% wetted area, and 10% for paved or hardstand area within the POS.

With regards to the Neighbourhood Centre (commercial area), as the development planning is still conceptual, we have conservatively assumed 90% impervious in our modelling for the purpose of this report. It is recommended that this percentage of impervious be refined at UWMP and detailed design stage.

The above assumptions are considered conservative, and refinement of these assumptions can be reviewed and approved at the detailed design phase, which could highlight additional drainage capacity within the downstream infrastructure.

10.4 Loss Model

The following assumptions are in accordance with the approved LWMS Addendum Report, dated February 2018.

The following Uniform Loss Model was applied to all Impervious, and Pervious Areas. The use of 3m/day continuing loss is based on permeability test results for the sandy fill materials that will be sourced from Parkland Heights. In 2009, geotechnical testing undertaken by SKM found the sandy material at Parkland Heights to have an infiltration rate from 4.3m/day to 5.8m/day. Furthermore, these sandy materials have recently been placed over the Guildford Formation at the North Baldivis Development Area and initial infiltration tests carried out over North Baldivis Bulk Earthwork areas have shown an average infiltration rate of 5m/day prior to installation of subsoil drainage. Mortons Urban Solutions (MUS) believes 3m/day continuing loss is conservative and suitable for this development with the consideration for clogging over time.

Table 4 – Loss Model Assumptions		
	Initial Loss	Continuing Loss
Impervious Area	Nil.	Nil.
Pervious Area	9mm	3m per day

It is recognised that ARR 2016 recommends using 60% to 80% of the pre-development storm initial loss, which is supplied by ARR Data Hub (data.arr-software.org/). This would equate a Pervious Area's Initial Loss of 18mm to 24mm for this proposed urban catchment. However, we have proceeded with caution for sites such as this, where there is no measurable surface runoff that would enable us to calibrate our Hydrological Model. As a result, we have assumed 9mm initial loss for all Pervious Areas.

For pits and drainage basins infiltration model, refer to Section 10.6.

10.5 Hydrology

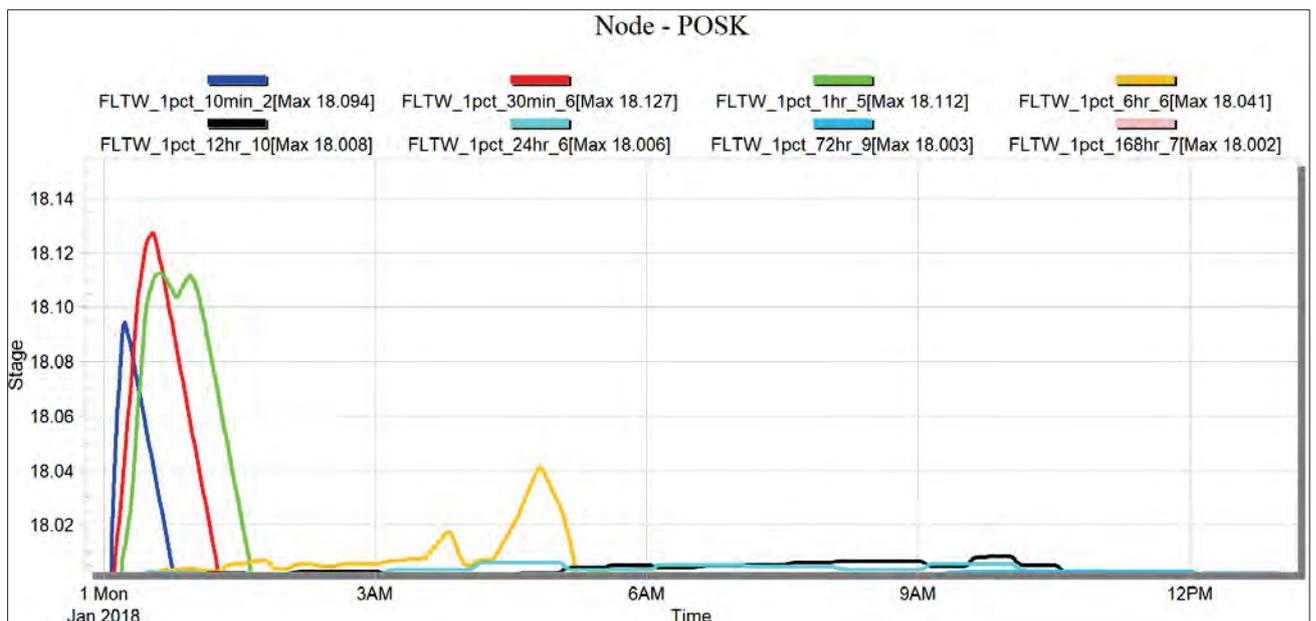
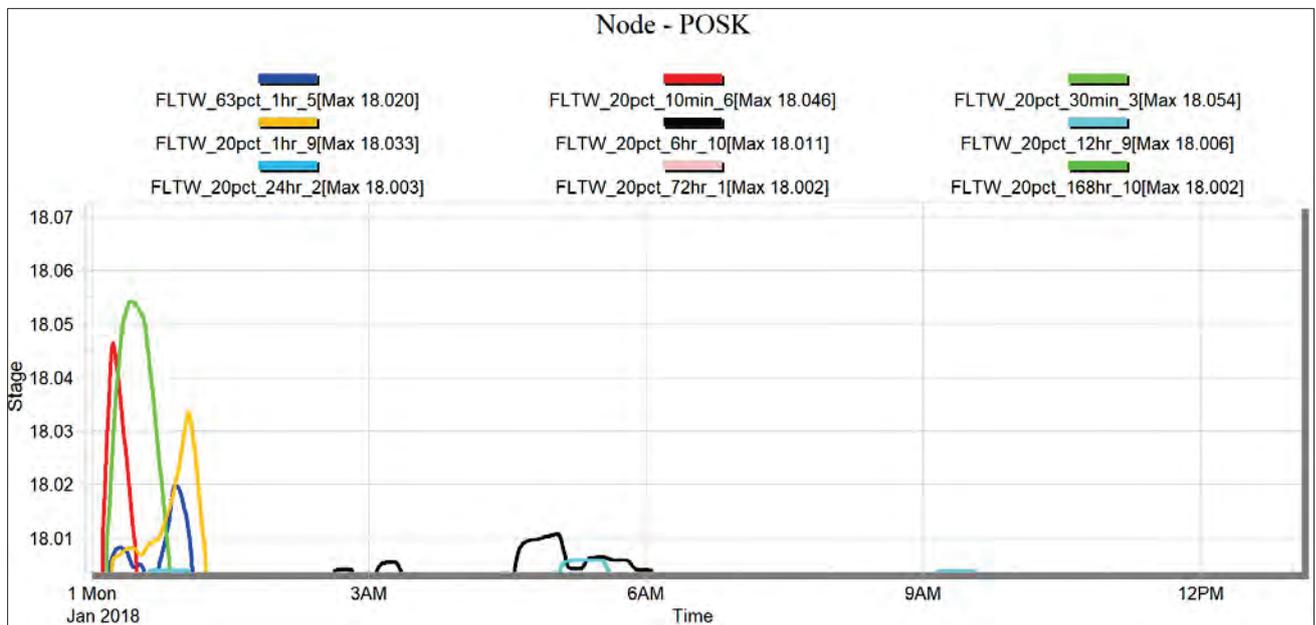
To determine the critical (Median-Max) design storm for each sub-catchment and for the following Annual Exceedance Probability (AEP); 63% AEP, 20% AEP, 10% AEP, and 1% AEP, a total of 320 storm ensembles were modelled.

10.5.1 POS K, Temporary Storage Requirement (using existing basin)

The combined hydrology and hydraulic modelling results and critical storms for POS K, when receiving runoff from Stage 12 contributing catchment areas only, are summarised in this section. POS K Temporary Basin has been pre-earthwork to allow for a much greater catchment area of 5.95 ha, therefore, runoff from Stage 12 northern catchment area will make little impact to this temporary basin.

Table 6 – POS K Temporary Storage Requirement (Stage 12 Only)

Critical Storm	Volume (m ³)	Surface Area (m ²)	Depth (m)	Max Water Level (m AHD)
63% AEP 1hr Storm 5	12	909	0.02	18.02
20% AEP 30min Storm 3	44	944	0.05	18.05
1% AEP 30min Storm 6	115	1019	0.12	18.13

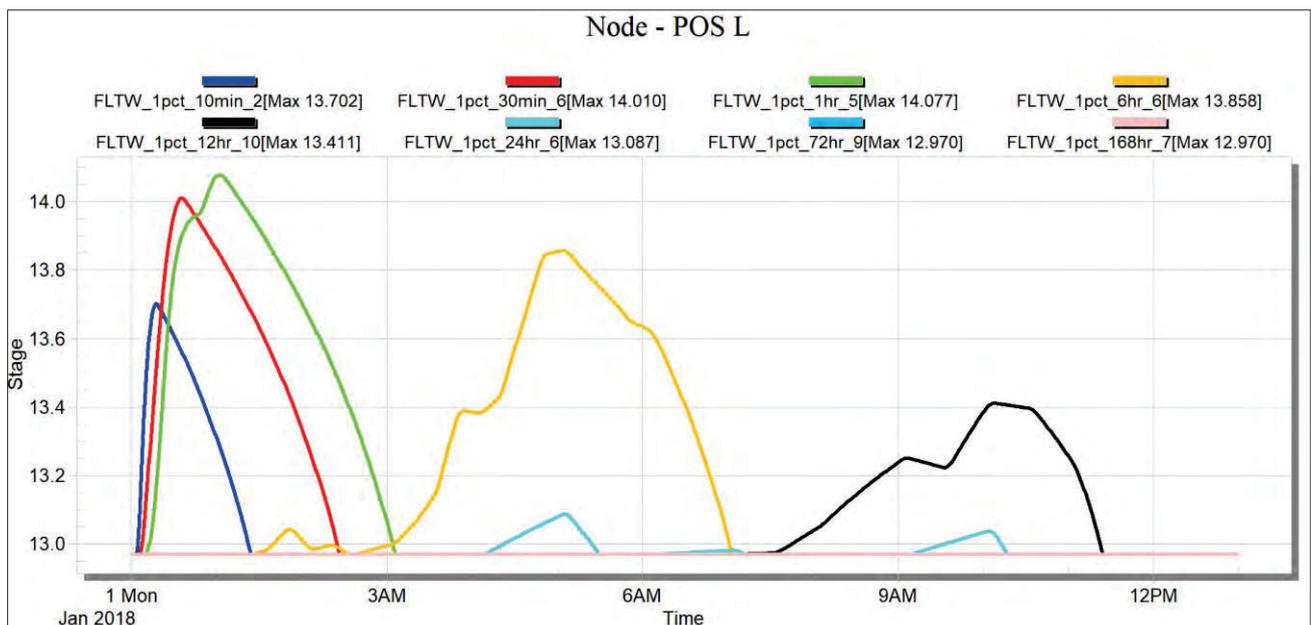
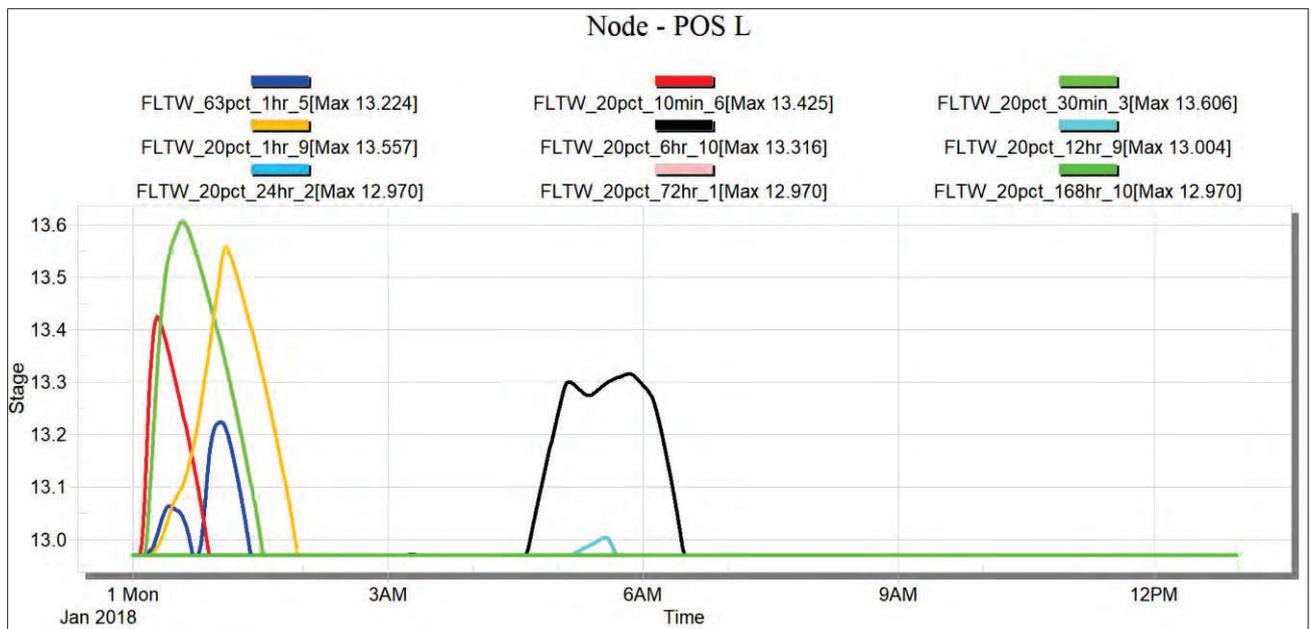


10.5.2 POS L, Temporary Storage Requirement

The combined hydrology and hydraulic modelling results and critical storms for POS L, when receiving runoff from Stage 12 contributing catchment areas only, are summarised in this section.

Table 7 – POS L Temporary Storage Requirement (Stage 12 Only)

Storm	Volume (m ³)	Surface Area (m ²)	Depth (m)	Max Water Level (m AHD)
63% AEP 1hr Storm 5	44	166	0.3	13.30
20% AEP 30min Storm 3	137	289	0.6	13.60
1% AEP 1hr Storm 5*	303	420	1.1	14.08



10.6 Infiltration Model

Infiltration Model is based on Deep Water Table Model and Clogged Base Model. Design checks were also undertaken for Unclogged Base Model, which use Green Ampt model for the initial soakage until the wetted front reaches the water table, then the Shallow Water Table model is then used for the later part of the soakage period. It was established that the Unclogged Base Model is not applicable to this site, due to the significant separation from groundwater.

All trapped drainage pits have been modelled with 600mm storage trap, with infiltration through the pit's base only. Drainage basins' infiltration area model is a stepwise linear model constructed using the temporary basin design contours.

The geotechnical recommended hydraulic conductivity of 4.3m/day was used as the base for these infiltration models.

10.7 Hydraulic

Results from MUS' Hydraulic Modelling are presented in **Appendix D**

The hydraulic system has been designed for ultimate flow scenario, and checked against the critical 10% & 20% AEP, in accordance with the Stormwater Management Strategy detailed in Section 6.1.2.

Ultimate Discharge into POS K Basin will be 0.68 m³/s at a velocity of 1.26 m/s, during the critical 10% AEP storm event, via a DN900 pipe.

Ultimate Discharge into POS K GPT will be 0.68m³/s at a velocity of 1.54m/s, therefore an ecoBITE 2100 has been selected, capable of treating flows up to 0.736m³/s and capable of conveying the maximum flow of 0.95 m³/s (FOS of 1.4).

Ultimate Discharge into POS L temporary basin will be 0.383 m³/s at a velocity of 1.92 m/s, during the critical 10% AEP storm event, via a DN450 pipe. This proposed temporary drainage basin in POS L will be removed in conjunction with Stage 9 and POS M development.

Ultimate Discharge into POS M will be 1.077 m³/s at a velocity of 2 m/s, during the critical 10% AEP storm event, via a DN900 pipe. It is likely that an eco-BITE 3000 will be required at this location.

11.0 CONCLUSION

Parkland Heights Stage 12, including all future contributing catchment areas, have been designed and modelled in accordance with the latest Subdivision Plans, Approved Structure Plans, LWMS Strategy, City of Rockingham's Guidelines and Policy, IPWEA Guidelines, and AR&R 2016.

This Drainage Management Plan Report has been prepared to support the submission of a subdivision application for land located in Stage 12, Parkland Heights, Baldivis, and to comply with Condition 2 and Advice Note 2, of the WAPC Subdivision Application Number 155055. Rockingham

Park Pty Ltd, The developer of Stage 12, will ensure WSUD occurs at the site and will meet the BUWM (WAPC, 2008) design objectives.

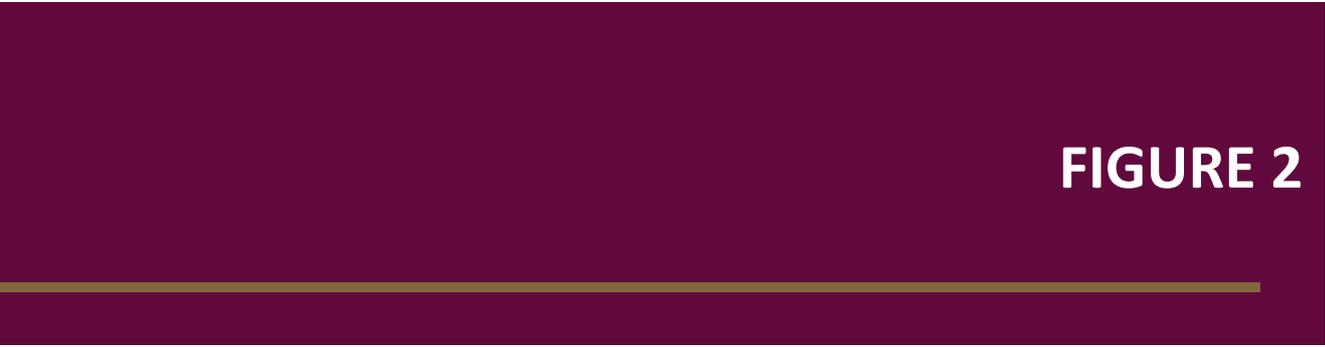
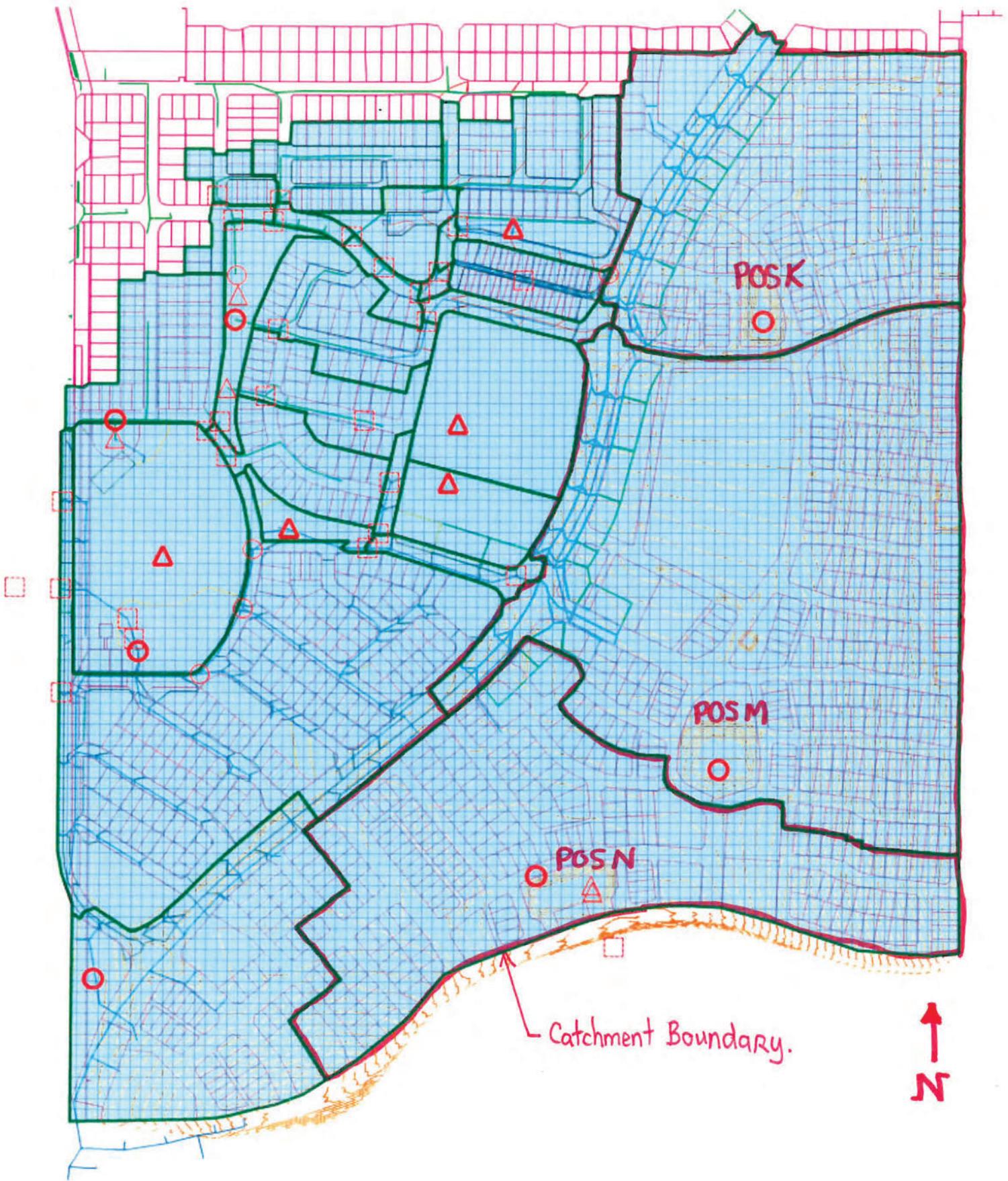


FIGURE 2

Parkland Heights Estate Stormwater Catchment Plan

(drawing no. XPSWMM Runoff Model 1, dated 24/05/2019)

Prepared by C. Le



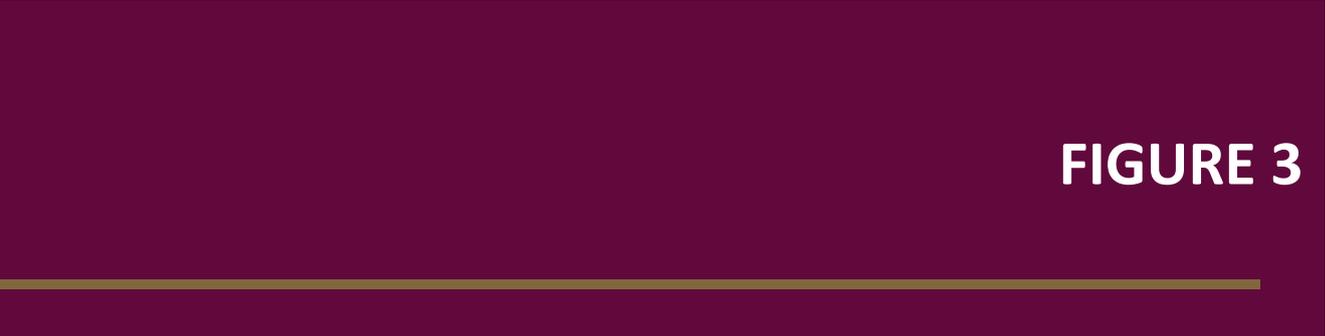


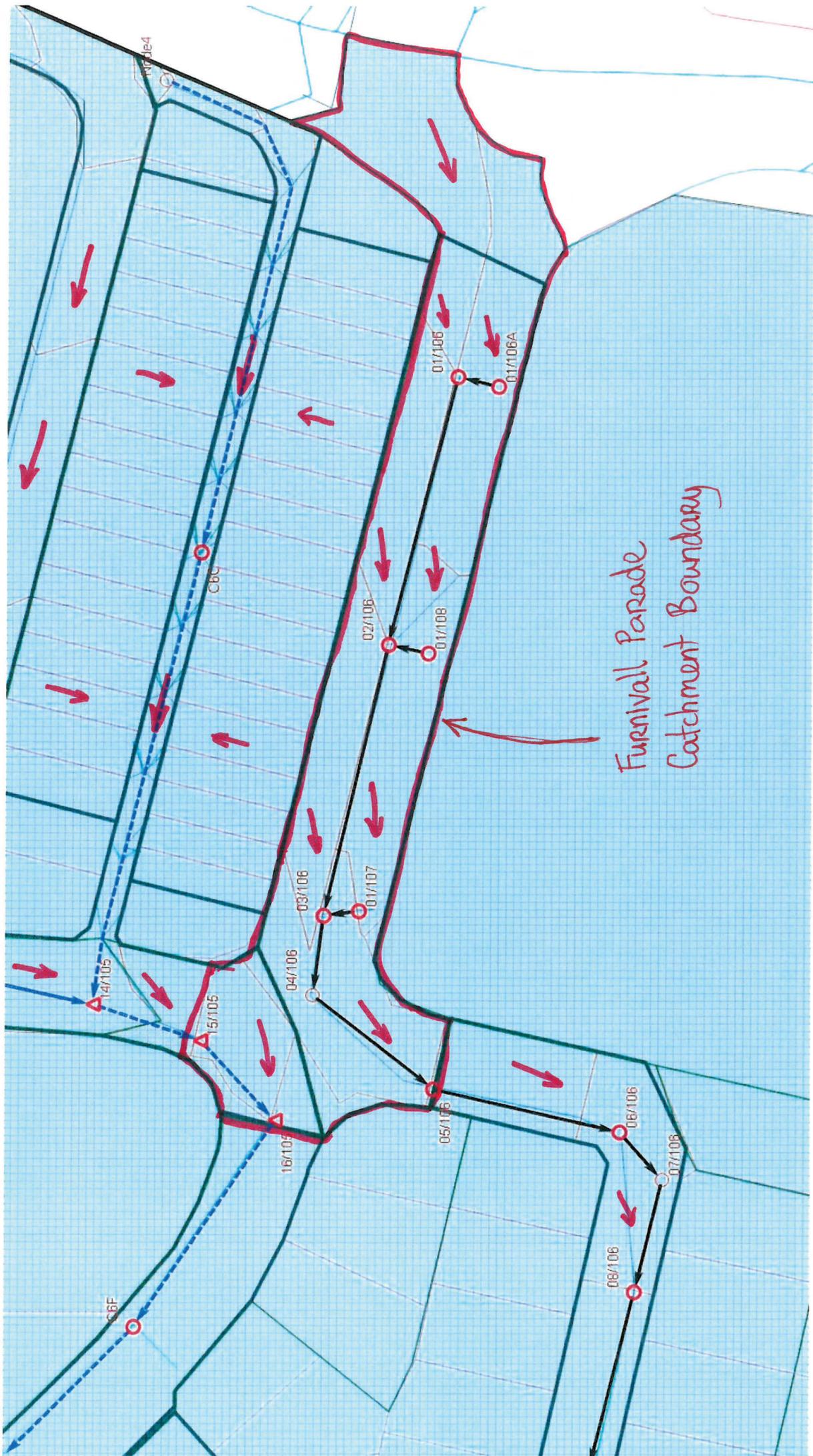
FIGURE 3

Furnivall Parade Catchment Boundary

(drawing no. XPSWMM Runoff Model 2, dated 24/05/2019)

Prepared by C. Le

↑ N



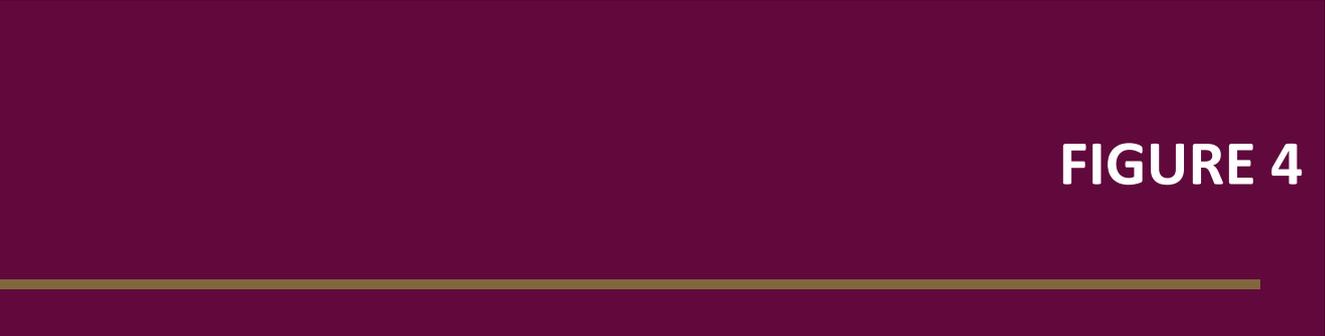


FIGURE 4

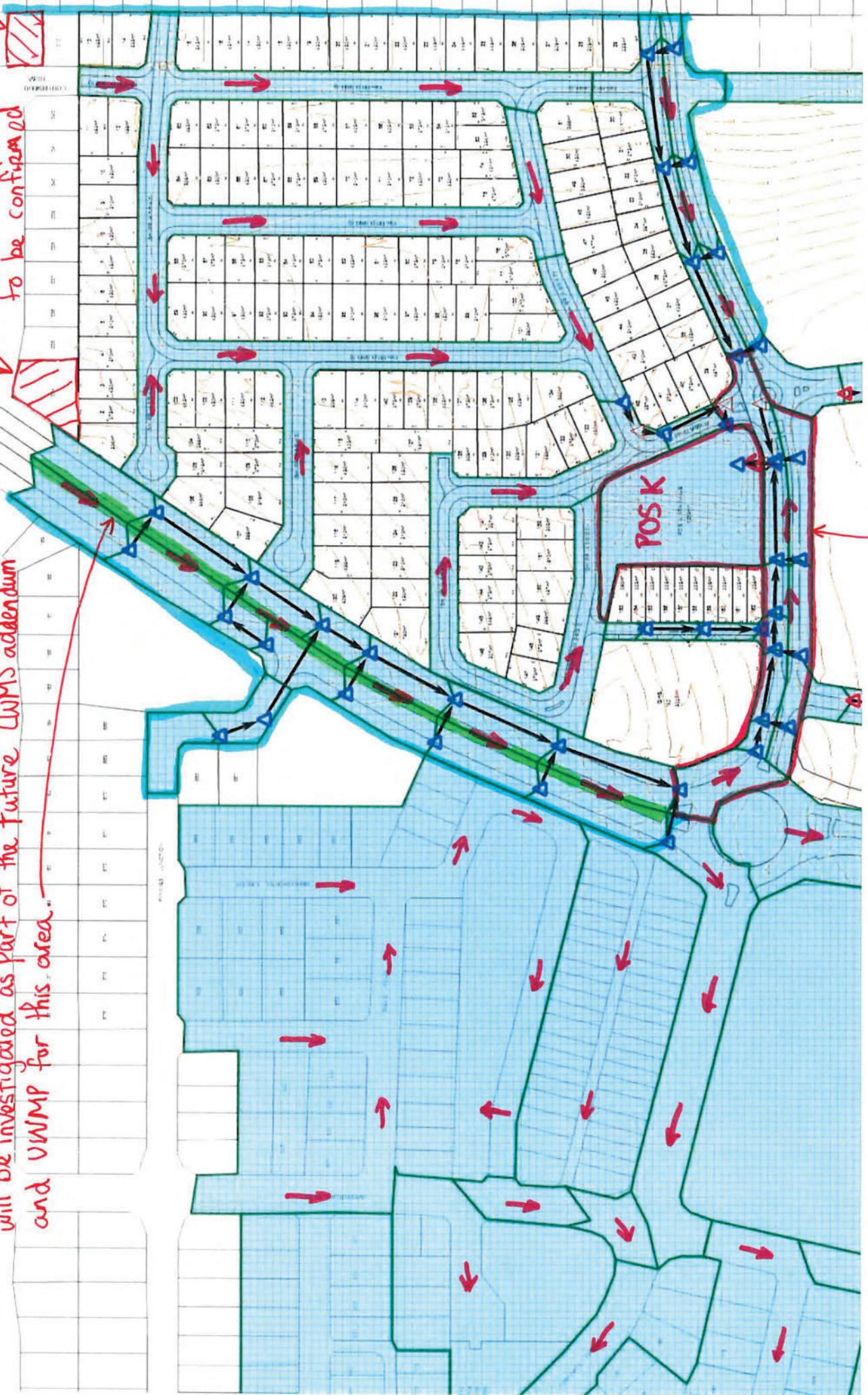
POS K Pits and Pipes Sub-Catchment Boundaries

(drawing no. XPSWMM Runoff Model 3, dated 24/05/2019)

Prepared by C. Le

Central Median Swale within Nairn Drive will be investigated as part of the future LWMS addendum and VWMP for this area.

Catchment Areas & Connections to be configured



Temporary POS-K Basin's Catchment Boundary

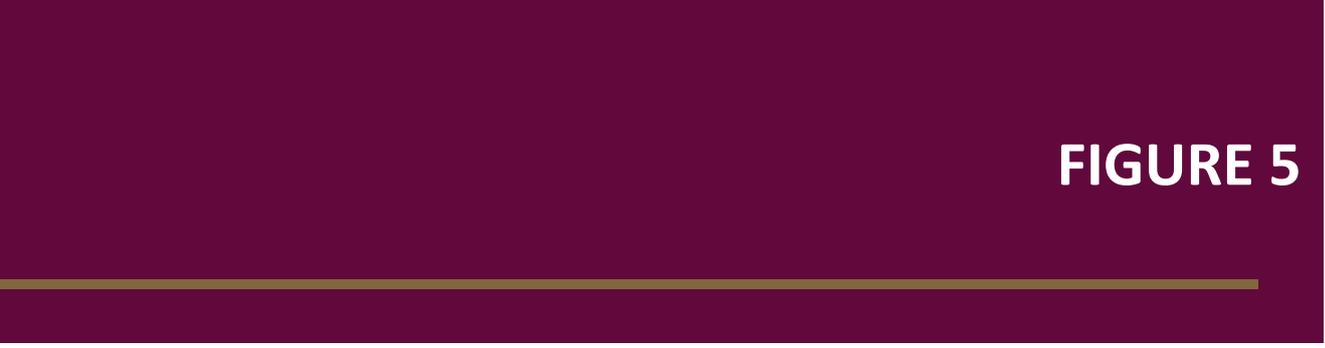


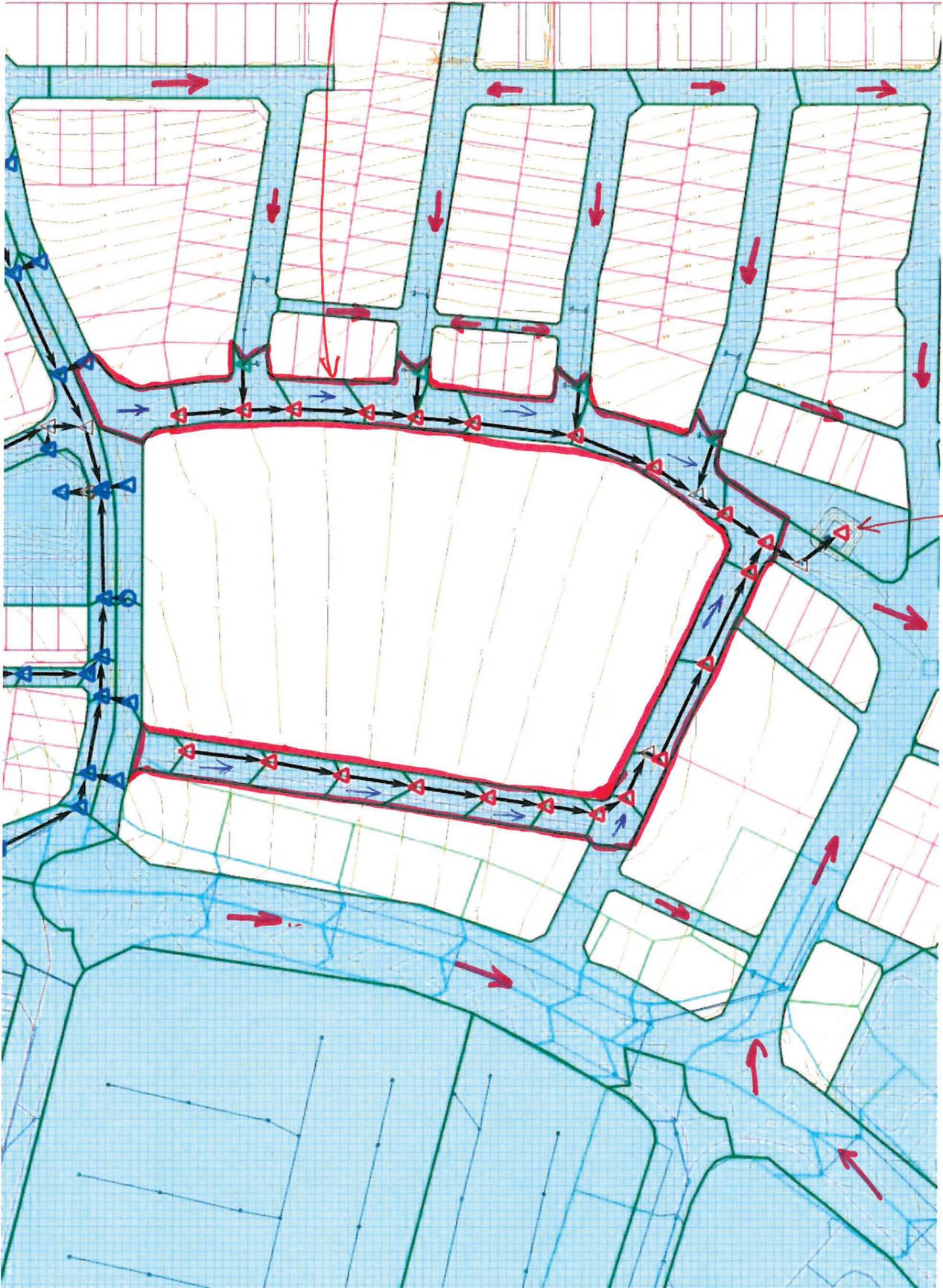
FIGURE 5

POS L Sub-Catchment Boundaries for Temporary Basin

(drawing no. XPSWMM Runoff Model 4, dated 24/05/2019)
Prepared by C. Le

↑ N

Interim Catchment
Boundary for POS-L



↳ POS-L Temporary Basin.

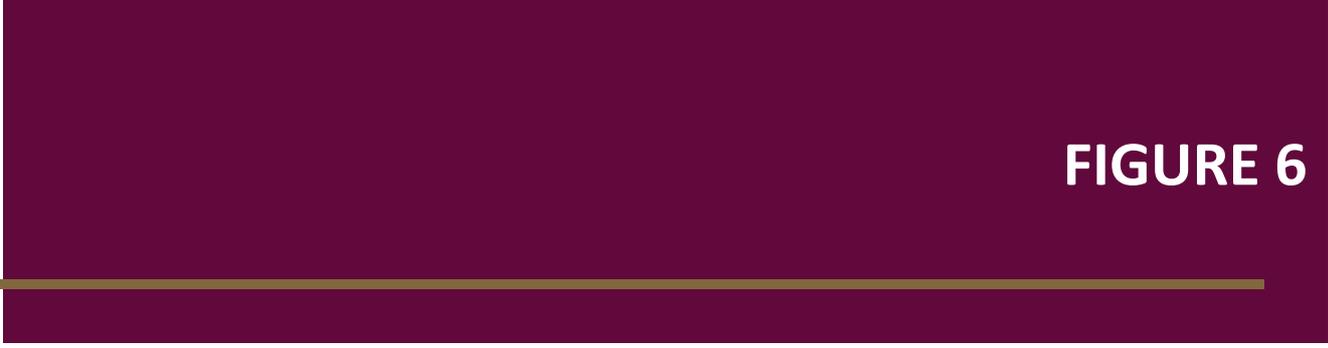


FIGURE 6

POS M Pits & Pipes Sub-Catchment Boundaries

(drawing no. XPSWMM Runoff Model 5, dated 24/05/2019)
Prepared by C. Le

← N



APPENDIX A

WAPC Subdivision Approval Conditions and Plan

(WAPC no. 155055, dated 11 April 2017)
Prepared by Creative Planning & Design



Your Ref : PCG 94
Enquiries : Regan Douglas (Ph 6551 9289)

Creative Design + Planning
P O Box 7655
CLOISTERS SQUARE WA 6850

Approval Subject To Condition(s) Freehold (Green Title) Subdivision

Application No : 155055

Planning and Development Act 2005

Applicant	:	Creative Design + Planning P O Box 7655, CLOISTERS SQUARE WA 6850
Owner	:	Rockingham Park Pty Ltd P O Box 907, CLAREMONT WA 6910
Application Receipt	:	11 April 2017

Lot Number	:	9009
Diagram / Plan	:	406823
Location	:	-
C/T Volume/Folio	:	2891/11
Street Address	:	Sixty Eight Road, Baldivis
Local Government	:	City of Rockingham

The Western Australian Planning Commission has considered the application referred to and is prepared to endorse a deposited plan in accordance with the plan date-stamped **11 April 2017** once the condition(s) set out have been fulfilled.

This decision is valid for **three years** from the date of this advice, which includes the lodgement of the deposited plan within this period.

The deposited plan for this approval and all required written advice confirming that the requirement(s) outlined in the condition(s) have been fulfilled must be submitted by **04 July 2020** or this approval no longer will remain valid.

Reconsideration - 28 days

Under section 151(1) of the *Planning and Development Act 2005*, the applicant/owner may, within 28 days from the date of this decision, make a written request to the WAPC to reconsider any condition(s) imposed in its decision. One of the matters to which the WAPC will have regard in reconsideration of its decision is whether there is compelling evidence by way of additional information or justification from the applicant/owner to warrant a reconsideration of the decision. A request for reconsideration is to be submitted to the WAPC on a Form 3A with appropriate fees. An application for reconsideration may be submitted to the WAPC prior to submission of an application for review. Form 3A and a schedule of fees are available on the WAPC website: <http://www.planning.wa.gov.au>

Right to apply for a review - 28 days

Should the applicant/owner be aggrieved by this decision, there is a right to apply for a review under Part 14 section 251 of the *Planning and Development Act 2005*. The application for review must be submitted in accordance with part 2 of the *State Administrative Tribunal Rules 2004* and should be lodged within 28 days of the date of this decision to: the State Administrative Tribunal, Level 6, State Administrative Tribunal Building, 565 Hay Street, PERTH, WA 6000. It is recommended that you contact the tribunal for further details: telephone 9219 3111 or go to its website: <http://www.sat.justice.wa.gov.au>

Deposited plan

The deposited plan is to be submitted to the Western Australian Land Information Authority (Landgate) for certification. Once certified, Landgate will forward it to the WAPC. In addition, the applicant/owner is responsible for submission of a Form 1C with appropriate fees to the WAPC requesting endorsement of the deposited plan. A copy of the deposited plan with confirmation of submission to Landgate is to be submitted with all required written advice confirming compliance with any condition(s) from the nominated agency/authority or local government. Form 1C and a schedule of fees are available on the WAPC website: <http://www.planning.wa.gov.au>

Condition(s)

The WAPC is prepared to endorse a deposited plan in accordance with the plan submitted once the condition(s) set out have been fulfilled.

The condition(s) of this approval are to be fulfilled to the satisfaction of the WAPC.

The condition(s) must be fulfilled before submission of a copy of the deposited plan for endorsement.

The agency/authority or local government noted in brackets at the end of the condition(s) identify the body responsible for providing written advice confirming that the WAPC's requirement(s) outlined in the condition(s) have been fulfilled. The written advice of the agency/authority or local government is to be obtained by the applicant/owner. When the written advice of each identified agency/authority or local government has been obtained, it

should be submitted to the WAPC with a Form 1C and appropriate fees and a copy of the deposited plan.

If there is no agency/authority or local government noted in brackets at the end of the condition(s), a written request for confirmation that the requirement(s) outlined in the condition(s) have been fulfilled should be submitted to the WAPC, prior to lodgement of the deposited plan for endorsement.

Prior to the commencement of any subdivision works or the implementation of any condition(s) in any other way, the applicant/owner is to liaise with the nominated agency/authority or local government on the requirement(s) it considers necessary to fulfil the condition(s).

The applicant/owner is to make reasonable enquiry to the nominated agency/authority or local government to obtain confirmation that the requirement(s) of the condition(s) have been fulfilled. This may include the provision of supplementary information. In the event that the nominated agency/authority or local government will not provide its written confirmation following reasonable enquiry, the applicant/owner then may approach the WAPC for confirmation that the condition(s) have been fulfilled.

In approaching the WAPC, the applicant/owner is to provide all necessary information, including proof of reasonable enquiry to the nominated agency/authority or local government.

The condition(s) of this approval, with accompanying advice, are:

CONDITIONS:

Drainage and site works

1. Engineering drawings and specifications are to be submitted, approved, and works undertaken in accordance with the approved engineering drawings, specifications and approved plan of subdivision, for grading and/or stabilisation of the site to ensure that:
 - a) lots can accommodate their intended use; and
 - b) finished ground levels at the boundaries of the lot(s) the subject of this approval match or otherwise coordinate with the existing and/or proposed finished ground levels of the land abutting. (Local Government)
2. Prior to the commencement of subdivisional works, an urban water management plan is to be prepared and approved, in consultation with the Department of Water, consistent with any approved local water management strategy. (Local Government)
3. Engineering drawings and specifications are to be submitted and approved, and works undertaken in accordance with the approved engineering drawings and specifications and approved plan of subdivision, for the filling and/or draining of the land, including ensuring that stormwater is contained on-site, or appropriately

treated and connected to the local drainage system. Engineering drawings and specifications are to be in accordance with an approved urban water management plan for the site. (Local Government)

4. Prior to the commencement of subdivisional works, the landowner/applicant is to provide a pre-works geotechnical report certifying that the land is physically capable of development or advising how the land is to be remediated and compacted to ensure it is capable of development; and in the event that remediation works are required, the landowner/applicant is to provide a post geotechnical report certifying that all subdivisional works have been carried out in accordance with the pre-works geotechnical report. (Local Government).

Schools

5. The land denoted as proposed primary school site on the approved plan of subdivision is to be set aside as a separate lot, pending the acquisition of the land by the Department of Education. (Department of Education)

Transport

6. Engineering drawings and specifications are to be submitted, approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, to ensure that those lots not fronting an existing road are provided with frontage to a constructed road(s) connected by a constructed road(s) to the local road system and such road(s) are constructed and drained at the landowner/applicant's cost. As an alternative, and subject to the agreement of the Local Government the Western Australian Planning Commission (WAPC) is prepared to accept the landowner/applicant paying to the local government the cost of such road works as estimated by the local government and the local government providing formal assurance to the WAPC confirming that the works will be completed within a reasonable period as agreed by the WAPC. (Local Government)
7. Engineering drawings and specifications are to be submitted and approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications to ensure that:
 - a) street lighting is installed on all new subdivisional roads to the standards of the relevant licensed service provider;
 - b) roads that have been designed to connect with existing or proposed roads abutting the subject land are coordinated so the road reserve location and width connect seamlessly; and
 - d) embayment parking is provided within all of the proposed streets.

to the satisfaction of the Western Australian Planning Commission. (Local Government)

8. Engineering drawings and specifications are to be submitted, approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, for the provision of shared paths through and connecting to the application area in accordance with the approved Parkland Heights Local Structure Plan.

The approved shared paths are to be constructed by the landowner/applicant.
(Local Government)

9. All local streets within the subdivision being truncated in accordance with the Western Australian Planning Commission's *Liveable Neighbourhoods* policy.(Local Government)
10. The western road reserve abutting the school site to be increased to 18 metres width. (Local Government)

Water and sewer

11. Arrangements being made with the Water Corporation so that provision of a suitable water supply service will be available to the lot shown on the approved plan of subdivision. (Water Corporation)
12. Arrangements being made with the Water Corporation so that provision of a sewerage service will be available to the lot shown on the approved plan of subdivision. (Water Corporation)

ADVICE:

1. The landowner/applicant should contact 'Dial Before You Dig' on '1100' prior to the commencement of development works to determine the location of buried gas infrastructure.
2. In regard to Condition 2, it is understood that the City of Rockingham will accept a drainage management plan to fulfil this condition.
3. In regard to Conditions 11 and 12, the landowner/applicant shall make arrangements with the Water Corporation for the provision of the necessary services. On receipt of a request from the landowner/applicant, a Land Development Agreement under Section 83 of the *Water Services Act 2012* will be prepared by the Water Corporation to document the specific requirements for the proposed subdivision.
4. In regard to Condition 10, the increase in the width of the western road reserve to 18 metres is advocated by Transcore's transport assessments for subject land dated July 2011 and March 2017. Further, it is also warranted by the increase in traffic associated with the proposed amendment to the Lot 1507 Eighty Road, Baldivis



Local Structure Plan which will increase the scale of the Village Centre from a 'Local' centre to a 'Neighbourhood' centre.

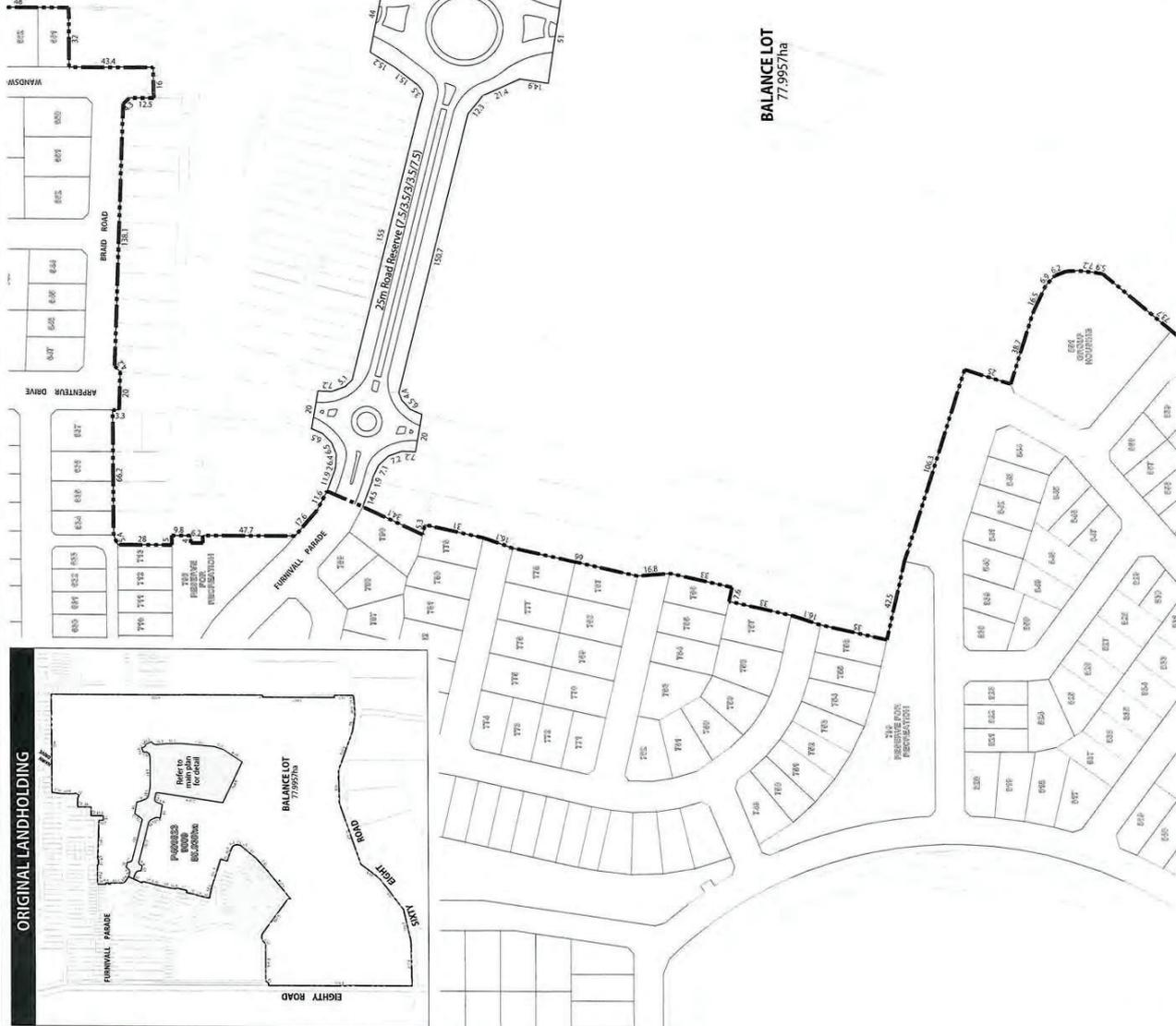
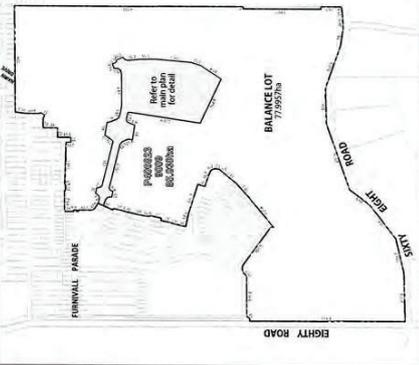
5. The Department of Planning's Infrastructure and Land Use Coordination Division recommends that the intersection of the road on the western site of the school site with Furnivall Parade be restricted to left-in/left-out vehicular movements.

A handwritten signature in black ink, appearing to read "Kerrine Blenkinsop". The signature is written in a cursive, flowing style.

Kerrine Blenkinsop
Secretary
Western Australian Planning Commission

4 July 2017

ORIGINAL LANDHOLDING



LEGEND

--- APPLICATION BOUNDARY (85.031ha)
--- DESIGN CONTOURS (1m)

LOT SUMMARY

LOTS	1
Balance Lots	1
Total Number Lots	2

Minimum Lot Size 4.0316ha
Maximum Lot Size 4.0316ha
Average Lot Size 4.0316ha
Total Lot Area 4.0316ha



A 28 Brown St, East Perth WA 6004
P (08) 9225 0200
E info@creativejp.com.au
W creativejp.com.au

Scale 1:2500 @ A3

DATE:	10/02/2017	DRAWN:	JP
REVISED:		PLANNER:	TV
PROJECTION:	PCG 94	CHECK:	BK
DAITUM:	AHD	PLAN NUMBER:	RHPPI-3-002

DEPARTMENT OF PLANNING	FILE
DATE	155055
11-Apr-2017	

PROPOSED SUBDIVISION
Lot 9009 Sixty Eight Road, BALDIWIS
A Rockingham Park Pty Ltd Project

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APPENDIX B

Stormwater Drainage Design Drawing(s)

Prepared by Mortons Urban Solutions

PROJECT NAME PARKLAND HEIGHTS SCHOOL SITE	CLIENT Rockingham Park Pty Ltd	 	ISSUES TENDER COUNCIL CONSTRUCTION	DATE 28-04-18	AMENDMENT 1. 10-07-18 DESIGN REVIEW 2. 19-03-19 DESIGN REVISION 3. 28-04-18 CONSOLE ISSUE	APPROVED MORTONS URBAN SOLUTIONS WAPC REF: 1550055	ASSOCIATED CONSULTANTS  Electrical Engineering Excellence	DRAWING TITLE DRAINAGE PLAN SHEET 01
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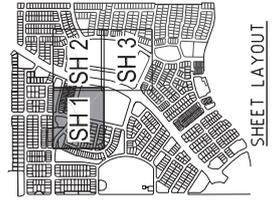
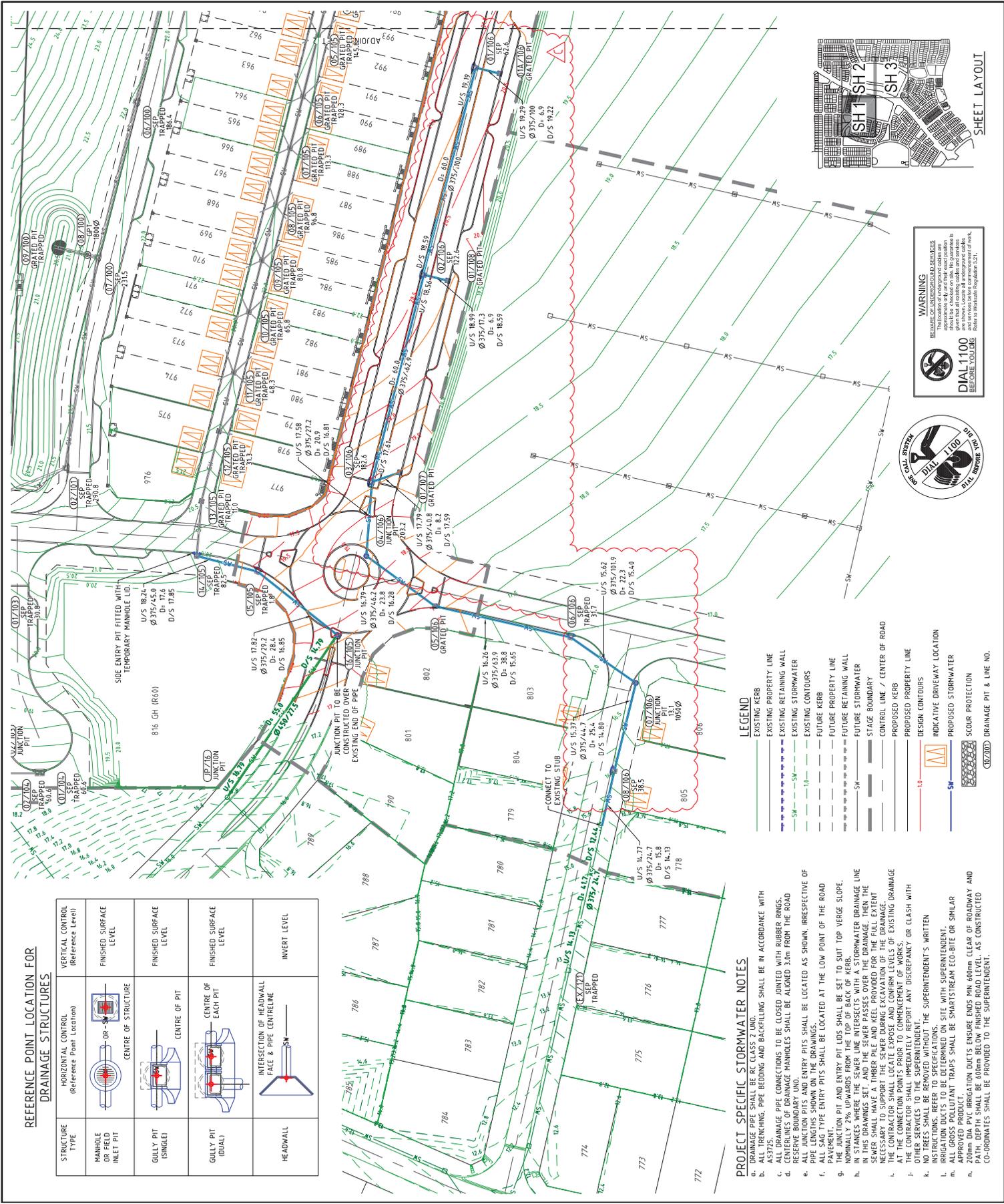


MORTONS
urbansolutions
Civil Engineering
Project Co-ordination

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Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel: 08 9380 9780

Perth Office
Perth Office
A/BN 39 19 375 955
Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel: 08 9380 9780

APPROVED BY: [Signature]
DRAWING NUMBER: 26601-SS-600
DATE: 26-02-18
SCALE: AS SHOWN



WARNING
RELIANCE ON INFORMATION PROVIDED herein is at the user's discretion. The user is responsible for ensuring that all existing cables and services are located and marked prior to construction. Refer to Worksafe Regulation 13.1.

DIAL 1100 BEFORE YOU DIG



CALL SYSTEM
DIAL 1100



LEGEND

	EXISTING KERB
	EXISTING PROPERTY LINE
	EXISTING RETAINING WALL
	EXISTING STORMWATER
	EXISTING CONTOURS
	FUTURE KERB
	FUTURE RETAINING WALL
	FUTURE STORMWATER
	STAGE BOUNDARY
	CONTROL LINE / CENTER OF ROAD
	PROPOSED KERB
	PROPOSED PROPERTY LINE
	DESIGN CONTOURS
	INDICATIVE DRIVEWAY LOCATION
	PROPOSED STORMWATER
	SCOUR PROTECTION
	Ø375/100 DRAINAGE PIT & LINE IN D.

PROJECT SPECIFIC STORMWATER NOTES

- DRAINAGE PIPE SHALL BE RC CLASS 2 UNO.
- ALL TRENCHING, PIPE BEDDING AND BACKFILLING SHALL BE IN ACCORDANCE WITH AS 4886.1.
- ALL DRAINAGE PIPE CONNECTIONS TO BE CLOSED, JOINED WITH RUBBER RINGS.
- CENTERLINES OF DRAINAGE MANHOLES SHALL BE ALIGNED 3.0m FROM THE ROAD RESERVE BOUNDARY UNO.
- ALL JUNCTION PITS AND ENTRY PITS SHALL BE LOCATED AT THE LOW POINT OF THE ROAD PAVEMENT.
- ALL SAG TYPE ENTRY PITS SHALL BE LOCATED AT THE LOW POINT OF THE ROAD PAVEMENT.
- THE JUNCTION PIT AND ENTRY PIT LIDS SHALL BE SET TO SUIT TOP VERGE SLOPE, NOMINALLY 2% UPWARDS FROM THE TOP OF BACK OF KERB.
- IN STANCES WHERE THE SEWER LINE INTERSECTS WITH A STORMWATER DRAINAGE LINE, THE STORMWATER DRAINAGE LINE SHALL TAKE PRIORITY.
- SEWER SHALL HAVE A TIMBER PILE AND KEEL PROVIDED FOR THE FULL EXTENT NECESSARY TO SUPPORT THE SEWER DURING EXCAVATION OF THE DRAINAGE.
- THE CONTRACTOR SHALL LOCATE AND CONFIRM LEVELS OF EXISTING DRAINAGE AT THE CONNECTION POINTS PRIOR TO COMMENCEMENT OF WORKS.
- THE CONTRACTOR SHALL REPORT ANY DISCREPANCY OR CLASH WITH EXISTING SERVICES TO THE SUPERINTENDENT.
- NO TREES SHALL BE REMOVED WITHOUT THE SUPERINTENDENT'S WRITTEN INSTRUCTIONS. REFER TO SPECIFICATIONS.
- IRRIGATION DUCTS TO BE DETERMINED ON SITE WITH SUPERINTENDENT.
- APPROVED PRODUCTANT TRAPS SHALL BE SMARTSTREAM ECO-BITE OR SIMILAR.
- 200mm DIA PVC BRIGGATION DUCTS ENSURE ENDS MN 600mm CLEAR OF ROADWAY AND PATH. DEPTH SHALL BE 600mm BELOW FINISHED ROAD LEVEL. AS CONSTRUCTED CO-ORDINATES SHALL BE PROVIDED TO THE SUPERINTENDENT.

REFERENCE POINT LOCATION FOR DRAINAGE STRUCTURES

STRUCTURE TYPE	HORIZONTAL CONTROL (Reference Point Location)	VERTICAL CONTROL (Reference Level)
MANHOLE OR FIELD INLET PIT		FINISHED SURFACE LEVEL
GULLY PIT (SINGLE)		FINISHED SURFACE LEVEL
GULLY PIT (DUAL)		FINISHED SURFACE LEVEL
HEADWALL		INVERT LEVEL

PROJECT NAME
PARKLAND HEIGHTS SCHOOL SITE



CLIENT
Rockingham Park Pty Ltd



ISSUES	DATE
TENDER	28-04-18
COUNCIL	
CONSTRUCTION	

WAPC REF: 155055

ASSOCIATED CONSULTANTS
3 CONSULTING ENGINEERS PTY LTD
 Electrical Engineering Excellence

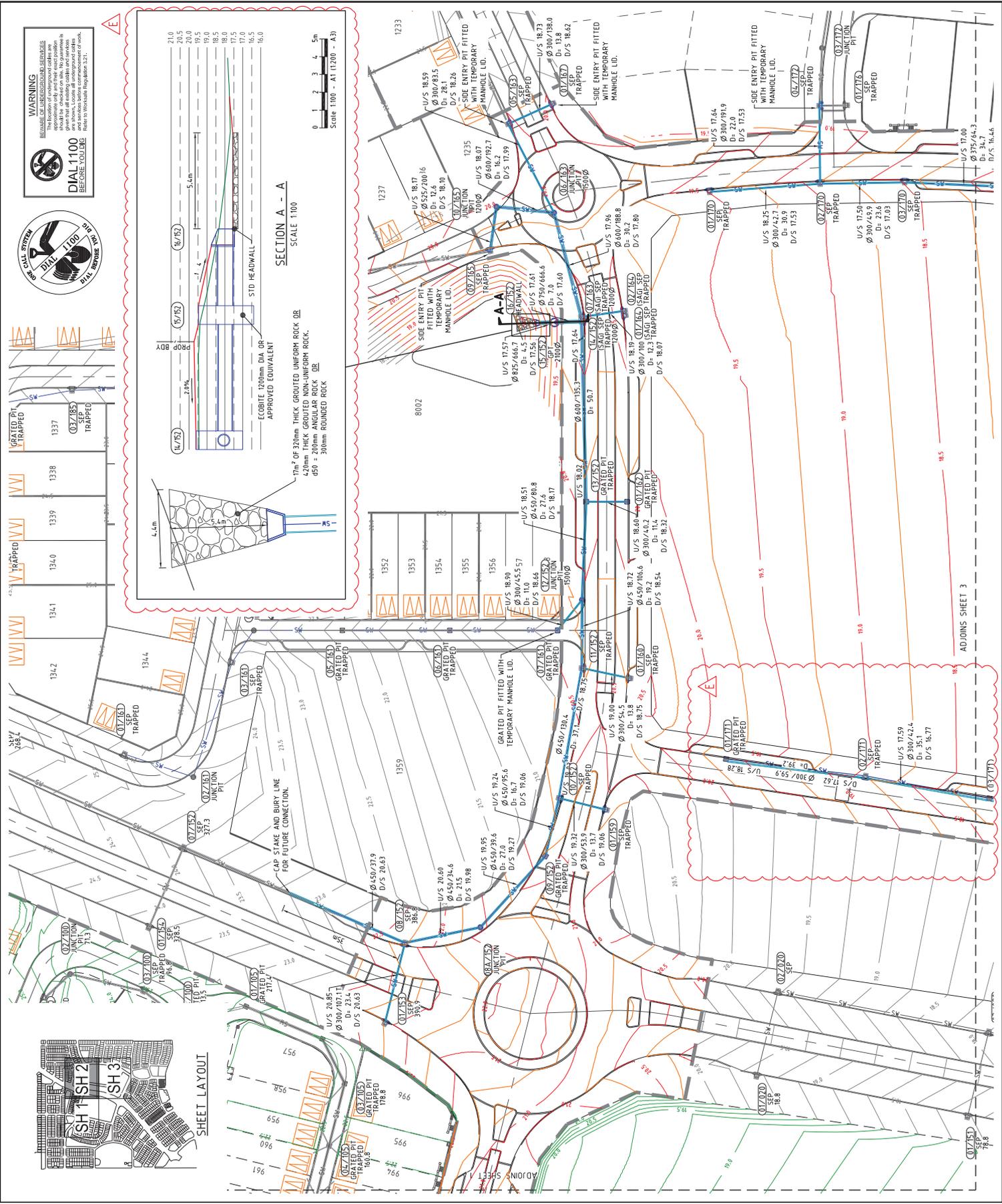
DRAWING TITLE
DRAINAGE PLAN SHEET 02

MORTONS
 urbansolutions
 Civil Engineering
 Project Coordinating

MUS Pty Ltd T/A:
 Mortons-Urban Solutions
 ABN 39 16 375 965
 Email: mortons@urbansolutions.net.au
 Website: www.urbansolutions.net.au
 Tel: 08 9380 9700

Postal Address:
 Ut 100 Railway Road
 Subbase 008
 Perth Office
 Perth Office
 Ut 100 Railway Road
 Subbase 008

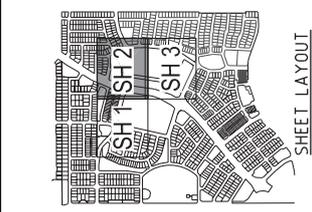
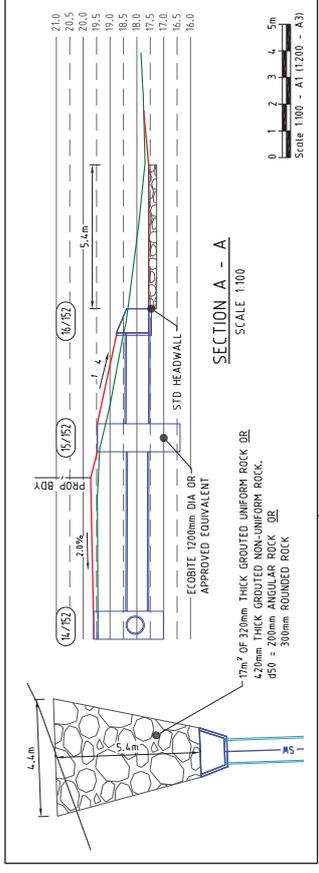
APPROVED: [Signature] DATE: 26-02-18
 DRAWING NUMBER: 26601-SS-601
 SHEET: E



WARNING
 BEWARE OF UNDERGROUND SERVICES
 The location of underground services are shown on this drawing for information only. No guarantee is given that all existing, hidden and/or unmarked services have been located and marked. All services should be located and marked before commencement of work.
 Refer to Victorian Regulations 2421.

DIAL 1100 BEFORE YOU DIG

CALL SYSTEM
 DIAL 1100
 DIG YOUR WAY



ADJOINS SHEET 3

PROJECT NAME

PARKLAND HEIGHTS SCHOOL SITE
 CLIENT
Rockingham Park Pty Ltd

Scale: 1:500 - At (1:1000 - A3)
 0 5 10 15 20 25m
 Horiz. Scale 1:500 - At (1:1000 - A3)
 0 1 2 3 4 5m
 Vert. Scale 1:100 - At (1:200 - A3)

ISSUES	DATE
TENDER	20-06-18
COUNCIL	20-06-18
CONSTRUCTION	

REV	DATE	DESCRIPTION
A	20-06-18	CONTRACT ISSUE
B	19-07-18	DESIGN REVISION
C	20-06-18	DESIGN REVISION UPDATED

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WAPC REF: 155055

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 Electrical Engineering Excellence

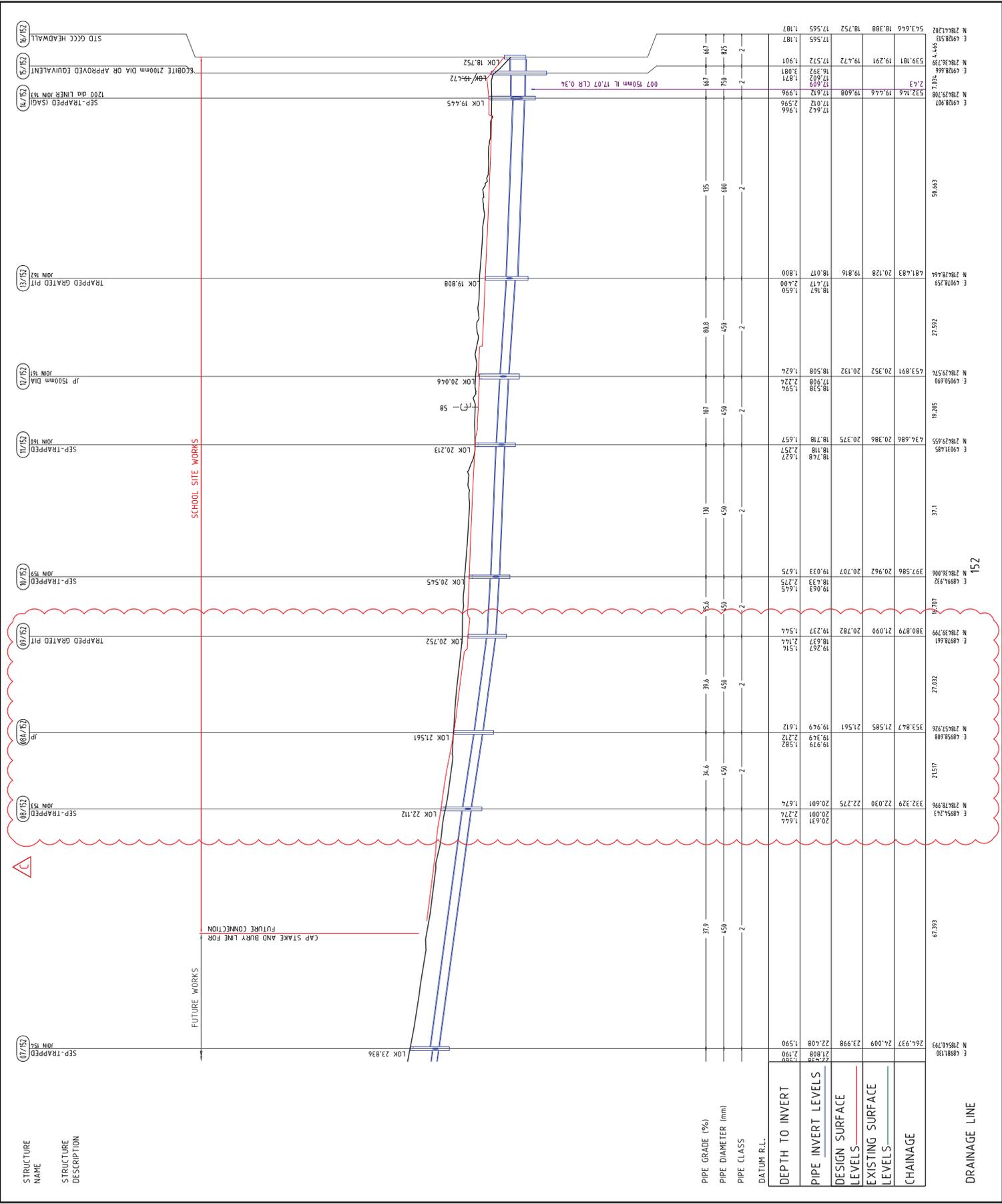
DRAWING TITLE
STORMWATER PROFILES
SHEET 03

MORTONS
 Urban Solutions
 Civil Engineering
 Project Coordination

MUS Pty Ltd T/A:
 Mortons-Urban Solutions
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 Subiaco 6008
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APPROVED: [Signature] DATE: 26-02-18
 DRAWING NUMBER: 28601-SS-622
 AMEND: C



PROJECT NAME
PARKLAND HEIGHTS SCHOOL SITE



CLIENT
Rockingham Park Pty Ltd

ISSUES
 TENDER
 COUNCIL
 CONSTRUCTION

DATE
 27-04-18

REVISIONS
 A 25-06-18 CONICAL ISSUE
 B 19-07-18 DESIGN REVISION
 C 10-07-19 DESIGN REVISION

PREPARED BY
 AMENDMENT
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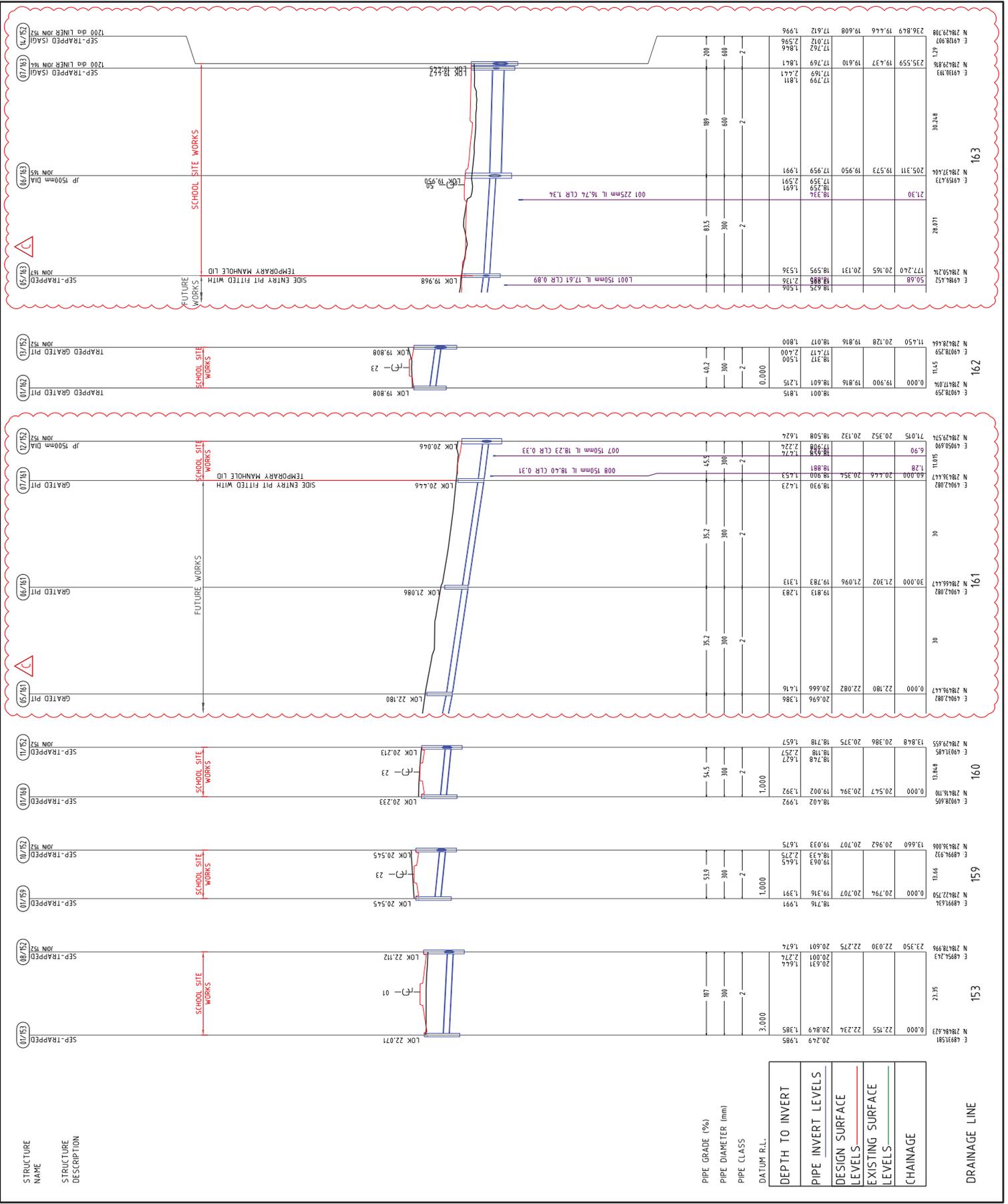
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DRAWING TITLE
STORMWATER PROFILES SHEET 04

MORTONS
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APPROVED BY: [Signature] DATE: 26-02-18
 DRAWING NUMBER: 28601-SS-623



PROJECT NAME

PARKLAND HEIGHTS SCHOOL SITE
CLIENT
Rockingham Park Pty Ltd

ISSUES
 TENDER: 27-04-18
 COUNCIL: 27-04-18
 CONSTRUCTION: 27-04-18

DATE
 27-04-18

REVISIONS

NO.	DESCRIPTION	DATE
A	PRELIMINARY	27-04-18
B	15-04-18 DESIGN REVISION	15-04-18
C	10-07-18 DESIGN REVISION	10-07-18
D	25-06-18 COUNCIL ISSUE	25-06-18
E	AMENDMENT	

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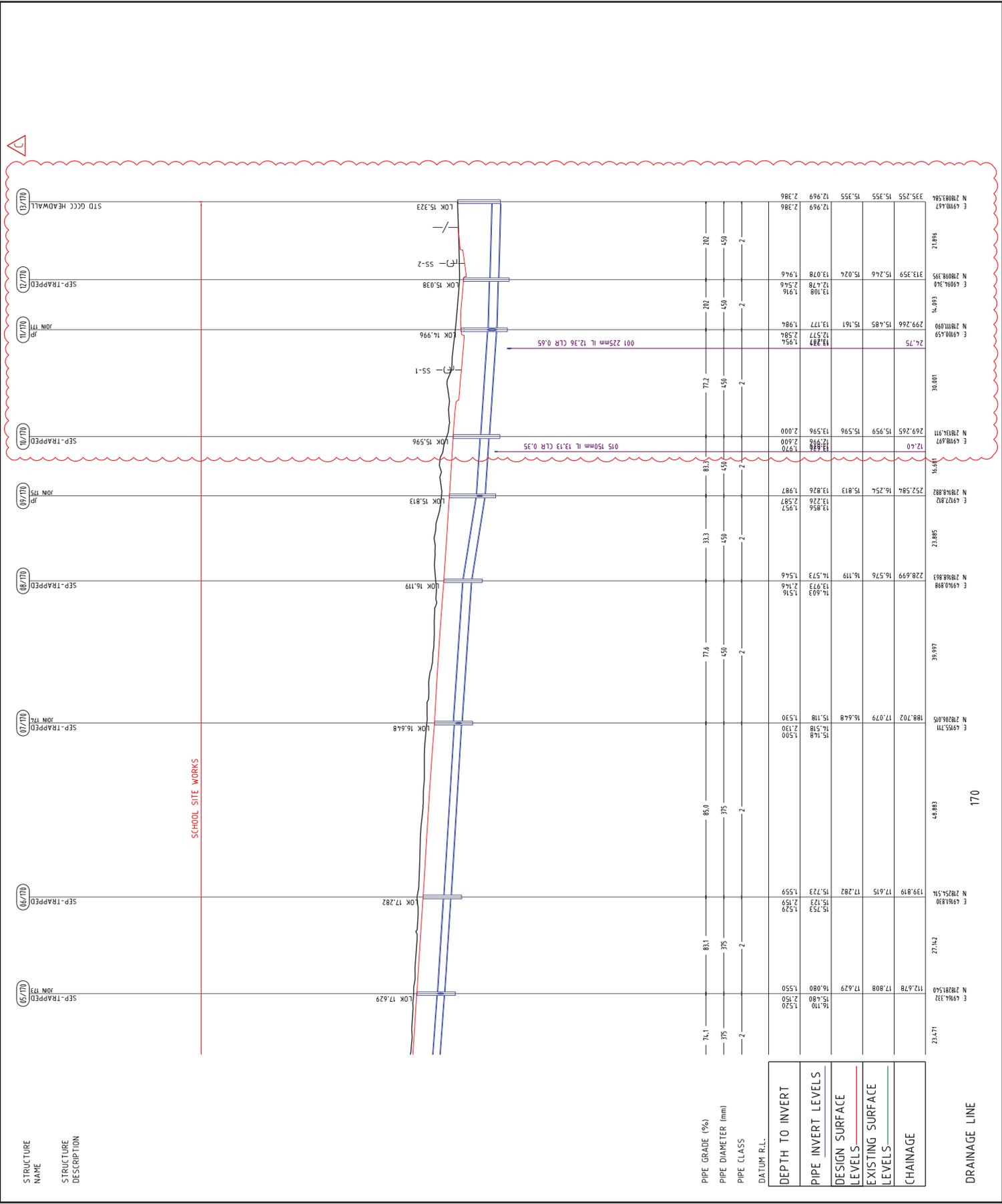
DRAWING TITLE
STORMWATER PROFILES
SHEET 06

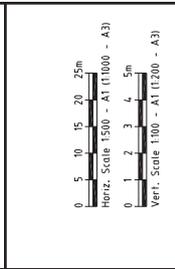
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APPROVED: [Signature] DATE: 26-02-18
 DRAWING NUMBER: 28601-SS-625
 ANKING: C





ISSUES	DATE
TENDER	20-04-18
COUNCIL	
CONSTRUCTION	
C	10-07-18 DESIGN REVIEW
B	19-03-19 DESIGN REVIEW
A	25-06-19 COUNCIL ISSUE

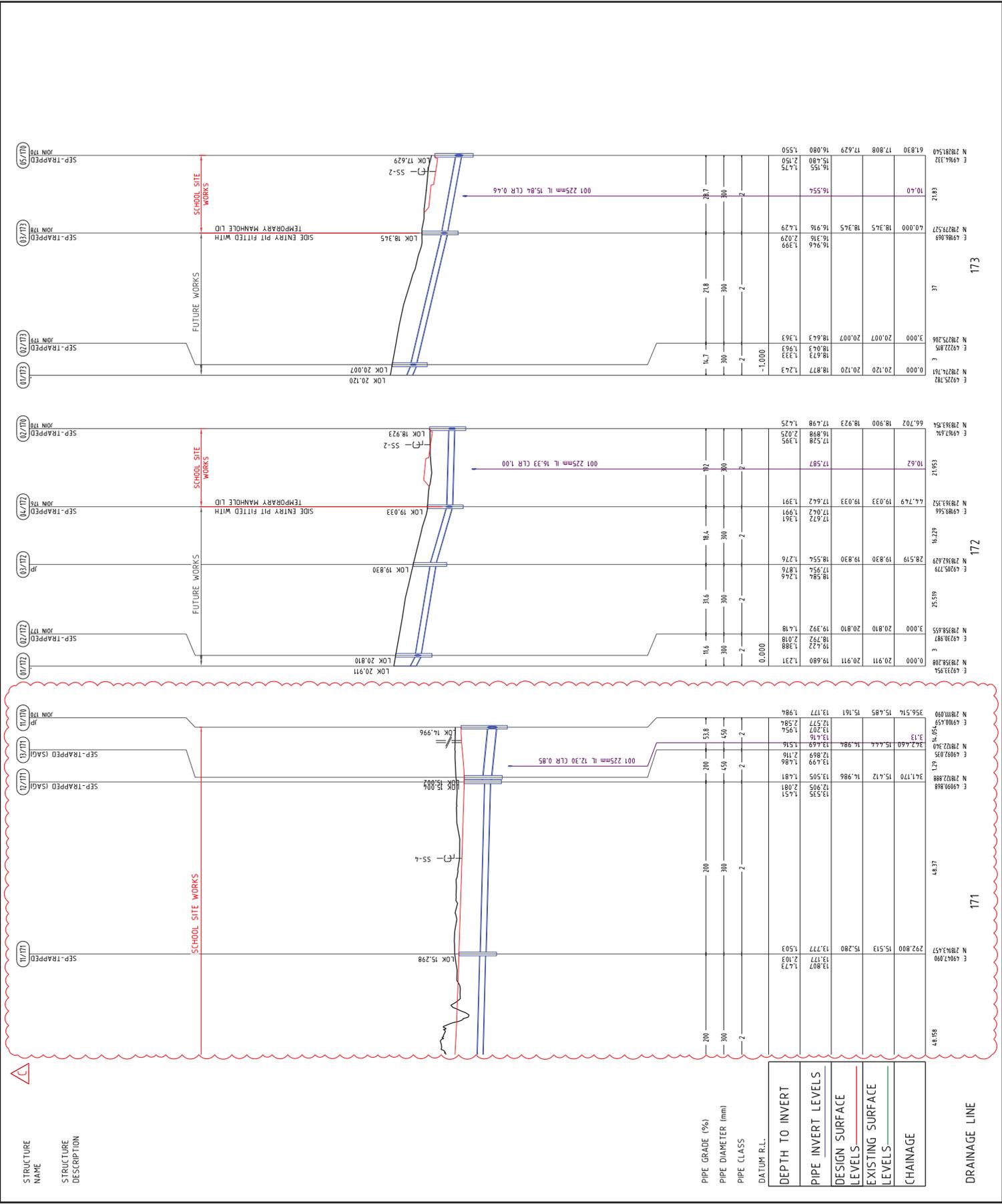
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DRAWING TITLE
STORMWATER PROFILES SHEET 08

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APPROVED BY: [Signature] DATE: 26-02-18
 DRAWING NUMBER: 28601-SS-627



PROJECT NAME
PARKLAND HEIGHTS SCHOOL SITE

CLIENT
Rockingham Park Pty Ltd

ISSUES
 TENDER: 19-23-19
 COUNCIL: 19-23-19
 CONSTRUCTION: 19-23-19

DATE
 19-23-19

DESIGN REVISION

PRELIMINARY
 AMENDMENT

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DRAWING TITLE
STORMWATER PROFILES
SHEET 09

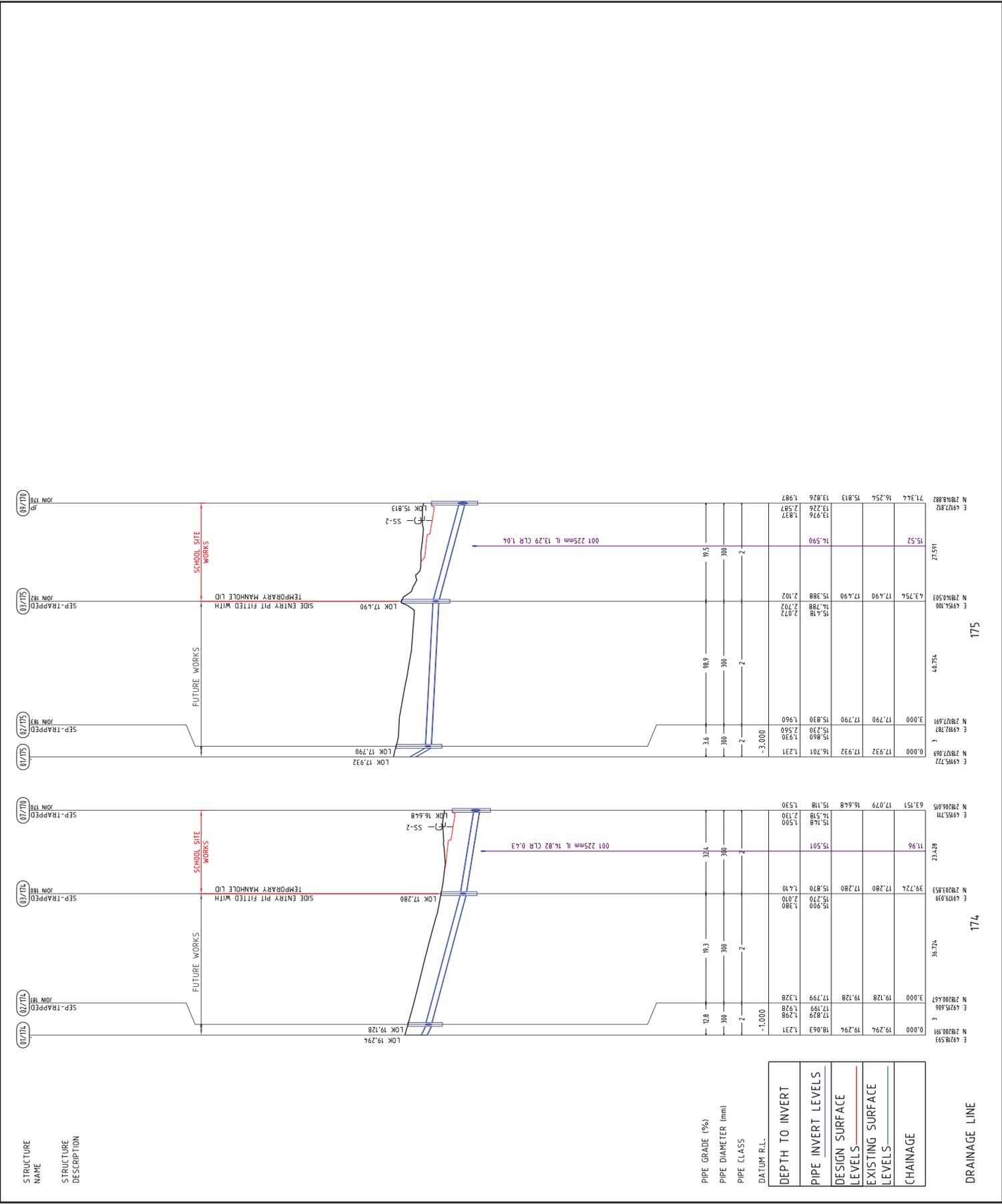
MORTONS Urbansolutions
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APPROVED: [Signature] DATE: 19-03-19
 DRAWING NUMBER: 28601-SS-628
 AMENDMENT: A



APPENDIX C

Design Rainfall Data System (2016)

(dated May 2019)
Prepared by BOM and AR&R



Location

Label: Parkland Heights

Latitude: -32.361 [Nearest grid cell: 32.3625 (S)]

Longitude: 115.806 [Nearest grid cell: 115.8125 (E)]

IFD Design Rainfall Depth (mm)

Issued: 21 May 2019

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).

[FAQ for New ARR probability terminology.](#)

Unit: ▼

Duration	Annual Exceedance Probability (AEP)						
	63.2%	50%#	20%*	10%	5%	2%	1%
1 min	1.90	2.09	2.70	3.13	3.55	4.13	4.58
2 min	3.34	3.64	4.58	5.23	5.87	6.71	7.36
3 min	4.47	4.88	6.18	7.08	7.98	9.16	10.1
4 min	5.38	5.90	7.53	8.66	9.79	11.3	12.5
5 min	6.16	6.76	8.69	10.0	11.4	13.2	14.6
10 min	8.89	9.81	12.8	14.8	16.9	19.6	21.8
15 min	10.7	11.8	15.4	17.9	20.3	23.7	26.3
20 min	12.1	13.4	17.3	20.1	22.9	26.6	29.5
25 min	13.3	14.6	18.9	21.9	24.9	29.0	32.1
30 min	14.3	15.7	20.3	23.5	26.6	30.9	34.3
45 min	16.7	18.3	23.5	27.1	30.7	35.6	39.4
1 hour	18.6	20.3	26.0	29.9	33.9	39.3	43.6
1.5 hour	21.6	23.5	29.9	34.5	39.1	45.5	50.5
2 hour	23.9	26.1	33.1	38.2	43.4	50.6	56.4
3 hour	27.7	30.1	38.3	44.3	50.5	59.2	66.4
4.5 hour	31.8	34.7	44.3	51.5	58.9	69.7	78.6
6 hour	35.1	38.3	49.1	57.2	65.8	78.3	88.7
9 hour	40.0	43.7	56.5	66.2	76.5	91.6	104
12 hour	43.7	47.8	62.1	73.0	84.6	102	116
18 hour	49.1	53.9	70.4	82.9	96.3	116	132
24 hour	53.1	58.4	76.3	89.9	104	125	143
30 hour	56.4	61.9	80.9	95.2	110	132	150
36 hour	59.1	64.9	84.7	99.4	115	137	155
48 hour	63.8	70.0	90.8	106	122	144	161
72 hour	71.6	78.4	100	116	132	153	170
96 hour	78.8	86.0	109	125	141	162	178
120 hour	85.9	93.6	118	134	150	171	187

144 hour	93.3	102	127	144	160	182	199
168 hour	101	110	137	155	171	195	214

Note:

The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.

* The 20% AEP IFD **does not** correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.

This page was created at **18:34 on Tuesday 21 May 2019 (AWST)**

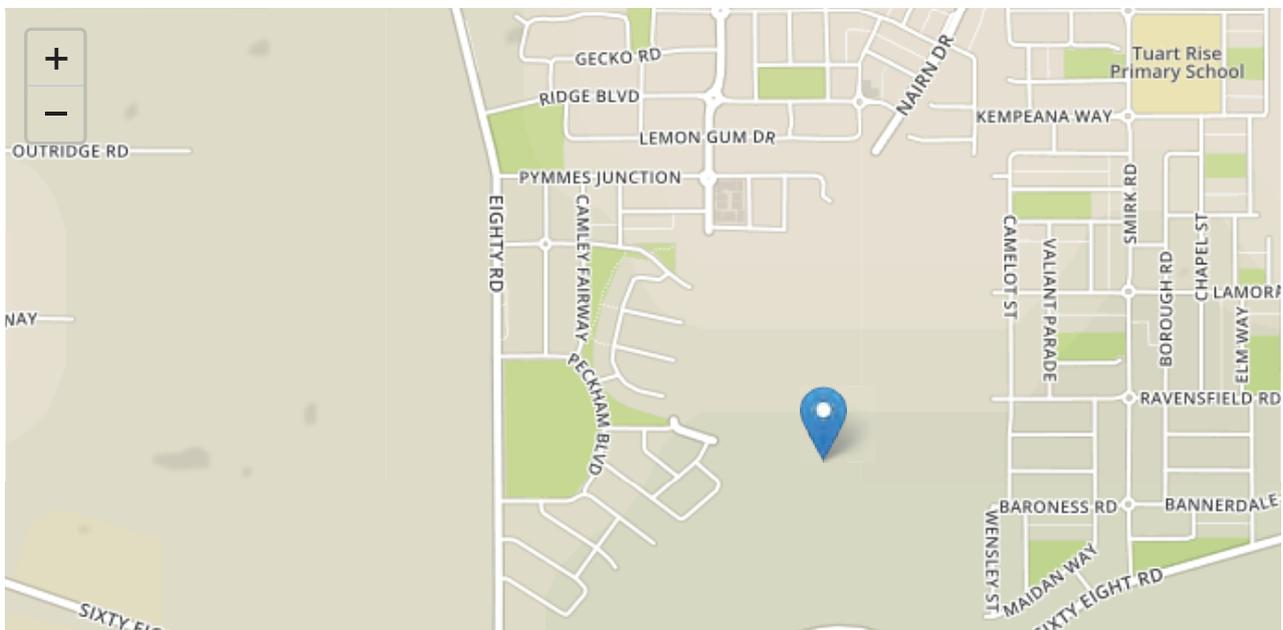
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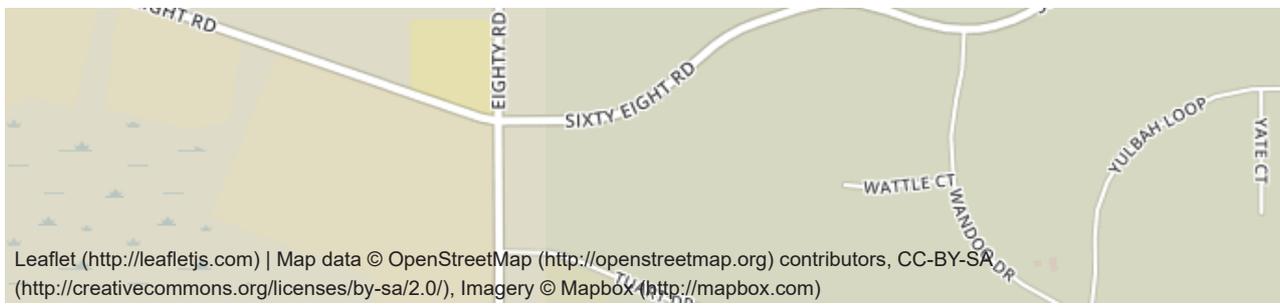
ATTENTION: This site was updated recently, changing some of the functionality. Please see the changelog ([./changelog](#)) for further information

Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	115.806
Latitude	-32.361
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Interim Climate Change Factors	show
Baseflow Factors	show





Data

River Region

Division	South West Coast
River Number	12
River Name	Murray River (Wa)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2016_v1

ARF Parameters

$$ARF = Min \left\{ 1, \left[1 - a (Area^b - \log_{10} Duration) Duration^{-d} + eArea^f Duration^g (0.3 + \log_{10} AEP) + h10^{iArea \frac{Duration}{1440}} (0.3 + \log_{10} AEP) \right] \right\}$$

Zone	a	b	c	d	e	f	g	h	i
SW WA	0.183	0.259	0.271	0.33	3.85e-06	0.41	0.55	0.00817	-0.00045

Short Duration ARF

$$ARF = Min \left[1, 1 - 0.287 (Area^{0.265} - 0.439 \log_{10}(Duration)) \cdot Duration^{-0.36} + 2.26 \times 10^{-3} \times Area^{0.226} \cdot Duration^{0.125} (0.3 + \log_{10}(AEP)) + 0.0141 \times Area^{0.213} \times 10^{-0.021 \frac{(Duration-180)^2}{1440}} (0.3 + \log_{10}(AEP)) \right]$$

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2016_v1

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

ID	1973.0
Storm Initial Losses (mm)	30.0
Storm Continuing Losses (mm/h)	2.9

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2016_v1

Temporal Patterns | Download (.zip) (static/temporal_patterns/TP/FLTwest.zip)

code	FLTwest
Label	Southern and South Western Flatlands (West)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2016_v2

Areal Temporal Patterns | Download (.zip) (./static/temporal_patterns/Areal/Areal_FLTwest.zip)

code	FLTwest
arealabel	Southern and South Western Flatlands (West)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2016_v2

BOM IFDs

Click here (http://www.bom.gov.au/water/designRainfalls/reviced-ifd/?year=2016&coordinate_type=dd&latitude=-32.361&longitude=115.806&sdmin=true&sdhr=true&sdday=true&user_label=) to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

Time Accessed	21 May 2019 08:37PM
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Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	5.6 (0.275)	5.9 (0.228)	6.1 (0.205)	6.3 (0.187)	5.6 (0.143)	5.1 (0.116)
90 (1.5)	6.1 (0.257)	6.4 (0.212)	6.6 (0.190)	6.7 (0.172)	6.3 (0.138)	5.9 (0.117)
120 (2.0)	3.9 (0.148)	4.9 (0.148)	5.6 (0.146)	6.3 (0.144)	6.3 (0.124)	6.3 (0.112)
180 (3.0)	4.5 (0.149)	4.7 (0.122)	4.8 (0.109)	4.9 (0.098)	4.8 (0.082)	4.7 (0.072)
360 (6.0)	2.5 (0.065)	2.4 (0.048)	2.3 (0.040)	2.2 (0.034)	2.9 (0.038)	3.5 (0.039)
720 (12.0)	0.4 (0.008)	0.5 (0.009)	0.6 (0.009)	0.7 (0.008)	1.6 (0.016)	2.4 (0.020)
1080 (18.0)	0.0 (0.000)	0.1 (0.001)	0.2 (0.002)	0.2 (0.002)	1.0 (0.009)	1.6 (0.012)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.4 (0.003)	0.6 (0.004)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	1.8 (0.088)	1.2 (0.046)	0.8 (0.027)	0.4 (0.013)	0.2 (0.006)	0.1 (0.001)
90 (1.5)	1.5 (0.064)	1.0 (0.032)	0.6 (0.018)	0.3 (0.007)	0.4 (0.009)	0.5 (0.010)
120 (2.0)	0.4 (0.015)	0.8 (0.025)	1.1 (0.029)	1.4 (0.032)	0.7 (0.014)	0.2 (0.004)
180 (3.0)	0.6 (0.021)	0.9 (0.022)	1.0 (0.023)	1.2 (0.023)	0.5 (0.008)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	11.4 (0.559)	14.7 (0.565)	16.9 (0.564)	19.0 (0.560)	16.9 (0.430)	15.4 (0.353)
90 (1.5)	15.0 (0.638)	17.6 (0.589)	19.4 (0.561)	21.0 (0.537)	16.2 (0.357)	12.6 (0.250)
120 (2.0)	15.3 (0.585)	17.3 (0.523)	18.7 (0.489)	20.0 (0.461)	18.2 (0.360)	16.9 (0.299)
180 (3.0)	11.8 (0.393)	11.4 (0.298)	11.1 (0.251)	10.8 (0.215)	11.9 (0.201)	12.7 (0.191)
360 (6.0)	8.0 (0.209)	8.4 (0.172)	8.7 (0.152)	9.0 (0.137)	13.1 (0.167)	16.1 (0.182)
720 (12.0)	11.2 (0.235)	9.9 (0.159)	9.0 (0.123)	8.1 (0.095)	11.8 (0.116)	14.6 (0.126)
1080 (18.0)	10.6 (0.196)	8.4 (0.119)	7.0 (0.084)	5.6 (0.058)	11.3 (0.098)	15.6 (0.118)
1440 (24.0)	2.6 (0.044)	3.7 (0.049)	4.5 (0.050)	5.3 (0.051)	9.0 (0.072)	11.9 (0.083)
2160 (36.0)	1.5 (0.023)	2.5 (0.030)	3.2 (0.032)	3.9 (0.034)	6.7 (0.049)	8.9 (0.058)
2880 (48.0)	0.5 (0.007)	4.0 (0.044)	6.4 (0.060)	8.6 (0.071)	6.4 (0.044)	4.7 (0.029)
4320 (72.0)	0.7 (0.009)	1.7 (0.017)	2.3 (0.020)	3.0 (0.023)	2.1 (0.014)	1.5 (0.009)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	24.9 (1.225)	31.1 (1.197)	35.2 (1.176)	39.1 (1.153)	35.6 (0.905)	33.0 (0.756)
90 (1.5)	28.5 (1.209)	32.7 (1.093)	35.6 (1.031)	38.3 (0.978)	47.6 (1.046)	54.5 (1.079)
120 (2.0)	27.5 (1.055)	30.6 (0.924)	32.7 (0.855)	34.6 (0.798)	38.6 (0.763)	41.6 (0.738)
180 (3.0)	26.8 (0.890)	30.1 (0.785)	32.2 (0.728)	34.3 (0.679)	39.1 (0.661)	42.8 (0.644)
360 (6.0)	19.4 (0.508)	19.9 (0.406)	20.2 (0.354)	20.6 (0.312)	28.4 (0.363)	34.3 (0.386)
720 (12.0)	31.1 (0.650)	28.2 (0.454)	26.3 (0.360)	24.5 (0.289)	33.2 (0.326)	39.8 (0.342)
1080 (18.0)	33.7 (0.626)	29.0 (0.413)	26.0 (0.313)	23.0 (0.239)	35.6 (0.307)	45.0 (0.340)
1440 (24.0)	24.2 (0.415)	22.9 (0.300)	22.0 (0.245)	21.2 (0.203)	28.3 (0.226)	33.7 (0.236)
2160 (36.0)	18.2 (0.280)	20.7 (0.245)	22.4 (0.226)	24.0 (0.209)	26.1 (0.191)	27.6 (0.178)
2880 (48.0)	11.6 (0.166)	18.6 (0.205)	23.2 (0.218)	27.6 (0.226)	23.0 (0.160)	19.5 (0.121)
4320 (72.0)	18.4 (0.235)	25.9 (0.258)	30.9 (0.266)	35.6 (0.270)	30.5 (0.199)	26.7 (0.157)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

Interim Climate Change Factors

	RCP 4.5	RCP6	RCP 8.5
2030	0.758 (3.8%)	0.675 (3.3%)	0.782 (3.9%)
2040	0.970 (4.8%)	0.868 (4.3%)	1.132 (5.7%)
2050	1.179 (5.9%)	1.094 (5.5%)	1.501 (7.6%)
2060	1.370 (6.9%)	1.332 (6.7%)	1.900 (9.7%)
2070	1.526 (7.7%)	1.564 (7.9%)	2.342 (12.1%)
2080	1.631 (8.3%)	1.769 (9.0%)	2.839 (14.9%)
2090	1.667 (8.5%)	1.929 (9.9%)	3.404 (18.1%)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2019_v1
Note	ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

Baseflow Factors

Downstream	0
Area (km2)	271.542848
Catchment Number	9535
Volume Factor	0.001209
Peak Factor	0.084487

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2016_v1

[Download TXT \(downloads/0c49eb35-e76b-4d01-b654-b8bafecc1aaa.txt\)](#)

[Download JSON \(downloads/f5873769-88d0-4253-836d-aef2208a075f.json\)](#)

[Generating PDF... \(downloads/995c302b-336c-488c-aad5-29ee72a2e3fc.pdf\)](#)



APPENDIX D

Hydraulic Modelling Results

Prepared by Mortons Urban Solutions

Link

Storm	Link195	Link194
Max Flow	0.006	0.002
Max Velocity	0.770	0.620
Diameter (Height)	0.300	0.300
Max Depth	0.772	0.034
Conduit Slope	2.202	2.943

Conduit Link195 from 12-152 to 03-161

Conduit Link195 from 03-161 to 02-161

Conduit Link194 from 02-161 to 01-161

7.1

14.2

21.3

28.4

33.5

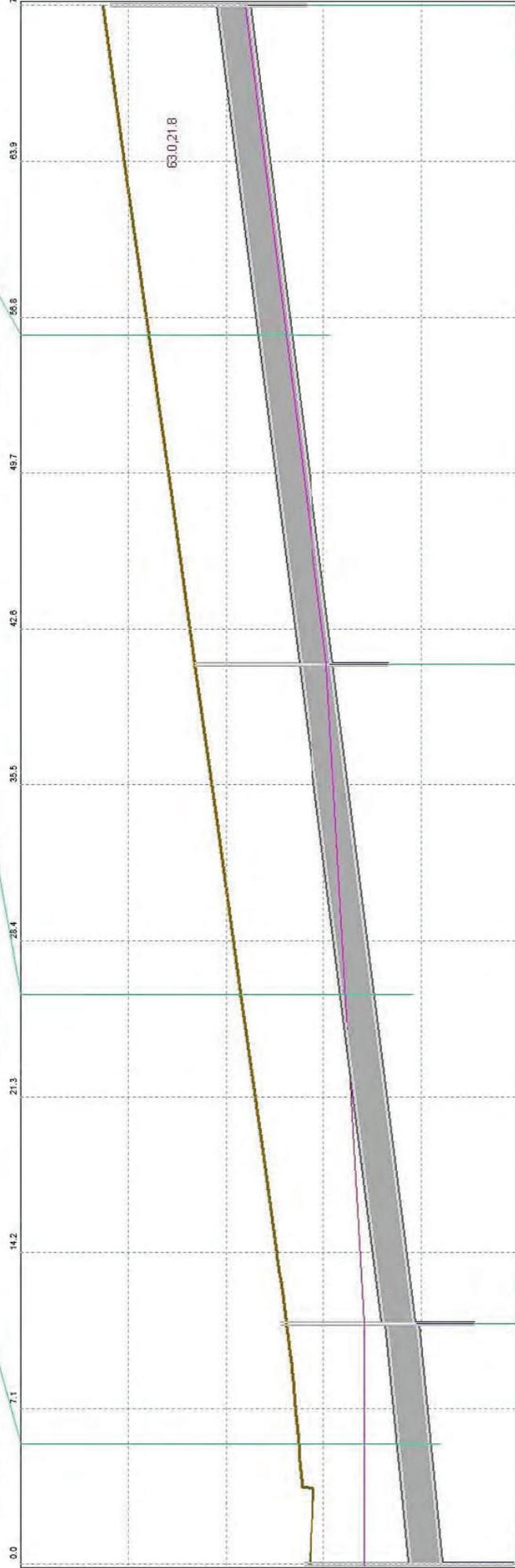
42.6

49.7

56.8

63.9

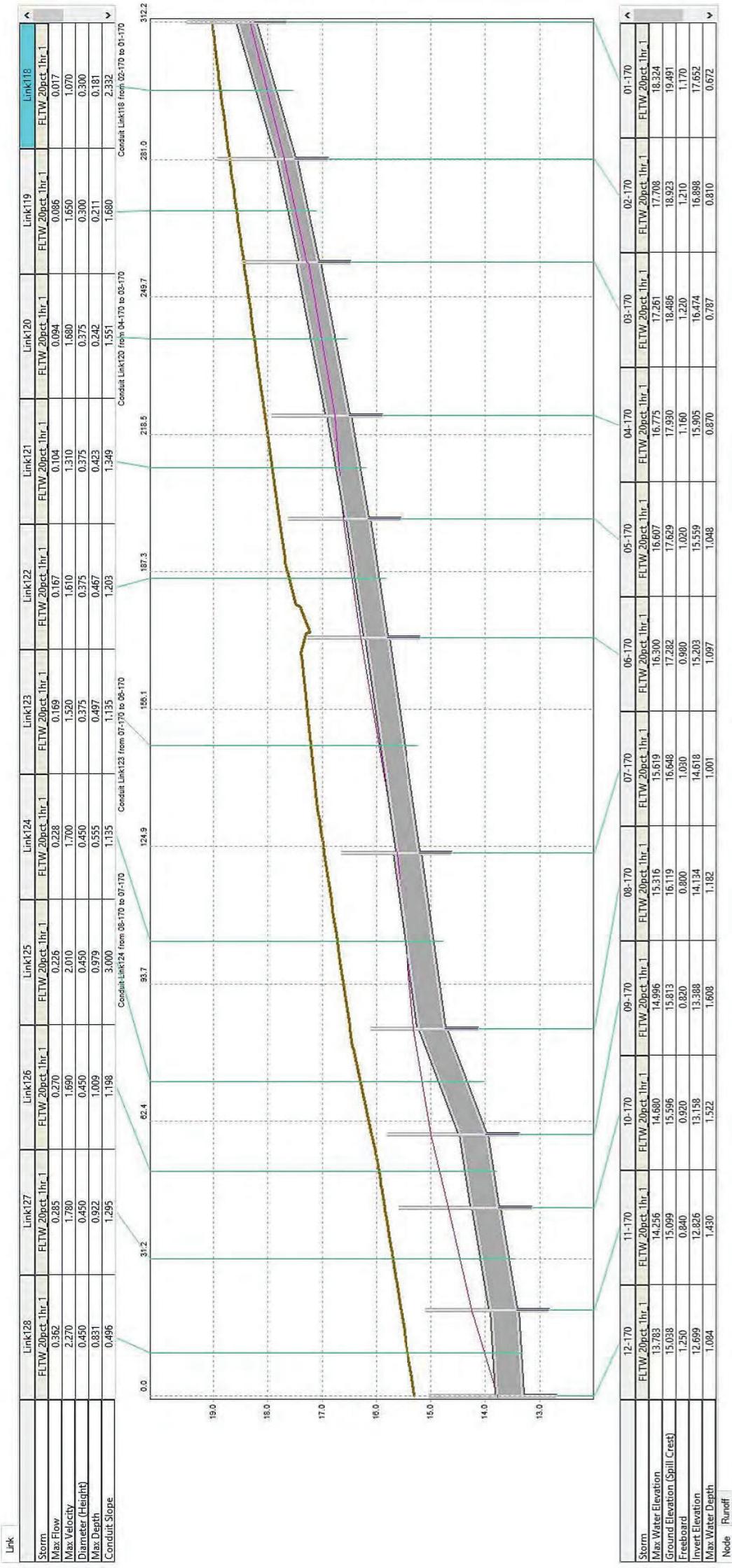
71.0



Storm	12-152	03-161	02-161	01-161
Max Water Elevation	19.574	19.575	19.956	20.806
Ground Elevation (Spill Crest)	20.206	20.446	21.330	22.180
Freeboard	0.630	0.870	1.360	1.370
Invert Elevation	18.057	18.449	19.332	20.185
Max Water Depth	1.517	1.126	0.654	0.621

Node

Runoff



Node	Runoff	12-170	11-170	10-170	09-170	08-170	07-170	06-170	05-170	04-170	03-170	02-170	01-170
Storm	FLTW_20pct_1hr_1												
Max Water Elevation	13.783	14.256	14.680	14.996	15.316	15.619	15.813	16.007	16.201	16.395	16.589	16.783	16.977
Ground Elevation (Spill Crest)	15.038	15.099	15.596	15.813	16.119	16.648	17.282	17.629	17.990	18.486	18.923	19.491	19.923
Freeboard	1.250	0.840	0.920	0.820	0.800	1.030	1.020	1.160	1.220	1.160	1.220	1.210	1.170
Invert Elevation	12.699	12.826	13.158	13.388	14.134	14.618	15.203	15.559	15.905	16.474	16.888	17.652	17.652
Max Water Depth	1.084	1.430	1.522	1.608	1.182	1.001	1.097	1.048	0.870	0.787	0.810	0.810	0.672

Link

Link 185

Storm

Max Flow

Max Velocity

Diameter (Height)

Max Depth

Conduit Slope

Link 185

FLTW 20pct 1hr.9

0.006

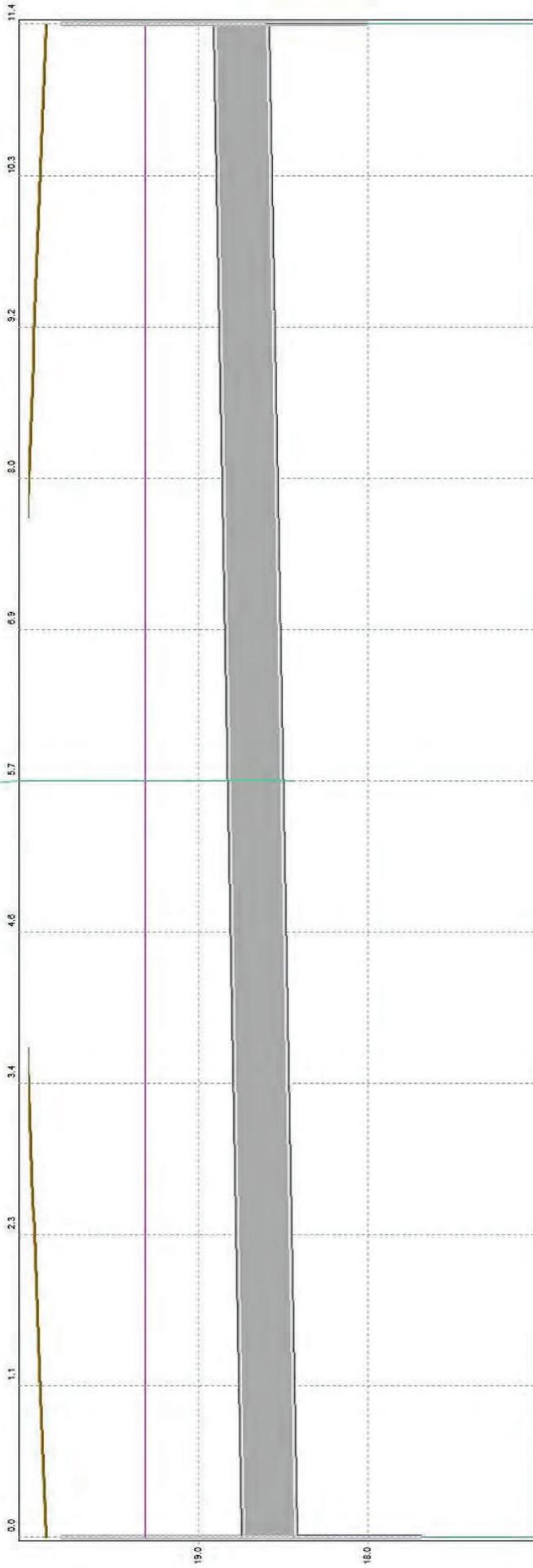
1.110

0.300

0.880

1.450

Conduit Link185 from 13-152 to 01-162



Storm

Max Water Elevation

Ground Elevation (Spill Crest)

Freeboard

Invert Elevation

Max Water Depth

13-152

FLTW 20pct 1hr.9

19.311

19.816

0.500

17.685

1.626

01-162

FLTW 20pct 1hr.9

19.312

19.816

0.500

18.001

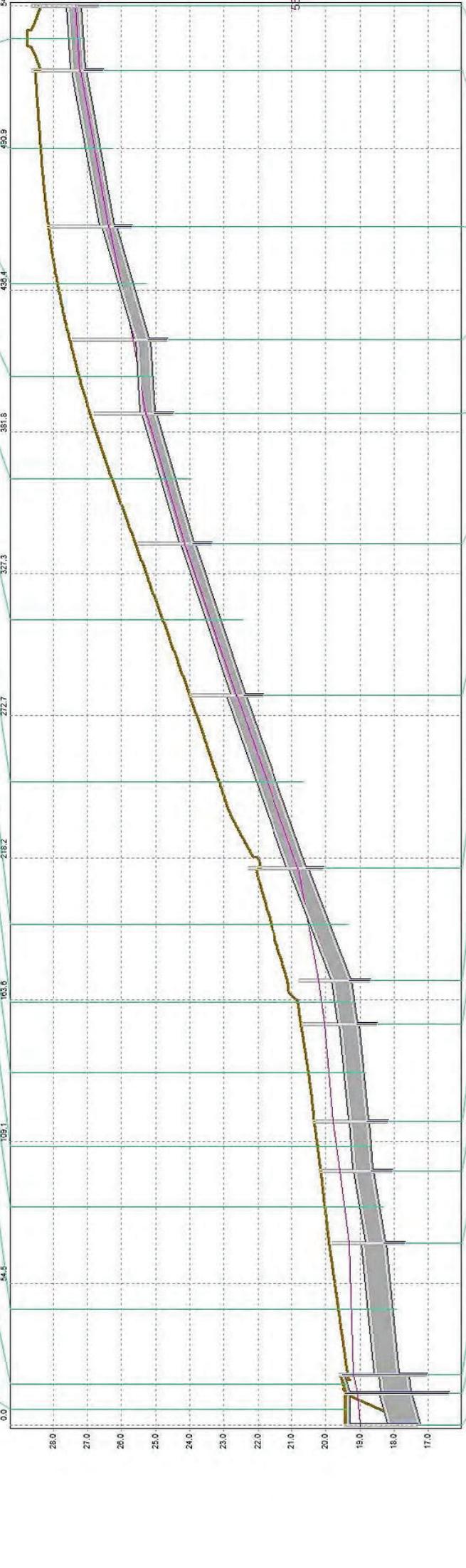
1.311

Node Runoff

Link

Storm	582.1	582.2	580.1	580.2	Link173	Link172	Link171	Link170	Link169	Link168	Link167	Link166	Link165	Link164	Link163	Link162	Link161
Max Flow	0.481	0.000	0.482	0.000	0.203	0.195	0.187	0.179	0.176	0.164	0.138	0.116	0.096	0.080	0.055	0.025	0.013
Max Velocity	0.900	0.000	1.080	0.000	1.360	1.350	1.170	1.190	1.200	2.240	2.090	1.980	1.840	1.150	1.490	1.140	0.610
Diameter (Height)	0.825	0.100	0.750	0.100	0.600	0.450	0.450	0.450	0.450	0.450	0.450	0.300	0.300	0.300	0.300	0.300	0.300
Max Depth	1.691	-0.371	1.576	-9e+99	1.276	1.000	0.995	0.965	0.915	0.874	0.197	0.236	0.208	0.429	0.399	0.105	0.106
Conduit Slope	1.968	0.000	0.500	1.943	0.716	1.237	0.502	0.767	1.046	2.887	2.658	2.526	2.216	0.499	2.204	1.355	0.503

Multiple UnknwnPipeDiameters 15-152 GPT to 14-152
 Conduit Link169 from 09-152 to 07-152
 Conduit Link168 from 07-152 to 06-152
 Conduit Link162 from 03-152 to 02-152



Storm	15-152 GPT	14-152	13-152	12-152	11-152	10-152	09-152	08-152	07-152	06-152	05-152	04-152	03-152	02-152	01-152
Max Water Elevation	19.000	19.059	19.194	19.574	19.773	20.037	20.202	20.810	22.605	24.150	25.261	25.654	26.355	27.205	27.359
Ground Elevation (Spill Crest)	19.472	19.472	19.608	20.206	20.375	20.707	20.782	22.277	23.998	25.505	26.802	27.450	28.163	28.645	28.645
Freeboard	0.470	0.410	0.500	0.630	0.600	0.670	0.580	1.470	1.390	1.360	1.540	1.800	1.810	1.440	1.290
Invert Elevation	17.310	16.377	17.022	18.057	18.183	18.488	18.703	20.057	21.838	23.344	24.483	24.655	25.687	26.530	26.654
Max Water Depth	1.690	2.682	2.172	1.626	1.590	1.539	1.499	0.753	0.767	0.806	0.778	0.999	0.668	0.675	0.705

Node Runoff

Link	582.1	582.2	580.1	580.2	Link187	Link186	Link191	Link190	Link189
Storm	FLTW_10pct_1hr_3								
Max Flow	0.812	0.000	0.814	0.000	0.544	0.519	0.444	0.341	0.350
Max Velocity	1.520	0.000	1.830	0.000	1.230	1.170	2.040	2.710	2.230
Diameter (In)	0.825	0.100	0.750	0.100	0.750	0.750	0.525	0.450	0.450
Max Depth	1.734	-0.328	1.674	-9e+99	1.248	1.248	1.270	1.170	0.856
Conduit Slope	1.968	0.000	0.500	1.943	2.846	0.499	2.221	5.105	1.777



Node	15-152 GPT	14-152	07-163	06-163	04-165	03-165	02-165	01-165
Storm	FLTW_10pct_1hr_3							
Max Water Ele	19.044	19.295	19.355	19.461	19.654	20.372	20.712	21.096
Ground Elevat	19.472	19.608	19.610	19.950	19.964	20.774	21.197	21.488
Freeboard	0.430	0.310	0.250	0.490	0.310	0.400	0.480	0.390
Invert Elevatio	17.310	17.022	17.479	17.660	17.779	18.593	19.328	19.648
Max Water De	1.734	2.273	1.876	1.801	1.875	1.779	1.384	1.448

Multiple Link from POSK to 15-152 GPT/Multiple Link from 15-152 GPT to 14-152
 Conduit Link188 from 07-163 to 06-163
 Conduit Link187 from 06-163 to 04-165
 Conduit Link192 from 05-163 to 04-165
 Conduit Link191 from 04-165 to 03-165
 Conduit Link190 from 03-165 to 02-165
 Conduit Link189 from 02-165 to 01-165

Link

Link 144

Storm

Max Flow

Max Velocity

Diameter (Height)

Max Depth

Conduit Slope

Link 144

FLTW 20pct 1hr 1

0.059

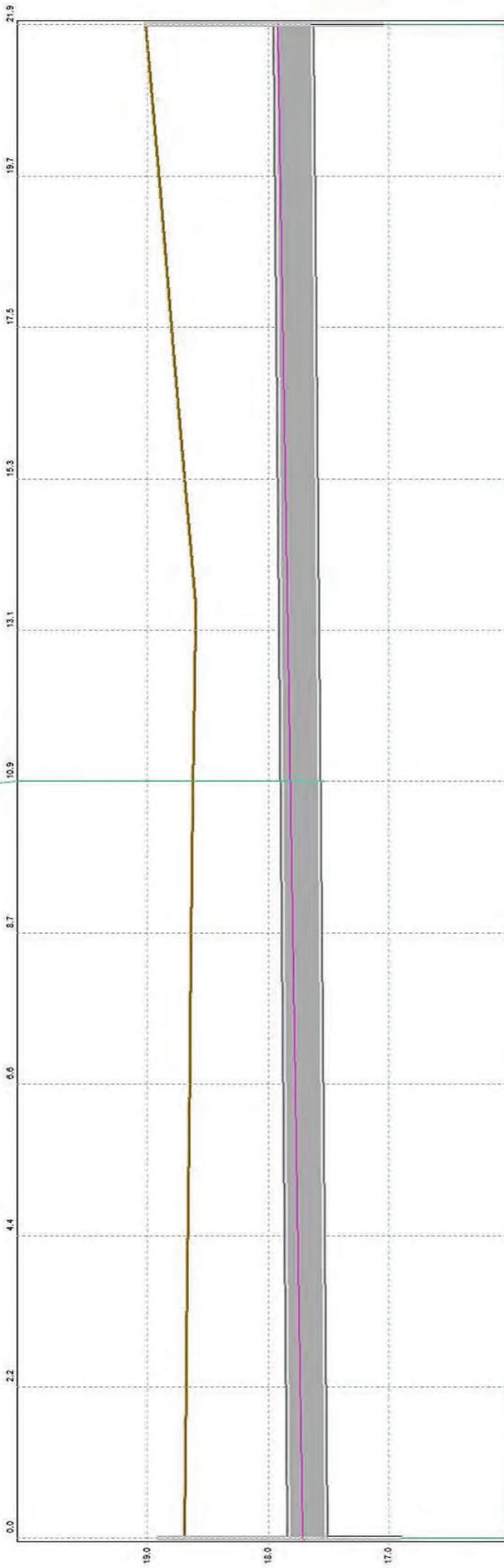
0.880

0.300

0.287

0.521

Conduit Link144 from 02-170 to 04-172



Storm

Max Water Elevation

Ground Elevation (Spill Crest)

Freeboard

Invert Elevation

Max Water Depth

Node

Runoff

02-170

FLTW 20pct 1hr 1

17.708

18.923

1.210

16.898

0.810

04-172

FLTW 20pct 1hr 1

17.929

19.033

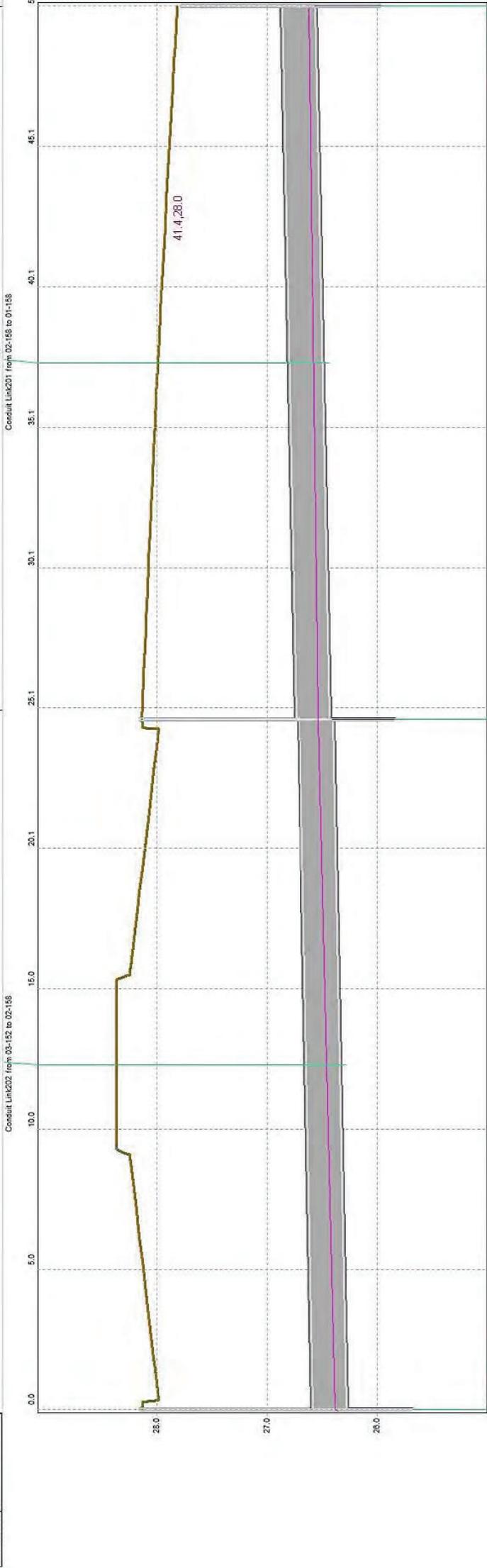
1.100

17.042

0.887

Link

Link202	Link201
Storm	Link201
Max Flow	FLTW_20pct_1hr_9
Max Velocity	0.078
Diameter (Height)	0.640
Max Depth	0.300
Conduit Slope	0.130
	0.499



03-152	02-158	01-158
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	26.555	26.624
Ground Elevation (Spill Crest)	28.163	27.790
Freeboard	1.810	1.170
Invert Elevation	25.687	25.967
Max Water Depth	0.668	0.657

Link

Link#208

Storm

FLTW_20oct_1hr_9

Max Flow

0.010

Max Velocity

0.520

Diameter (Height)

0.300

Max Depth

0.094

Conduit Slope

0.505

Conduit Link#208 from 03-163 to 01-169

0.0

1.4

2.7

4.1

5.5

6.8

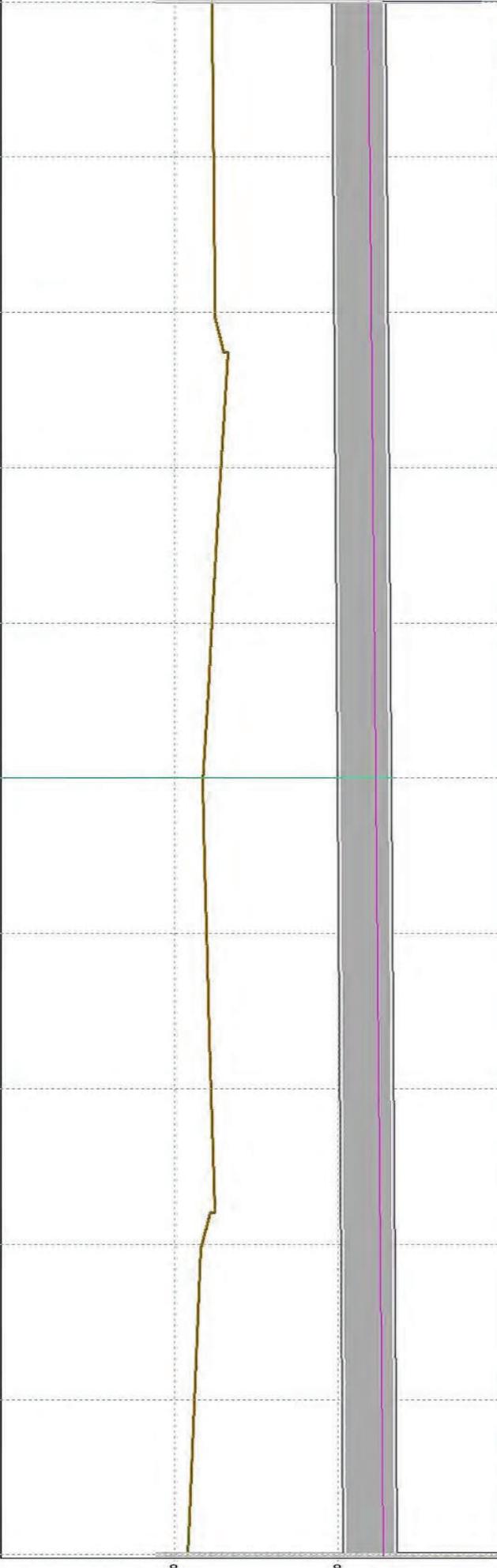
8.2

9.6

10.9

12.3

13.6



24.0

23.0

Storm

03-163

FLTW_20oct_1hr_9

Max Water Elevation

23.727

Ground Elevation (Spill Crest)

24.115

Freeboard

1.380

Invert Elevation

22.023

Max Water Depth

0.704

01-169

FLTW_20oct_1hr_9

Max Water Elevation

22.815

Ground Elevation (Spill Crest)

24.115

Freeboard

1.300

Invert Elevation

22.122

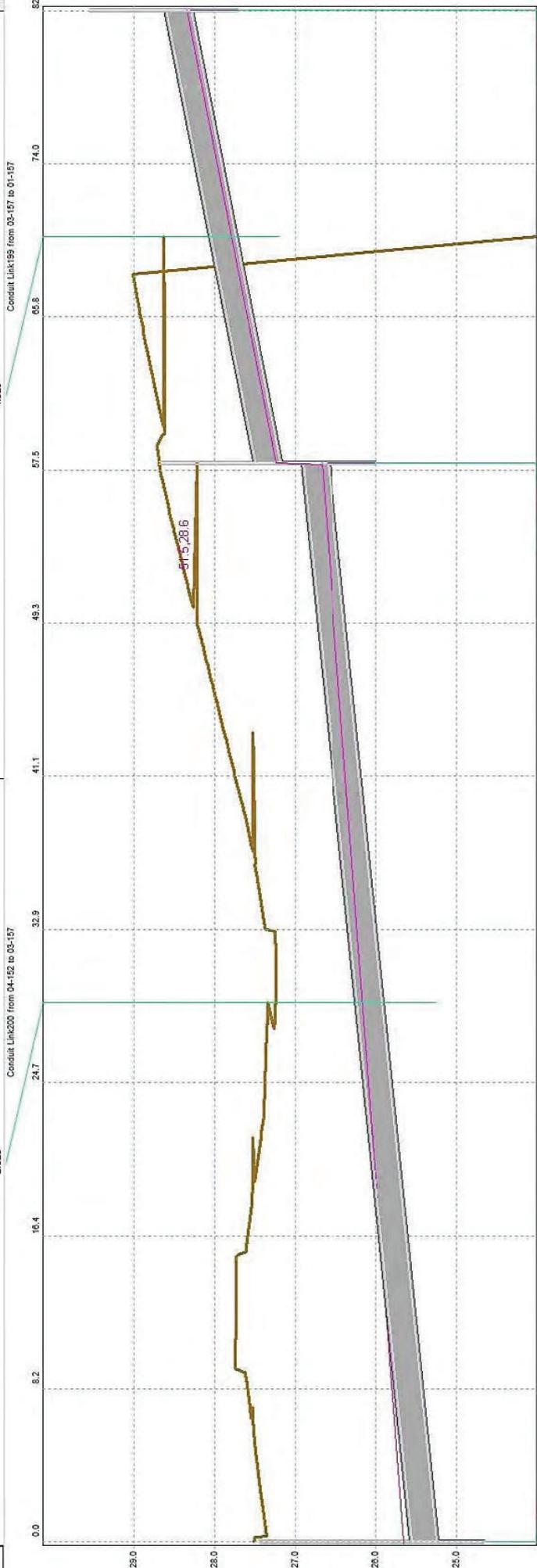
Max Water Depth

0.693

Node Runoff

Link

Link	Link200	Link199
Storm	Link200	Link199
Max Flow	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Velocity	0.016	0.009
Max Velocity	0.890	1.340
Diameter (Height)	0.300	0.300
Max Depth	0.399	0.046
Conduit Slope	2.323	4.329

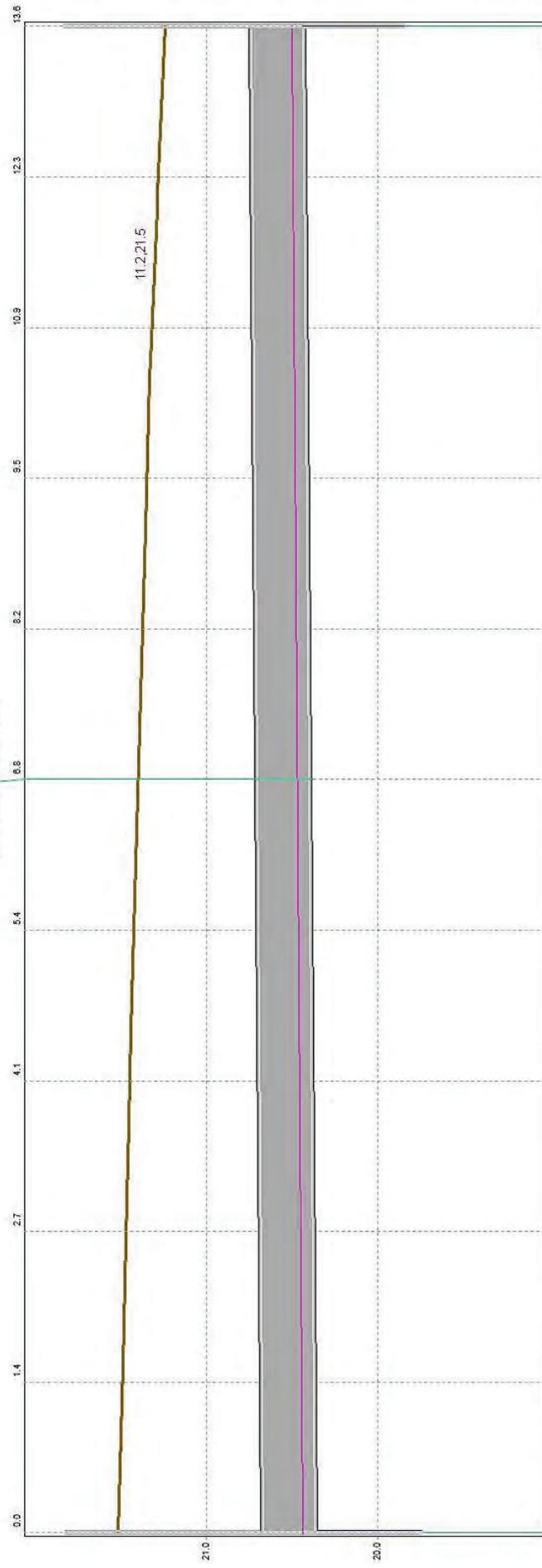


Storm	04-152	03-157	01-157
Max Water Elevation	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Ground Elevation (Spill Crest)	25.654	26.670	28.346
Freeboard	27.450	28.689	29.553
Invert Elevation	1.800	2.020	1.210
Max Water Depth	24.655	26.000	27.700
Node	0.999	0.670	0.646
Runoff			

Link

Link#209	
Storm	FLTW_20pct_1hr_9
Max Flow	0.005
Max Velocity	0.470
Diameter (Height)	0.300
Max Depth	0.068
Conduit Slope	0.499

Conduit Link#209 from 04-163 to 01-168



Node

Node 01-168	
Storm	FLTW_20pct_1hr_9
Max Water Elevation	20.502
Ground Elevation (Spill Crest)	21.830
Freeboard	1.330
Invert Elevation	19.838
Max Water Depth	0.664

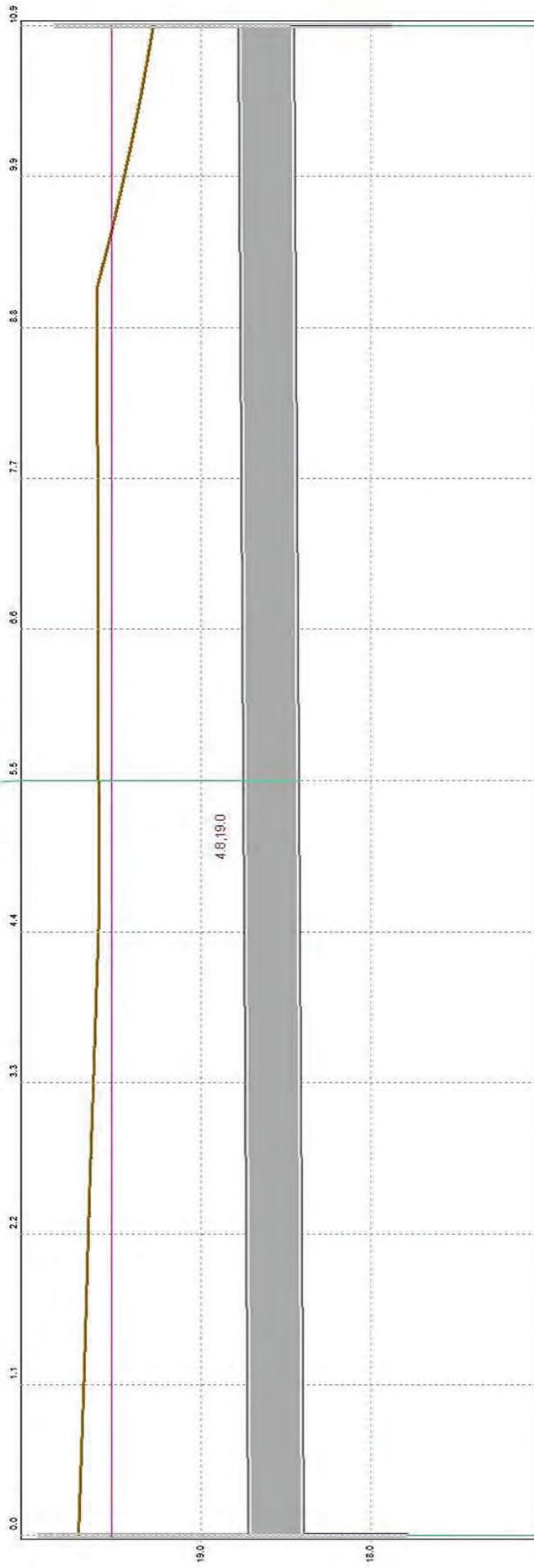
Runoff

Node 04-163	
Storm	FLTW_20pct_1hr_9
Max Water Elevation	20.438
Ground Elevation (Spill Crest)	21.828
Freeboard	1.390
Invert Elevation	19.740
Max Water Depth	0.698

Link

Link193	
Storm	FLTW_20pct_1hr_9
Max Flow	0.004
Max Velocity	0.100
Diameter (Height)	0.300
Max Depth	1.116
Conduit Slope	0.566

Conduit Link193 from 04-165 to 01-166



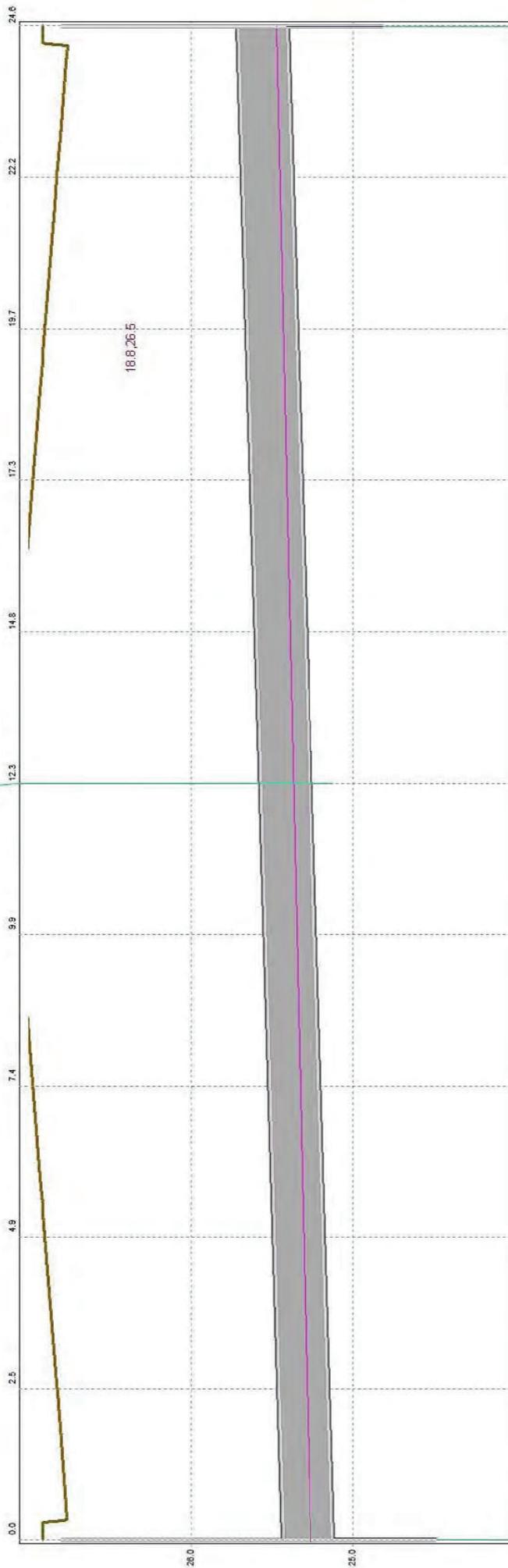
Node

Node Runoff	
Storm	01-166
Max Water Elevation	FLTW_20pct_1hr_9
Ground Elevation (Spill Crest)	19.522
Freeboard	19.684
Invert Elevation	0.340
Max Water Depth	17.871

Link

Link206	
Storm	FLTW 20pct 1hr 9
Max Flow	0.010
Max Velocity	0.770
Diameter (Height)	0.300
Max Depth	0.133
Conduit Slope	1.144

Conduit Link206 from 05-152 to 01-156



Storm

05-152	
Max Water Elevation	FLTW 20pct 1hr 9
Ground Elevation (Spill Crest)	25.476
Freeboard	26.802
Invert Elevation	1.330
Max Water Depth	24.810
Node	0.666

05-152

FLTW 20pct 1hr 9

25.476

26.802

1.330

24.810

0.666

01-156

FLTW 20pct 1hr 9

25.476

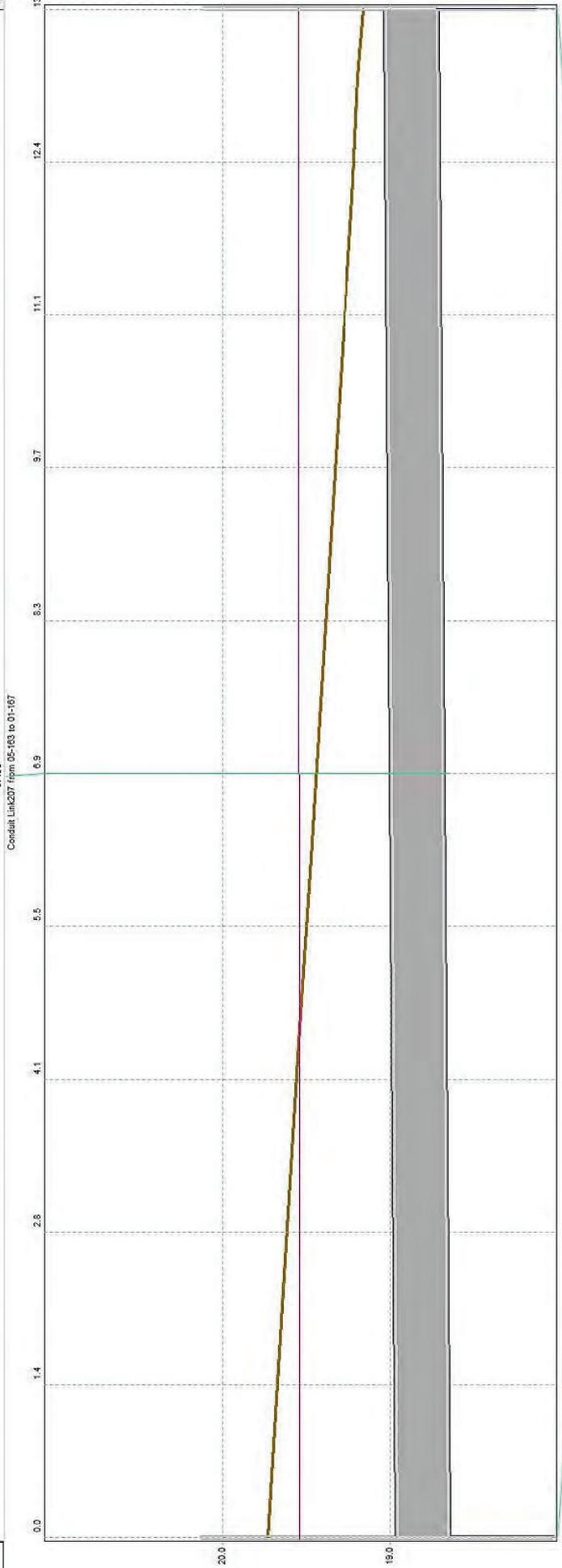
26.802

1.330

24.810

0.666

Link	Link207
Storm	FLTW_20pct_1hr_9
Max Flow	0.006
Max Velocity	0.330
Diameter (Height)	0.300
Max Depth	0.889
Conduit Slope	0.489



Storm	05-163	01-167
Max Water Elevation	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation (Spill Crest)	19.543	19.544
Ground Elevation (Spill Crest)	20.131	20.116
Freeboard	0.590	0.570
Invert Elevation	18.026	18.125
Max Water Depth	1.517	1.419
Node	Runoff	

Link

<

Link150

>

Storm

Max Flow

Max Velocity

Diameter (Height)

Max Depth

Conduit Slope

FLTW 20pct. 1hr.1

0.063

1.720

0.300

0.423

3.330

Conduit Link150 from 05-170 to 03-173

>

0.0

2.2

4.4

6.5

8.7

10.9

13.1

15.3

17.5

19.6

21.8

18.0

17.0

16.0

15.0

14.0

13.0

12.0

11.0

10.0

9.0

8.0

7.0

6.0

5.0

4.0

3.0

2.0

18.0

17.0

16.0

15.0

14.0

13.0

12.0

11.0

10.0

9.0

8.0

7.0

6.0

5.0

4.0

3.0

2.0

18.0

17.0

16.0

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14.0

13.0

12.0

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18.0

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12.0

11.0

10.0

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8.0

7.0

6.0

5.0

4.0

3.0

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18.0

17.0

16.0

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14.0

13.0

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11.0

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8.0

7.0

6.0

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3.0

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4.0

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18.0

17.0

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18.0

17.0

16.0

15.0

14.0

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12.0

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9.0

8.0

7.0

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5.0

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3.0

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5.0

4.0

3.0

2.0

18.0

17.0

16.0

15.0

14.0

13.0

12.0

11.0

10.0

9.0

8.0

7.0

6.0

5.0

4.0

3.0

2.0

18.0

17.0

16.0

15.0

14.0

13.0

12.0

11.0

10.0

9.0

8.0

7.0

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5.0

4.0

3.0

2.0

18.0

17.0

16.0

15.0

14.0

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11.0

10.0

9.0

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6.0

5.0

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3.0

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18.0

17.0

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12.0

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9.0

8.0

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5.0

4.0

3.0

2.0

18.0

17.0

16.0

15.0

14.0

13.0

12.0

11.0

10.0

9.0

8.0

7.0

6.0

5.0

4.0

3.0

2.0

18.0

17.0

16.0

15.0

14.0

13.0

12.0

11.0

10.0

9.0

8.0

7.0

6.0

5.0

4.0

3.0

2.0

18.0

17.0

16.0

15.0

14.0

13.0

12.0

11.0

10.0

9.0

8.0

7.0

6.0

5.0

4.0

3.0

2.0

18.0

17.0

16.0

15.0

14.0

13.0

12.0

11.0

10.0

9.0

8.0

7.0

6.0

5.0

4.0

3.0

2.0

18.0

17.0

16.0

15.0

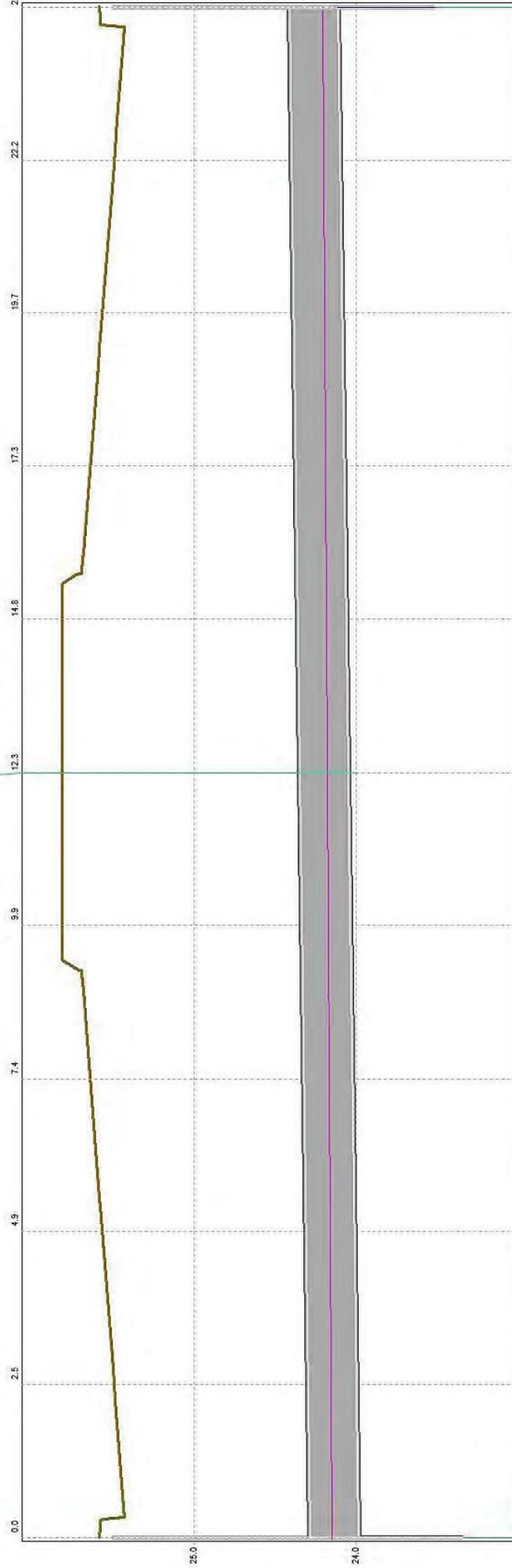
14.0

13.0

Link

Link205	
Storm	FLTW 20pct 1hr 9
Max Flow	0.010
Max Velocity	0.540
Diameter (Height)	0.300
Max Depth	0.161
Conduit Slope	0.503

Conduit Link205 from 06-152 to 01-155



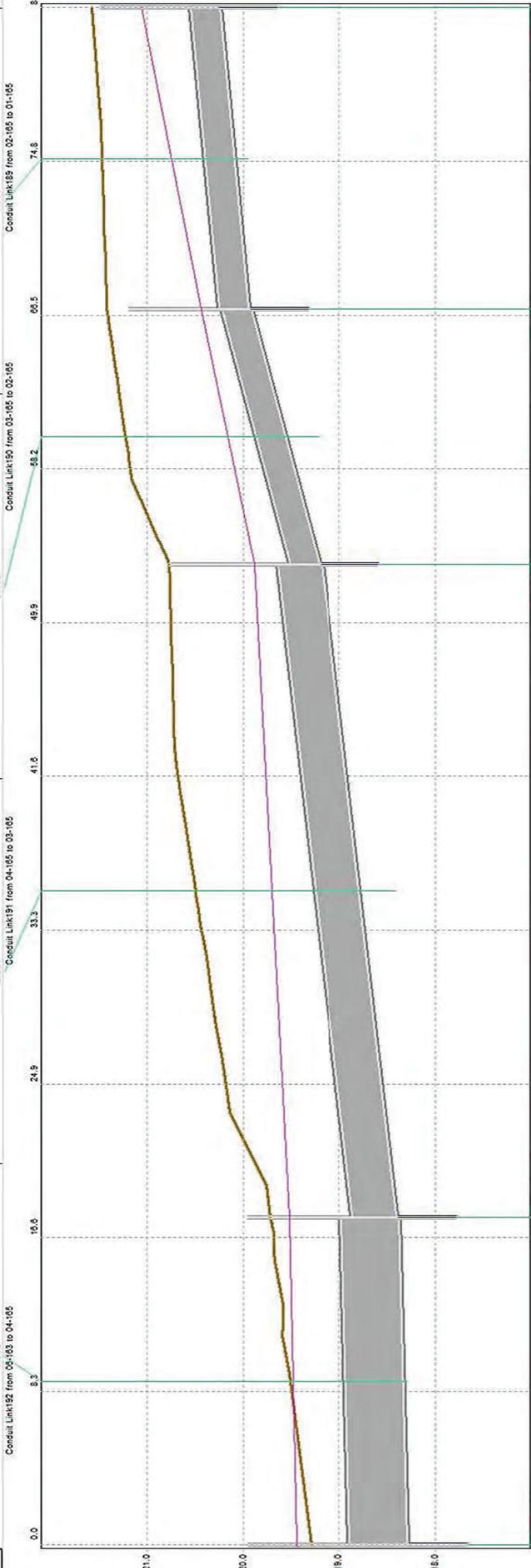
Storm

06-152		01-155	
Max Water Elevation	FLTW 20pct 1hr 9	24-150	24-206
Ground Elevation (Spill Crest)	25.505	25.505	25.504
Freeboard	1.360	1.300	1.300
Invert Elevation	23.344	23.344	23.513
Max Water Depth	0.806	0.806	0.693

Node Runoff

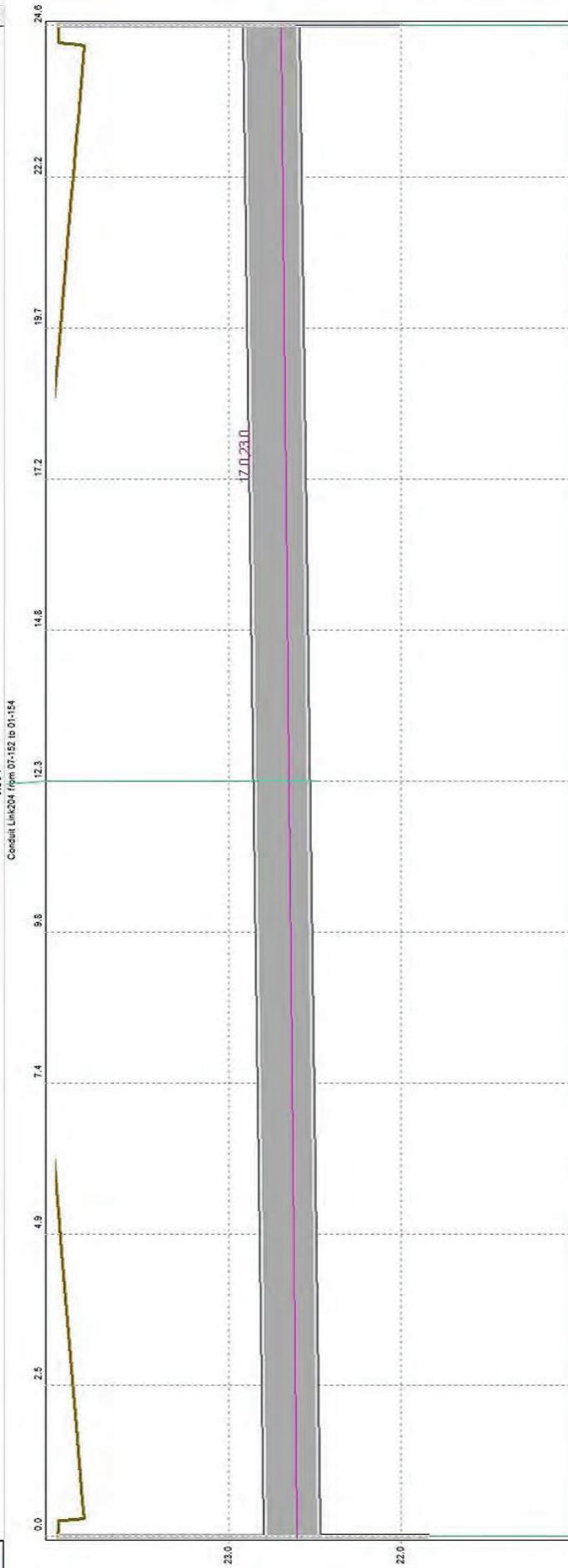
Link

Link	Link192	Link191	Link190	Link189
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Flow	0.210	0.207	0.154	0.151
Max Velocity	0.810	1.820	2.530	2.110
Diameter (Height)	0.600	0.450	0.300	0.300
Max Depth	1.155	1.116	0.665	0.809
Conduit Slope	0.502	2.221	5.105	1.777



Storm	05-163	04-165	03-165	02-165	01-165
Max Water Elevation	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Ground Elevation (Spill Crest)	19.442	19.321	19.884	20.429	21.044
Freeboard	19.950	19.964	20.774	21.197	21.488
Invert Elevation	0.510	0.440	0.890	0.770	0.440
Max Water Depth	17.660	17.779	18.593	19.328	19.648
Node	1.782	1.742	1.291	1.101	1.396
Runoff					

Link	Link204
Storm	FLTW_20pct_1hr_9
Max Flow	0.011
Max Velocity	0.580
Diameter (Height)	0.300
Max Depth	0.122
Conduit Slope	0.504



Storm	07-15Z	01-15Z
Max Water Elevation	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Ground Elevation (Spill Crest)	22.605	22.699
Freeboard	23.998	23.998
Invert Elevation	1.390	1.300
Max Water Depth	21.838	22.007
Node	0.767	0.692
Runoff		

Link

Link: 188

Storm

Max Flow

Max Velocity

Diameter (Height)

Max Depth

Conduit Slope

Link: 188

FLTW 20pct 1hr 9

0.070

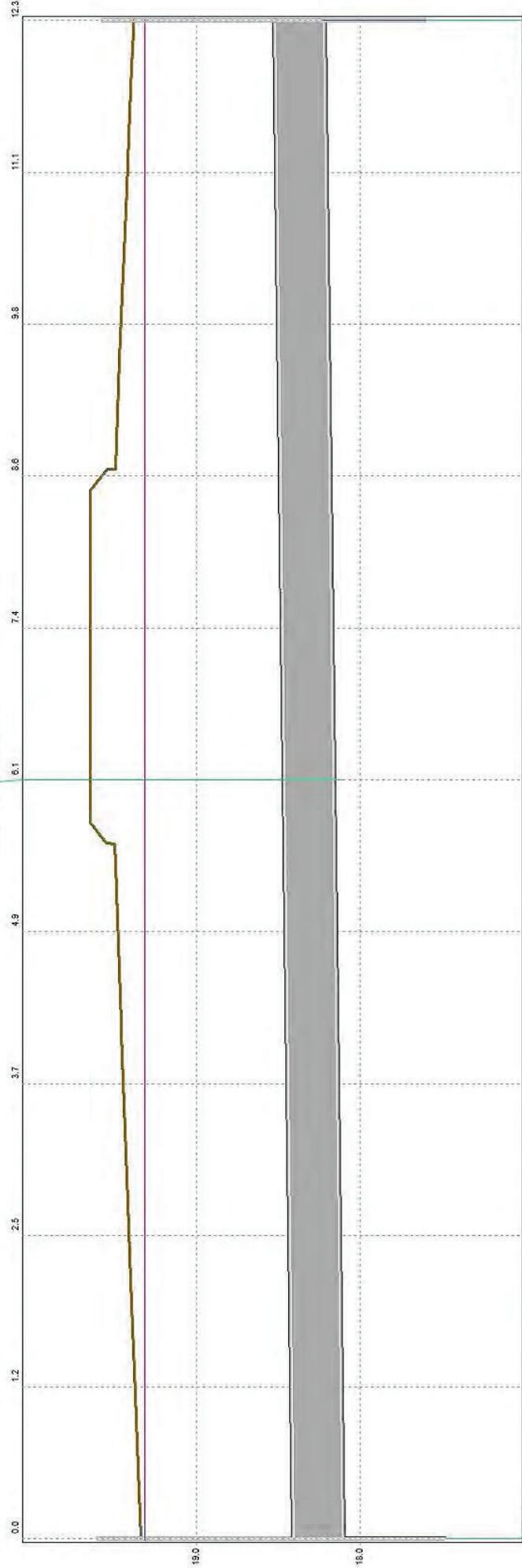
0.550

0.300

1.205

0.904

Conduit Link: 188 from 07-163 to 02-164



Storm

Max Water Elevation

Ground Elevation (Spill Crest)

Freeboard

Invert Elevation

Max Water Depth

Node

Runoff

07-163

FLTW 20pct 1hr 9

19.311

0.300

17.479

1.832

02-164

FLTW 20pct 1hr 9

19.315

0.270

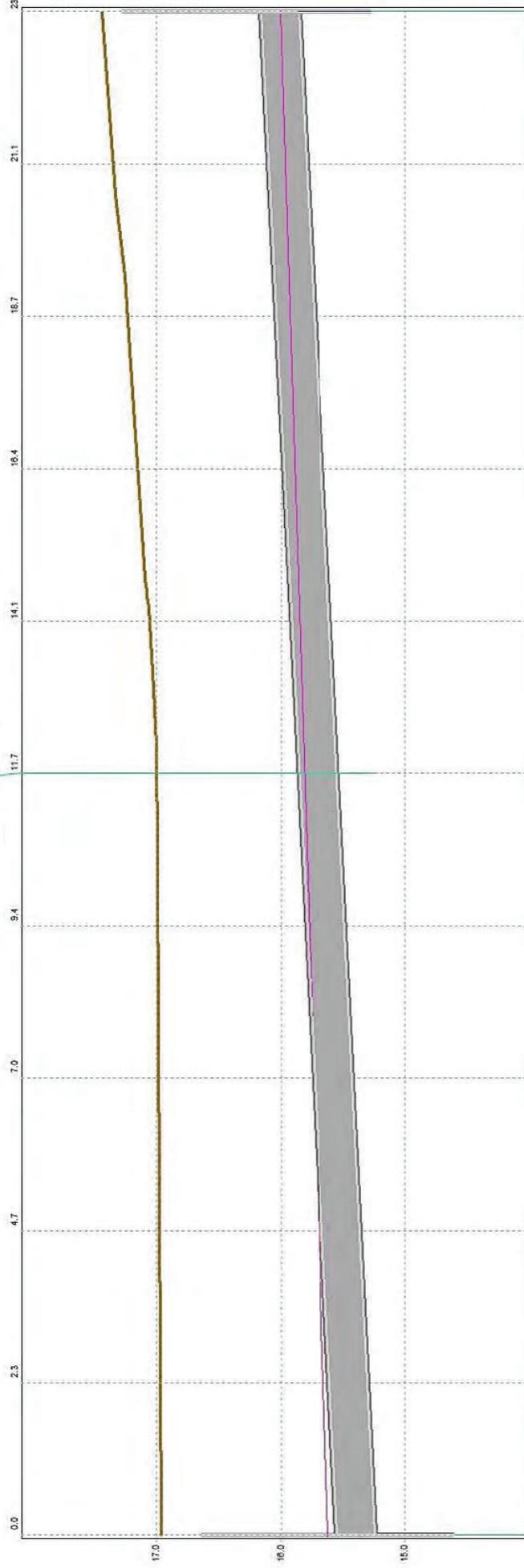
17.590

1.725

Link

Link148	
Storm	FLTW 20pct 1hr 1
Max Flow	0.047
Max Velocity	1.480
Diameter (Height)	0.300
Max Depth	0.375
Conduit Slope	2.055

Conduit Link148 from 01-170 to 03-174



Node

07-170		03-174	
Storm	FLTW 20pct 1hr 1	FLTW 20pct 1hr 1	FLTW 20pct 1hr 1
Max Water Elevation	15.619	16.007	16.007
Ground Elevation (Spill Crest)	16.648	17.280	17.280
Freeboard	1.030	1.270	1.270
Invert Elevation	14.618	15.270	15.270
Max Water Depth	1.001	0.737	0.737

Link

Link203

Storm

Max Flow

Max Velocity

Diameter (Height)

Max Depth

Conduit Slope

Link203

FLTW_20pct_1hr_9

0.013

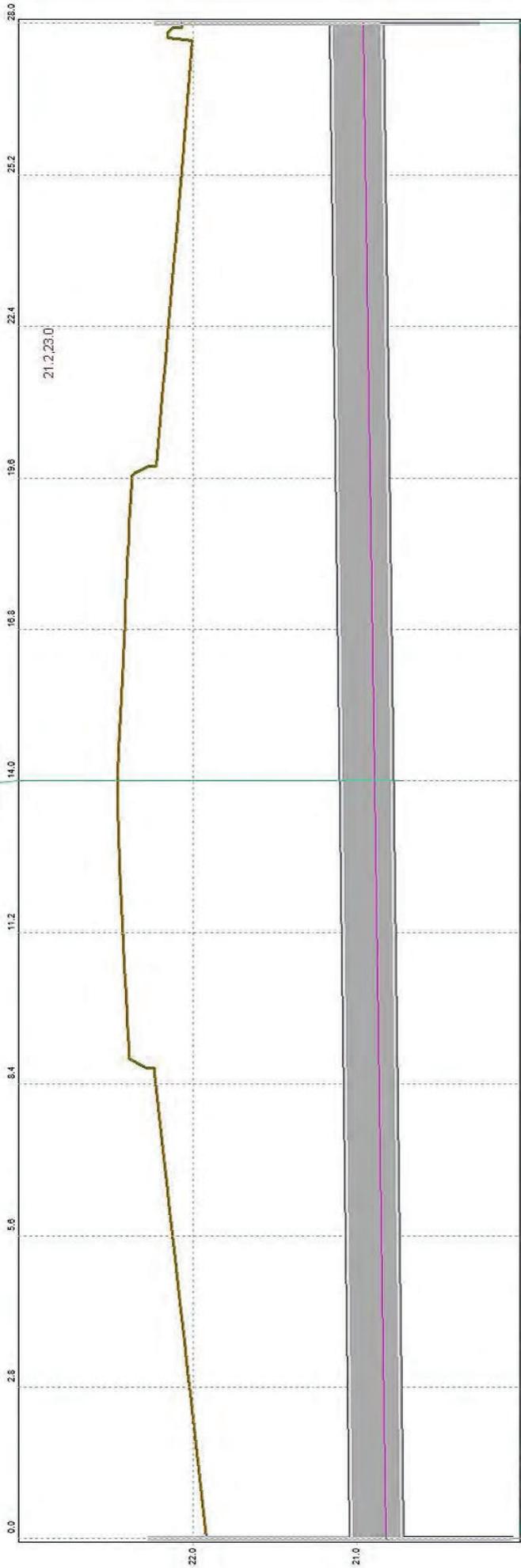
0.600

0.300

0.109

0.418

Conduit Link203 from 08-152 to 01-153



Storm

Max Water Elevation

Ground Elevation (Spill Crest)

Freeboard

Invert Elevation

Max Water Depth

Node

Runoff

08-152

FLTW_20pct_1hr_9

20.810

22.277

1.470

20.057

0.753

01-153

FLTW_20pct_1hr_9

20.958

22.234

1.280

20.249

0.709

Link

Link 146

Storm

Max Flow

Max Velocity

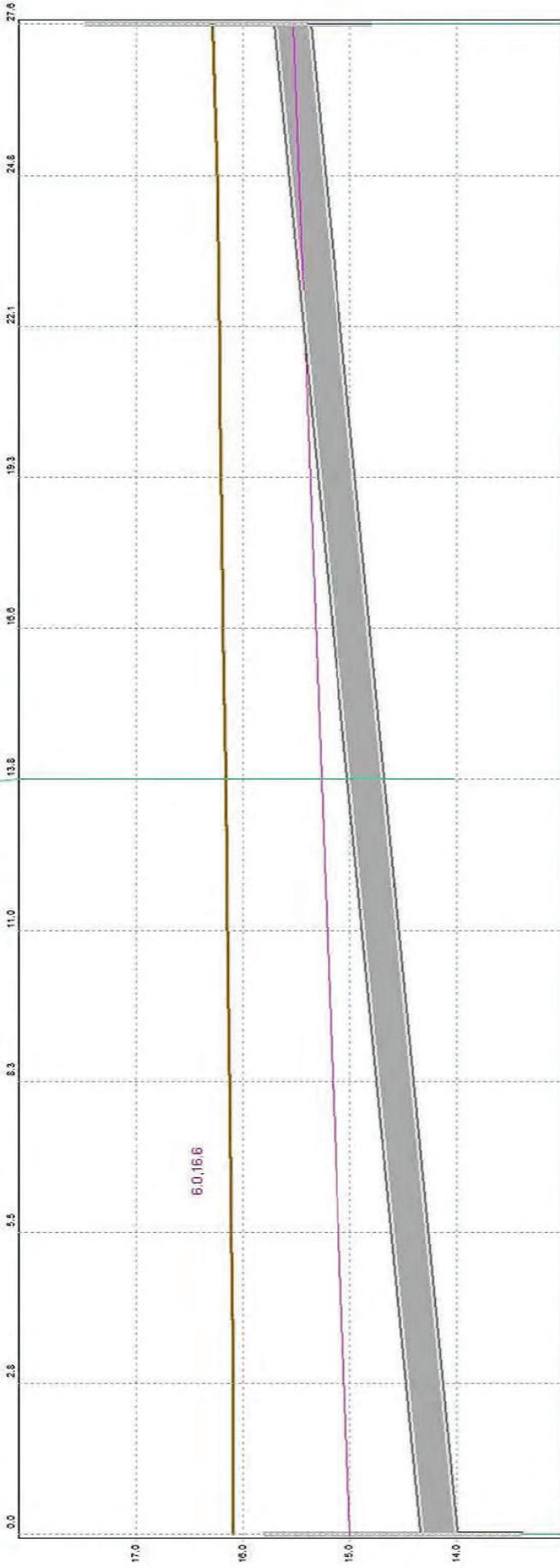
Diameter (Height)

Max Depth

Conduit Slope

Link 146
 FLTW 20oct_1hr_1
 0.062
 2.100
 0.300
 0.979
 -4.966

Conduit Link146 from 09-170 to 03-175



Storm

Max Water Elevation

Ground Elevation (Spill Crest)

Freeboard

Invert Elevation

Max Water Depth

Node

Runoff

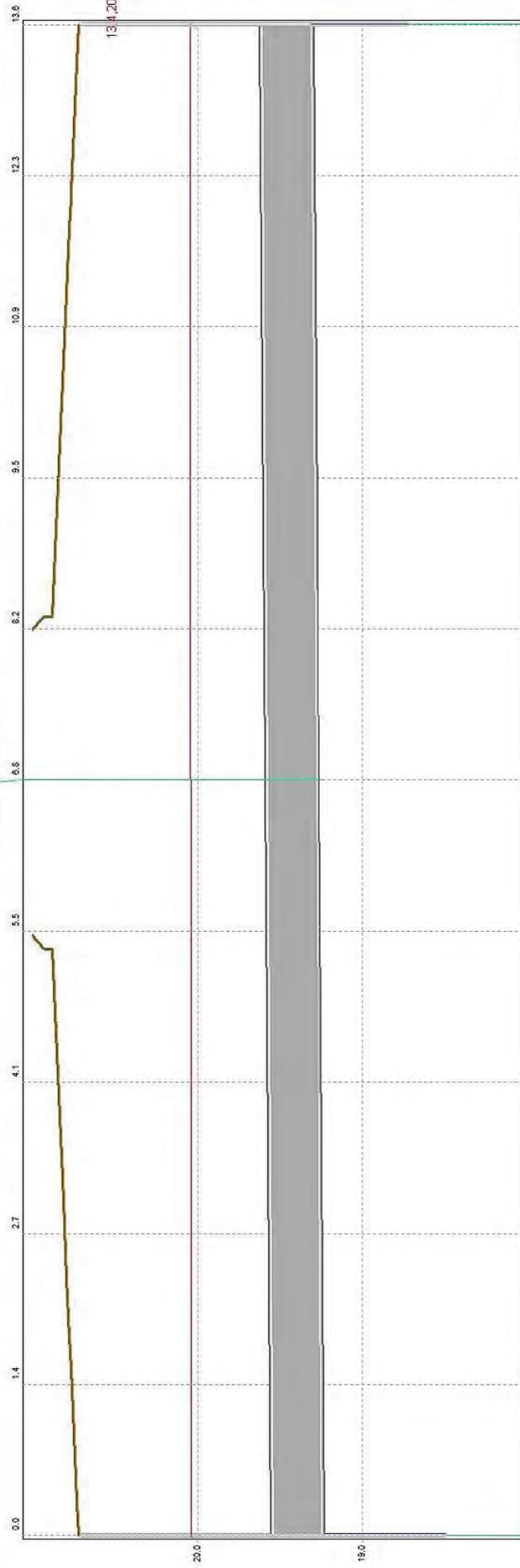
09-170
 FLTW 20oct_1hr_1
 14.996
 15.813
 0.820
 13.388
 1.608

03-175
 FLTW 20oct_1hr_1
 15.529
 17.490
 1.960
 14.788
 0.741

Link

Link198	
Storm	FLTW_20pct_1hr_9
Max Flow	0.006
Max Velocity	0.360
Diameter (Height)	0.300
Max Depth	0.795
Conduit Slope	0.499

Conduit Link198 from 10-152 to 01-159



Node

Node 198	
Storm	01-159
Max Water Elevation	FLTW_20pct_1hr_9
Ground Elevation (Spill Crest)	20.037
Freeboard	20.707
Invert Elevation	0.670
Max Water Depth	18.716
Runoff	1.321

Link

Link197

Storm

Max Flow

Max Velocity

Diameter (Height)

Max Depth

Conduit Slope

Link197

FLTW 20pct 1hr 9

0.006

0.350

0.300

0.845

0.501

Credit Link197 from 11-152 to 01-160

0.0

1.4

2.8

4.1

5.5

6.9

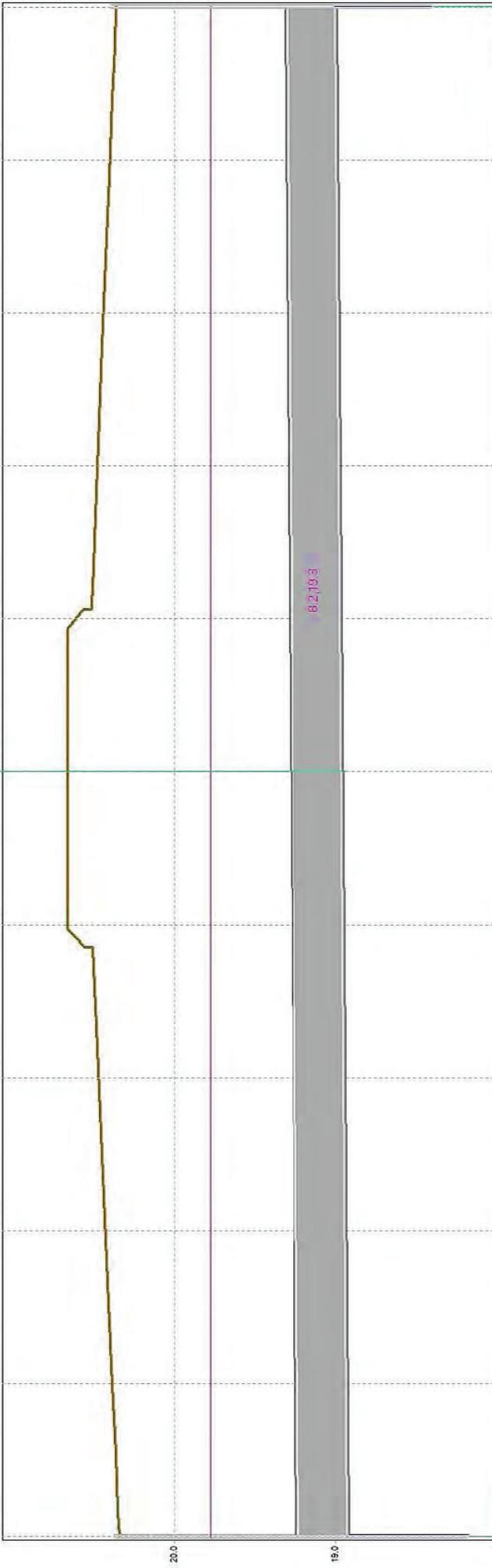
8.3

9.8

11.0

12.4

13.8



Storm

Max Water Elevation

Ground Elevation (Spill Crest)

Freeboard

Invert Elevation

Max Water Depth

11-152

FLTW 20pct 1hr 9

19.773

20.375

0.600

18.183

1.590

01-160

FLTW 20pct 1hr 9

19.774

20.394

0.620

18.402

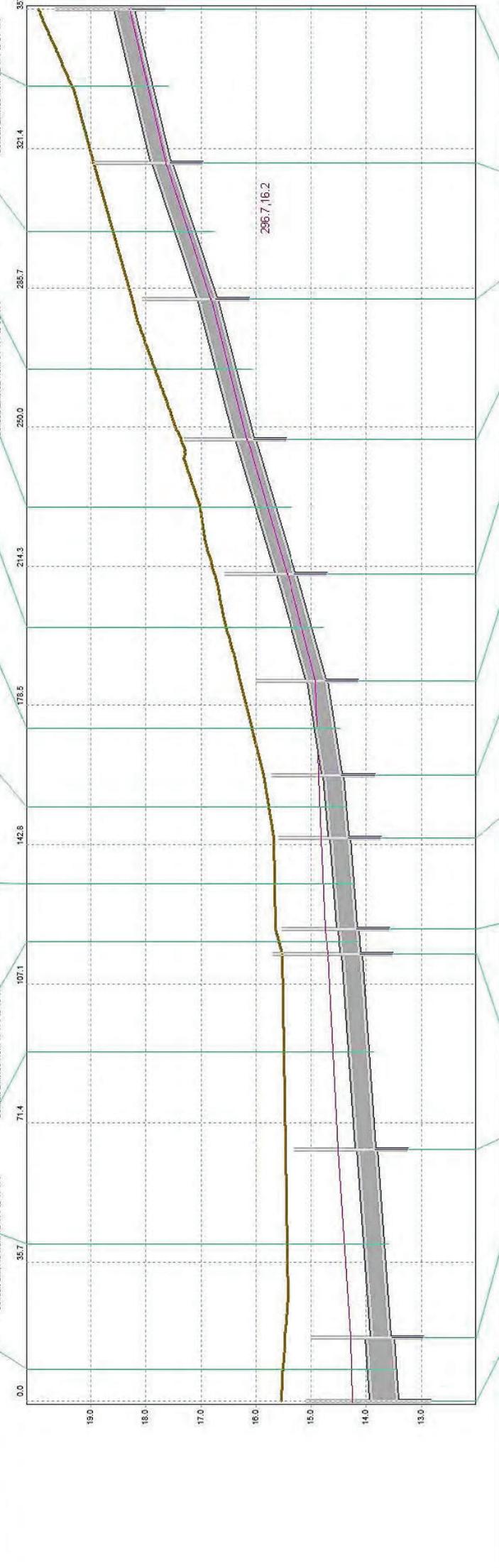
1.372

Node

Runoff

Link

	Link141	Link140	Link139	Link138	Link137	Link136	Link135	Link134	Link133	Link132	Link131	Link130
Storm	FLTW_20pct_1hr_1											
Max Flow	0.073	0.064	0.056	0.054	0.058	0.053	0.048	0.040	0.031	0.022	0.016	0.006
Max Velocity	0.510	0.930	0.900	0.810	0.890	0.890	1.180	1.500	1.430	1.260	1.250	0.810
Diameter (Height)	0.450	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
Max Depth	0.801	0.689	0.648	0.563	0.523	0.460	0.389	0.143	0.103	0.089	0.071	0.046
Conduit Slope	0.465	0.500	0.500	0.503	0.489	0.556	1.126	1.940	2.056	1.815	2.299	1.670



	11-170	12-171	11-171	10-171	09-171	08-171	07-171	06-171	05-171	04-171	03-171	02-171	01-171
Storm	FLTW_20pct_1hr_1												
Max Water Elevation	14.236	14.285	14.516	14.687	14.735	14.816	14.862	14.918	15.431	16.154	16.822	17.641	18.301
Ground Elevation (Spill Crest)	15.099	15.004	15.298	15.698	15.552	15.595	15.728	16.015	16.569	17.301	18.063	18.960	19.638
Freeboard	0.840	0.720	0.780	1.010	0.800	0.780	0.870	1.100	1.140	1.150	1.240	1.320	1.340
Invert Elevation	12.826	12.968	13.240	13.520	13.583	13.729	13.846	14.147	14.711	15.451	16.133	16.970	17.655
Max Water Depth	1.430	1.317	1.276	1.167	1.152	1.087	1.016	0.771	0.720	0.703	0.689	0.671	0.646

Node Runoff



APPENDIX E

Parkland Heights & Heritage Park Irrigation Schedule

(dated July 2019)
Prepared by LD TOTAL

PARKLAND HEIGHTS and HERITAGE PARK

IRRIGATION SCHEDULE

Current Licence 101.320kl
GWL 164680(10)

15th July 2019



7,500kl/ha/a	Pre Cal POS area m2	Irrigated turf area % Long-term	Total Irrigated Turf area (m ²) Long-term	Long-term Volume - Turf (kL/yr)	Irrigated Planting % Establishment (2yrs)	Total Irrigated Planting area (m2) - Long Term	Long-term Volume - Planting (kL/yr)	TOTAL VOLUME
	4,823							
PH POS A (under the CoR licence)								
PH POS B (under the CoR licence)	1,463							
PH POS C (under the CoR licence)	11,240							
PH POS D (under the CoR licence)	2,283							
PH POS E	5,681	as per current design	3,552	2,664	as per design	1,360	1,020	3,684
PH POS F (under the CoR licence)	57,736							
PH POS G	5,129	as per current design	4,452	3,339	as per design	1,090	818	4,157
PH POS H	2,747	as per current design	1,651	1,238	as per design	936	702	1,940
PH POS I	3,235	as per current design	2,043	1,532	as per design	935	701	2,234
PH POS J (Eighty Road)	5,317	as per current design			as per design	2,509	1,882	1,882
PH POS K	5,317	40.0%	2,127	1,595	40%	2,127	1,595	3,190
PH POS L	2,328	40.0%	931	698	40%	931	698	1,397
PH POS M	10,935	40.0%	4,374	3,281	40%	4,374	3,281	6,561
PH POS N	6,934	40.0%	2,774	2,080	40%	2,774	2,080	4,160
PH POS O	8,110	40.0%	3,244	2,433	40%	3,244	2,433	4,866
PH Streetscapes	2,000	50.0%	1,000	750	50%	1,000	750	1,500
PH School Site	20,000	100.0%	20,000	15,000	0%	0	0	15,000
HP POS 1 (under the CoR licence)								
HP POS 2 (under the CoR licence)								
HP POS 3 (under the CoR licence)								
HP POS 4 (under the CoR licence)								
HP POS 5 (upcoming for handover July 18)		as per current design						
HP P2 POS 1	22,283	40.0%	8,905	6,679	30%	6,679	5,009	11,688
HP Streetscape and Drainage	1,500	50.0%	750	563	50%	750	563	1,125
TOTALS FOR ESTATE								72,809

NOTES: ASSUMPTIONS + EXCLUSIONS:

The current GWL 164680(10) has an allocation of 101.320kl

80% irrigated areas has been assumed for the POS that have not been designed, this value is based on previous approved POS designs within the CoR

Pre cal areas do not include verge or streetscape sqm

This irrigation schedule does not include construction/dust suppression water management

The school site allocation is to be transferred to the Department of Education when construction of the school is due to commence



LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Rockingham Park Pty Ltd		
Description of Water Resource	Stakehill Perth - Superficial Swan	Annual Water Entitlement	101,320kL
Location of Water Source	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights LOT 954 ON PLAN 407830 - Lot 954 BALDIVIS - POS H - Parkland Heights		

Authorised Activities	Taking of water for	Location of Activity
	Dust suppression for earthworks and construction purposes	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights Lot 986 On Plan 202758 - Volume/Folio 2128/381 - Lot 986 Baldivis Rd Baldivis - Heritage Park Lot 993 On Plan 202758 - Volume/Folio 2125/382 - Lot 993 Baldivis Rd Baldivis - Heritage Park Road Reserve - PIN11754540 - Heritage Park
	Irrigation of up to 2ha ovals and playing fields	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights
	Irrigation of up to 5.8 ha of public open space	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights LOT 954 ON PLAN 407830 - Lot 954 BALDIVIS - POS H - Parkland Heights LOT 955 ON PLAN 407830 - Lot 955 BALDIVIS - POS I - Parkland Heights Lot 986 On Plan 202758 - Volume/Folio 2128/381 - Lot 986 Baldivis Rd Baldivis - Heritage Park Lot 993 On Plan 202758 - Volume/Folio 2125/382 - Lot 993 Baldivis Rd Baldivis - Heritage Park Road Reserve - PIN11754540 - Heritage Park
Duration of Licence	From 18 October 2018 to 4 February 2024	

This Licence is subject to the following terms, conditions and restrictions:

- The licensee shall not use water for sprinkler irrigation between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.
- Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.
- The volume of all water taken under this licence must be metered using an approved meter fitted to each drawpoint.
- The annual water year for water taken under this licence is defined as 1 January to 31 December.
- Unless otherwise approved by the Department of Water and Environmental Regulation, all meter readings must be recorded monthly via the Department of Water and Environmental Regulation's 'Water Online Portal' or on an approved Department of Water and Environmental Regulation 'Meter Water Use Card'. The meter readings must be reported via the 'Water Online Portal' or submitted via a completed 'Meter Water Use Card' to the Department of Water and Environmental Regulation every 12 Months, commencing 30/01/2019.

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000.



LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

This Licence is subject to the following terms, conditions and restrictions:

6. The licensee must ensure the installed meter(s) accuracy is maintained to within plus or minus 5% of the volume metered, in field conditions.
7. The licensee must notify the Department of Water and Environmental Regulation in writing of any water meter malfunction within seven days of the malfunction being noticed.
8. The licensee must obtain authorisation from the Department of Water and Environmental Regulation before removing, replacing or interfering with any meter required under this licence.

End of terms, conditions and restrictions

Appendix K
**Permeability assessment
of POS areas and median
strip**

Mortons Urban Solutions
Unit 4/100 Railway Road
SUBIACO WA 6008

Attention: Chris Le

**PERMEABILITY ASSESSMENT OF POS AREAS AND MEDIAN STRIP
PARKLANDS HEIGHTS PRIVATE ESTATE
BALDIVIS**

Dear Chris,

1. INTRODUCTION

This letter presents the outcomes of Galt Geotechnics (Galt's) permeability assessment of public open space (POS) areas and a median strip within the Parklands Heights Private Estate in Baldivis ("the site"). The location of the site relative to the surrounding area is shown on Figure 1, Site and Location Plan.

2. SITE DESCRIPTION

The assessed POS areas are designated K, L, M, N & E. The median strip is along Nairn Drive, extending north from Furnivall Parade. The configuration of the site is shown on the local structure plan presented in Attachment A and superimposed on a recent aerial photograph in Figure 1.

At the time of our investigation (5 & 7 May 2019), the site had been largely earthworked and a number of drainage basins were already formed in the POS areas. Photographs taken during the investigation are presented in Attachment B.

3. PERMEABILITY TESTING

Infiltration testing was conducted at 3 locations at each POS area and along the Nairn Drive median strip (total 18 tests), at a depth of about 0.9 m for each test. The testing was conducted using the inverse auger hole method described by Cocks¹. The locations of the tests are shown on Figure 1.

The subsurface soils at each site generally comprise:

- ☞ SAND (SP): fine to coarse grained, sub-rounded to sub-angular, typically yellow but also varying between grey-brown, grey-white grey and dark grey, trace fines.

The results of the infiltration testing are presented in Attachment C and a summary of the results is presented in Table 1

¹ Cocks, G (2007), "Disposal of Stormwater Runoff by Soakage in Perth Western Australia", Journal and News of the Australian Geomechanics Society, Volume 42 No. 3, pp 101-114

Table 1: Summary of Permeability Test Results

Location	Test Reference	Test Depth (m)	Minimum Unsaturated Permeability, k (m/day)		
			Test 1	Test 2	Test 3
POS K	K1	0.90	> 15	> 15	> 15
	K2	0.90	> 15	> 15	> 15
	K3	0.90	10.4	5.5	3.4
POS L	L1	0.95	> 15	> 15	> 15
	L2	0.89	6.3	3.7	2.6
	L3	0.85	12.1	>15	>15
POS M	M1	0.90	> 15	12.9	7.1
	M2	0.90	> 15	> 15	> 15
	M3	0.90	> 15	> 15	> 15
POS N	N1	0.90	> 15	> 15	> 15
	N2	0.90	> 15	> 15	> 15
	N3	0.90	> 15	> 15	> 15
POS E	E1	0.90	> 15	> 15	> 15
	E2	0.90	> 15	> 15	14.4
	E3	0.95	> 15	> 15	> 15
Nairn Drive median strip	IT1	0.95	> 15	> 15	> 15
	IT2	0.95	> 15	> 15	> 15
	IT3	0.95	> 15	> 15	> 15

Note: Permeabilities greater than 15 m/day are not reported due to the inaccuracies of the test method in highly permeable soils.

4. CLOSURE

We draw your attention to Attachment D of this letter report, "Understanding Your Report". The information provided within is intended to inform you as to what your realistic expectations of this report should be. This information is provided not to reduce the level of responsibility accepted by Galt, but to ensure that all parties who rely on this report are aware of the responsibilities each assumes in so doing.

GALT GEOTECHNICS PTY LTD



Harry Chambers

Geotechnical Engineer



Rick Piovesan CPEng

Geotechnical Engineer

- Attachments:
- Figure 1 – Site and Location Plan
 - A – Supplied Drawings
 - B – Photographs
 - C – Infiltration Test Results
 - D – Understanding Your Report

\\galtgeo.local\OsbornePark\Data\Jobs\2019\J1901164 - Bucky EV Parkland Heights Baldivis\03 Correspondence\J1901164 002 L Rev0.docx



Legend

- Site Boundary
- Infiltration Test



NOTES
Aerial imagery and Cadastre sourced from Landgate/SUP

SCALE	1:5,000 (A3)
DRAWN	CED
DATE DRAWN	9/08/2019
CHECKED	HWC
DATE CHECKED	9/08/2019
PROJECTION	GDA 1984 MGA Zone 50

Galt Geotechnics Pty Ltd
 ACN : 138 490 865
 Tel : +61 (0)8 8272-0200
 Address : 50 Edward Street
 Osborne Park WA 6017

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CLIENT	MORTONS URBAN SOLUTIONS
PROJECT	PERMEABILITY ASSESSMENT OF POSAREAS
LOCATION	PARKLANDS HEIGHTS PRIVATE ESTATE BALDIVIS
TITLE	SITE & LOCATION PLAN
Job No	J1901164
Fig No	FIGURE 1
Rev	A





ATTACHMENT A

Supplied Drawing

LEGEND

- ZONES/RESERVES**
- RESIDENTIAL R15
 - RESIDENTIAL R20
 - RESIDENTIAL R25
 - RESIDENTIAL R30
 - RESIDENTIAL R40
 - RESIDENTIAL R60
 - COMMERCIAL
 - SPECIAL USE
 - EDUCATION
 - PUBLIC OPEN SPACE

- OTHER**
- LOCAL STRUCTURE PLAN BOUNDARY
 - 400m NEIGHBOURHOOD WALKABLE CATCHMENT
 - PUMP STATION ODOUR BUFFER
 - POWERLINE EASEMENT
 - ROAD WIDENING (SKY EIGHT ROAD)
 - PLANNED BUS ROUTE
 - VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
 - SEWER PUMP STATION (900m² - 1220m²)

NOTES

- 1 The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
- 2 The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
- 3 POS Areas are indicative only and subject to further detailed design and drainage considerations.
- 4 All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-call and final survey and may vary from figures shown.
- 5 Baseline attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS2959 - Construction in Bushfire Prone Areas.
- 6 Sky-Eight Road widening to accommodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.



Scale: 1:5000 @ A3

0 60 120 180m

PLANS: RHP42-2001 REVISION: DRAWING: P
 DATE: 20/11/2018 PROJECTION: PCS 84 PLANNERS: BK
 DRAUGHTSMAN: AHD CHECKER: TV

Creative
 DESIGN & PLANNING

A 28 Brown Street, East Perth WA 6004
 P (08) 9325 0200
 E info@creativetp.com.au
 W creativetp.com.au

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LOCAL STRUCTURE PLAN MAP

Lot 1507 Eighty Road, BALDIMS

A Rockingham Park Project



ATTACHMENT B

Photographs



Photograph 1: Looking south overlooking POS M basin



Photograph 2: Looking west within POS N basin



Photograph 3: Looking south across POS K



Photograph 4: Looking east across POS K



Photograph 5: Looking north within POS E basin



Photograph 6: Looking south along Nairn Drive median strip



Photograph 7: Looking south from POS L location



Photograph 8: General view of the estate looking south

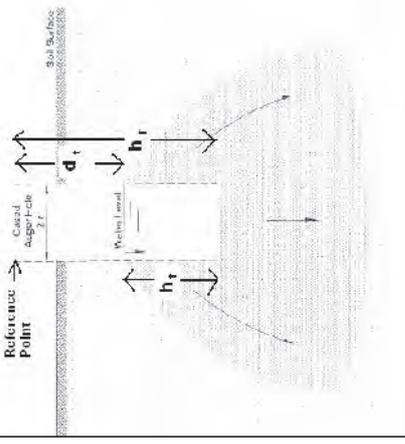


ATTACHMENT C

Infiltration Test Results

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09
Job No:	J1901164		
Client:	Mortons.U.S		
Project:	Parkland Heights		
Location:	Baldivis		
Calc by:	HWC		
BH Name:	E1		
Test Depth:	0.90		m



REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

$$K = 1.15r \frac{1}{t - t_0} \log_{10} \left(h_0 + \frac{1}{2}r \right) - \log_{10} \left(h_t + \frac{1}{2}r \right)$$

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	1	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m

Spreadsheet Legend

Required input
Calculated field
Comment field
Field not used
Fixed field

Test 1

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.77	0.23		
20	0.96	0.04	1.6E-03	135.6
40	1	0	1.4E-03	117.4
AVERAGE			1.5E-03	126.5

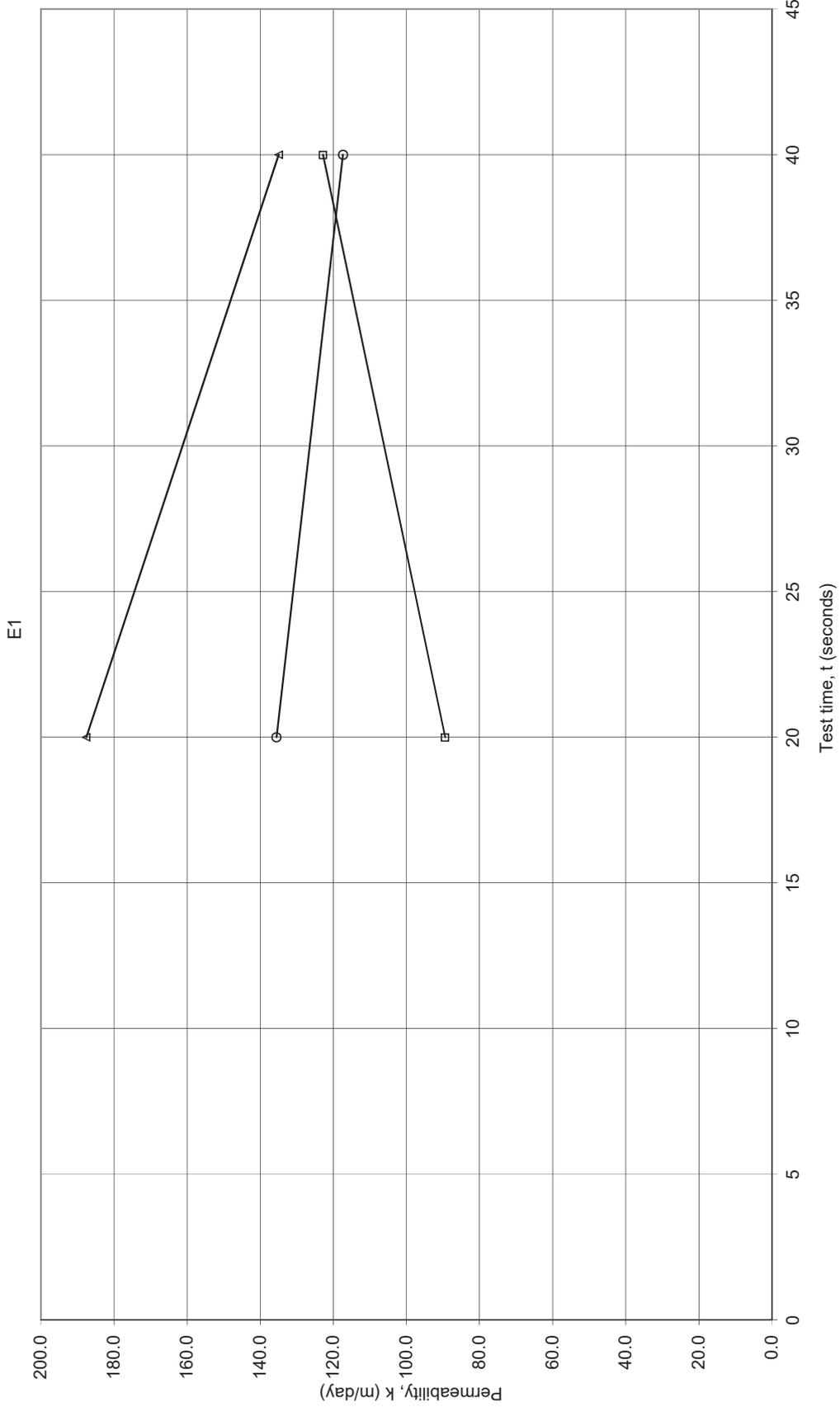
Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.74	0.26		
20	0.91	0.09	1.0E-03	89.4
40	1	0	1.4E-03	122.8
AVERAGE			1.2E-03	106.1

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.66	0.34		
20	0.97	0.03	2.2E-03	187.6
40	1	0	1.6E-03	134.9
AVERAGE			1.9E-03	161.3

Permeability by Inverse Auger Hole Method

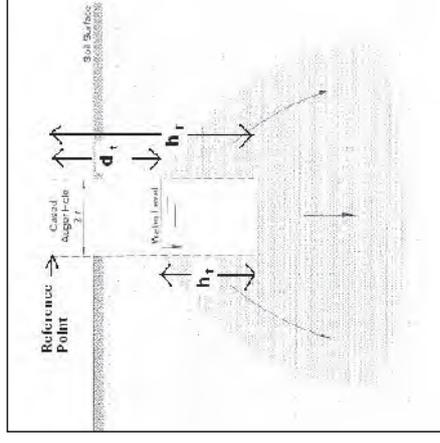


Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09
Job No:	J1901164		
Client:	Mortons.U.S		
Project:	Parkland Heights		
Location:	Baldivis		
Calc by:	HWC		
BH Name:	E2		
Test Depth:	0.90	m	
Spreadsheet Legend			
	Required input		
	Calculated field		
	Comment field		
	Field not used		
	Fixed field		
Parameter Description		Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h _r	reference point height above base	1	m
d _t	depth from reference point to water at time t		m
h _t	Water column height at time t		m
h ₀	h _t at t=0		m

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

$$K = 1.15r \frac{1}{t - t_0} \log_{10} \left(h_0 + \frac{1}{2}r \right) - \log_{10} \left(h_t + \frac{1}{2}r \right)$$



Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.72	0.28		
20	0.84	0.16	5.7E-04	49.1
40	0.91	0.09	5.6E-04	48.0
60	0.95	0.05	5.4E-04	46.2
80	1	0	7.3E-04	63.1
AVERAGE			6.0E-04	51.6

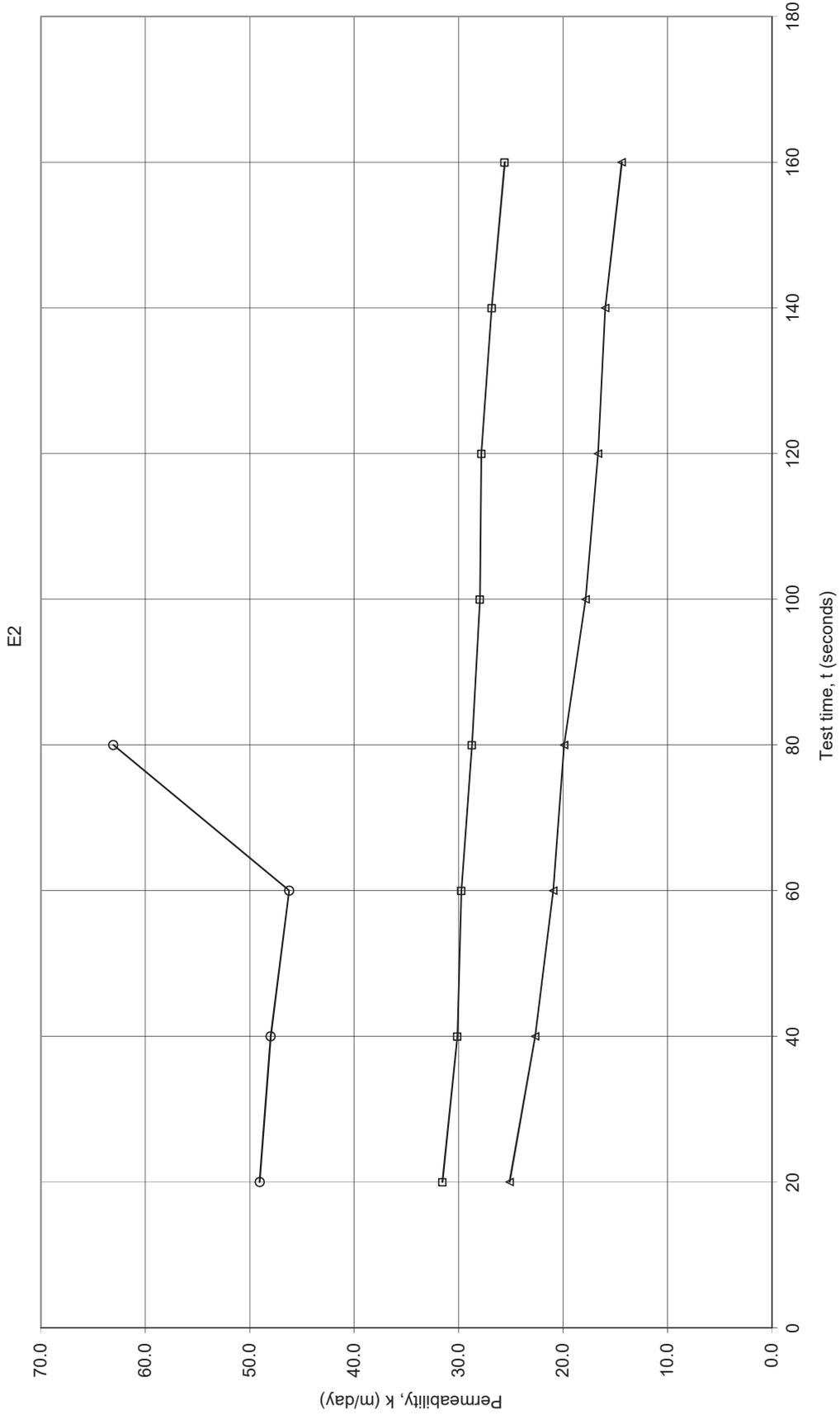
Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.59	0.41		
20	0.71	0.29	3.7E-04	31.6
40	0.79	0.21	3.5E-04	30.1
60	0.85	0.15	3.4E-04	29.7
80	0.89	0.11	3.3E-04	28.7
100	0.92	0.08	3.2E-04	28.0
120	0.945	0.055	3.2E-04	27.8
140	0.96	0.04	3.1E-04	26.8
160	0.97	0.03	3.0E-04	25.6
AVERAGE			3.3E-04	28.5

Test 3

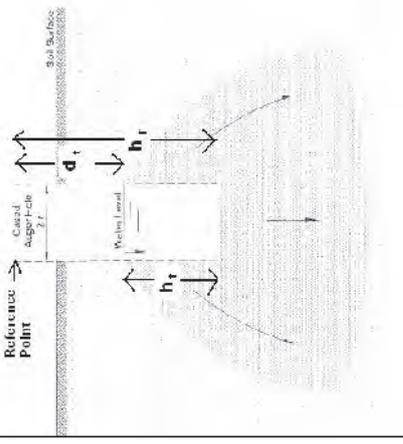
t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.54	0.46		
20	0.65	0.35	2.9E-04	25.1
40	0.72	0.28	2.6E-04	22.7
60	0.77	0.23	2.4E-04	21.0
80	0.81	0.19	2.3E-04	19.9
100	0.83	0.17	2.1E-04	17.8
120	0.85	0.15	1.9E-04	16.6
140	0.87	0.13	1.8E-04	16.0
160	0.875	0.125	1.7E-04	14.4
AVERAGE			2.2E-04	19.2

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09
Job No:	J1901164		
Client:	Mortons.U.S		
Project:	Parkland Heights		
Location:	Baldivis		
Calc by:	HWC		
BH Name:	E3		
Test Depth:	0.95 m		
Spreadsheet Legend			
Required input			
Calculated field			
Comment field			
Field not used			
Fixed field			



REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

$$K = 1.15r \frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h _r	reference point height above base	0.95	m
d _t	depth from reference point to water at time t		m
h _t	Water column height at time t		m
h ₀	h _t at t=0		m

Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.61	0.34		
20	0.83	0.12	1.0E-03	90.7
40	0.935	0.015	1.3E-03	110.1
AVERAGE			1.2E-03	100.4

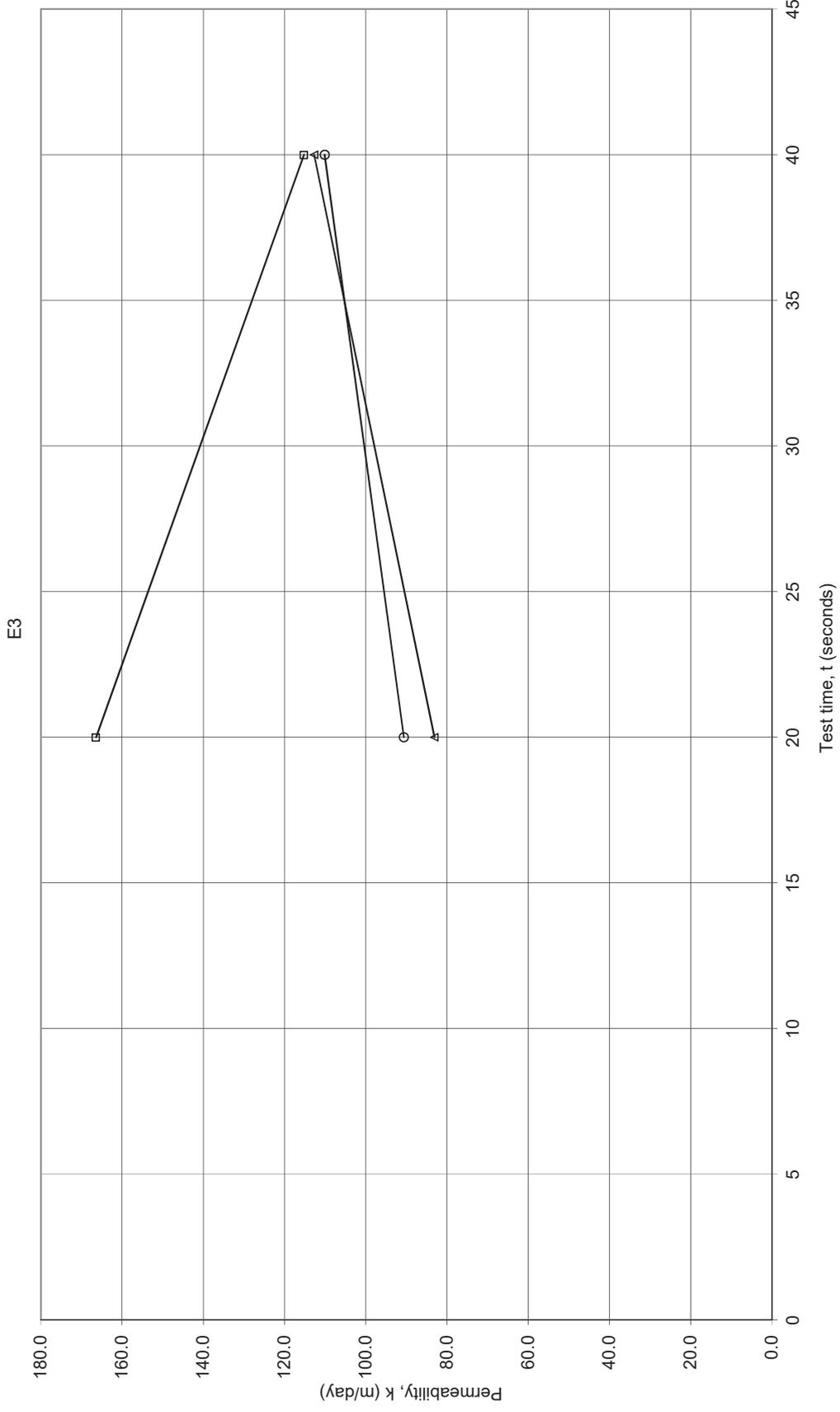
Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.57	0.38		
20	0.9	0.05	1.9E-03	166.4
40	0.935	0.015	1.3E-03	115.2
AVERAGE			1.6E-03	140.8

Test 3

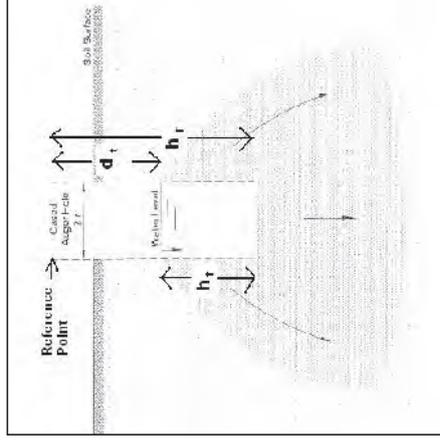
t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.59	0.36		
20	0.81	0.14	9.6E-04	83.1
40	0.935	0.015	1.3E-03	112.7
AVERAGE			1.1E-03	97.9

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author:	ORW	17-Oct-09
Job No:	J1901164	REFERENCE: Cocks, G. <i>Disposal of Stormwater Runoff by Soakage in Perth Western Australia</i> , Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114		
Client:	Mortons.U.S			
Project:	Parkland Heights			
Location:	Baldivis			
Calc by:	HWC			
BH Name:	K1			
Test Depth:	0.90 m			
Spreadsheet Legend				
Required input		Value	Units	
Calculated field		0.045	m/s	
Comment field			s	
Field not used			1 m	
Fixed field			m	
			m	
			m	



$$K = 1.15r \frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h _r	reference point height above base	1	m
d _t	depth from reference point to water at time t		m
h _t	Water column height at time t		m
h ₀	h _t at t=0		m

Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.52	0.48	4.0E-04	34.4
20	0.67	0.33	3.4E-04	29.7
40	0.75	0.25	2.9E-04	24.9
60	0.79	0.21	2.7E-04	23.3
80	0.83	0.17	2.5E-04	21.9
100	0.86	0.14	2.5E-04	21.6
120	0.89	0.11	2.4E-04	20.8
140	0.91	0.09	2.5E-04	21.9
160	0.94	0.06		
AVERAGE			2.9E-04	24.8

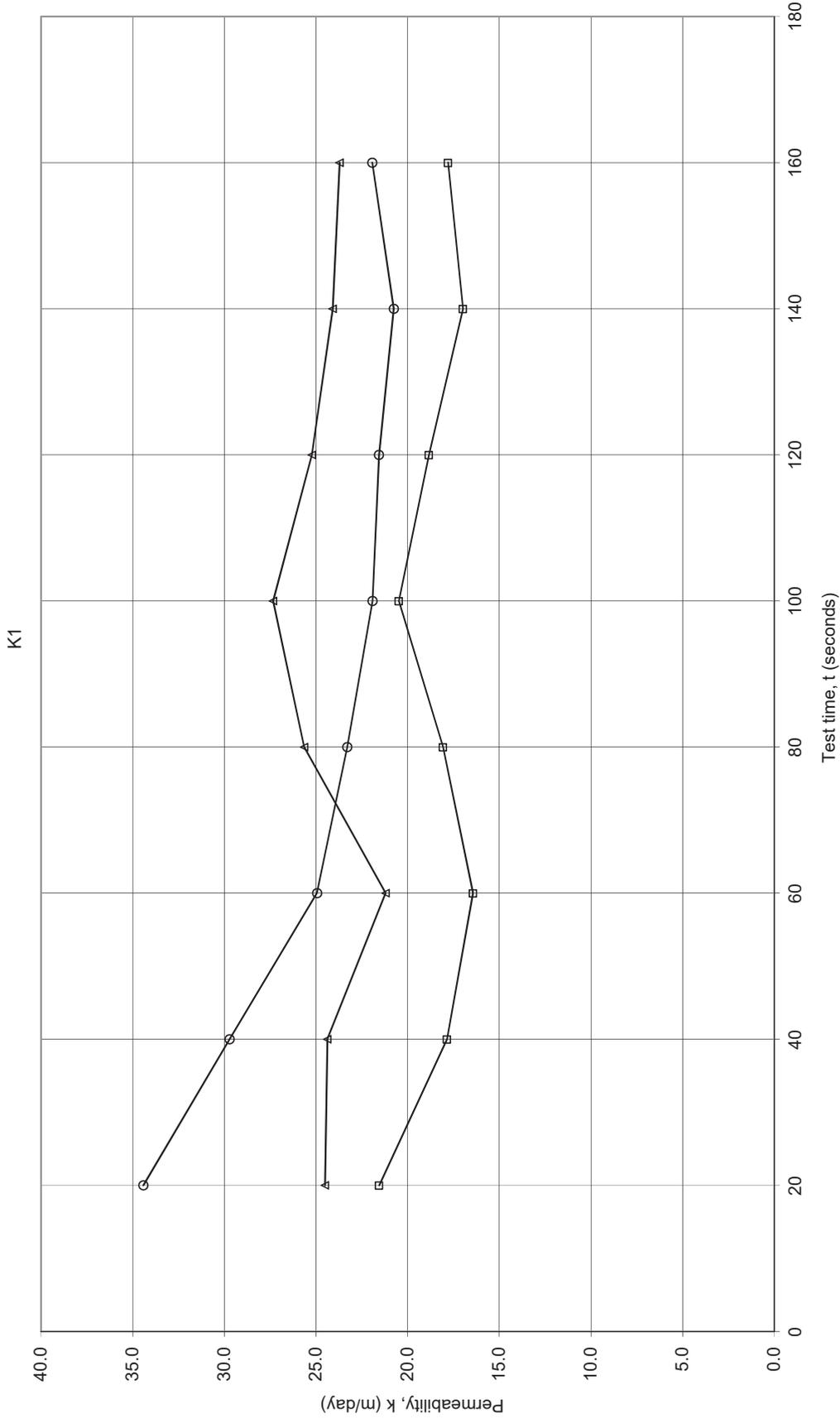
Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.47	0.53	2.5E-04	21.6
20	0.58	0.42	2.1E-04	17.9
40	0.64	0.36	1.9E-04	16.4
60	0.69	0.31	2.1E-04	18.1
80	0.76	0.24	2.4E-04	20.5
100	0.83	0.17	2.2E-04	18.8
120	0.85	0.15	2.0E-04	17.0
140	0.86	0.14		
160	0.895	0.105		
AVERAGE			2.1E-04	18.5

Test 3

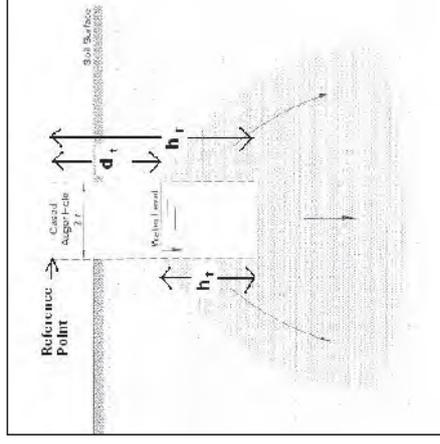
t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.44	0.56	2.8E-04	24.5
20	0.57	0.43	2.8E-04	24.4
40	0.67	0.33	2.5E-04	21.2
60	0.72	0.28	3.0E-04	25.6
80	0.82	0.18	3.2E-04	27.3
100	0.88	0.12	2.9E-04	25.2
120	0.9	0.1	2.8E-04	24.1
140	0.92	0.08		
160	0.94	0.06		
AVERAGE			2.8E-04	24.5

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author:	ORW	17-Oct-09
Job No:	J1901164	REFERENCE: Cocks, G. <i>Disposal of Stormwater Runoff by Soakage in Perth Western Australia</i> , Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114		
Client:	Mortons.U.S			
Project:	Parkland Heights			
Location:	Baldivis			
Calc by:	HWC			
BH Name:	K2			
Test Depth:	0.90 m			
Spreadsheet Legend				
Required input		Value	Units	
Calculated field		0.045	m	
Comment field			s	
Field not used			1 m	
Fixed field			m	
			m	
			m	



Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.58	0.42	4.7E-04	40.2
20	0.73	0.27	3.6E-04	31.2
40	0.79	0.21	3.3E-04	28.7
60	0.84	0.16	3.8E-04	33.2
80	0.91	0.09	3.8E-04	32.6
100	0.94	0.06	3.3E-04	28.2
120	0.945	0.055	2.8E-04	24.2
140	0.945	0.055	3.0E-04	25.9
160	0.97	0.03		
AVERAGE				30.5

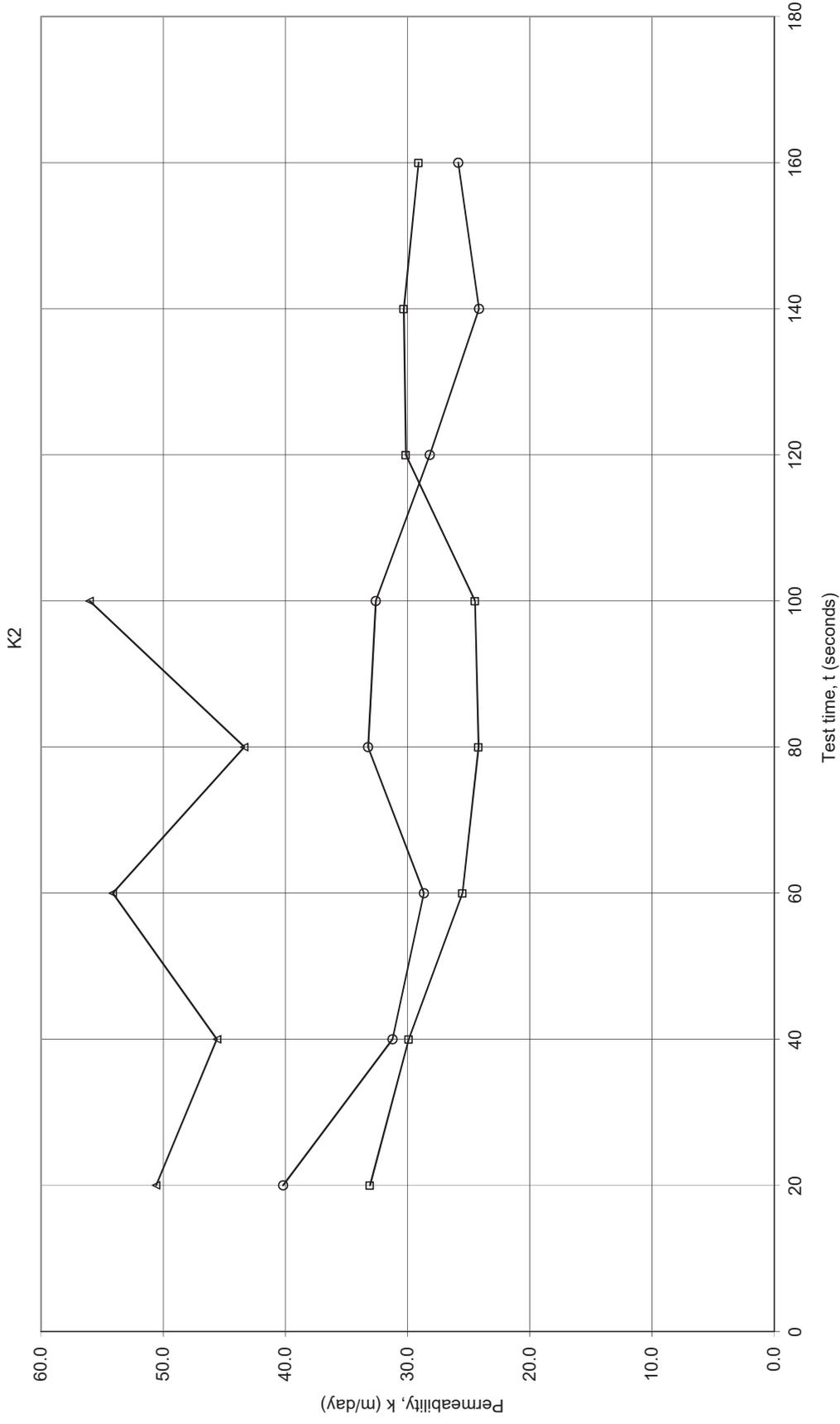
Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.555	0.445	3.8E-04	33.1
20	0.69	0.31	3.5E-04	29.9
40	0.77	0.23	3.0E-04	25.5
60	0.81	0.19	2.8E-04	24.2
80	0.85	0.15	2.8E-04	24.5
100	0.89	0.11	3.5E-04	30.2
120	0.95	0.05	3.5E-04	30.3
140	0.97	0.03		
160	0.98	0.02		
AVERAGE				28.3

Test 3

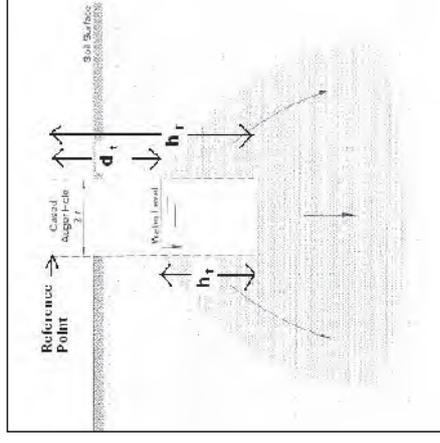
t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.53	0.47	5.9E-04	50.6
20	0.73	0.27	5.3E-04	45.6
40	0.83	0.17	6.3E-04	54.1
60	0.93	0.07	5.0E-04	43.4
80	0.94	0.06	6.5E-04	56.0
100	0.995	0.005		
AVERAGE				49.9

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09																																	
Job No: J1901164	REFERENCE: Cocks, G. <i>Disposal of Stormwater Runoff by Soakage in Perth Western Australia</i> , Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114																																			
Client: Mortons.U.S	$K = 1.15r \frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$																																			
Project: Parkland Heights	<table border="1"> <thead> <tr> <th>Parameter</th> <th>Description</th> <th>Value</th> <th>Units</th> </tr> </thead> <tbody> <tr> <td>K</td> <td>Permeability</td> <td></td> <td>m/s</td> </tr> <tr> <td>r</td> <td>radius of test hole</td> <td>0.045</td> <td>m</td> </tr> <tr> <td>t</td> <td>time since start of measurement</td> <td></td> <td>s</td> </tr> <tr> <td>h_r</td> <td>reference point height above base</td> <td>1</td> <td>m</td> </tr> <tr> <td>d_t</td> <td>depth from reference point to water at time t</td> <td></td> <td>m</td> </tr> <tr> <td>h_t</td> <td>Water column height at time t</td> <td></td> <td>m</td> </tr> <tr> <td>h₀</td> <td>h_t at t=0</td> <td></td> <td>m</td> </tr> </tbody> </table>			Parameter	Description	Value	Units	K	Permeability		m/s	r	radius of test hole	0.045	m	t	time since start of measurement		s	h _r	reference point height above base	1	m	d _t	depth from reference point to water at time t		m	h _t	Water column height at time t		m	h ₀	h _t at t=0		m	
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Location: Baldiivis	<table border="1"> <thead> <tr> <th>Spreadsheet Legend</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>Required input</td> <td></td> </tr> <tr> <td>Calculated field</td> <td></td> </tr> <tr> <td>Comment field</td> <td></td> </tr> <tr> <td>Field not used</td> <td></td> </tr> <tr> <td>Fixed field</td> <td></td> </tr> </tbody> </table>			Spreadsheet Legend	Value	Required input		Calculated field		Comment field		Field not used		Fixed field																						
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Test 1	Test 2	Test 3																																		
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60	60	60																																		
80	80	80																																		
100	100	100																																		
120	120	120																																		
140	140	140																																		
160	160	160																																		
AVERAGE	AVERAGE	AVERAGE																																		
BH Name: K3	<table border="1"> <thead> <tr> <th>K (m/s)</th> <th>K (m/day)</th> </tr> </thead> <tbody> <tr> <td>1.9E-04</td> <td>16.8</td> </tr> <tr> <td>1.2E-04</td> <td>10.8</td> </tr> <tr> <td>1.7E-04</td> <td>14.4</td> </tr> <tr> <td>1.6E-04</td> <td>13.6</td> </tr> <tr> <td>1.5E-04</td> <td>13.0</td> </tr> <tr> <td>1.4E-04</td> <td>12.1</td> </tr> <tr> <td>1.3E-04</td> <td>11.0</td> </tr> <tr> <td>1.2E-04</td> <td>10.4</td> </tr> <tr> <td>AVERAGE</td> <td>12.8</td> </tr> </tbody> </table>			K (m/s)	K (m/day)	1.9E-04	16.8	1.2E-04	10.8	1.7E-04	14.4	1.6E-04	13.6	1.5E-04	13.0	1.4E-04	12.1	1.3E-04	11.0	1.2E-04	10.4	AVERAGE	12.8													
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1.2E-04	10.4																																			
AVERAGE	12.8																																			
Test Depth: 0.90 m	<table border="1"> <thead> <tr> <th>h_t (m)</th> <th>h_t (m)</th> <th>h_t (m)</th> </tr> </thead> <tbody> <tr> <td>0.48</td> <td>0.6</td> <td>0.68</td> </tr> <tr> <td>0.4</td> <td>0.545</td> <td>0.65</td> </tr> <tr> <td>0.38</td> <td>0.505</td> <td>0.63</td> </tr> <tr> <td>0.3</td> <td>0.47</td> <td>0.605</td> </tr> <tr> <td>0.265</td> <td>0.45</td> <td>0.585</td> </tr> <tr> <td>0.235</td> <td>0.44</td> <td>0.56</td> </tr> <tr> <td>0.215</td> <td>0.42</td> <td>0.54</td> </tr> <tr> <td>0.205</td> <td>0.39</td> <td>0.525</td> </tr> <tr> <td>0.19</td> <td>0.37</td> <td>0.51</td> </tr> <tr> <td>AVERAGE</td> <td>7.8E-05</td> <td>4.2E-05</td> </tr> </tbody> </table>			h _t (m)	h _t (m)	h _t (m)	0.48	0.6	0.68	0.4	0.545	0.65	0.38	0.505	0.63	0.3	0.47	0.605	0.265	0.45	0.585	0.235	0.44	0.56	0.215	0.42	0.54	0.205	0.39	0.525	0.19	0.37	0.51	AVERAGE	7.8E-05	4.2E-05
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0.19	0.37	0.51																																		
AVERAGE	7.8E-05	4.2E-05																																		
Spreadsheet author: ORW	<table border="1"> <thead> <tr> <th>d_w (m)</th> <th>d_w (m)</th> <th>d_w (m)</th> </tr> </thead> <tbody> <tr> <td>0.52</td> <td>0.4</td> <td>0.32</td> </tr> <tr> <td>0.6</td> <td>0.455</td> <td>0.35</td> </tr> <tr> <td>0.62</td> <td>0.495</td> <td>0.37</td> </tr> <tr> <td>0.7</td> <td>0.53</td> <td>0.395</td> </tr> <tr> <td>0.735</td> <td>0.55</td> <td>0.415</td> </tr> <tr> <td>0.765</td> <td>0.56</td> <td>0.44</td> </tr> <tr> <td>0.785</td> <td>0.58</td> <td>0.46</td> </tr> <tr> <td>0.795</td> <td>0.61</td> <td>0.475</td> </tr> <tr> <td>0.81</td> <td>0.63</td> <td>0.49</td> </tr> <tr> <td>AVERAGE</td> <td>1.5E-04</td> <td>4.2E-05</td> </tr> </tbody> </table>			d _w (m)	d _w (m)	d _w (m)	0.52	0.4	0.32	0.6	0.455	0.35	0.62	0.495	0.37	0.7	0.53	0.395	0.735	0.55	0.415	0.765	0.56	0.44	0.785	0.58	0.46	0.795	0.61	0.475	0.81	0.63	0.49	AVERAGE	1.5E-04	4.2E-05
d _w (m)	d _w (m)	d _w (m)																																		
0.52	0.4	0.32																																		
0.6	0.455	0.35																																		
0.62	0.495	0.37																																		
0.7	0.53	0.395																																		
0.735	0.55	0.415																																		
0.765	0.56	0.44																																		
0.785	0.58	0.46																																		
0.795	0.61	0.475																																		
0.81	0.63	0.49																																		
AVERAGE	1.5E-04	4.2E-05																																		

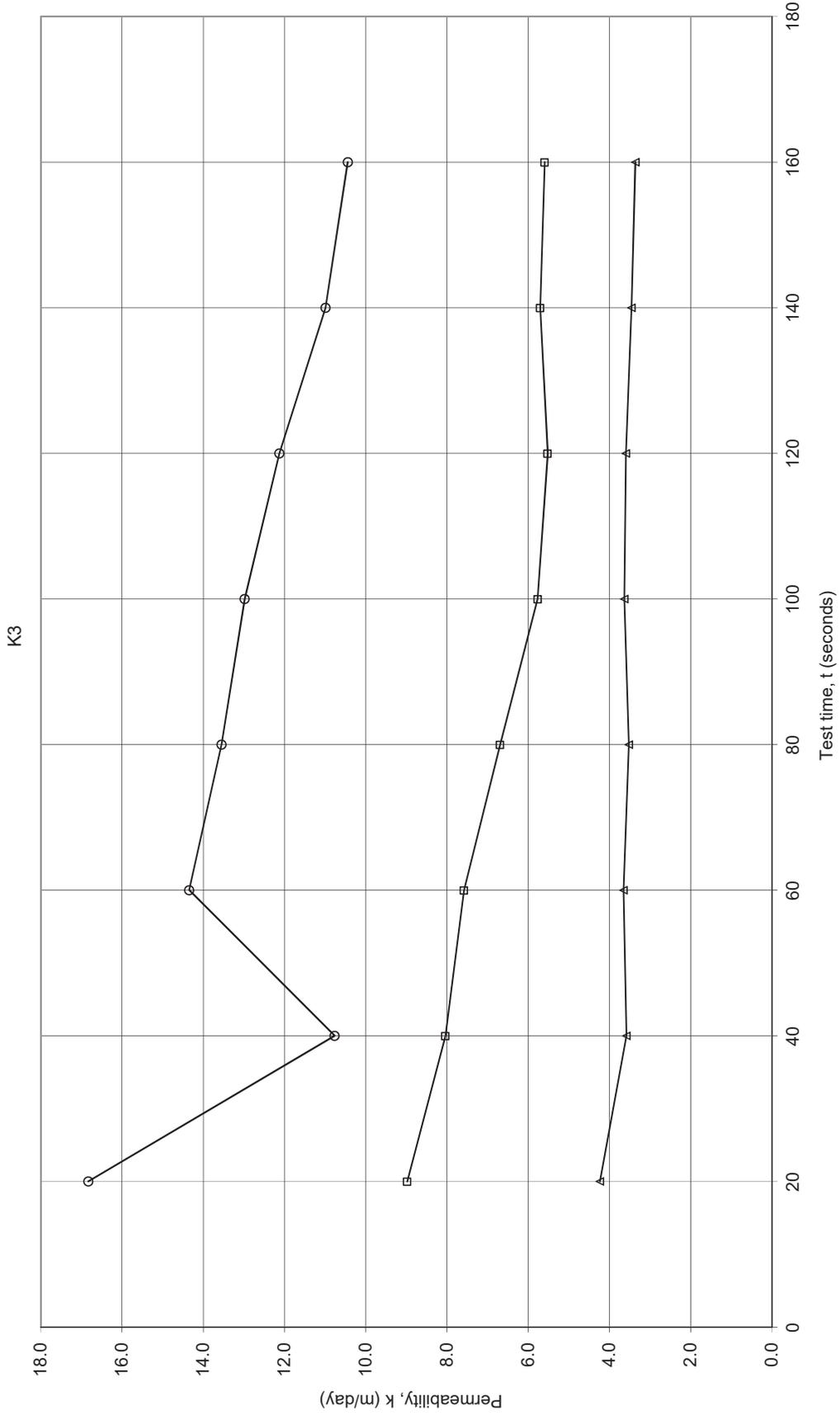


Test 1	Test 2	Test 3
0	0	0
20	20	20
40	40	40
60	60	60
80	80	80
100	100	100
120	120	120
140	140	140
160	160	160
AVERAGE	AVERAGE	AVERAGE

Test 1	Test 2	Test 3
1.9E-04	1.0E-04	4.9E-05
1.2E-04	9.3E-05	4.1E-05
1.7E-04	8.8E-05	4.2E-05
1.6E-04	7.7E-05	4.1E-05
1.5E-04	6.7E-05	4.2E-05
1.4E-04	6.4E-05	4.2E-05
1.3E-04	6.6E-05	4.0E-05
1.2E-04	6.5E-05	3.9E-05
AVERAGE	7.8E-05	4.2E-05

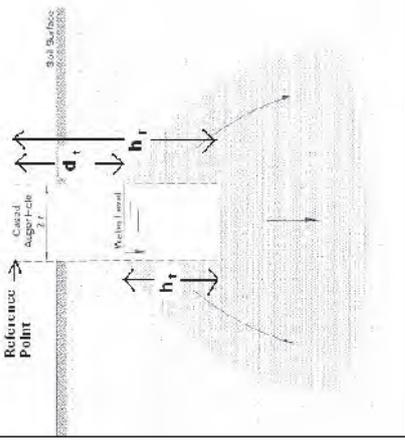
Test 1	Test 2	Test 3
16.8	9.0	4.2
10.8	8.0	3.6
14.4	7.6	3.7
13.6	6.7	3.5
13.0	5.8	3.6
12.1	5.5	3.6
11.0	5.7	3.5
10.4	5.6	3.4
AVERAGE	12.8	3.6

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09
Job No:	J1901164		
Client:	Mortons.U.S		
Project:	Parkland Heights		
Location:	Baldivis		
Calc by:	HWC		
BH Name:	L1		
Test Depth:	0.95 m		
Spreadsheet Legend			
	Required input		
	Calculated field		
	Comment field		
	Field not used		
	Fixed field		
Parameter Description		Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h _r	reference point height above base	0.95	m
d _t	depth from reference point to water at time t		m
h _t	Water column height at time t		m
h ₀	h _t at t=0		m



REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

$$K = 1.15r \frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.52	0.43	3.6E-04	31.4
20	0.645	0.305	2.4E-04	20.4
40	0.675	0.275	3.7E-04	32.2
60	0.805	0.145	3.9E-04	33.8
80	0.86	0.09	4.1E-04	35.6
100	0.9	0.05	4.0E-04	34.9
120	0.92	0.03		
AVERAGE			3.6E-04	31.4

Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.39	0.56	4.7E-04	40.8
20	0.59	0.36	3.5E-04	30.2
40	0.66	0.29	3.5E-04	30.4
60	0.745	0.205	2.8E-04	24.5
80	0.76	0.19	3.0E-04	26.0
100	0.82	0.13	2.7E-04	23.4
120	0.835	0.115	2.6E-04	22.2
140	0.855	0.095		
160	0.87	0.08		
AVERAGE			3.2E-04	27.3

Test 3

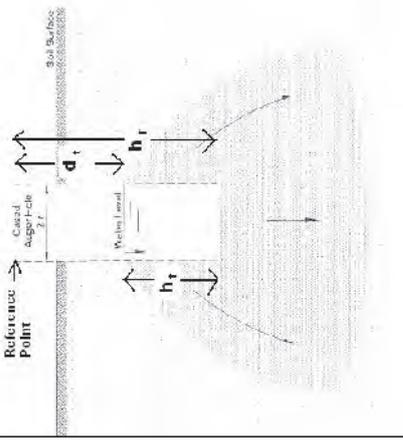
t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.37	0.58	3.9E-04	33.3
20	0.545	0.405	3.4E-04	29.6
40	0.645	0.305	3.2E-04	27.5
60	0.715	0.235	3.1E-04	26.5
80	0.77	0.18	2.7E-04	23.2
100	0.79	0.16	2.3E-04	20.2
120	0.8	0.15	2.6E-04	22.1
140	0.85	0.1		
160	0.87	0.08		
AVERAGE			3.0E-04	25.5

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09
Job No:	J1901164		
Client:	Mortons.U.S		
Project:	Parkland Heights		
Location:	Baldivis		
Calc by:	HWC		
BH Name:	L2		
Test Depth:	0.89 m		
Spreadsheet Legend			
Required input			
Calculated field			
Comment field			
Field not used			
Fixed field			



REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

$$K = 1.15r \frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h _r	reference point height above base	0.95	m
d _t	depth from reference point to water at time t		m
h _t	Water column height at time t		m
h ₀	h _t at t=0		m

Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0	0.95	2.7E-04	23.6
20	0.21	0.74	2.0E-04	17.2
40	0.29	0.66	1.6E-04	13.9
60	0.34	0.61	1.4E-04	12.0
80	0.38	0.57	1.2E-04	10.0
100	0.39	0.56	1.0E-04	8.7
120	0.405	0.545	8.9E-05	7.7
140	0.415	0.535	8.1E-05	7.0
160	0.425	0.525	7.3E-05	6.3
180	0.43	0.52		
AVERAGE				11.8

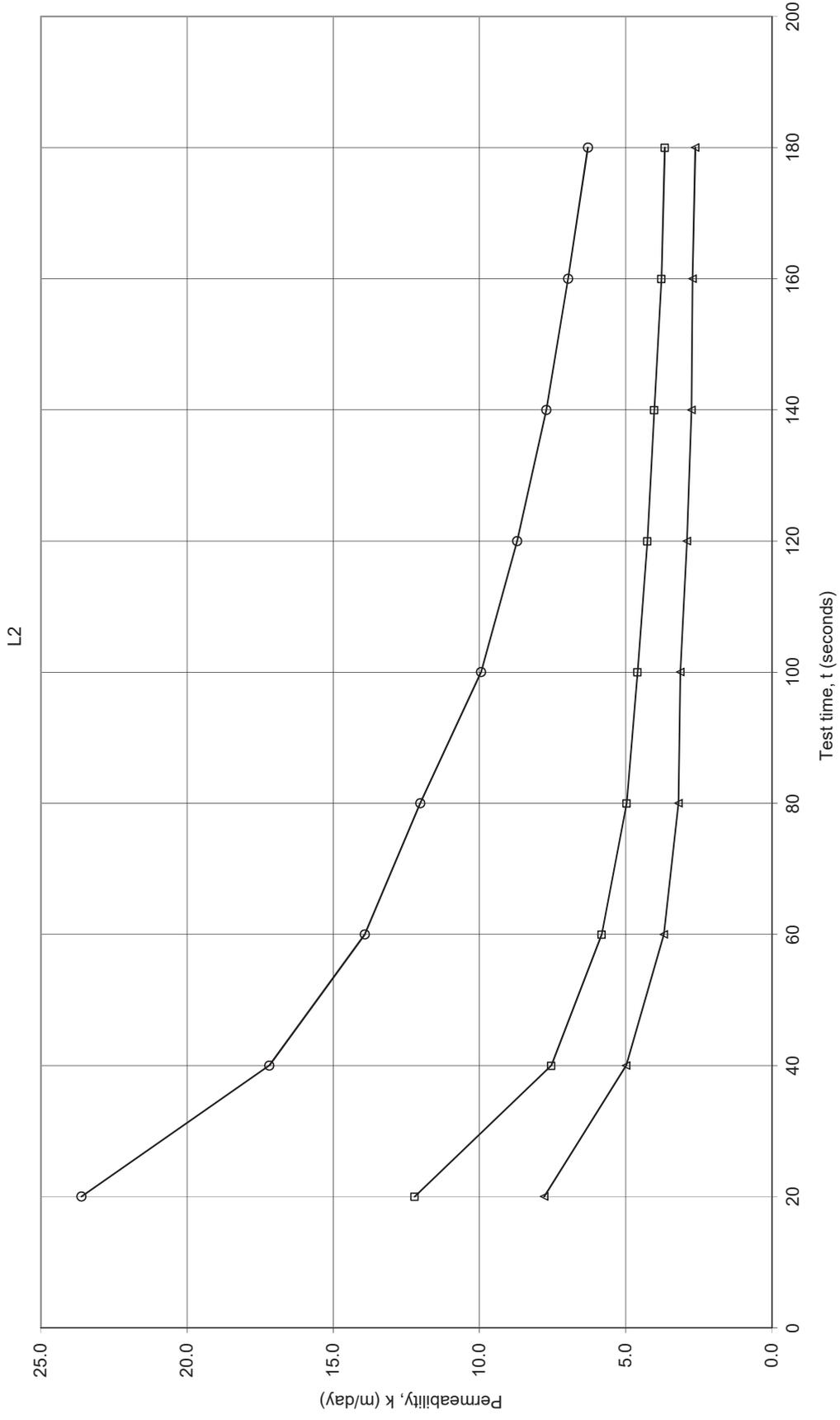
Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0	0.95	1.4E-04	12.2
20	0.115	0.835	8.7E-05	7.5
40	0.14	0.81	6.7E-05	5.8
60	0.16	0.79	5.8E-05	5.0
80	0.18	0.77	5.3E-05	4.6
100	0.205	0.745	4.9E-05	4.3
120	0.225	0.725	4.7E-05	4.0
140	0.245	0.705	4.4E-05	3.8
160	0.26	0.69	4.2E-05	3.7
180	0.28	0.67		
AVERAGE				5.7

Test 3

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0	0.95	9.0E-05	7.8
20	0.075	0.875	5.8E-05	5.0
40	0.095	0.855	4.3E-05	3.7
60	0.105	0.845	3.7E-05	3.2
80	0.12	0.83	3.6E-05	3.1
100	0.145	0.805	3.4E-05	2.9
120	0.16	0.79	3.2E-05	2.8
140	0.175	0.775	3.1E-05	2.7
160	0.195	0.755	3.0E-05	2.6
180	0.21	0.74		
AVERAGE				3.8

Permeability by Inverse Auger Hole Method

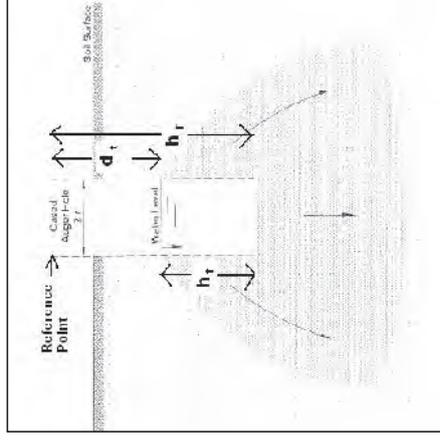


Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09
Job No:	J1901164		
Client:	Mortons.U.S		
Project:	Parkland Heights		
Location:	Baldivis		
Calc by:	HWC		
BH Name:	L3		
Test Depth:	0.85 m		
Spreadsheet Legend			
	Required input		
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	Comment field		
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	Fixed field		
Parameter Description		Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h _r	reference point height above base	0.95	m
d _t	depth from reference point to water at time t		m
h _t	Water column height at time t		m
h ₀	h _t at t=0		m

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

$$K = 1.15r \frac{1}{t - t_0} \log_{10} \left(h_0 + \frac{1}{2}r \right) - \log_{10} \left(h_t + \frac{1}{2}r \right)$$



Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.64	0.31	3.5E-04	30.6
20	0.73	0.22	2.5E-04	21.7
40	0.76	0.19	2.1E-04	18.5
60	0.785	0.165	1.8E-04	15.2
80	0.795	0.155	1.5E-04	13.3
100	0.805	0.145	1.4E-04	12.1
120	0.815	0.135		
AVERAGE			2.2E-04	18.6

Test 2

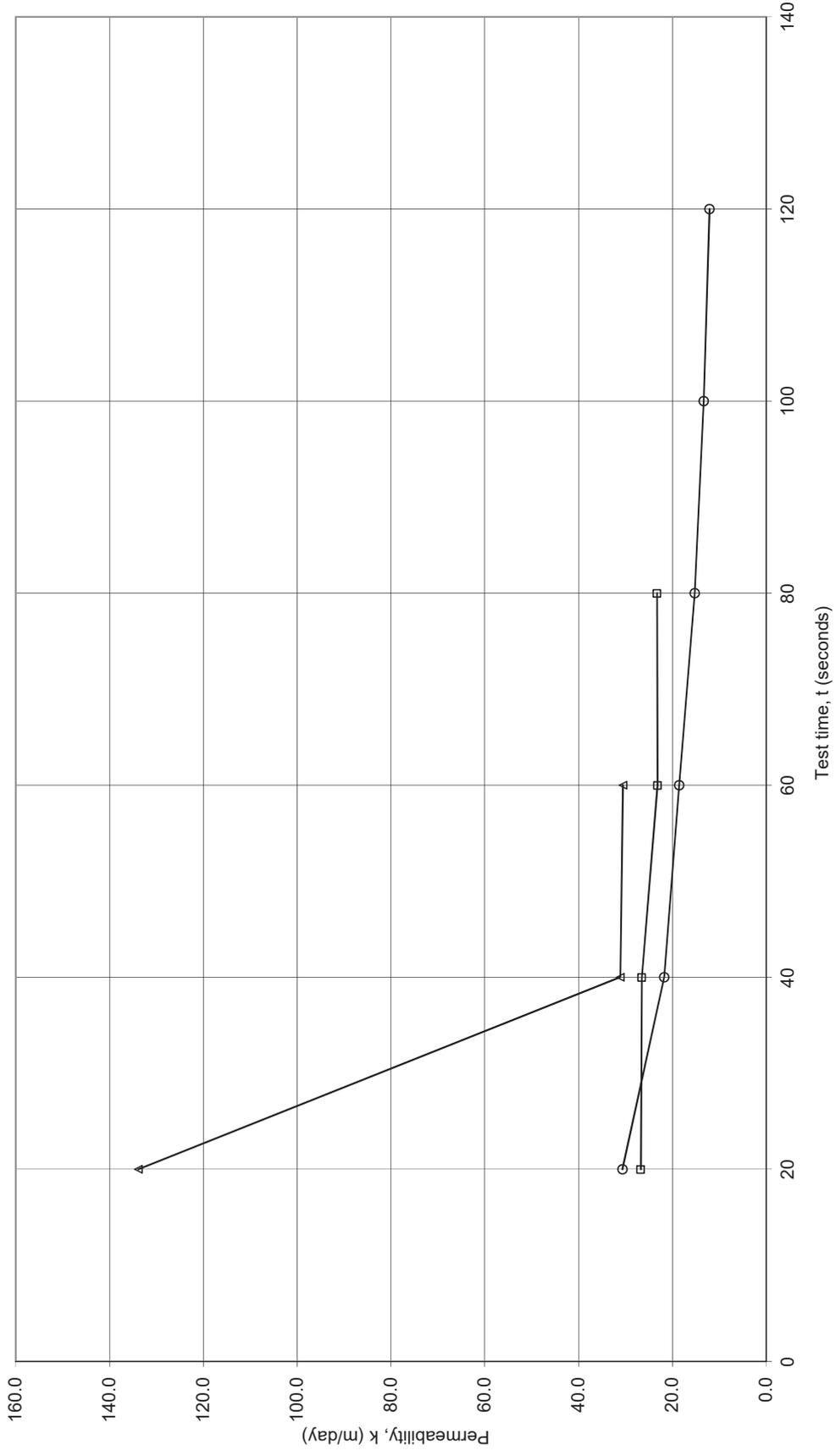
t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.64	0.31	3.1E-04	26.7
20	0.72	0.23	3.1E-04	26.5
40	0.78	0.17	2.7E-04	23.2
60	0.81	0.14	2.7E-04	23.3
80	0.845	0.105		
AVERAGE			2.9E-04	24.9

Test 3

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.645	0.305	1.5E-03	133.9
20	0.89	0.06	3.6E-04	31.1
40	0.8	0.15	3.5E-04	30.5
60	0.845	0.105		
AVERAGE			7.5E-04	65.2

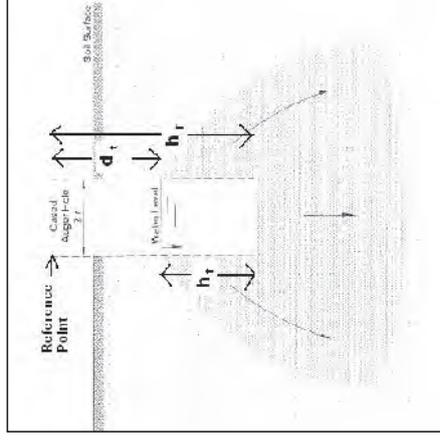
Permeability by Inverse Auger Hole Method

L3



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author:	ORW	17-Oct-09
Job No:	J1901164	REFERENCE: Cocks, G. <i>Disposal of Stormwater Runoff by Soakage in Perth Western Australia</i> , Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114		
Client:	Mortons.U.S			
Project:	Parkland Heights			
Location:	Baldivis			
Calc by:	HWC			
BH Name:	M1			
Test Depth:	0.90 m			
Spreadsheet Legend				
Required input		Value	Units	
Calculated field		0.045	m	
Comment field			s	
Field not used		1	m	
Fixed field			m	
			m	
			m	
$K = 1.15r \frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$				
Parameter Description				
K	Permeability		m/s	
r	radius of test hole	0.045	m	
t	time since start of measurement		s	
h _r	reference point height above base		1 m	
d _t	depth from reference point to water at time t		m	
h _t	Water column height at time t		m	
h ₀	h _t at t=0		m	



Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.415	0.585	4.4E-04	37.6
20	0.61	0.39	4.7E-04	40.7
40	0.76	0.24	4.4E-04	38.0
60	0.835	0.165	4.1E-04	35.2
80	0.88	0.12	3.6E-04	31.1
100	0.9	0.1		
AVERAGE			4.2E-04	36.5

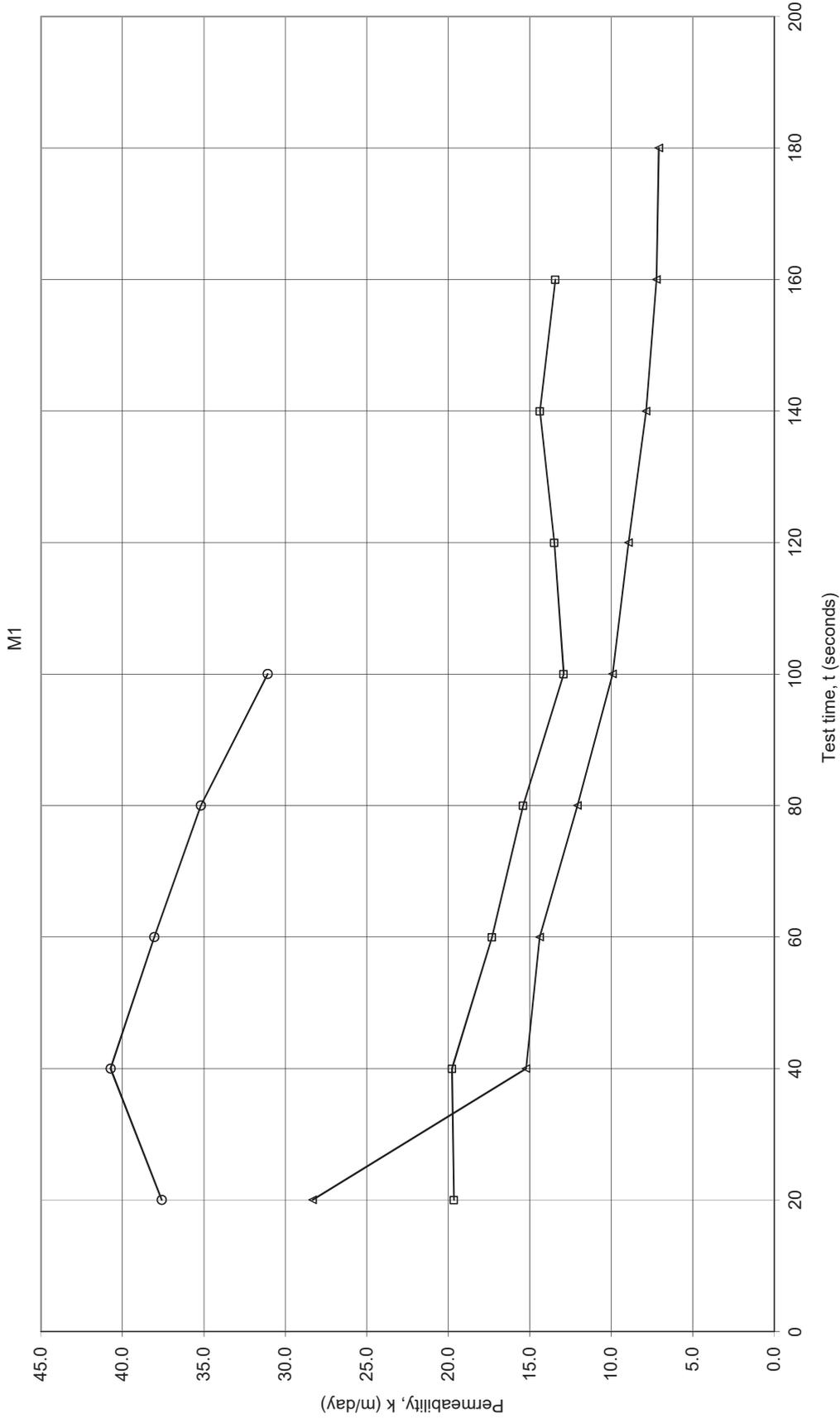
Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.395	0.605	2.3E-04	19.7
20	0.51	0.49	2.3E-04	19.8
40	0.605	0.395	2.0E-04	17.3
60	0.655	0.345	1.8E-04	15.4
80	0.69	0.31	1.5E-04	12.9
100	0.7	0.3	1.6E-04	13.5
120	0.75	0.25	1.7E-04	14.4
140	0.8	0.2	1.6E-04	13.4
160	0.815	0.185		
AVERAGE			1.8E-04	15.8

Test 3

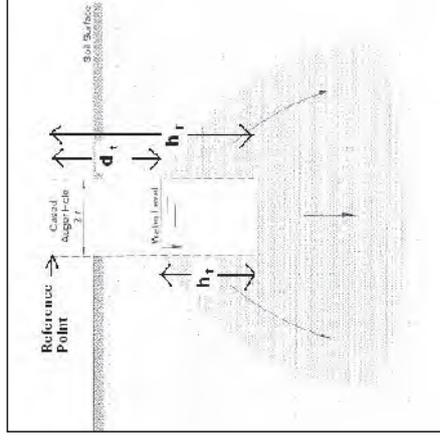
t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.41	0.59	3.3E-04	28.3
20	0.565	0.435	1.8E-04	15.2
40	0.575	0.425	1.7E-04	14.4
60	0.63	0.37	1.4E-04	12.1
80	0.65	0.35	1.1E-04	9.9
100	0.655	0.345	1.0E-04	8.9
120	0.67	0.33	9.1E-05	7.9
140	0.675	0.325	8.4E-05	7.2
160	0.685	0.315	8.2E-05	7.1
180	0.705	0.295		
AVERAGE			1.4E-04	12.3

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09																																				
Job No: J1901164	REFERENCE: Cocks, G. <i>Disposal of Stormwater Runoff by Soakage in Perth Western Australia</i> , Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114																																						
Client: Mortons.U.S	$K = 1.15r \frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$																																						
Project: Parkland Heights	<table border="1"> <thead> <tr> <th>Parameter</th> <th>Description</th> <th>Value</th> <th>Units</th> </tr> </thead> <tbody> <tr> <td>K</td> <td>Permeability</td> <td></td> <td>m/s</td> </tr> <tr> <td>r</td> <td>radius of test hole</td> <td>0.045</td> <td>m</td> </tr> <tr> <td>t</td> <td>time since start of measurement</td> <td></td> <td>s</td> </tr> <tr> <td>h_r</td> <td>reference point height above base</td> <td>1</td> <td>m</td> </tr> <tr> <td>d_t</td> <td>depth from reference point to water at time t</td> <td></td> <td>m</td> </tr> <tr> <td>h_t</td> <td>Water column height at time t</td> <td></td> <td>m</td> </tr> <tr> <td>h_0</td> <td>h_t at t=0</td> <td></td> <td>m</td> </tr> </tbody> </table>			Parameter	Description	Value	Units	K	Permeability		m/s	r	radius of test hole	0.045	m	t	time since start of measurement		s	h_r	reference point height above base	1	m	d_t	depth from reference point to water at time t		m	h_t	Water column height at time t		m	h_0	h_t at t=0		m				
Parameter	Description	Value	Units																																				
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r	radius of test hole	0.045	m																																				
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h_r	reference point height above base	1	m																																				
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h_t	Water column height at time t		m																																				
h_0	h_t at t=0		m																																				
Location: Baldavis	<table border="1"> <thead> <tr> <th>Spreadsheet Legend</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>Required input</td> <td></td> </tr> <tr> <td>Calculated field</td> <td></td> </tr> <tr> <td>Comment field</td> <td></td> </tr> <tr> <td>Field not used</td> <td></td> </tr> <tr> <td>Fixed field</td> <td></td> </tr> </tbody> </table>			Spreadsheet Legend	Value	Required input		Calculated field		Comment field		Field not used		Fixed field																									
Spreadsheet Legend	Value																																						
Required input																																							
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Comment field																																							
Field not used																																							
Fixed field																																							
Calc by: HWC	<table border="1"> <thead> <tr> <th>Test 1</th> <th>Test 2</th> <th>Test 3</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>20</td> <td>20</td> <td>20</td> </tr> <tr> <td>40</td> <td>40</td> <td>40</td> </tr> <tr> <td>60</td> <td>60</td> <td>60</td> </tr> <tr> <td>80</td> <td>80</td> <td>80</td> </tr> <tr> <td>100</td> <td>100</td> <td>100</td> </tr> <tr> <td>120</td> <td>120</td> <td>120</td> </tr> <tr> <td>140</td> <td>140</td> <td>120</td> </tr> <tr> <td>160</td> <td>160</td> <td>120</td> </tr> <tr> <td>180</td> <td>180</td> <td>120</td> </tr> <tr> <td>AVERAGE</td> <td>AVERAGE</td> <td>AVERAGE</td> </tr> </tbody> </table>			Test 1	Test 2	Test 3	0	0	0	20	20	20	40	40	40	60	60	60	80	80	80	100	100	100	120	120	120	140	140	120	160	160	120	180	180	120	AVERAGE	AVERAGE	AVERAGE
Test 1	Test 2	Test 3																																					
0	0	0																																					
20	20	20																																					
40	40	40																																					
60	60	60																																					
80	80	80																																					
100	100	100																																					
120	120	120																																					
140	140	120																																					
160	160	120																																					
180	180	120																																					
AVERAGE	AVERAGE	AVERAGE																																					



Test 1

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.58	0.42	5.0E-04	43.6
20	0.74	0.26	4.4E-04	37.9
40	0.82	0.18	3.8E-04	32.4
60	0.86	0.14	4.1E-04	35.5
80	0.92	0.08	3.8E-04	32.6
100	0.94	0.06	3.1E-04	27.2
120	0.94	0.06	2.7E-04	23.3
140	0.94	0.06	2.4E-04	20.4
160	0.94	0.06	2.1E-04	18.1
AVERAGE			3.5E-04	30.1

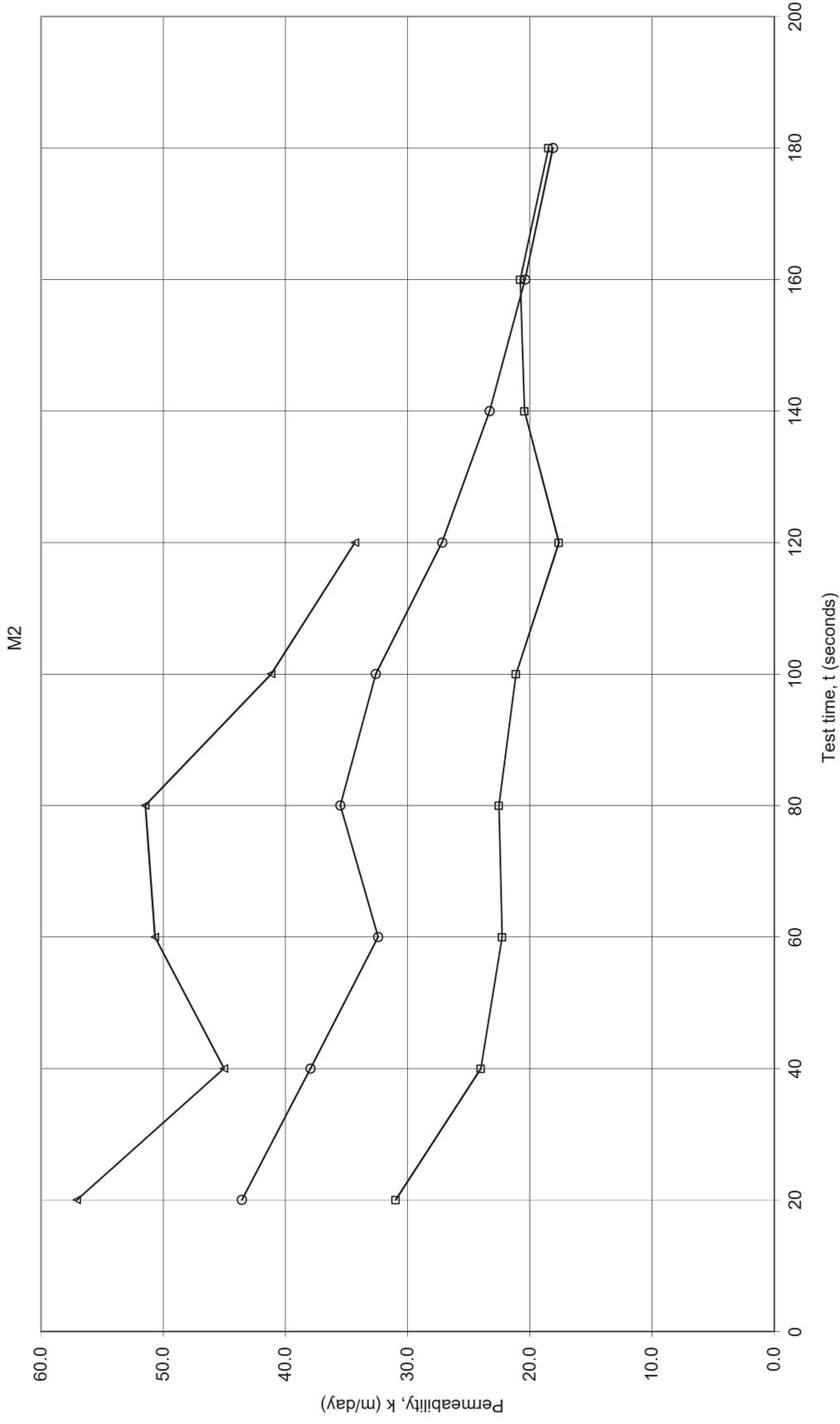
Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.51	0.49	3.6E-04	31.0
20	0.65	0.35	2.8E-04	24.0
40	0.71	0.29	2.6E-04	22.3
60	0.765	0.235	2.6E-04	22.5
80	0.82	0.18	2.4E-04	21.1
100	0.85	0.15	2.0E-04	17.6
120	0.85	0.15	2.4E-04	20.4
140	0.905	0.095	2.4E-04	20.8
160	0.93	0.07	2.1E-04	18.5
180	0.93	0.07		
AVERAGE			2.5E-04	22.0

Test 3

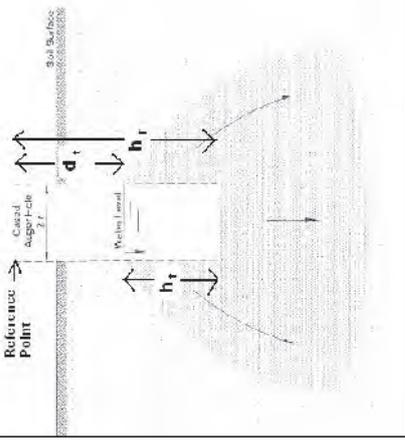
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.46	0.54	6.6E-04	57.1
20	0.71	0.29	5.2E-04	45.0
40	0.8	0.2	5.9E-04	50.7
60	0.905	0.095	6.0E-04	51.5
80	0.955	0.045	4.8E-04	41.2
100	0.955	0.045	4.0E-04	34.3
120	0.955	0.045		
AVERAGE			5.4E-04	46.6

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09
Job No:	J1901164		
Client:	Mortons.U.S		
Project:	Parkland Heights		
Location:	Baldivis		
Calc by:	HWC		
BH Name:	M3		
Test Depth:	0.90		m



REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

$$K = 1.15r \frac{1}{t - t_0} \log_{10} \left(h_0 + \frac{1}{2}r \right) - \log_{10} \left(h_t + \frac{1}{2}r \right)$$

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h _r	reference point height above base	1	m
d _t	depth from reference point to water at time t		m
h _t	Water column height at time t		m
h ₀	h _t at t=0		m

Spreadsheet Legend

- Required input
- Calculated field
- Comment field
- Field not used
- Fixed field

Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.575	0.425		
20	0.815	0.185	8.6E-04	74.6
40	0.9	0.1	7.3E-04	62.9
60	0.96	0.04	7.4E-04	63.7
AVERAGE			7.8E-04	67.1

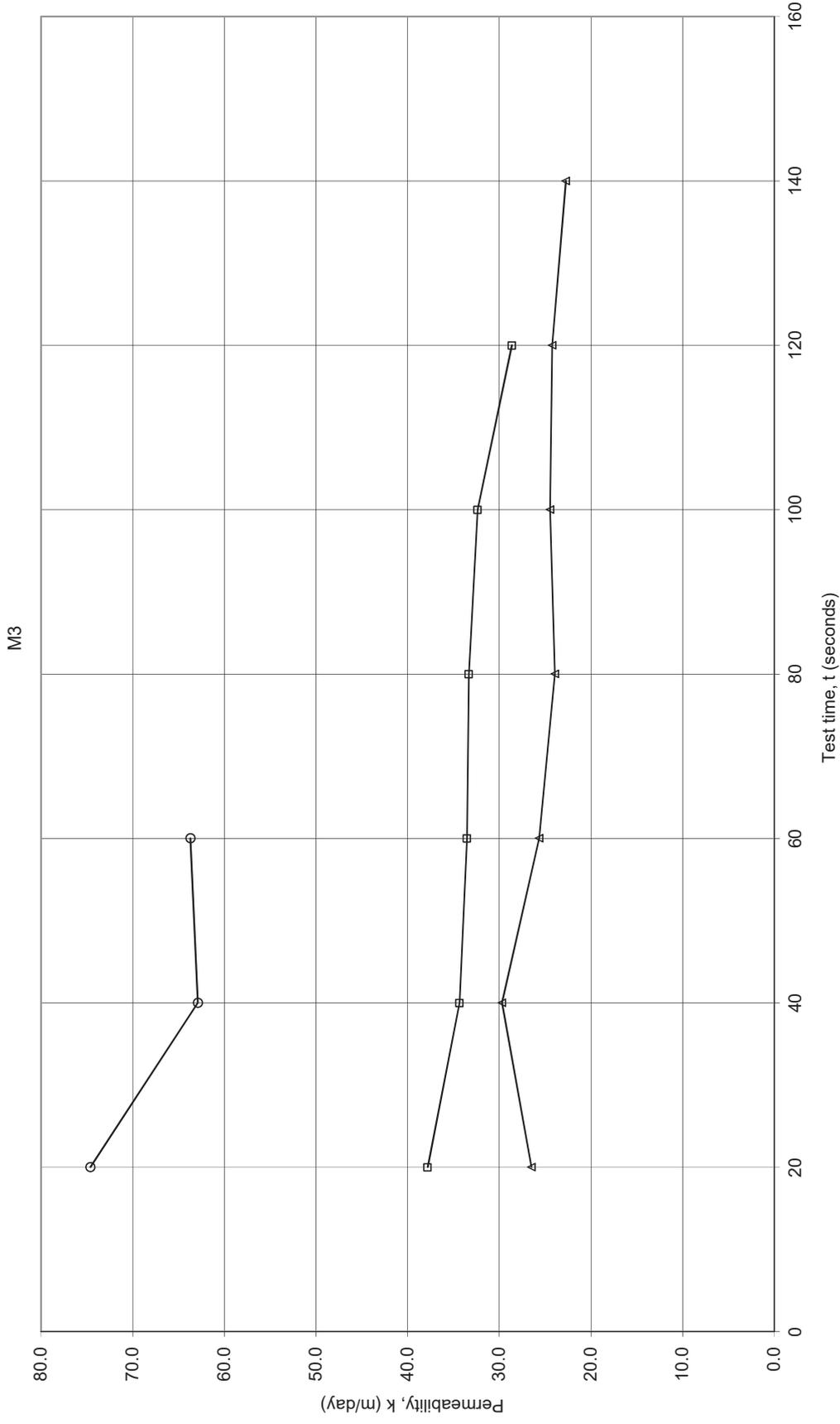
Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.48	0.52		
20	0.655	0.345	4.4E-04	37.8
40	0.755	0.245	4.0E-04	34.3
60	0.83	0.17	3.9E-04	33.5
80	0.885	0.115	3.9E-04	33.3
100	0.92	0.08	3.7E-04	32.4
120	0.93	0.07	3.3E-04	28.6
AVERAGE			3.9E-04	33.3

Test 3

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.52	0.48		
20	0.64	0.36	3.1E-04	26.5
40	0.75	0.25	3.4E-04	29.7
60	0.795	0.205	3.0E-04	25.6
80	0.835	0.165	2.8E-04	23.9
100	0.88	0.12	2.8E-04	24.5
120	0.91	0.09	2.8E-04	24.2
140	0.925	0.075	2.6E-04	22.7
AVERAGE			2.9E-04	25.3

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

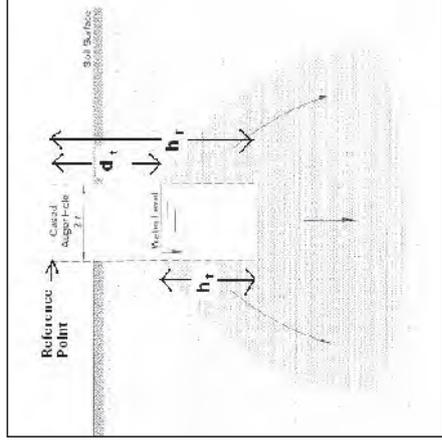
Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09
Job No: J1901164	REFERENCE: Cocks, G. <i>Disposal of Stormwater Runoff by Soakage in Perth Western Australia</i> , Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114		
Client: Mortons.U.S			
Project: Parkland Heights			
Location: Baldivis			
Calc by: HWC			
BH Name: N1			
Test Depth: 0.90 m			

$$K = 1.15r \frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h _r	reference point height above base	1	m
d _t	depth from reference point to water at time t		m
h _t	Water column height at time t		m
h ₀	h _t at t=0		m

Spreadsheet Legend

Required input
Calculated field
Comment field
Field not used
Fixed field



Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.55	0.45	4.1E-04	35.6
20	0.695	0.305	6.9E-04	59.9
40	0.885	0.115	9.0E-04	77.9
60	0.98	0.02	8.6E-04	73.9
80	1	0	6.8E-04	59.1
100	1	0		
AVERAGE			7.1E-04	61.3

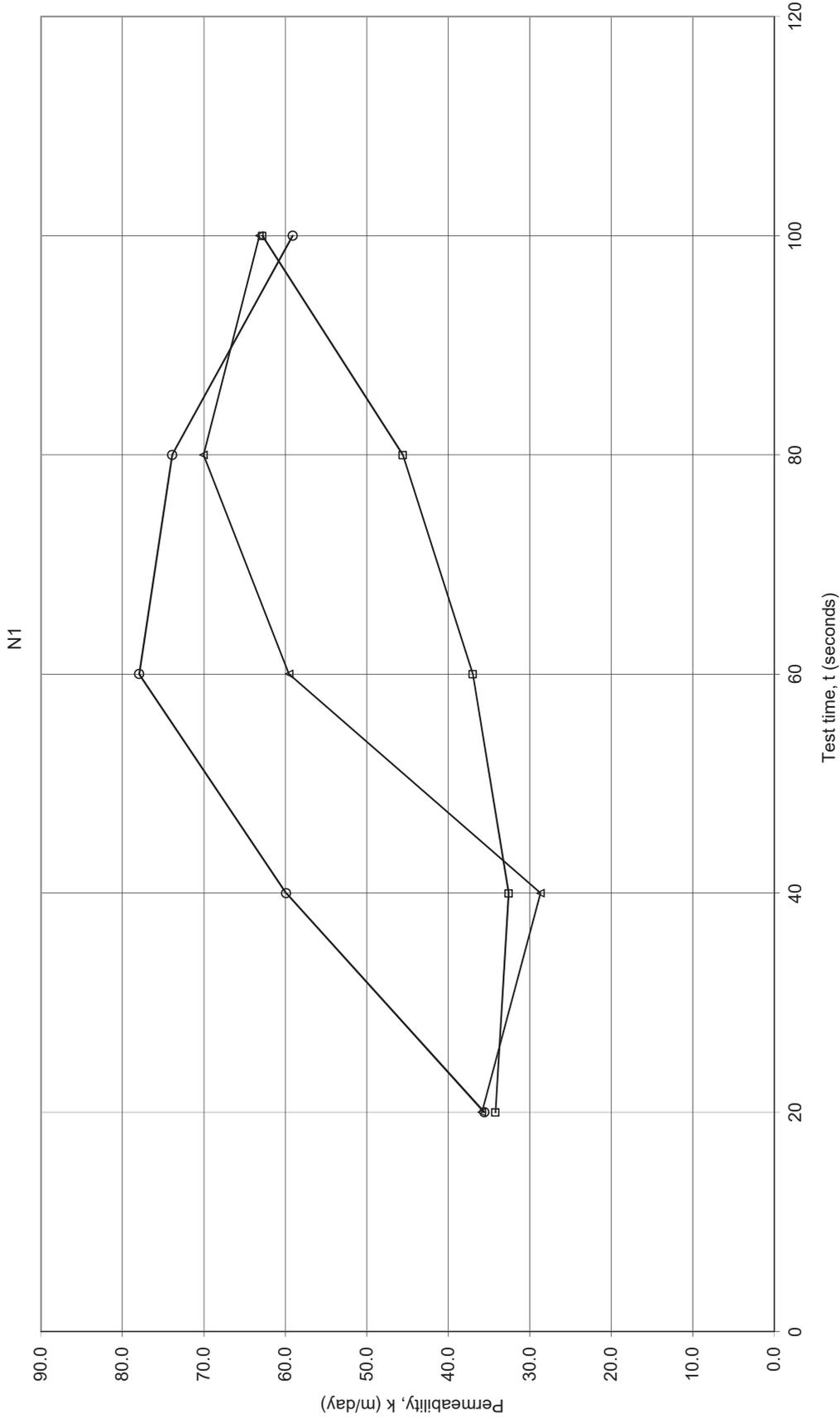
Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.45	0.55	4.0E-04	34.2
20	0.62	0.38	3.8E-04	32.6
40	0.73	0.27	4.3E-04	37.0
60	0.84	0.16	5.3E-04	45.6
80	0.935	0.065	7.3E-04	62.8
100	1	0		
AVERAGE			4.9E-04	42.4

Test 3

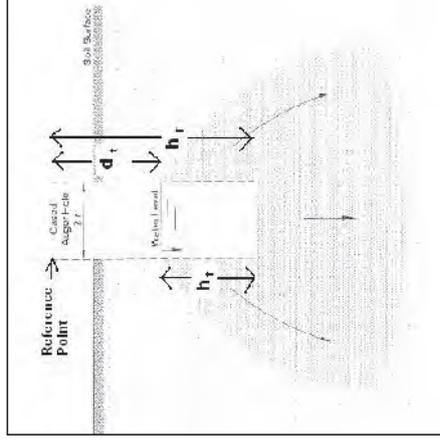
t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.44	0.56	4.2E-04	35.9
20	0.62	0.38	3.3E-04	28.7
40	0.7	0.3	6.9E-04	59.6
60	0.93	0.07	8.1E-04	70.1
80	0.99	0.01	7.3E-04	63.2
100	1	0		
AVERAGE			6.0E-04	51.5

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author:	ORW	17-Oct-09
Job No:	J1901164	REFERENCE: Cocks, G. <i>Disposal of Stormwater Runoff by Soakage in Perth Western Australia</i> , Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114		
Client:	Mortons.U.S			
Project:	Parkland Heights			
Location:	Baldivis			
Calc by:	HWC			
BH Name:	N2			
Test Depth:	0.90 m			
Spreadsheet Legend				
Required input		Value	Units	
Calculated field		0.045	m/s	
Comment field			s	
Field not used			1 m	
Fixed field			m	
			m	
			m	



$$K = 1.15r \frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h _r	reference point height above base	1	m
d _t	depth from reference point to water at time t		m
h _t	Water column height at time t		m
h ₀	h _t at t=0		m

Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.52	0.48		
20	0.71	0.29	5.3E-04	46.1
40	0.81	0.19	4.8E-04	41.8
60	0.855	0.145	4.1E-04	35.6
80	0.935	0.065	4.9E-04	42.4
100	0.97	0.03	5.1E-04	43.9
120	1	0	5.8E-04	50.3
AVERAGE			5.0E-04	43.3

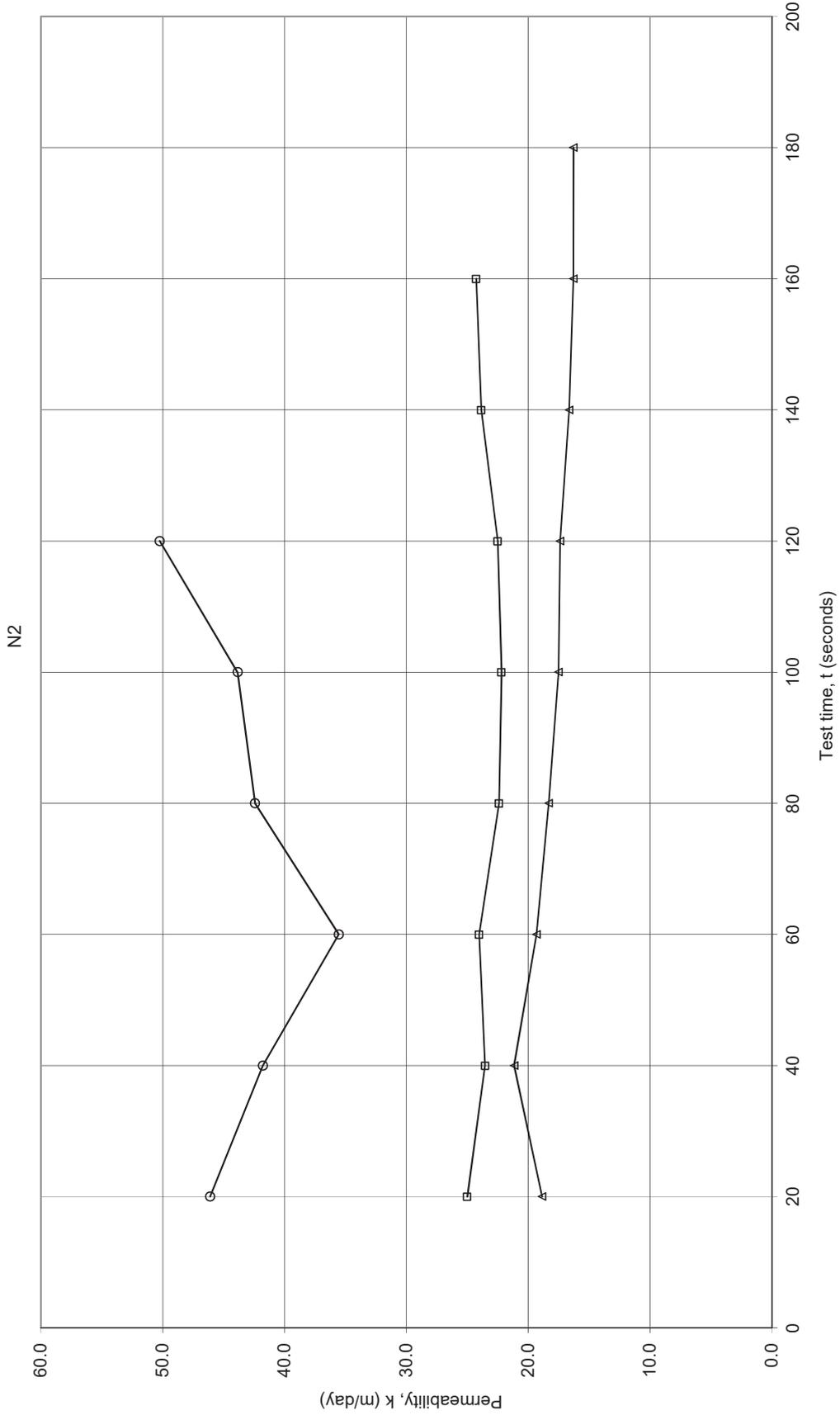
Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.45	0.55		
20	0.58	0.42	2.9E-04	25.0
40	0.67	0.33	2.7E-04	23.5
60	0.75	0.25	2.8E-04	24.0
80	0.795	0.205	2.6E-04	22.4
100	0.84	0.16	2.6E-04	22.2
120	0.88	0.12	2.6E-04	22.5
140	0.92	0.08	2.8E-04	23.9
160	0.945	0.055	2.8E-04	24.3
AVERAGE			2.7E-04	23.5

Test 3

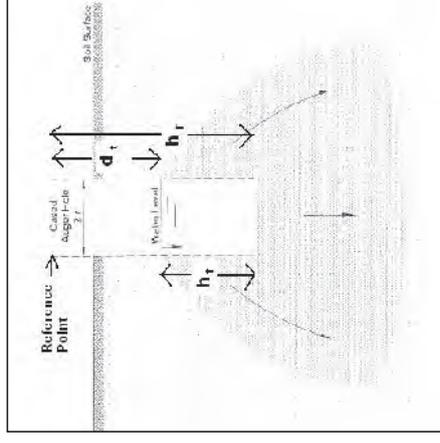
t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.4	0.6		
20	0.51	0.49	2.2E-04	18.9
40	0.62	0.38	2.5E-04	21.2
60	0.68	0.32	2.2E-04	19.3
80	0.73	0.27	2.1E-04	18.3
100	0.77	0.23	2.0E-04	17.5
120	0.81	0.19	2.0E-04	17.4
140	0.835	0.165	1.9E-04	16.6
160	0.86	0.14	1.9E-04	16.3
180	0.885	0.115	1.9E-04	16.3
AVERAGE			2.1E-04	18.0

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09																																
Job No: J1901164	REFERENCE: Cocks, G. <i>Disposal of Stormwater Runoff by Soakage in Perth Western Australia</i> , Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114																																		
Client: Mortons.U.S	$K = 1.15r \frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$																																		
Project: Parkland Heights	<table border="1"> <thead> <tr> <th>Parameter</th> <th>Description</th> <th>Value</th> <th>Units</th> </tr> </thead> <tbody> <tr> <td>K</td> <td>Permeability</td> <td></td> <td>m/s</td> </tr> <tr> <td>r</td> <td>radius of test hole</td> <td>0.045</td> <td>m</td> </tr> <tr> <td>t</td> <td>time since start of measurement</td> <td></td> <td>s</td> </tr> <tr> <td>h_r</td> <td>reference point height above base</td> <td>1</td> <td>m</td> </tr> <tr> <td>d_t</td> <td>depth from reference point to water at time t</td> <td></td> <td>m</td> </tr> <tr> <td>h_t</td> <td>Water column height at time t</td> <td></td> <td>m</td> </tr> <tr> <td>h_0</td> <td>h_t at t=0</td> <td></td> <td>m</td> </tr> </tbody> </table>			Parameter	Description	Value	Units	K	Permeability		m/s	r	radius of test hole	0.045	m	t	time since start of measurement		s	h_r	reference point height above base	1	m	d_t	depth from reference point to water at time t		m	h_t	Water column height at time t		m	h_0	h_t at t=0		m
Parameter	Description	Value	Units																																
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Location: Baldvís	<table border="1"> <thead> <tr> <th>Spreadsheet Legend</th> </tr> </thead> <tbody> <tr> <td>Required input</td> </tr> <tr> <td>Calculated field</td> </tr> <tr> <td>Comment field</td> </tr> <tr> <td>Field not used</td> </tr> <tr> <td>Fixed field</td> </tr> </tbody> </table>			Spreadsheet Legend	Required input	Calculated field	Comment field	Field not used	Fixed field																										
Spreadsheet Legend																																			
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Calculated field																																			
Comment field																																			
Field not used																																			
Fixed field																																			
Calc by: HWC																																			
BH Name: N3																																			
Test Depth: 0.90	m																																		



Test 1

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.625	0.375		
20	0.815	0.185	7.3E-04	63.1
40	0.91	0.09	7.1E-04	61.3
60	0.985	0.015	8.8E-04	76.4
80	1	0	8.1E-04	69.7
AVERAGE			7.8E-04	67.6

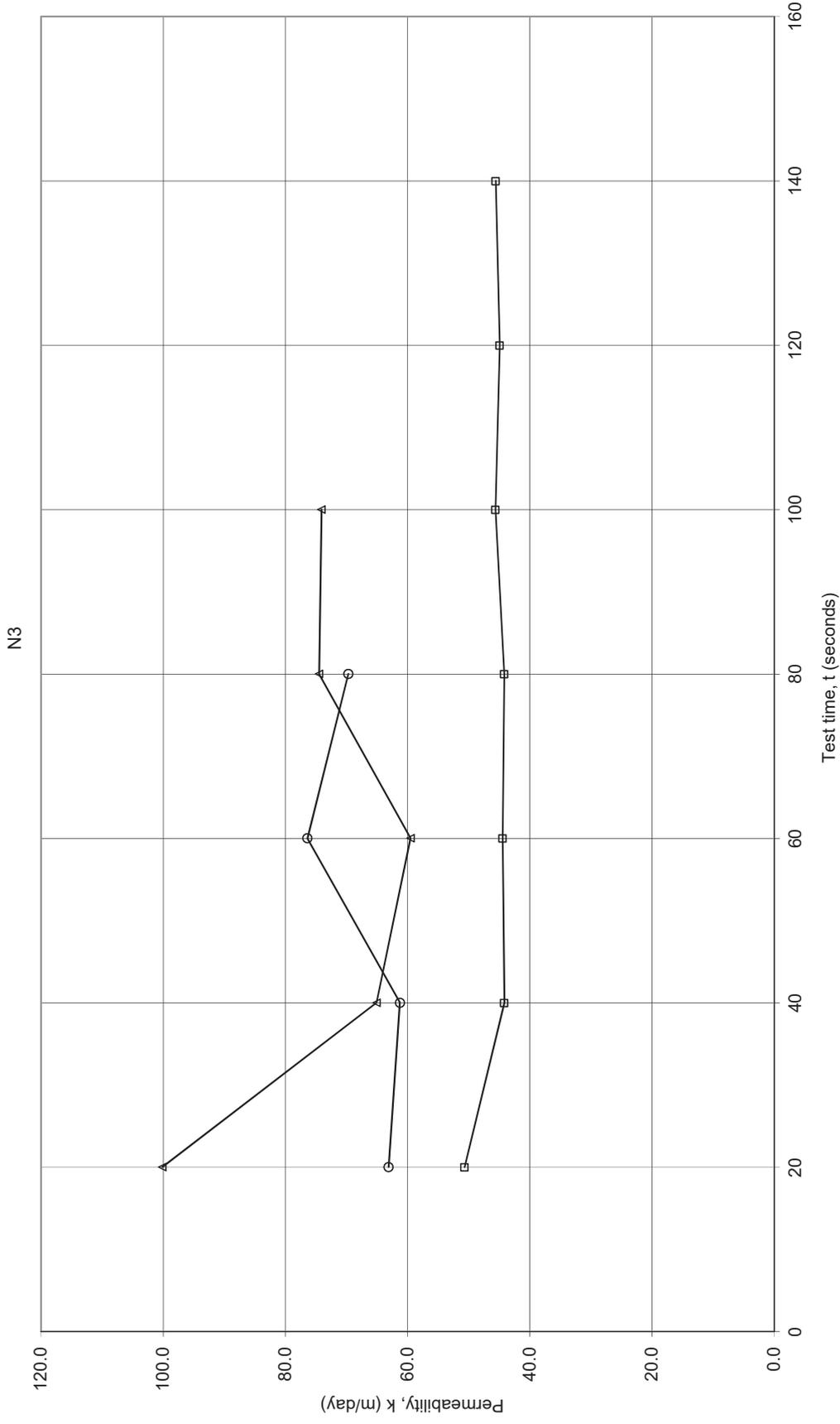
Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.42	0.58		
20	0.665	0.335	5.9E-04	50.7
40	0.78	0.22	5.1E-04	44.2
60	0.87	0.13	5.1E-04	44.5
80	0.925	0.075	5.1E-04	44.2
100	0.965	0.035	5.3E-04	45.6
120	0.985	0.015	5.2E-04	44.9
140	1	0	5.3E-04	45.6
AVERAGE			5.3E-04	45.7

Test 3

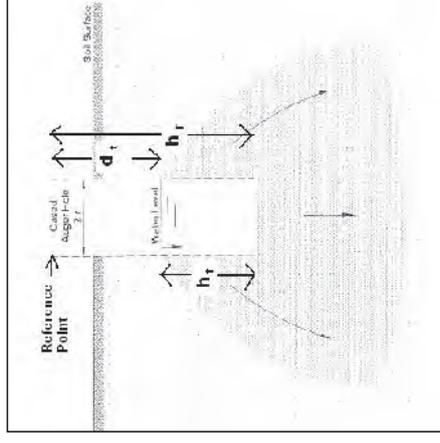
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0	1		
20	0.658	0.342	1.2E-03	100.1
40	0.755	0.245	7.5E-04	65.1
60	0.86	0.14	6.9E-04	59.5
80	0.975	0.025	8.6E-04	74.5
100	1	0	8.6E-04	74.1
AVERAGE			8.6E-04	74.7

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09																																
Job No: J1901164	REFERENCE: Cocks, G. <i>Disposal of Stormwater Runoff by Soakage in Perth Western Australia</i> , Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114																																		
Client: Mortons.U.S	$K = 1.15r \frac{1}{t - t_0} \log_{10} \left(h_0 + \frac{1}{2}r \right) - \log_{10} \left(h_t + \frac{1}{2}r \right)$																																		
Project: Parkland Heights	<table border="1"> <thead> <tr> <th>Parameter</th> <th>Description</th> <th>Value</th> <th>Units</th> </tr> </thead> <tbody> <tr> <td>K</td> <td>Permeability</td> <td></td> <td>m/s</td> </tr> <tr> <td>r</td> <td>radius of test hole</td> <td>0.045</td> <td>m</td> </tr> <tr> <td>t</td> <td>time since start of measurement</td> <td></td> <td>s</td> </tr> <tr> <td>h_r</td> <td>reference point height above base</td> <td>0.95</td> <td>m</td> </tr> <tr> <td>d_t</td> <td>depth from reference point to water at time t</td> <td></td> <td>m</td> </tr> <tr> <td>h_t</td> <td>Water column height at time t</td> <td></td> <td>m</td> </tr> <tr> <td>h₀</td> <td>h_t at t=0</td> <td></td> <td>m</td> </tr> </tbody> </table>			Parameter	Description	Value	Units	K	Permeability		m/s	r	radius of test hole	0.045	m	t	time since start of measurement		s	h _r	reference point height above base	0.95	m	d _t	depth from reference point to water at time t		m	h _t	Water column height at time t		m	h ₀	h _t at t=0		m
Parameter	Description	Value	Units																																
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h ₀	h _t at t=0		m																																
Location: Baldivis	Spreadsheet Legend Required input Calculated field Comment field Field not used Fixed field																																		
Calc by: HWC																																			
BH Name: IT1																																			
Test Depth: 0.95	m																																		



Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.55	0.4	6.2E-04	53.9
20	0.73	0.22	4.7E-04	40.8
40	0.79	0.16	5.1E-04	44.3
60	0.865	0.085	5.9E-04	50.6
80	0.92	0.03	5.2E-04	44.6
100	0.93	0.02		
AVERAGE			5.4E-04	46.8

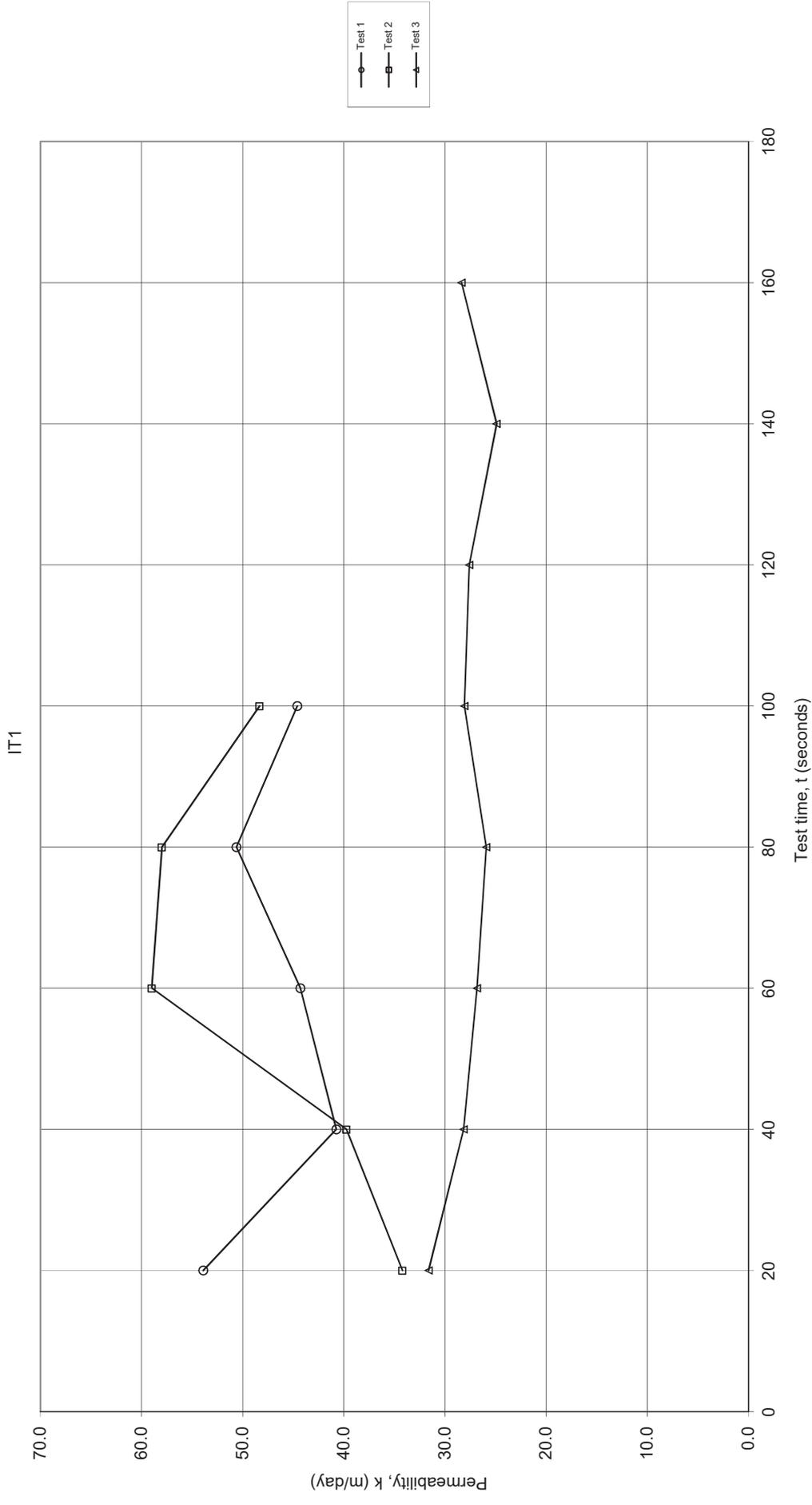
Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.4	0.55	4.0E-04	34.2
20	0.57	0.38	4.6E-04	39.7
40	0.72	0.23	6.8E-04	59.0
60	0.88	0.07	6.7E-04	58.0
80	0.92	0.03	5.6E-04	48.3
100	0.925	0.025		
AVERAGE			5.5E-04	47.9

Test 3

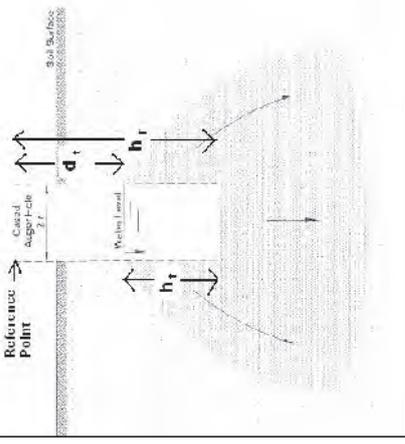
t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.325	0.625	3.7E-04	31.6
20	0.505	0.445	3.3E-04	28.2
40	0.61	0.34	3.1E-04	26.8
60	0.69	0.26	3.0E-04	25.9
80	0.75	0.2	3.2E-04	28.1
100	0.82	0.13	3.2E-04	27.6
120	0.855	0.095	2.9E-04	24.9
140	0.865	0.085	3.3E-04	28.4
160	0.91	0.04		
AVERAGE			3.2E-04	27.7

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09
Job No:	J1901164		
Client:	Mortons.U.S		
Project:	Parkland Heights		
Location:	Baldivis		
Calc by:	HWC		
BH Name:	IT2		
Test Depth:	0.95 m		



REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

$$K = 1.15r \frac{1}{t - t_0} \log_{10} \left(h_0 + \frac{r}{2} \right) - \log_{10} \left(h_t + \frac{r}{2} \right)$$

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h _r	reference point height above base	0.95	m
d _t	depth from reference point to water at time t		m
h _t	Water column height at time t		m
h ₀	h _t at t=0		m

Spreadsheet Legend

Required input
Calculated field
Comment field
Field not used
Fixed field

Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.64	0.31		
20	0.84	0.11	1.0E-03	89.3
40	0.91	0.04	9.4E-04	81.1
60	0.935	0.015	8.2E-04	70.6
AVERAGE			9.3E-04	80.4

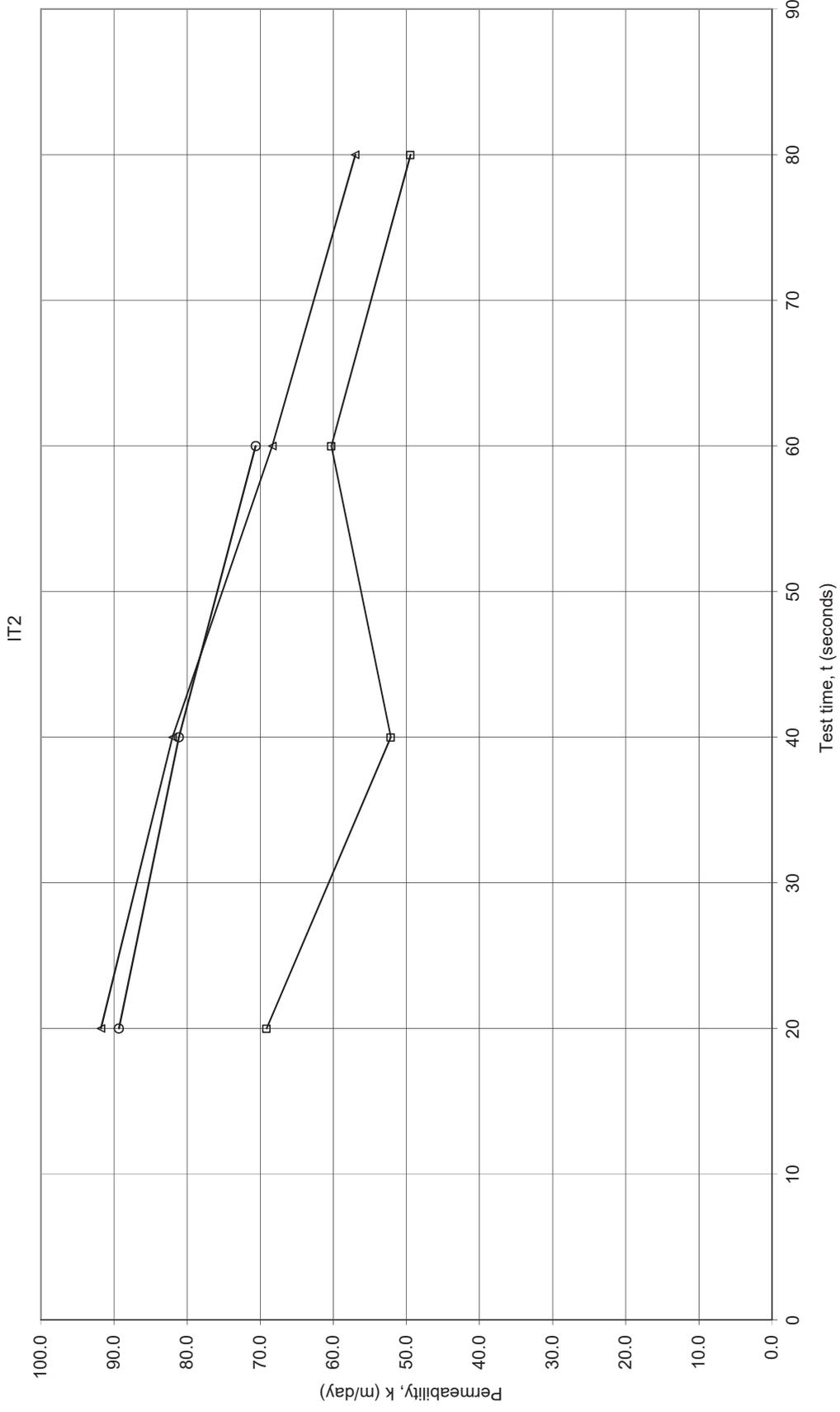
Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.57	0.38		
20	0.775	0.175	8.0E-04	69.1
40	0.835	0.115	6.0E-04	52.1
60	0.91	0.04	7.0E-04	60.3
80	0.92	0.03	5.7E-04	49.4
AVERAGE			6.7E-04	57.7

Test 3

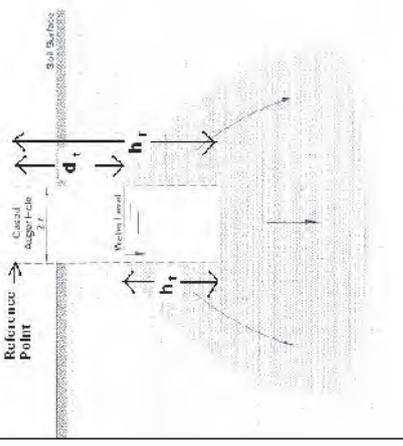
t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.58	0.37		
20	0.82	0.13	1.1E-03	91.8
40	0.9	0.05	9.5E-04	82.0
60	0.925	0.025	7.9E-04	68.3
80	0.935	0.015	6.6E-04	57.0
AVERAGE			8.7E-04	74.8

Permeability by Inverse Auger Hole Method



Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author: ORW	17-Oct-09
Job No:	J1901164		
Client:	Mortons.U.S		
Project:	Parkland Heights		
Location:	Baldivis		
Calc by:	HWC		
BH Name:	IT3		
Test Depth:	0.95 m		



REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

$$K = 1.15r \frac{1}{t - t_0} \log_{10} \left(h_0 + \frac{1}{2}r \right) - \log_{10} \left(h_t + \frac{1}{2}r \right)$$

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h _r	reference point height above base	0.95	m
d _t	depth from reference point to water at time t		m
h _t	Water column height at time t		m
h ₀	h _t at t=0		m

Spreadsheet Legend

Required input
Calculated field
Comment field
Field not used
Fixed field

Test 1

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.48	0.47	4.4E-04	38.1
20	0.64	0.31	3.5E-04	30.5
40	0.71	0.24	2.8E-04	24.3
60	0.74	0.21	3.4E-04	29.3
80	0.825	0.125	3.3E-04	28.7
100	0.86	0.09	3.3E-04	28.9
120	0.89	0.06	3.4E-04	29.8
140	0.915	0.035	3.1E-04	27.2
160	0.92	0.03		
AVERAGE				29.6

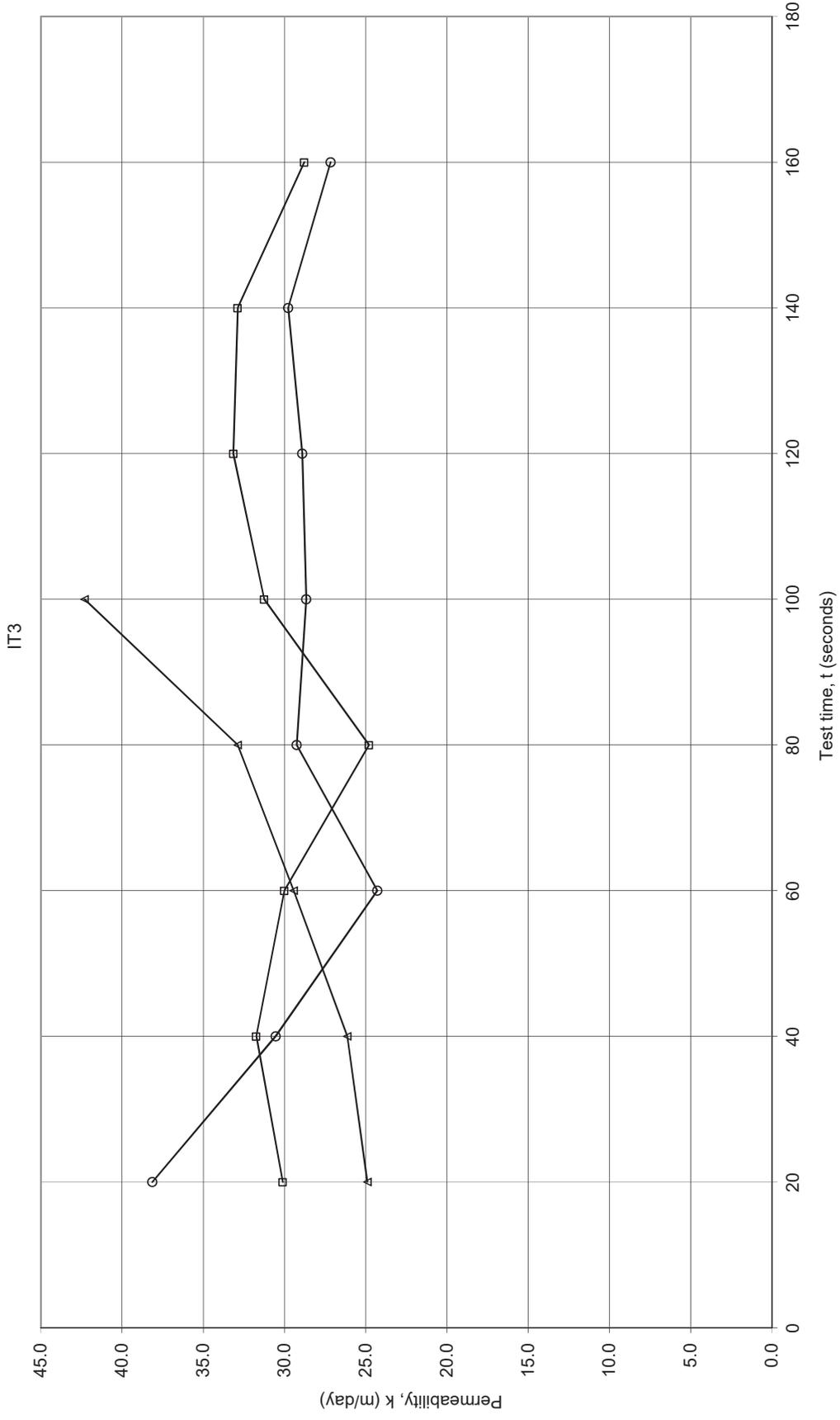
Test 2

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.41	0.54	3.5E-04	30.1
20	0.56	0.39	3.7E-04	31.7
40	0.68	0.27	3.5E-04	30.0
60	0.75	0.2	2.9E-04	24.8
80	0.77	0.18	3.6E-04	31.3
100	0.86	0.09	3.8E-04	33.2
120	0.9	0.05	3.8E-04	32.9
140	0.92	0.03	3.3E-04	28.8
160	0.92	0.03		
AVERAGE				30.3

Test 3

t (s)	d _w (m)	h _t (m)	K (m/s)	K (m/day)
0	0.42	0.53	2.9E-04	24.9
20	0.545	0.405	3.0E-04	26.1
40	0.65	0.3	3.4E-04	29.4
60	0.75	0.2	3.8E-04	32.9
80	0.83	0.12	4.9E-04	42.3
100	0.91	0.04		
AVERAGE				31.1

Permeability by Inverse Auger Hole Method





ATTACHMENT D

Understanding Your Report

UNDERSTANDING YOUR REPORT

GALT FORM PMP11 Rev3

1. EXPECTATIONS OF THE REPORT

This document has been prepared to clarify what is and is not provided in your report. It is intended to inform you of what your realistic expectations of this report should be and how to manage your risks associated with the conditions on site.

Geotechnical engineering and environmental science are less exact than other engineering and scientific disciplines. We include this information to help you understand where our responsibilities begin and end. You should read and understand this information. Please contact us if you do not understand the report or this explanation. We have extensive experience in a wide variety of projects and we can help you to manage your risk.

2. THIS REPORT RELATES TO PROJECT-SPECIFIC CONDITIONS

This report was developed for a unique set of project-specific conditions to meet the needs of the nominated client. It took into account the following:

- ✦ the project objectives as we understood them and as described in this report;
- ✦ the specific site mentioned in this report; and
- ✦ the current and proposed development at the site.

It should not be used for any purpose other than that indicated in the report. You should not rely on this report if any of the following conditions apply:

- ✦ the report was not written for you;
- ✦ the report was not written for the site specific to your development;
- ✦ the report was not written for your project (including a development at the correct site but other than that listed in the report); or
- ✦ the report was written before significant changes occurred at the site (such as a development or a change in ground conditions).

You should always inform us of changes in the proposed project (including minor changes) and request an assessment of their impact.

Where we are not informed of developments relevant to your report, we cannot be held responsible or liable for problems that may arise as a consequence.

Where design is to be carried out by others using information provided by us, we recommend that we be involved in the design process by being engaged for consultation with other members of the project team. Furthermore, we recommend that we be able to review work produced by other members of the project team that relies on information provided in our report.

3. SOIL LOGS

Our reports often include logs of intrusive and non-intrusive investigation techniques. These logs are based on our interpretation of field data and laboratory results. The logs should only be read in conjunction with the report they were issued with and should not be re-drawn for inclusion in other documents not prepared by us.

4. THIRD PARTY RELIANCE

We have prepared this report for use by the client. This report must be regarded as confidential to the client and the client's professional advisors. We do not accept any responsibility for contents of this document from any party other than the nominated client. We take no responsibility for any damages suffered by a third party because of any decisions or actions they may make based on this report. Any reliance or decisions made by a third party based on this report are the responsibility of the third party and not of us.

5. CHANGE IN SUBSURFACE CONDITIONS

The recommendations in this report are based on the ground conditions that existed at the time when the study was undertaken. Changes in ground conditions can occur in numerous ways including anthropogenic events (such as construction or contaminating activities on or adjacent to the site) or natural events (such as floods, groundwater fluctuations or earthquakes). We should be consulted prior to use of this report so that we can comment on its reliability. It is important to note that where ground conditions have changed, additional sampling, testing or analysis may be required to fully assess the changed conditions.

6. SUBSURFACE CONDITIONS DURING CONSTRUCTION

Practical constraints mean that we cannot know every minute detail about the subsurface conditions at a particular site. We use professional judgement to form an opinion about the subsurface conditions at the site. Some variation to our evaluated conditions is likely and significant variation is possible. Accordingly, our report should not be considered as final as it is developed from professional judgement and opinion.

The most effective means of dealing with unanticipated ground conditions is to engage us for construction support. We can only finalise our recommendations by observing actual subsurface conditions encountered during construction. We cannot accept liability for a report's recommendations if we cannot observe construction.

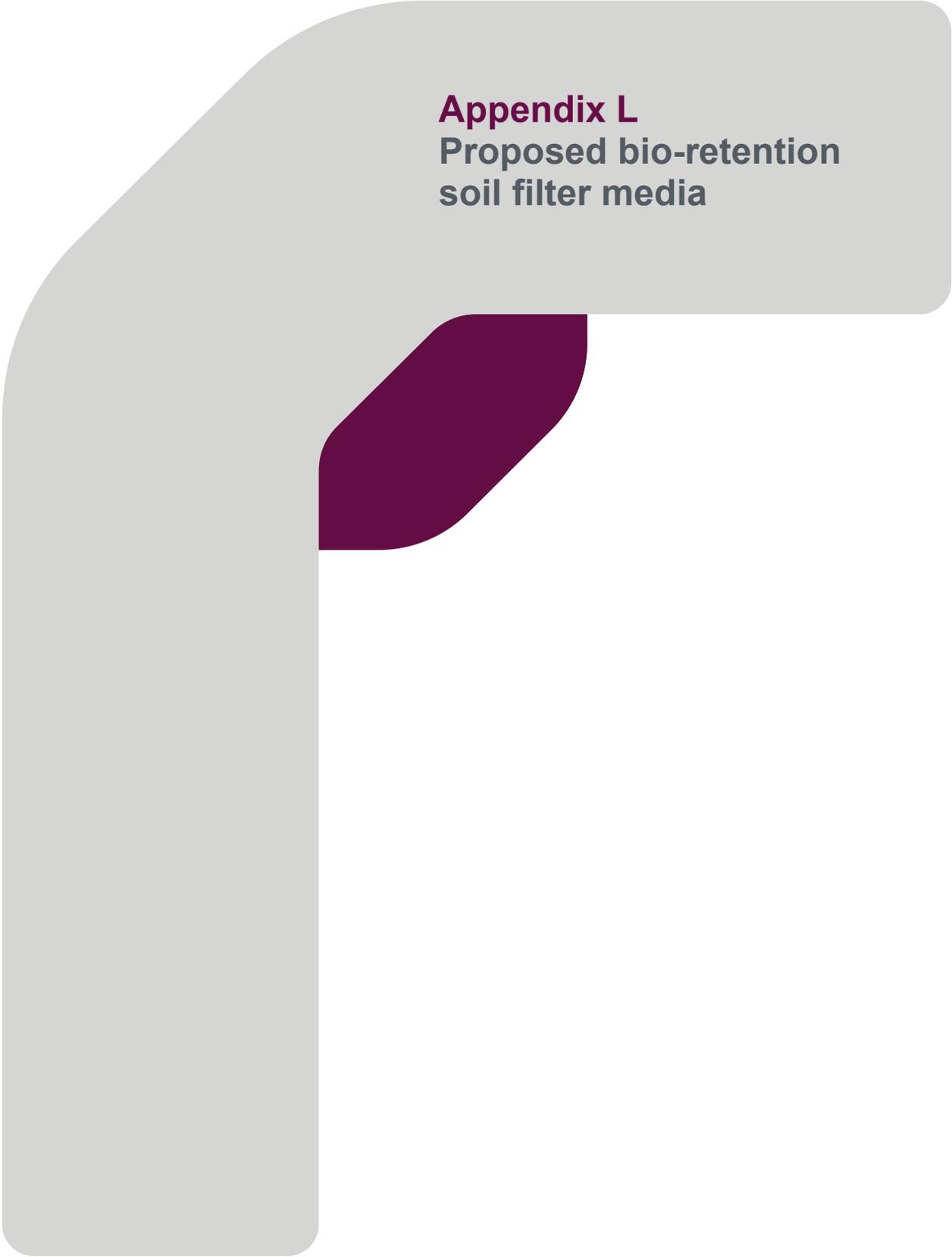
7. ENVIRONMENTAL AND GEOTECHNICAL ISSUES

Unless specifically mentioned otherwise in our report, environmental considerations are not addressed in geotechnical reports. Similarly, geotechnical issues are not addressed in environmental reports. The investigation techniques used for geotechnical investigations can differ from those used for environmental investigations. It is the client's responsibility to satisfy themselves that geotechnical and environmental considerations have been taken into account for the site.

Geotechnical advice presented in a Galt Environmental report has been provided by Galt Geotechnics under a sub-contract agreement. Similarly, environmental advice presented in a Galt Geotechnics report has been provided by Galt Environmental under a sub-contract agreement.

Unless specifically noted otherwise, no parties shall draw any inferences about the applicability of the Western Australian state government landfill levy from the contents of this document.

O:\Administration\Standard Forms and Documents\PMP11-Rev3 Understanding your Report.docx



Appendix L
Proposed bio-retention
soil filter media

Mortons Urban Solutions
Unit 4/100 Railway Road
SUBIACO WA 6008

Attention: Chris Le

**TESTING OF PROPOSED BIO RETENTION SOIL FILTER MEDIA
PARKLANDS HEIGHTS PRIVATE ESTATE
BALDIVIS**

Dear Chris,

1. INTRODUCTION

This letter presents the results of Galt Geotechnics (Galt's) testing of proposed bio retention soil filter media for the public open space (POS) areas and a median strip within the Parklands Heights Private Estate in Baldivis ("the site"). The location of the site relative to the surrounding area is shown on Figure 1, Site and Location Plan.

2. SITE DESCRIPTION

The assessed POS areas are designated K, L, M, N & E. The median strip is along Nairn Drive, extending north from Furnivall Parade. The configuration of the site is shown on Figure 1.

The site has been largely earthworked and a number of drainage basins are already formed in the POS areas. Photographs taken during the investigation are presented in Attachment A.

3. FIELDWORK

Representative samples were collected from 0-0.5 m depth from each POS area (K, L, M, N & E) and from the north and south ends of the Nairn Drive median strip (total 7 samples). The sample locations are shown on Figure 1. Photographs taken during the sampling are presented in Attachment A.

The subsurface soils at each site generally comprise:

- ☞ SAND (SP): fine to coarse grained, sub-rounded to sub-angular, typically yellow but also varying between grey-brown, grey-white grey and dark grey, trace fines.

4. LABORATORY TEST RESULTS AND DISCUSSION

Samples were submitted to the following NATA accredited laboratories for testing:

- ☛ Western Geotechnical & Laboratory Services:
 - Particle size distribution (UGSA sieve sizes).
 - Saturated hydraulic conductivity (Jakobsen & McIntyre Method).
- ☛ Envirolab Services (WA) Pty Ltd:
 - pH.
 - Electrical conductivity.
- ☛ CSBP:
 - Phosphorous retention index (PRI).

Laboratory test results are presented in Attachment B and are summarised in Table 1. Table 1 also includes the soil parameters required for bio retention soil filter media to compare the test results to the requirements.

Table 1: Summary of Laboratory Test Results and Required Soil Parameters

Soil Parameters	Sample Reference (0.00 – 0.50 m)							Bio Retention Soil Filter Media
	POS K	POS L	POS M	POS N	POS E	Nairn Dr North	Nairn Dr South	
<i>Saturated hydraulic conductivity (mm/hr)</i>	238	720	900	148	432	1476	720	100-300
<i>Clay and silt (< 0.05 mm)</i>	4.0	3.4	1.8	4.4	3.6	2.0	2.2	< 3%
<i>Very fine sand (0.05-0.15 mm)</i>	3.5	2.3	1.1	9.8	1.8	1.8	3.8	5-30%
<i>Fine sand (0.15-0.25 mm)</i>	13.5	13.3	9.6	41.6	15.6	7.3	25.7	10-30%
<i>Medium to coarse sand (0.25-1.00 mm)</i>	78.1	80.2	86.9	43.4	78.2	88.6	68.0	40-60%
<i>Coarse sand (1.00-2.00 mm)</i>	0.7	0.4	0.6	0.8	0.3	0.3	0.3	7-10%
<i>Fine gravel (2.00-3.40 mm)</i>	0.2	0.4	0	0	0.1	0	0	< 3%
<i>pH</i>	8.6	9.2	7.8	7.0	9.4	8.7	8.2	5.5-7.5
<i>Electrical conductivity (dS/m)</i>	0.048	0.055	0.0097	0.0087	0.046	0.027	0.010	< 1.2
<i>Phosphorous retention index (ml/g)</i>	6.8	2.1	3.0	8.7	3.4	1.6	2.6	> 10

Note: red values denote non-conforming parameters

The test results indicate that the sand at the POS areas and Nairn Drive median strip generally does not conform to the criteria provided.

5. CLOSURE

We draw your attention to Attachment C of this letter report, "Understanding Your Report". The information provided within is intended to inform you as to what your realistic expectations of this report should be. This information is provided not to reduce the level of responsibility accepted by Galt, but to ensure that all parties who rely on this report are aware of the responsibilities each assumes in so doing.

GALT GEOTECHNICS PTY LTD



Harry Chambers

Geotechnical Engineer



Rick Piovesan CPEng

Geotechnical Engineer

Attachments: Figure 1 – Site and Location Plan
 A – Photographs
 B – Laboratory Test Results
 C – Understanding Your Report

\\galtgeo.local\OsbornePark\Data\Jobs\2019\J1901164 - Buckby EV Parkland Heights Baldvis\03 Correspondence\J1901164 005 L Rev0.docx



Legend

- Site Boundary
- Sampling Location



0 80 160 240 320 400
Meters

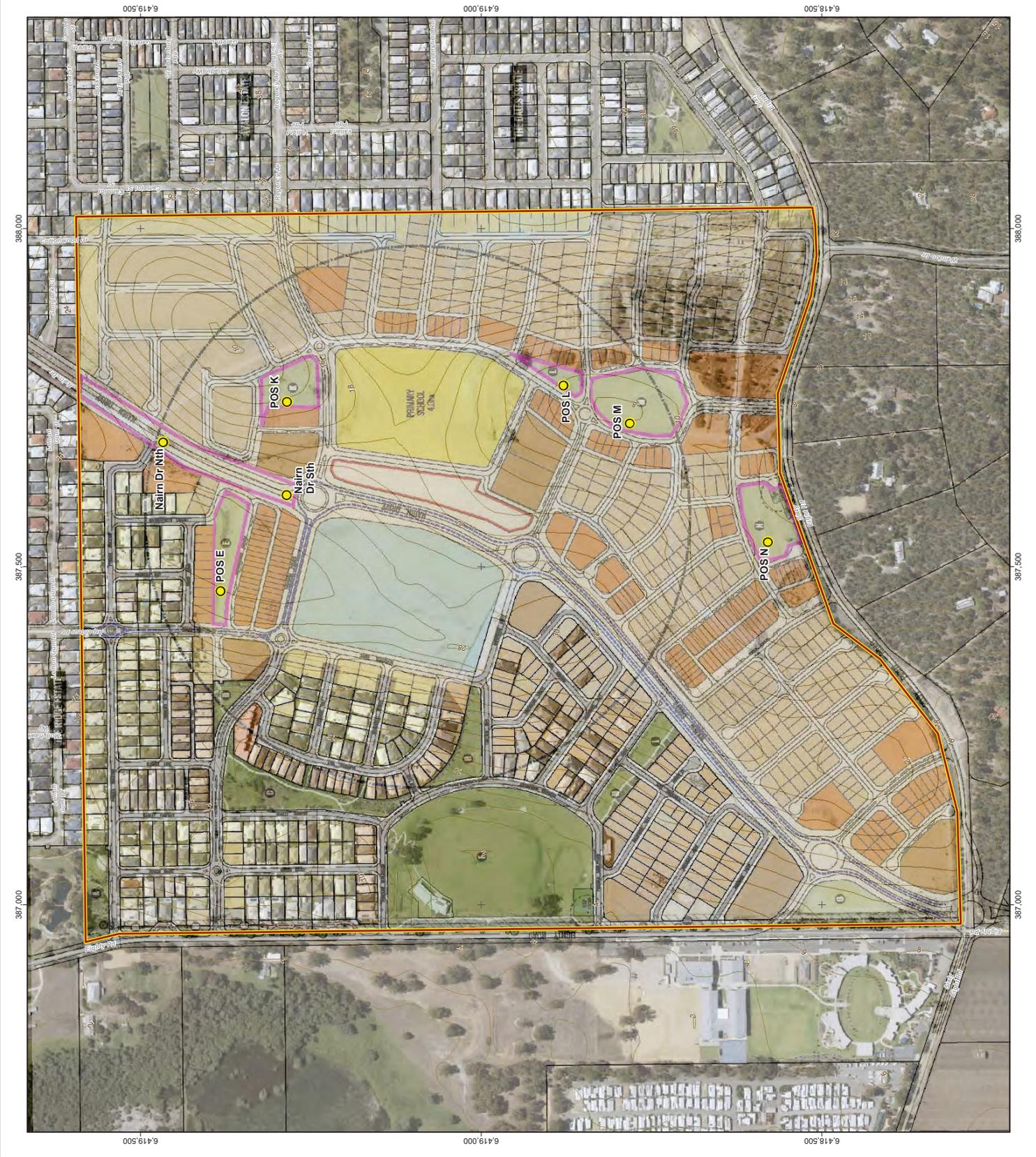
NOTES
Aerial Imagery and Cadastre sourced from Landgate/SUP

SCALE	1:5,500	(A3)
DRAWN	CED	
DATE DRAWN	15/10/2019	
CHECKED	HWC	
DATE CHECKED	15/10/2019	
PROJECTION	GDA 1984 MGA Zone 50	



Galt Geotechnics Pty Ltd
 ACN : 138 480 865
 Tel : +61 (0)8 8272-0200
 Address : 50 Edward Street
 Osborne Park WA 6017

CLIENT **MORTONS URBAN SOLUTIONS**
 PROJECT **TESTING OF BIOTENTION SOIL FILTER MEDIA**
 LOCATION **PARKLANDS HEIGHTS PRIVATE ESTATE BALDIVIS**
 TITLE **SITE & LOCATION PLAN**
 Job No **J1901164** Figure No **FIGURE 1** Rev **A**





ATTACHMENT A

Photographs



Photograph 1: General view of POS E



Photograph 2: General view of POS K



Photograph 3: General view of POS L



Photograph 4: General view of POS M



Photograph 5: General view of POS N



Photograph 6: Sample collected from south side of Nairn Drive median strip



Photograph 7: General view of north side of Nairn Drive median strip



ATTACHMENT B

Laboratory Test Results



SOIL | AGGREGATE | CONCRETE | CRUSHING

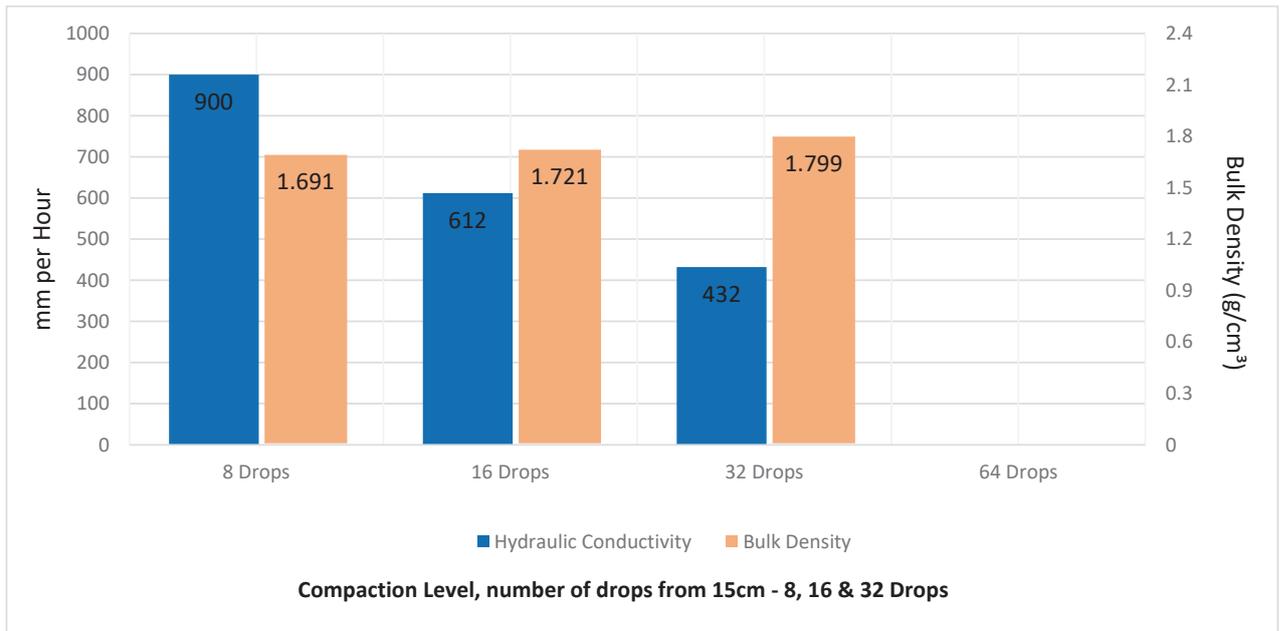
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3027_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3027
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	POS E 0.0-0.5m	Date Tested:	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Comments:

Approved Signatory:



Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3027_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3027
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	POS E 0.0-0.5m	Date Tested:	3-10-2019

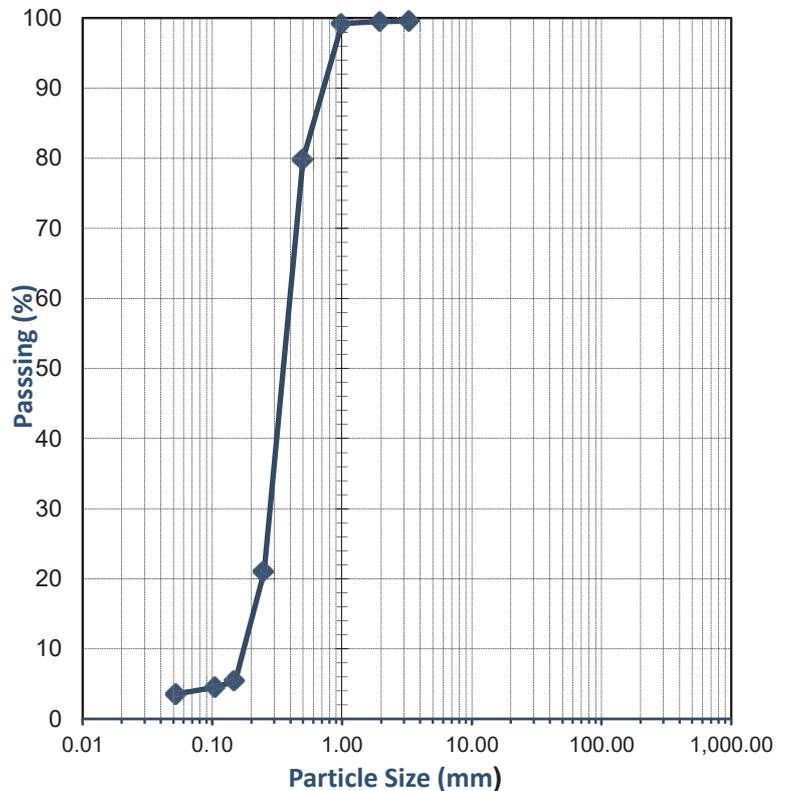
TEST RESULTS - Particle Size Distribution of Soil

Sampling Method:

Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.1
1.00	0.3
0.500	19.4
0.250	58.8
0.150	15.6
0.106	0.9
ψ 0.053	0.9

Sieve Size (mm)	Percent Passing (%)
3.35	99.6
2.00	99.5
1.00	99.2
0.500	79.8
0.250	21.0
0.150	5.4
0.106	4.5
ψ 0.053	3.6



Comments: ψ Sieve fraction 0.053 μm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 09-October-2019



Accreditation No. 20599
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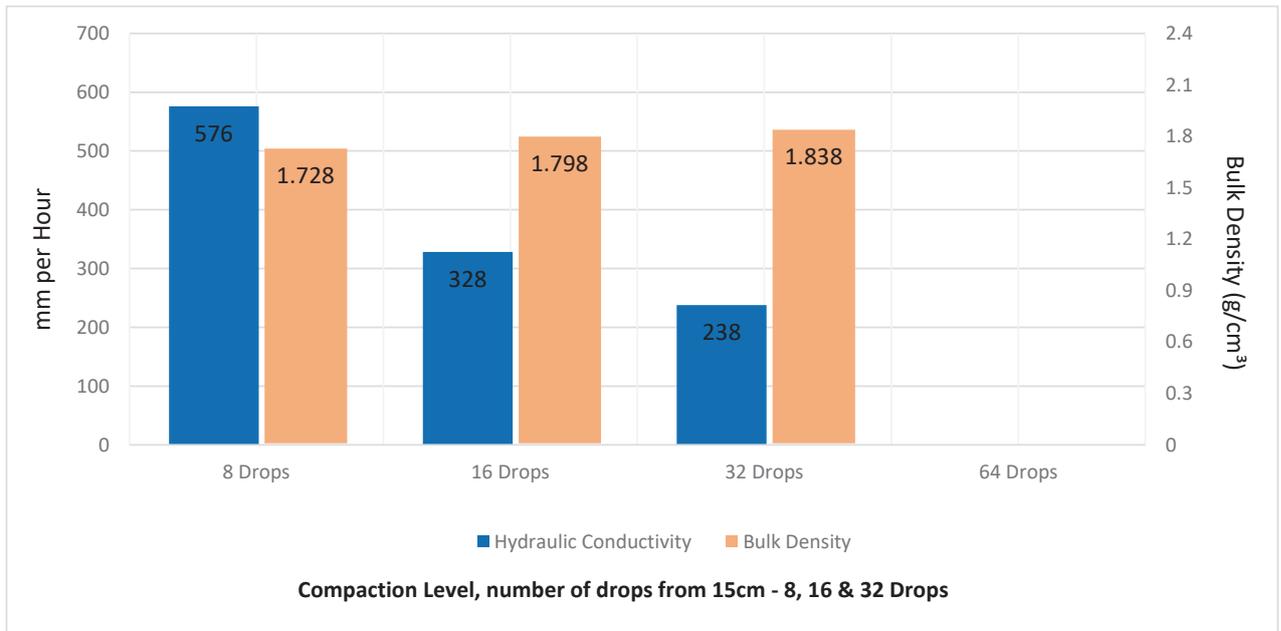
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3028_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3028
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	POS K 0.0-0.5m	Date Tested:	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

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TEST REPORT - AS 1289.3.6.1 - UGSA

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3028_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3028
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	POS K 0.0-0.5m	Date Tested:	3-10-2019

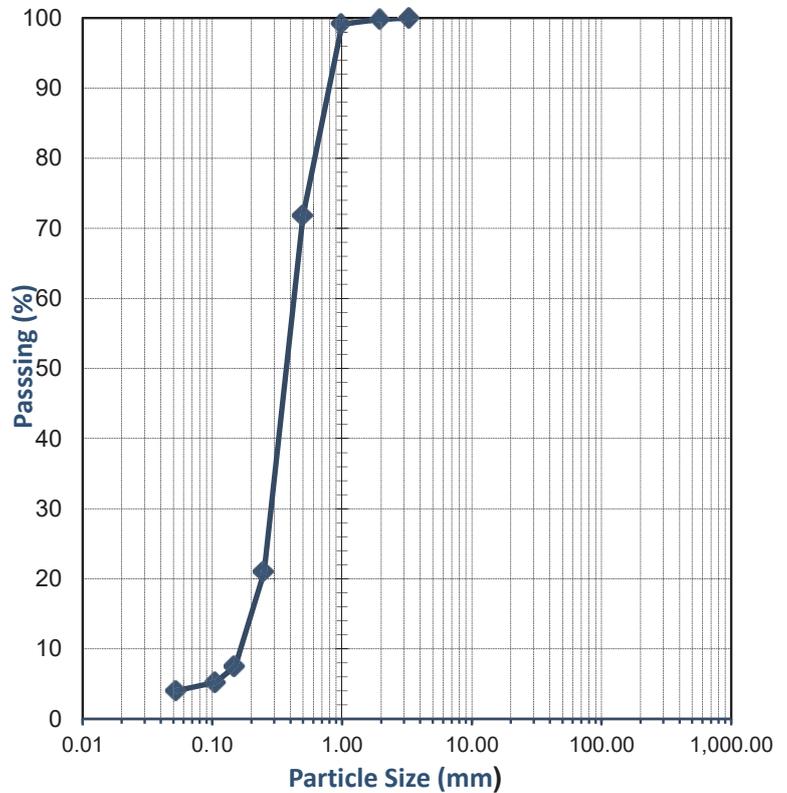
TEST RESULTS - Particle Size Distribution of Soil

Sampling Method:

Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.2
1.00	0.7
0.500	27.4
0.250	50.8
0.150	13.4
0.106	2.3
ψ 0.053	1.2

Sieve Size (mm)	Percent Passing (%)
3.35	100.0
2.00	99.8
1.00	99.1
0.500	71.8
0.250	21.0
0.150	7.5
0.106	5.2
ψ 0.053	4.0



Comments: ψ Sieve fraction 0.053 μm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:
Name: Matt van Herk
Function: General Manager
Date: 09-October-2019

Accreditation No. 20599
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with ISO/IEC 17025 - Testing

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SOIL | AGGREGATE | CONCRETE | CRUSHING

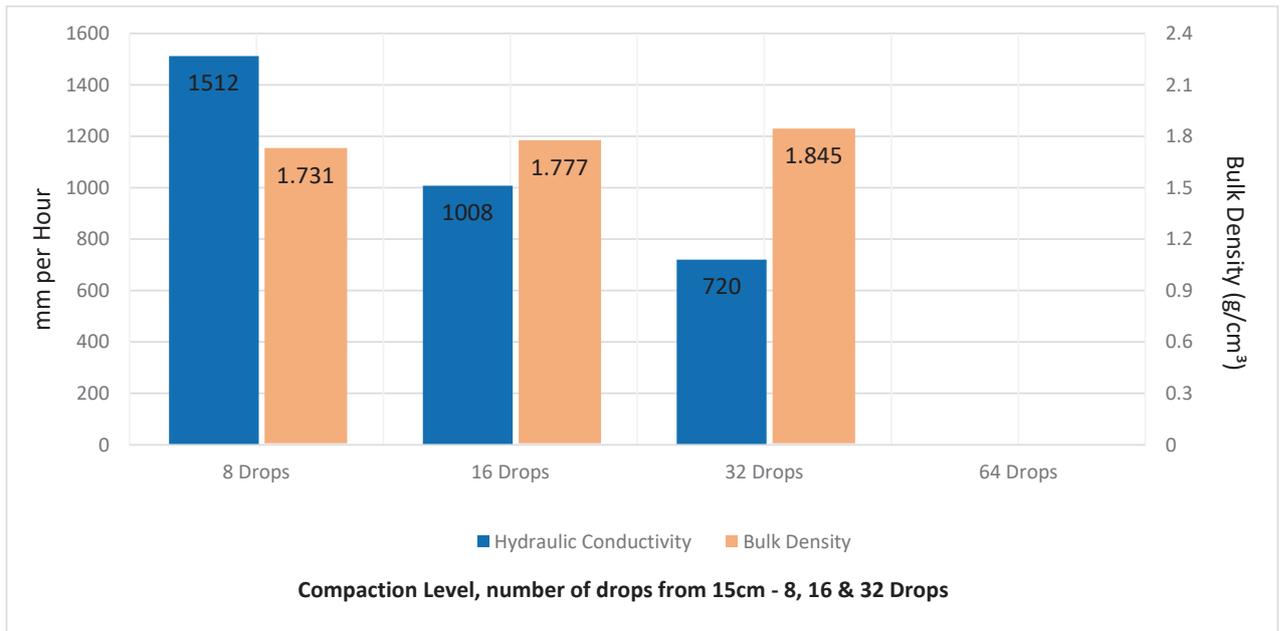
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3029_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3029
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	POS L 0.0-0.5m	Date Tested:	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3029_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3029
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	POS L 0.0-0.5m	Date Tested:	3-10-2019

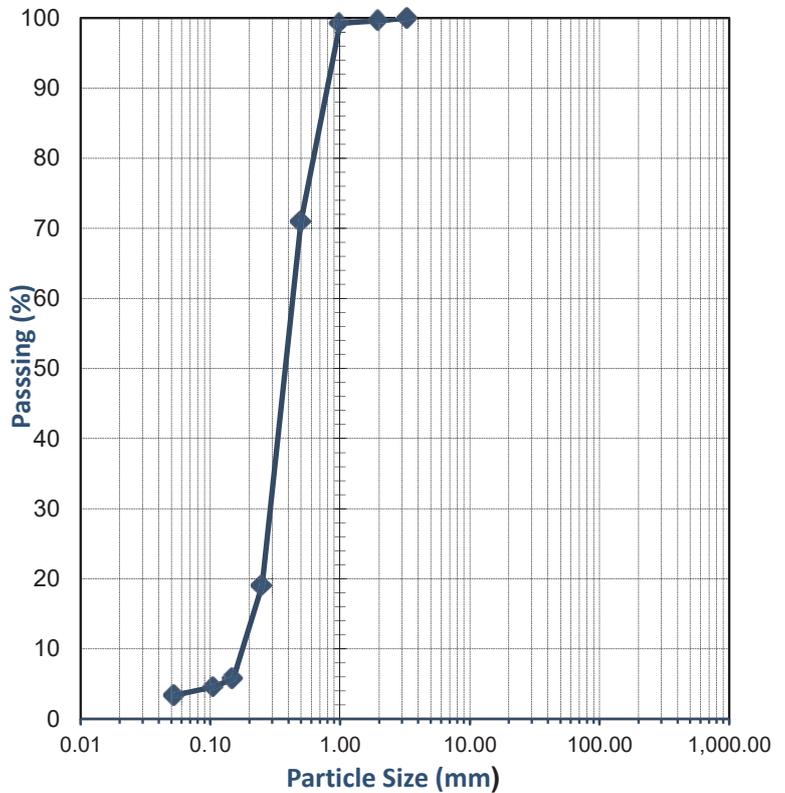
TEST RESULTS - Particle Size Distribution of Soil

Sampling Method:

Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.4
1.00	0.4
0.500	28.3
0.250	52.0
0.150	13.3
0.106	1.2
ψ 0.053	1.2

Sieve Size (mm)	Percent Passing (%)
3.35	100.0
2.00	99.6
1.00	99.2
0.500	71.0
0.250	19.0
0.150	5.7
0.106	4.6
ψ 0.053	3.4



Comments: ψ Sieve fraction 0.053 μm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:
Name: Matt van Herk
Function: General Manager
Date: 09-October-2019

Accreditation No. 20599
 Accredited for compliance
 with ISO/IEC 17025 - Testing

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SOIL | AGGREGATE | CONCRETE | CRUSHING

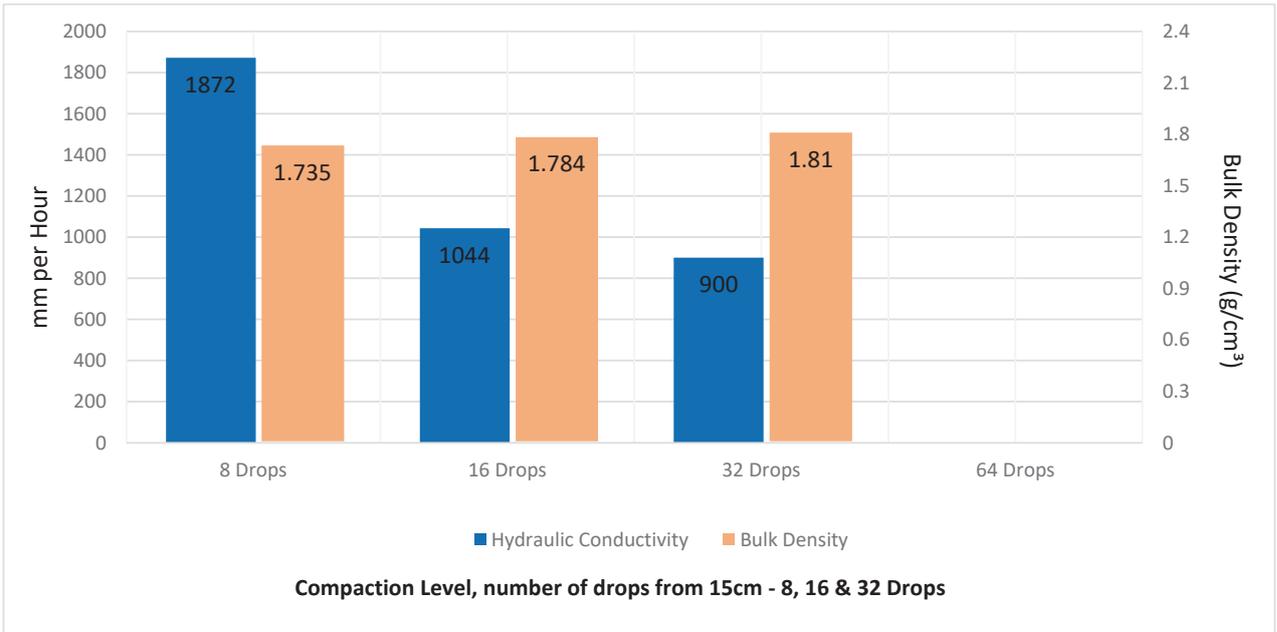
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3030_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3030
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	POS M 0.0-0.5m	Date Tested:	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3030_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3030
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	POS M 0.0-0.5m	Date Tested:	3-10-2019

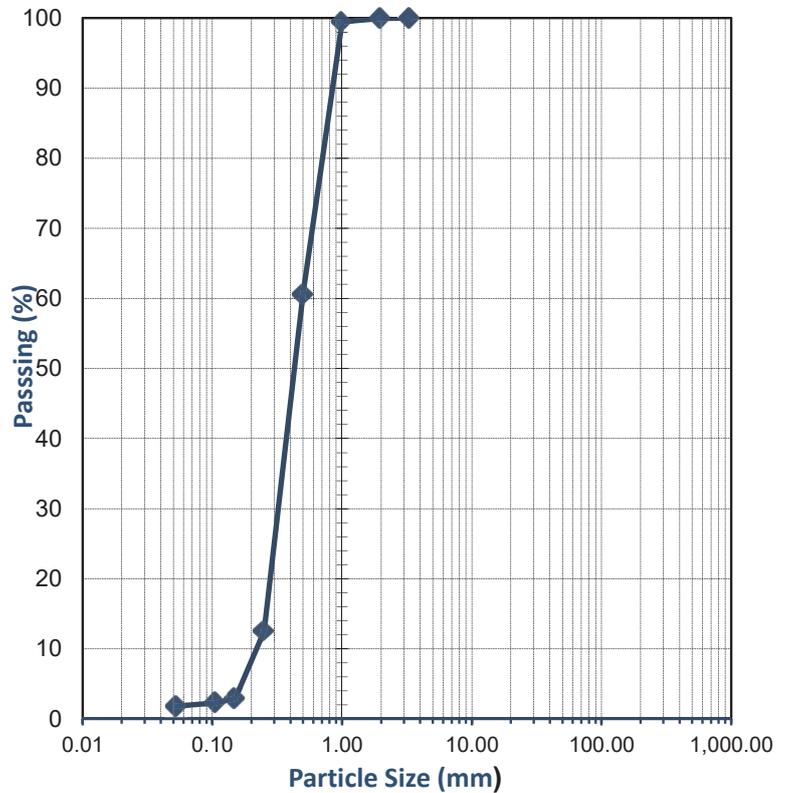
TEST RESULTS - Particle Size Distribution of Soil

Sampling Method:

Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.0
1.00	0.5
0.500	38.8
0.250	48.1
0.150	9.6
0.106	0.6
ψ 0.053	0.5

Sieve Size (mm)	Percent Passing (%)
3.35	100.0
2.00	100.0
1.00	99.4
0.500	60.6
0.250	12.5
0.150	2.9
0.106	2.3
ψ 0.053	1.8



Comments: ψ Sieve fraction 0.053 μm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:
Name: Matt van Herk
Function: General Manager
Date: 09-October-2019

Accreditation No. 20599
Accredited for compliance
with ISO/IEC 17025 - Testing

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SOIL | AGGREGATE | CONCRETE | CRUSHING

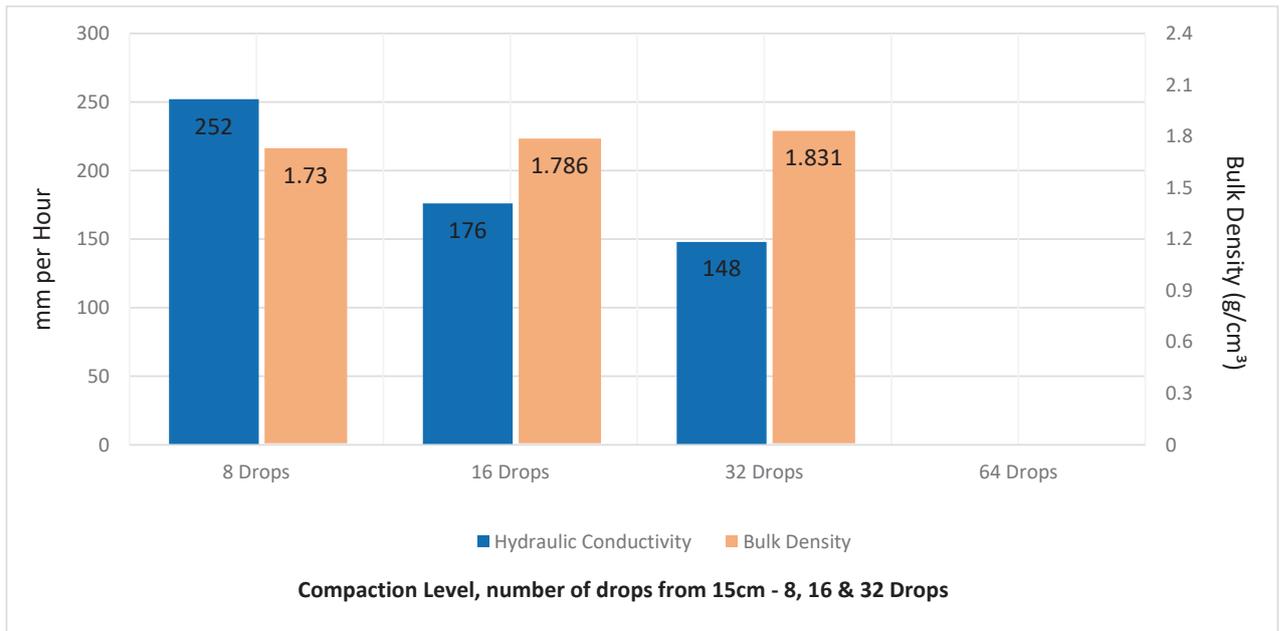
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3031_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3031
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	POS N 0.0-0.5m	Date Tested:	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3031_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3031
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	POS N 0.0-0.5m	Date Tested:	3-10-2019

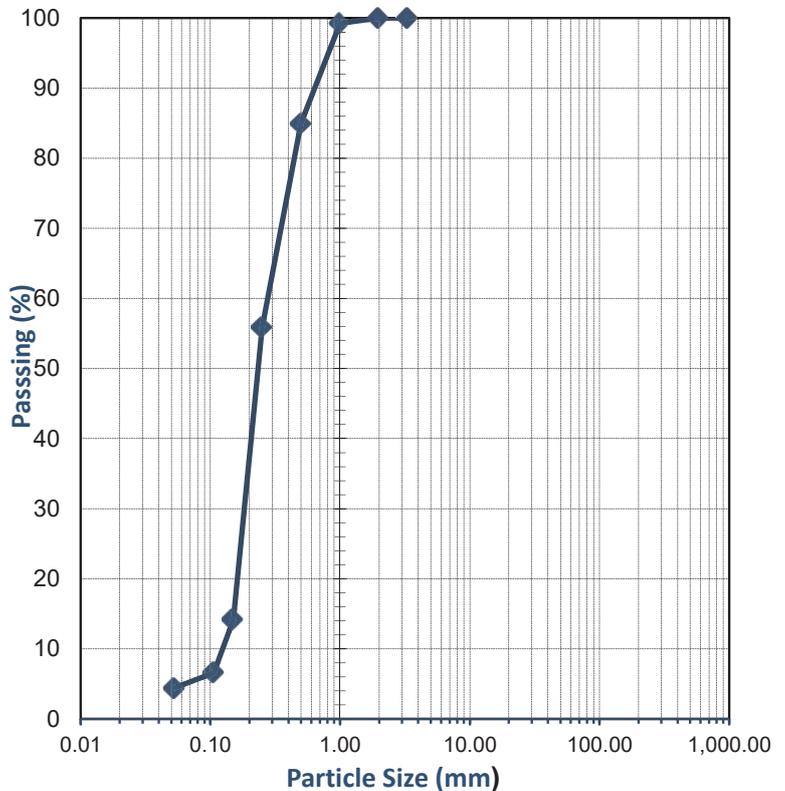
TEST RESULTS - Particle Size Distribution of Soil

Sampling Method:

Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.0
1.00	0.8
0.500	14.3
0.250	29.2
0.150	41.6
0.106	7.6
ψ 0.053	2.1

Sieve Size (mm)	Percent Passing (%)
3.35	100.0
2.00	100.0
1.00	99.2
0.500	85.0
0.250	55.8
0.150	14.2
0.106	6.6
ψ 0.053	4.4



Comments: ψ Sieve fraction 0.053 μm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:
Name: Matt van Herk
Function: General Manager
Date: 09-October-2019

Accreditation No. 20599
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with ISO/IEC 17025 - Testing

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SOIL | AGGREGATE | CONCRETE | CRUSHING

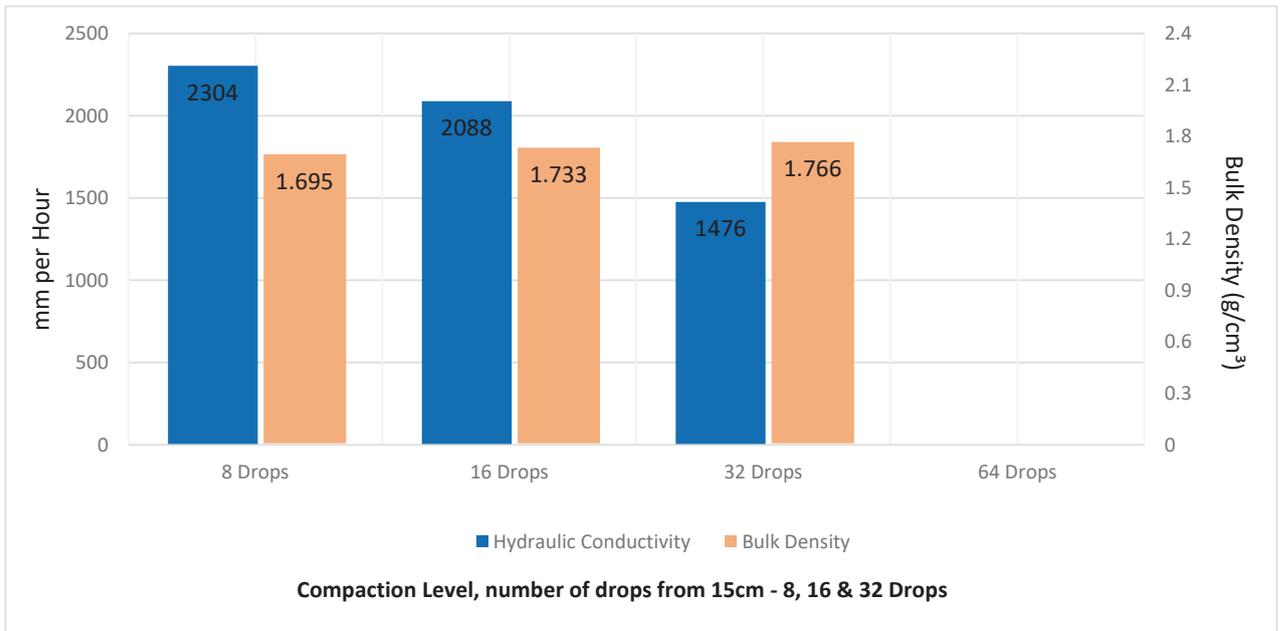
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3032_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3032
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	Nairn - North 0.0-0.5m	Date Tested:	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3032_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3032
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	Nairn - North 0.0-0.5m	Date Tested:	3-10-2019

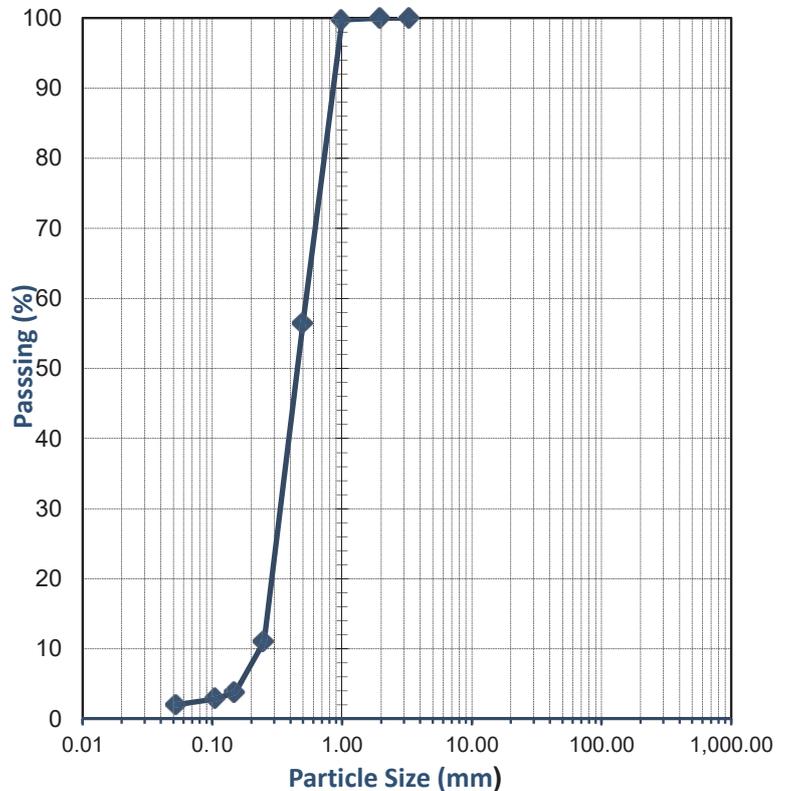
TEST RESULTS - Particle Size Distribution of Soil

Sampling Method:

Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.0
1.00	0.2
0.500	43.3
0.250	45.4
0.150	7.2
0.106	0.9
ψ 0.053	0.8

Sieve Size (mm)	Percent Passing (%)
3.35	100.0
2.00	100.0
1.00	99.7
0.500	56.5
0.250	11.1
0.150	3.8
0.106	2.9
ψ 0.053	2.0



Comments: ψ Sieve fraction 0.053 μm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 09-October-2019



Accreditation No. 20599
Accredited for compliance
with ISO/IEC 17025 - Testing

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SOIL | AGGREGATE | CONCRETE | CRUSHING

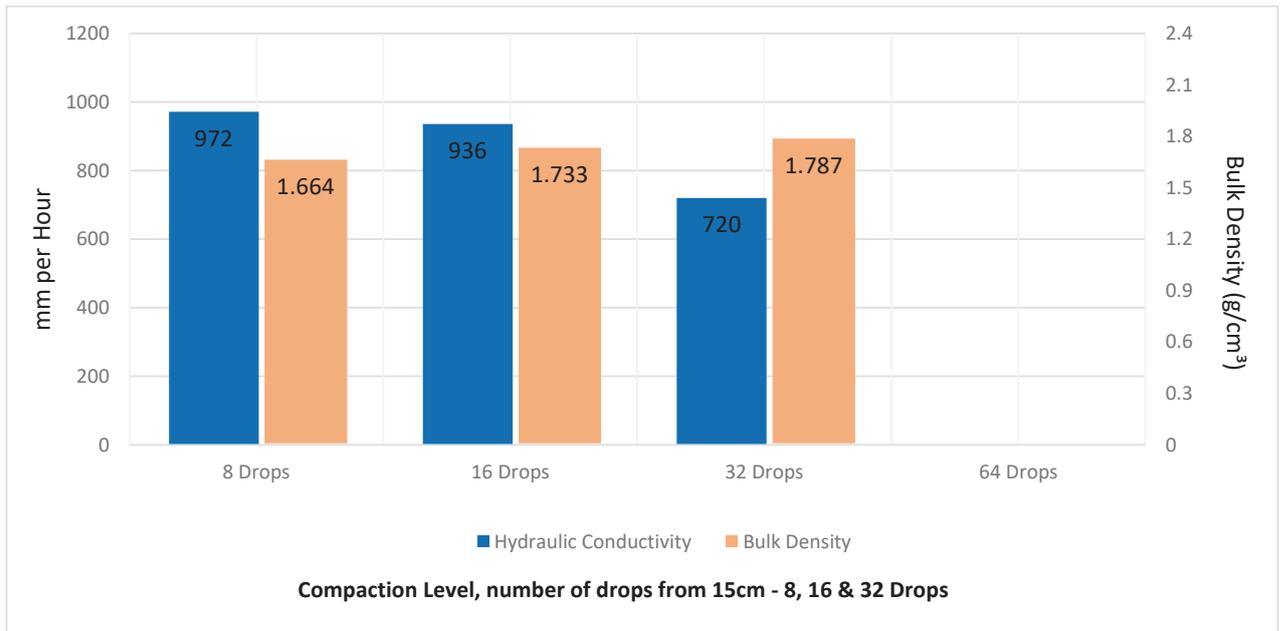
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3033_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3033
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	Nairn - South 0.0-0.5m	Date Tested:	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

Client:	Mortons Urban Solutions	Ticket No.	S408
Client Address:	-	Report No.	WG19/3033_1_UGSA
Project:	Proposed Bioretention Media	Sample No.	WG19/3033
Location:	Parklands Heights Estate, Baldivis	Date Sampled:	Not Specified
Sample Identification:	Nairn - South 0.0-0.5m	Date Tested:	3-10-2019

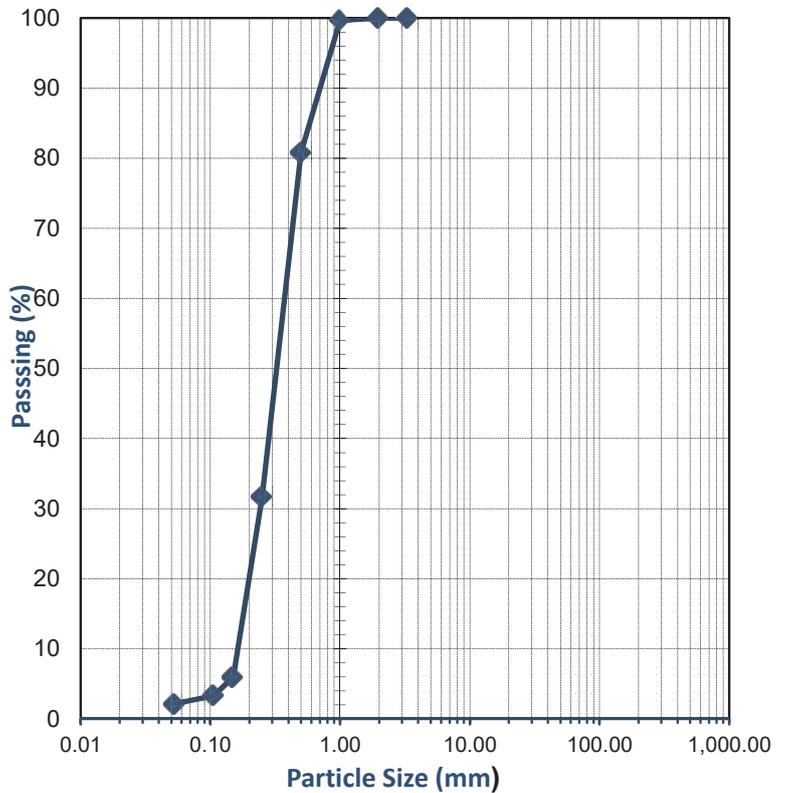
TEST RESULTS - Particle Size Distribution of Soil

Sampling Method:

Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.0
1.00	0.3
0.500	18.9
0.250	49.1
0.150	25.7
0.106	2.7
ψ 0.053	1.1

Sieve Size (mm)	Percent Passing (%)
3.35	100.0
2.00	100.0
1.00	99.7
0.500	80.8
0.250	31.7
0.150	6.0
0.106	3.3
ψ 0.053	2.2



Comments: ψ Sieve fraction 0.053 μm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:
Name: Matt van Herk
Function: General Manager
Date: 09-October-2019

Accreditation No. 20599
Accredited for compliance
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Analysis Results

CSBP Soil and Plant Laboratory



95386

Western Geotechnical & Laboratory Service

Lab No	6ES19089	6ES19090	6ES19091	6ES19092	6ES19093	6ES19094	6ES19095
Depth	0-10	0-10	0-10	0-10	0-10	0-10	0-10
Name	POS E 0.0-0.5M	POS K 0.0-0.5M	POS L 0.0-0.5M	POS M 0.0-0.5M	POS N 0.0-0.5M	NAIRN NORTH 0.0-0.5M	NAIRN SOUTH 0.0-0.5M
Code	WG19/3027	WG19/3028	WG19/3029	WG19/3030	WG19/3031	WG19/3032	WG19/3033
Customer	MORTONS URBAN SOLUTIONS						
Phosphorus Retention Index	3.4	6.8	2.1	3.0	8.7	1.6	2.6



CERTIFICATE OF ANALYSIS 233854

Client Details

Client	Western Geotechnical & Laboratory Services
Attention	Matt van Herk
Address	235 Bank Street, Welshpool, WA, 6101

Sample Details

Your Reference	<u>S408/Mortons Urban Solutions/Proposed</u>
Number of Samples	7 Soil
Date samples received	03/10/2019
Date completed instructions received	03/10/2019
Location	Bioretention Media/Parkland Heights

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	10/10/2019
Date of Issue	10/10/2019

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By

Heram Halim, Operations Manager

Authorised By

Michael Kubiak, Laboratory Manager

Miscellaneous Inorg - soil						
Our Reference		233854-1	233854-2	233854-3	233854-4	233854-5
Your Reference	UNITS	POS E	POS K	POS L	POS M	POS N
Depth		0.0-0.5m	0.0-0.5m	0.0-0.5m	0.0-0.5m	0.0-0.5m
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	09/10/2019	09/10/2019	09/10/2019	09/10/2019	09/10/2019
Date analysed	-	10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
pH	pH Units	9.4	8.6	9.2	7.8	7.0
Electrical Conductivity (EC)	µS/cm	46	48	55	9.7	8.7

Miscellaneous Inorg - soil			
Our Reference		233854-6	233854-7
Your Reference	UNITS	Nairn - North	Nairn - South
Depth		0.0-0.5m	0.0-0.5m
Type of sample		Soil	Soil
Date prepared	-	09/10/2019	09/10/2019
Date analysed	-	10/10/2019	10/10/2019
pH	pH Units	8.7	8.2
Electrical Conductivity (EC)	µS/cm	27	10

Method ID	Methodology Summary
INORG-001	pH - Measured using pH meter and electrode base on APHA latest edition, Method 4500-H+. Please note that the results for water analyses may be indicative only, as analysis can be completed outside of the APHA recommended holding times. Soils are reported from a 1:5 water extract unless otherwise specified.
INORG-002	Conductivity and Salinity - measured using a conductivity cell at 25°C based on APHA latest edition Method 2510. Soils reported from a 1:5 water extract unless otherwise specified.

Client Reference: S408/Mortons Urban Solutions/Proposed

QUALITY CONTROL: Miscellaneous Inorg - soil				Duplicate				Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			09/10/2019	1	09/10/2019	09/10/2019		09/10/2019	[NT]
Date analysed	-			10/10/2019	1	10/10/2019	10/10/2019		10/10/2019	[NT]
pH	pH Units		INORG-001	[NT]	1	9.4	9.4	0	101	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	<1	1	46	43	7	108	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.
Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.	
The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available).	

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) a

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.



ATTACHMENT C

Understanding Your Report

UNDERSTANDING YOUR REPORT

GALT FORM PMP11 Rev3

1. EXPECTATIONS OF THE REPORT

This document has been prepared to clarify what is and is not provided in your report. It is intended to inform you of what your realistic expectations of this report should be and how to manage your risks associated with the conditions on site.

Geotechnical engineering and environmental science are less exact than other engineering and scientific disciplines. We include this information to help you understand where our responsibilities begin and end. You should read and understand this information. Please contact us if you do not understand the report or this explanation. We have extensive experience in a wide variety of projects and we can help you to manage your risk.

2. THIS REPORT RELATES TO PROJECT-SPECIFIC CONDITIONS

This report was developed for a unique set of project-specific conditions to meet the needs of the nominated client. It took into account the following:

- ✦ the project objectives as we understood them and as described in this report;
- ✦ the specific site mentioned in this report; and
- ✦ the current and proposed development at the site.

It should not be used for any purpose other than that indicated in the report. You should not rely on this report if any of the following conditions apply:

- ✦ the report was not written for you;
- ✦ the report was not written for the site specific to your development;
- ✦ the report was not written for your project (including a development at the correct site but other than that listed in the report); or
- ✦ the report was written before significant changes occurred at the site (such as a development or a change in ground conditions).

You should always inform us of changes in the proposed project (including minor changes) and request an assessment of their impact.

Where we are not informed of developments relevant to your report, we cannot be held responsible or liable for problems that may arise as a consequence.

Where design is to be carried out by others using information provided by us, we recommend that we be involved in the design process by being engaged for consultation with other members of the project team. Furthermore, we recommend that we be able to review work produced by other members of the project team that relies on information provided in our report.

3. SOIL LOGS

Our reports often include logs of intrusive and non-intrusive investigation techniques. These logs are based on our interpretation of field data and laboratory results. The logs should only be read in conjunction with the report they were issued with and should not be re-drawn for inclusion in other documents not prepared by us.

4. THIRD PARTY RELIANCE

We have prepared this report for use by the client. This report must be regarded as confidential to the client and the client's professional advisors. We do not accept any responsibility for contents of this document from any party other than the nominated client. We take no responsibility for any damages suffered by a third party because of any decisions or actions they may make based on this report. Any reliance or decisions made by a third party based on this report are the responsibility of the third party and not of us.

5. CHANGE IN SUBSURFACE CONDITIONS

The recommendations in this report are based on the ground conditions that existed at the time when the study was undertaken. Changes in ground conditions can occur in numerous ways including anthropogenic events (such as construction or contaminating activities on or adjacent to the site) or natural events (such as floods, groundwater fluctuations or earthquakes). We should be consulted prior to use of this report so that we can comment on its reliability. It is important to note that where ground conditions have changed, additional sampling, testing or analysis may be required to fully assess the changed conditions.

6. SUBSURFACE CONDITIONS DURING CONSTRUCTION

Practical constraints mean that we cannot know every minute detail about the subsurface conditions at a particular site. We use professional judgement to form an opinion about the subsurface conditions at the site. Some variation to our evaluated conditions is likely and significant variation is possible. Accordingly, our report should not be considered as final as it is developed from professional judgement and opinion.

The most effective means of dealing with unanticipated ground conditions is to engage us for construction support. We can only finalise our recommendations by observing actual subsurface conditions encountered during construction. We cannot accept liability for a report's recommendations if we cannot observe construction.

7. ENVIRONMENTAL AND GEOTECHNICAL ISSUES

Unless specifically mentioned otherwise in our report, environmental considerations are not addressed in geotechnical reports. Similarly, geotechnical issues are not addressed in environmental reports. The investigation techniques used for geotechnical investigations can differ from those used for environmental investigations. It is the client's responsibility to satisfy themselves that geotechnical and environmental considerations have been taken into account for the site.

Geotechnical advice presented in a Galt Environmental report has been provided by Galt Geotechnics under a sub-contract agreement. Similarly, environmental advice presented in a Galt Geotechnics report has been provided by Galt Environmental under a sub-contract agreement.

Unless specifically noted otherwise, no parties shall draw any inferences about the applicability of the Western Australian state government landfill levy from the contents of this document.

O:\Administration\Standard Forms and Documents\PMP11-Rev3 Understanding your Report.docx

Appendix 3 Engineering Report

Parkland Heights, Lot 1507 Eighty Road, Baldivis - Local Structure Plan Amendment

Civil Engineering Services Report

Project No: 22-319

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Appendix One: Proposed Freehold Division (RHPPH-3-012B)

Appendix Two: Local Structure Plan Map (RHPPH-2-001A)

Revision	Description	Author	Date
A	Initial Issue	Kyle Johnston	26 June 2024



1 Introduction

1.1 General

Pritchard Francis has been engaged to prepare an engineering services report to support a Local Structure Plan (LSP) amendment for Lot 1507 Eighty Road, Baldvis. The below represents a summary of engineering services, both current and future planned services to facilitate the development of the Proposed Freehold Division (RHPPH-3-012B) found in Appendix One, which is supported by the Local Structure Plan Map (RHPPH-2-001A) found in Appendix Two.

This report outlines the capacity of existing utilities to service the development and is based on infrastructure planning currently available from authorities and infrastructure mapping services online. The services under assessment are:

- Water and Sewer Reticulation (Water Corporation)
- Drainage (City of Armadale)
- Gas (ATCO Gas Australia)
- Power (Western Power)
- Communications (Telstra, NBN)

In addition to a utility service capacity assessment, the report also covers geology and preliminary earthworks advice for the development.



Figure 1 - Aerial Photograph of Proposed Development Site (MetroMap, June 2024)





Figure 2 - Local Structure Plan (LSP) Map, Lot 1507 Eighty Road, Baldivis

1.2 Report Qualifications

In line with this report, Pritchard Francis make the following qualifications:

- This report was prepared exclusively for Rockingham Park Pty Ltd. Unless otherwise stated, the use of this report by third parties is not permitted.
- The information provided in this report may be considered valid for three (3) months from the date of the report.
- The information provided in this report is based upon the information and documentation provided by the client. Pritchard Francis have relied on such information and documents being true. Where we are uninformed of developments outside of this report, Pritchard Francis cannot be held responsible or liable for any problems or issues that may arise consequently.
- Assumptions have been made which, if incorrect, have the potential to impact the recommendations of this report. Major development implications existing through avenues which cannot be assured at the time of this report, including the upgrading and provision of utility services, WAPC Conditions, DA Conditions, Local Authority Scheme Requirements, timing of adjacent developments, etc.
- Unless otherwise stated, the capacities of existing services have not been verified via calculations. Where required, specialist consultants may need to be engaged to provide accurate assessments of existing and future servicing capacities.
- A geotechnical report has not been conducted at present. Pritchard Francis has undertaken a desktop geological assessment and considered the geotechnical findings from geotechnical investigations of nearby sites.
- All cost estimates mentioned in this report represent our best judgment based on information available at the time of providing but Pritchard Francis cannot and does not warrant that it represents the final construction cost. Pritchard Francis is not a Quantity Surveyor and does not employ quantity surveyors.
- The civil designs presented in this report are conceptual in nature, and by no means depict the ultimate design solution. Detail design and documentation will be necessary to validate all design levels and gradients to ensure compliant with the client brief, Australian Standards, Austroads and relevant authority guidelines.
- Where design is carried out by third parties using information provided by Pritchard Francis, it is recommended that Pritchard Francis be engaged or involved in the design process.



2 Information Sources

The table below outlines the background and service information obtained by Pritchard Francis to facilitate this report.

Description of Data	Obtained From	Date
Local Structure Plan Map	CDP-AU PTY LTD	09 June 2024
Proposed Freehold Subdivision	CDP-AU PTY LTD	09 June 2024
LWMS	CDP-AU PTY LTD	09 June 2024
Geotechnical Information	ENV Australia Pty Ltd (2011)	19 June 2024
Water Corporation Data	Water Corporation Esinet	19 June 2024
Aerial Image	MNG Mapping	19 June 2024
Groundwater Data	ENV Australia Pty Ltd (2011)	19 June 2024
Acid Sulphate Soils (ASS)	ENV Australia Pty Ltd (2011)	19 June 2024

3 Codes and Standards

This project will be designed and documented in accordance with all relevant standards and codes of practice. In general, the codes relevant to the civil design will be:

- AS 2890.5-2020 On-Street Parking
- AS 3798-2007 Guidelines on Earthworks for Commercial and Residential Developments.
- Australian Rainfall and Runoff (2016).
- Australian Runoff Quality (2006).
- IPWEA Local Government Guidelines for Subdivisional Development Edition 2.3-2017 or City of Armadale Standards.

All work and materials shall comply with all relevant standards.



4 Site Conditions

4.1 Geology

4.1.1 Geotechnical Conditions

Currently, there is no geotechnical investigation report for the proposed development site. Pritchard Francis recommends a geotechnical investigation to be performed prior to design. Pritchard Francis has undertaken a desktop geological study based on information from a previous report by ENV Australia Pty Ltd.

The desktop study carried out by ENV Australia Pty Ltd in 2011 states that the 1 in 50,000 Environmental Geology Series describes the geology at and surrounding the site as:

- S7 Sand – (Sand derived from Tamala limestone) pale yellowish brown, medium to coarse-grained, sub-angular to well-rounded quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin.

This soil unit is also known as “Spearwood Sand”. ENV also recorded the presence of a layer of clayey sand at a depth of 1.7m at groundwater bore however it is believed that this layer was only isolated to a small area in the north-western corner of the Parkland Heights development. The physical properties of the site geology are described as follows:

- High permeability
- Low to medium slope stability; and
- Moderate ease of excavation

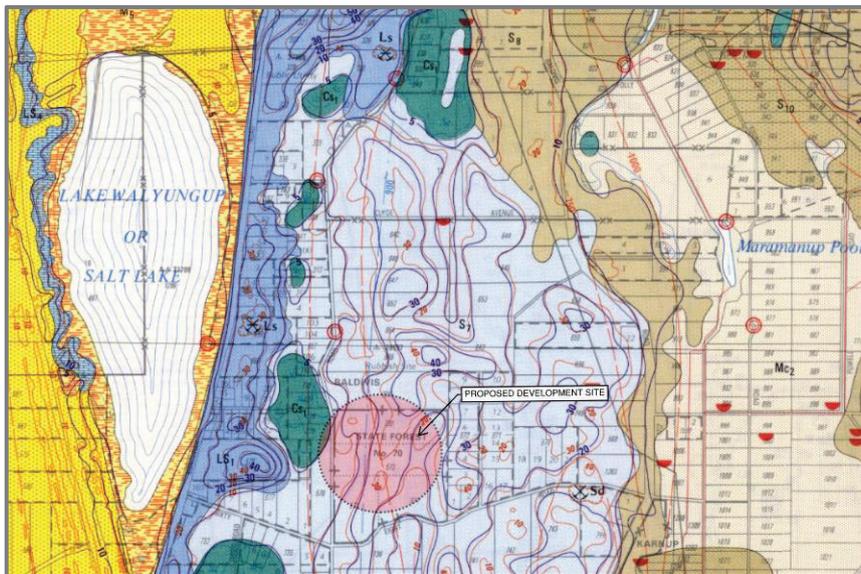


Figure 3 - 1 in 50,000 Environmental Geology Map of Proposed Development Site (City of Rockingham, June 2024)



4.2 Topography and Survey

Prichard Francis has utilised the Water Corporation Esinet Data to extract 1.0m contour intervals and obtain specific heights. Locally, the existing site levels vary throughout the site as noted below:

- RL – 9.00 AHD to RL 15.00 AHD to the north of the proposed development site.
- RL – 24.00 AHD to RL 29.00 AHD to the west of the proposed development site.
- RL – 23.00 AHD to RL 33.00 AHD to the east of the proposed development site.
- RL – 11.00 AHD to RL 8.00 AHD to the south of the proposed development site.

In summary, the land typically falls to the east of the proposed Nairn Drive and rises sharply west again to the boundary of Wensley Street.

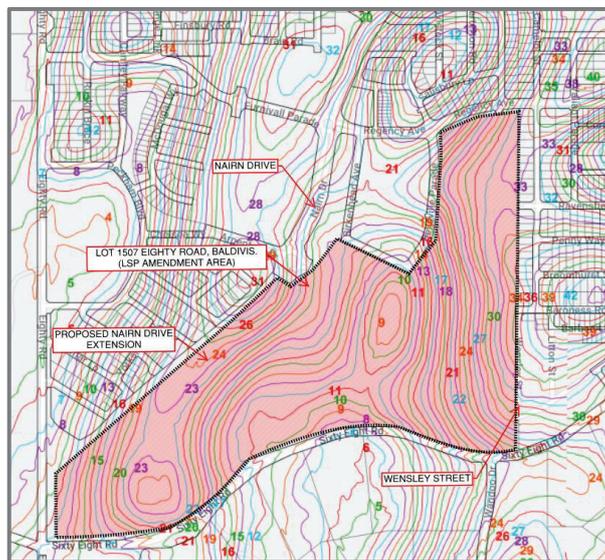


Figure 4 - Existing Topography (Esinet, 2024)

4.3 Groundwater Level

A desktop study carried out by ENV Australia Pty Ltd in 2011 states that the Annual Average Maximum Groundwater Levels (AAMGs) on the site were calculated from levels measured in October 2009. Using the figure found within the report we can anticipate that groundwater levels within the proposed local structure plan area and ranges from < 5m to > 30m AHD. This is noted in Figure 5 below.

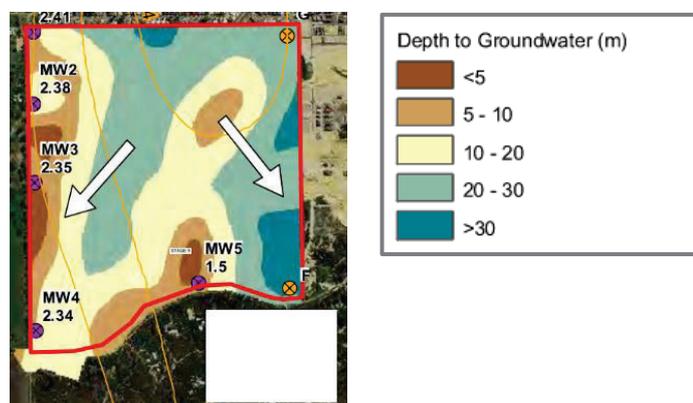


Figure 5 - Existing Groundwater Levels, Lot 1507 Eighty Road, Baldvis (ENV, 2011)



4.4 Earthworks Strategy

The subject site has previously been earth-worked in part for sand extraction in the 2000's which has created some steep grades within the site as outlined in the topography and survey section. These grades are particularly steep adjacent to Wensley Place, east of the site and to the proposed Nairn Drive extension in the west of the site. This will need to be considered in the finished design levels to best integrate the ultimate road and lot levels.

The proposed development isn't expected to require groundwater management with soils suitable for stormwater infiltration (sand with low percentage fines) and appropriate separation to the groundwater table (6 m minimum). Opportunities for cut to fill will be investigated to shape the landform with consideration to the existing vegetation on site and requirements for best practise road design in line with Austroads and IPWEA guidelines.

4.5 Acid Sulphate Soil

A previous report by ENV Australia Pty Ltd indicates that an Acid Sulphate Soils (ASS) investigation was undertaken on the site in 2009. The investigation indicates the development was generally at a low risk of ASS, in line with the ASS risk mapping of the site. It is however noted in the report that one soil sample showed evidence of ASS. This was found in the north-west of the site at a depth of 2.25m due to the close proximity to a high-risk ASS area associated with an adjacent wetland. Given the distance from the proposed development, Pritchard Francis anticipate that there will be a low risk of ASS in the proposed development however it is recommended that localised investigation is carried out.

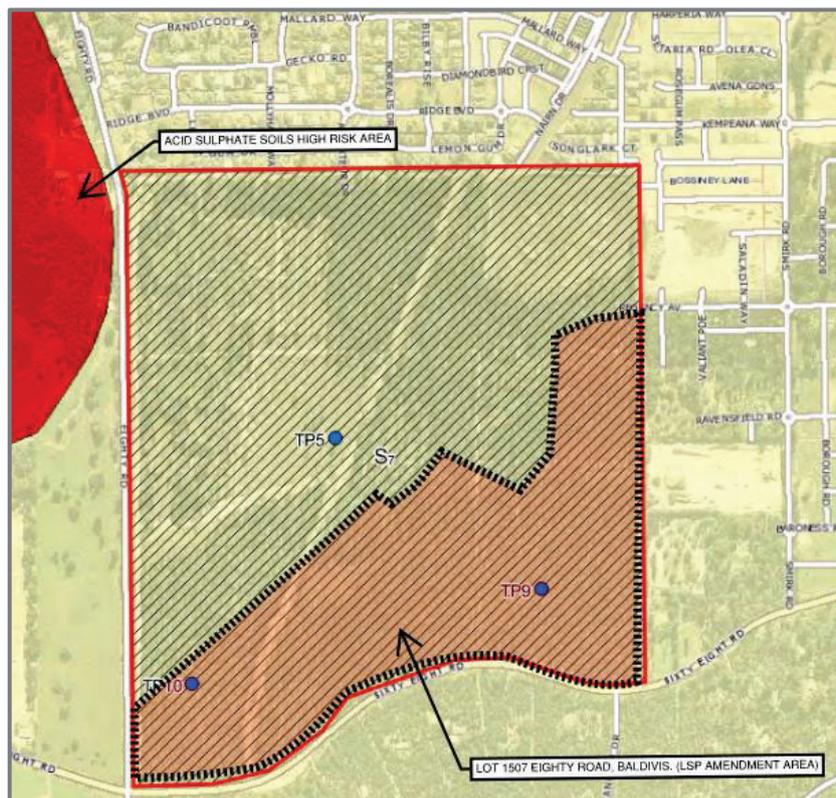


Figure 6 - Acid Sulphate Soils (ASS) Risk (ENV, 2011)



5 Utilities Infrastructure

5.1 Sewerage Reticulation

The proposed development area is located in a sewer license under Water Corporations control. The Water corporation Esinet Data confirms the presence of sewer reticulation infrastructure that travels through the proposed local structure plan area via a \varnothing 225PVC gravity sewer from Regency Avenue to Nairn Drive to a pumping station on Sixty-Eight Road. From the pumping station a \varnothing 250PE sewer pressure main then travels west towards the Brightwood Development.

Pritchard Francis note that all infrastructure is in place to service the proposed development.

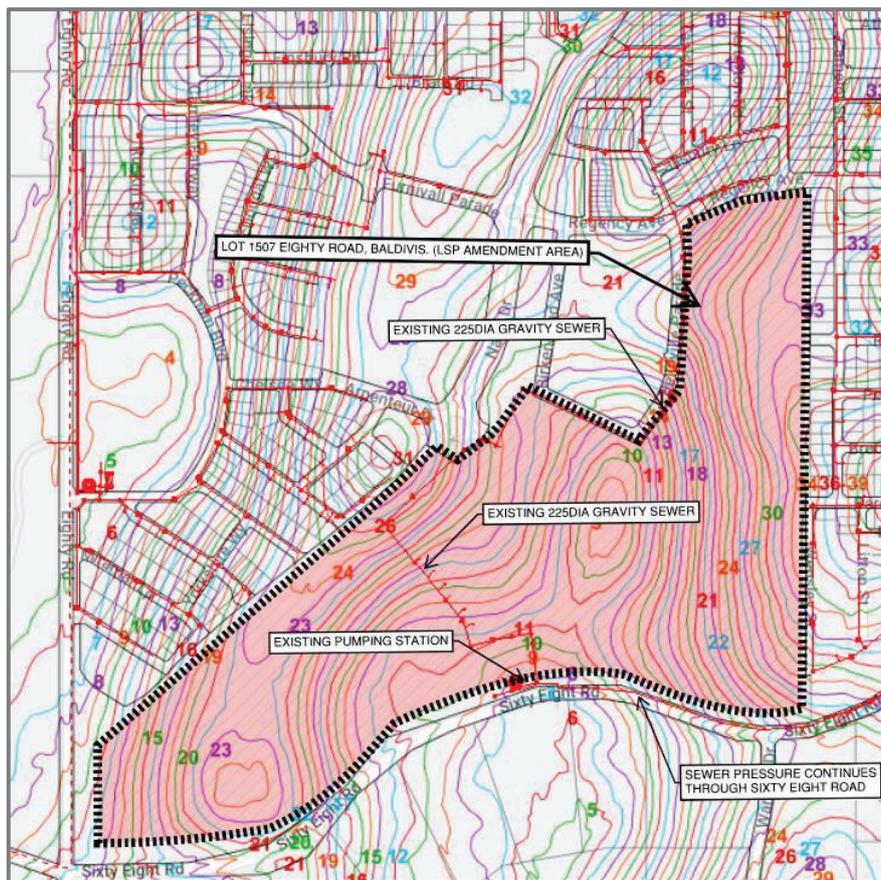


Figure 7 - Existing Sewerage Reticulation (Esinet, June 2024)



5.2 Water Reticulation

The proposed development is located in a potable water license area under Water Corporations control. The Water Corporation Esinet data confirms the presence of water reticulation infrastructure that travels through the proposed local structure plan area via a $\varnothing 150\text{P}-12$ from Regency Avenue through to Naim Drive and through the site to Sixty-Eight Road. Pritchard Francis note that the extension of water reticulation infrastructure in the adjoining residential development will be sufficient for the proposed development.

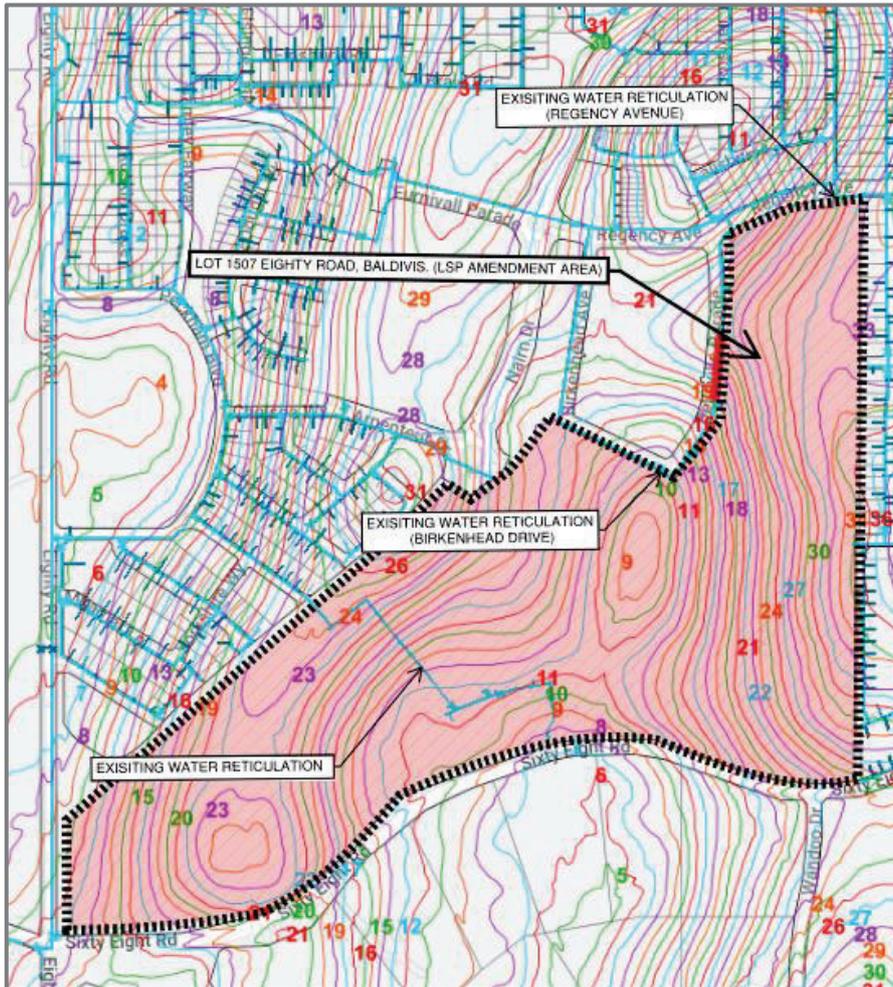


Figure 8 - Existing Water Reticulation (Esinet, June 2024)



5.3 Gas Supply

A desktop investigation indicates that there is existing gas infrastructure within the vicinity of proposed local structure plan area. It is anticipated that the existing gas infrastructure has capacity to service the proposed development.

This will be confirmed by ATCO Gas as regional planning approvals progress.

5.4 Power Supply

5.4.1 Existing UGP Network

MNG Mapping indicates there is existing power infrastructure within the vicinity of the proposed development site, sufficient to service the proposed development. The subject site has existing High Voltage (HV) aerial feeders running in an east west direction along Sixty-Eight Road. As well as this there is an existing overground and underground power network in the Parkland Heights development to the North of the subject road. See Figure 9 below.

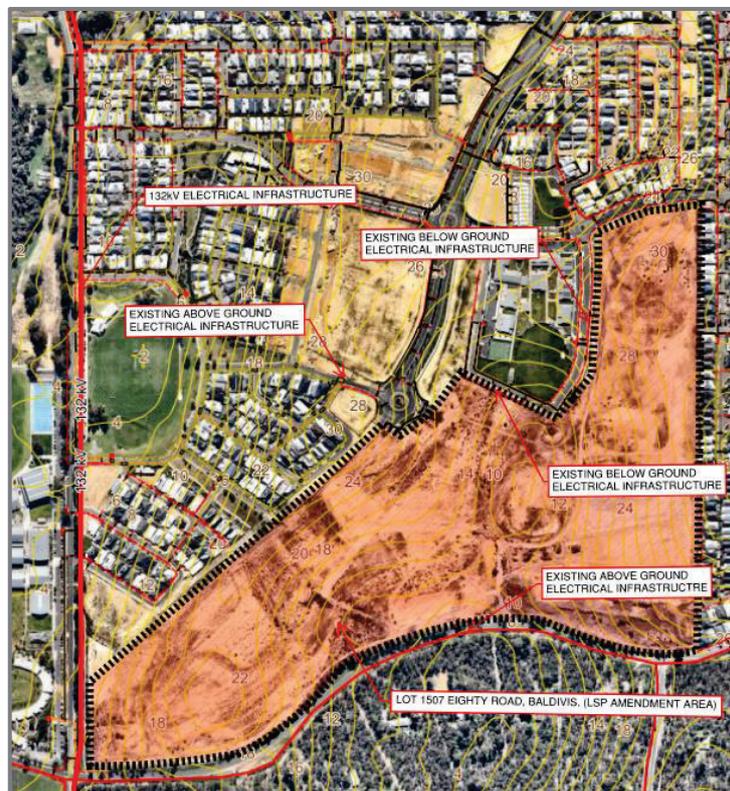


Figure 9 - Existing Electrical Infrastructure

5.4.2 Proposed UGP Network

As a standard, network upgrades would be addressed through the HV pool of funds. This infrastructure is capable of servicing the initial stages of the proposed amendment. Network capacity will be further determined at the formal structure planning stage, and this is not an impediment to the normal progression of this MRS amendment request. A high voltage feeder upgrade is likely to be provided by Western Power as part of the development of the urban front and further strengthening of the HV network from the Parkland Heights residential network to the North.



5.5 Communication

5.5.1 Existing NBN Co Network

The subject site is located within an NBN rollout area with infrastructure installed in the adjoining Parkland Heights residential development. A review of this infrastructure to service urban residential development would be undertaken at the formal structure plan stage in the normal manner.

5.5.2 Proposed NBN Co Network

Developers have two obligations in relation to communications. Firstly, to provide fibre ready pit and pipe and secondly to provide telecommunications infrastructure. The Federal government, in its telecommunications policy statement on new developments, has determined that Telstra and NBN Co must function as Infrastructure Providers of Last Resort (IPoLR's), should Developers wish to engage them for telecommunications infrastructure. However, Developers have the choice of engaging the services of competitors, such as Opticomm or LBN, should they wish.

NBN Co charge for telecommunications infrastructure on a partial cost recovery basis, which normally works out at a reasonable cost to Developers, when compared to other alternatives. We are not aware of any reason as to why the Developer should not engage NBN Co for telecommunications infrastructure and recommend such engagement. NBN Co levy two infrastructure charges, a Deployment Charge of \$600/premise for single residential services or \$400/premise for Multi Dwelling Units and a Backhaul Charge, where there is insufficient infrastructure.

The first development within this precinct will need to negotiate with NBN Co charges for backhaul if any at all. We do not see the proposed NBN Co network being an impediment to the MRS amendment request.

6 Conclusion

The subject site has planning carried out by all service authorities with all services found within the existing Parkland Heights development. There is no noted shortfall in regional infrastructure or constraints that would prevent development of this land for Urban use.



Appendices

Appendix One: Proposed Freehold Division (RHPPH-3-012B)

Appendix Two: Local Structure Plan Map (RHPPH-2-001A)



Appendix One:

Proposed Freehold Division (RHPPH-3-012B)





LEGEND

- LOT 9018 APPLICATION AREA (58,052ha)
- CONTOURS (1m)
- SIXTY EIGHT ROAD WIDENING (73m²)
- WATER MAIN/DRAIN
- SEWER/MANHOLE
- SHARED PATH (2.5m)
- SHARED PATH (2.0m)
- FOOTPATH (1.5m)

RESIDENTIAL LOT SUMMARY

Size	No. Lots	% Total Lots
235m ² - 319m ²	29	14.36%
320m ² - 449m ²	101	50.00%
450m ² - 499m ²	47	23.27%
500m ² - 549m ²	17	8.42%
550m ² - 599m ²	4	1.98%
600m ² - 699m ²	3	1.49%
700m ² - 799m ²	1	0.50%
Total Residential Lots	202	

Minimum Lot Size 260m²
Maximum Lot Size 105m²
Average Lot Size 415m²
Total Lot Area 83,354ha

SUBJECT LAND SUMMARY

The proposed subdivision of Lots 9018 on Plan 428041 creates the following lot yields

- 202 Residential Lots
- 1 Public Open Space & Drainage Lot
- 1 Pump Station Lot
- 1 Balance Lot

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
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cdp
Town Planning & Urban Design

Scale 1:2000 @ A3

0 20 40 80m

DATE: 12/02/2024
DRAWING: P
PROJECT: PDS 34
CHECK: CH

PROPOSED FREEHOLD SUBDIVISION

Lot 9018 Nairn Drive, PARKLANDS HEIGHTS Page 1 of 2

A Rockingham Park Project

Appendix Two: Local Structure Plan Map (RHPPH-2-001A)





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