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TECHNICAL MEMORANDUM - WATER MANAGEMENT PLAN

Austin Lakes - Southern LSP

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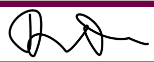
R. Dawson		19 June 2026

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Contents

1 BACKGROUND & PURPOSE 1

2 PRE-DEVELOPEMNT HYDROLOGY SUMMARY 2

2.1 Development location 2
2.2 Groundwater 2
2.3 Surface water hydrology 2
2.3.1 Pre-development drainage 2
2.3.2 Flood mapping 3

3 STORMWATER MANAGEMENT 4

3.1 Drainage strategy 4
3.2 Changes to catchment and discharge rates 5
3.3 Drainage modelling 6
3.3.1 Modelling parameters 7
3.3.2 Tailwater levels 7
3.3.3 Basins 9

4 GROUNDWATER MANAGEMENT SUMMARY 11

5 OTHER CONSIDERATIONS 12

5.1 Post-development monitoring 12
5.2 POS irrigation 12

6 CONCLUDING REMARKS 13

7 REFERENCES 14

Tables

(contained within report text)

Table 1: Drainage design criteria and management measures 4
Table 2: Pro-rata discharge rate calculation 5
Table 3: Estimated allowable peak discharge rate in the 100 year ARI - 6 hour storm 6
Table 4: Catchment area (ha) land usage 7
Table 5: Model loss rates 7
Table 6: Modelled basin details 9
Table 7 : Modelled post development discharge rate in the 1% AEP - 6-hour storm 10

Figures

(compiled at rear of report)

Figure A: Study Area

Figure B: AAMGL contours

Figure C: Stormwater management strategy

Figure D: Pre and post development catchment plan

Graphs

(contained within report text)

Graph 1: Murray River 1% AEP 36-hour stage hydrograph (tailwater level) at Outfall W05 8
Graph 2: Murray River 1% AEP 36-hour stage hydrograph (tailwater level) at Outfall W06 8
Graph 3: Murray River 1% AEP 36-hour stage hydrograph (tailwater level) at Outfall W08 9

Appendices

(compiled at rear of report)

Appendix A : LSP concept plan

Appendix B : AAMGL contour calcs

Appendix C : Stormwater management plan – Stages 21-31

Appendix D : Drainage strategy concept

1 BACKGROUND & PURPOSE

This technical memorandum has been prepared to support the resubmission of the Structure Plan for the Austin Lakes Development (the Development) within the Shire of Murray. Specifically, it discusses water management aspects of the balance of the Structure Plan area (Study Area) not covered by existing urban water management plans (UWMPs). Figure A shows the study area boundary and extents of existing UWMPs (noting that the RPS 2026 UWMP is still pending approval).

The current Structure Plan was scheduled to expire in October 2025. Due to significant changes in both the proposed and constructed elements of the development since the original plan, a resubmission is necessary. Following advice from the Shire of Murray to Wolfdene (dated 28 November 2024), it has been determined that this technical memorandum can serve as a substitute for a full Local Water Management Strategy (LWMS) to accompany the Structure Plan resubmission. This report focuses on the undeveloped stages of the Austin Lakes development, which is broadly the south-west portion of the Structure Plan area (Figure A).

The initial Outline Development Plan (ODP) for the Austin Cove Phase 2 area (now Austin Lakes) was prepared in 2006 by Chappell Lambert Everett (CLE). Concurrently, an Urban Water Management Strategy (UWMS) was developed by JDA Consultant Hydrologists and Bayley Environmental Services (BES) in 2008, which received approval from both the Shire of Murray and the Department of Water. This strategy predated the introduction of the Better Urban Water Management (BUWM) framework by the Western Australian Planning Commission (WAPC) in 2008. Earthworks commenced in early 2009, initially focusing on the northern portion of the Development.

In 2010, Satterley Property Group (SPG), the then-developer, decided to discontinue the construction of additional lake structures originally proposed in the ODP and UWMS. This decision rendered much of the drainage strategy outlined in the 2008 UWMS obsolete. As the development progressed, stage-specific UWMPs were prepared in the absence of an overarching LWMS, leaving water management fragmented across different stages.

The primary objective of this report is to establish a cohesive and updated water management framework for the remaining stages of the development. This framework aims to provide clear guidance on stormwater management, and greater certainty regarding the areas capacity to safely and effectively manage the water regime. This memorandum supersedes relevant sections of the 2008 UWMS while retaining all other aspects of the original water management strategy.

2 PRE-DEVELOPEMNT HYDROLOGY SUMMARY

2.1 Development location

The Austin Lakes development is located within the Shire of Murray, approximately 75 km south of the Perth CBD. The entire estate encompasses a 271 hectares (ha) landholding in South Yunderup and is being developed for residential purposes. BMP Property Investments Pty Ltd is the developer. A concept plan for the development has been prepared by CLE Town Planning + Design to illustrate the current and proposed land uses (Appendix A).

The Development is generally flat and low-lying. Natural surface elevation ranges from 0.5 mAHD to 2.5 mAHD. Small sandy ridges located close to the centre of the site reach a maximum of 2.5 mAHD. The low-lying areas of 0.5 mAHD are located in the south-western corner and eastern portion of the site.

2.2 Groundwater

Monthly groundwater monitoring commenced in January 2006, via a network of 41 shallow bores and nearby DEC/DWER bores. Historical water levels measured in the DEC/DWER bores were used to determine Average Annual Groundwater Levels (AAMGLs) as documented in the UWMS. The bores show a seasonal variation in groundwater levels of between 1.0 and 1.5 m.

The pre-development AAMGLs were originally calculated in the UWMS from the maximum 2007 groundwater levels which occurred in September. It was agreed with the Shire of Murray and the (then) DEC that the AAMGLs would be remodelled using all available data (including data from 2006, 2007 and 2008) in preparing UWMPs for each stage of subdivision. Consequently, the AAMGLs have been re-calculated by RPS in 2022, using groundwater levels from bore monitoring, surface water features, drainage lines and the topographic surface. The full details of this work are provided in Appendix B, and the AAMGL contours are presented in Figure B.

The estimated AAMGLs ranges from approximately 1.6 mAHD at the northwestern boundary to 2.0 mAHD at the southern and southeastern boundary.

Pre-development winter groundwater levels are close to the ground surface across the site, with standing water predicted in the floodway, the northern CCW wetland, and the south-western claypans.

Regional groundwater flow direction in the superficial aquifer is westerly to north-westerly, with groundwater moving towards both the Peel Inlet and the Murray River.

Groundwater samples were analysed for nutrients and dissolved metals by a NATA accredited laboratory. Average parameters measured between 2006 and 2009 from the bores have been provided in subsequent UWMP reports.

2.3 Surface water hydrology

2.3.1 Pre-development drainage

The Development is within the catchment of the Murray River, with all drainage from the site ultimately discharging to the Peel Inlet via overflow channels and floodways of the Murray River. None of the site drainage discharges directly to the main flow channel of the Murray River.

An extensive network of shallow (0.5m – 1.5m deep) agricultural drains was constructed across the site to collect and divert surface water and shallow groundwater through the wetlands to the north, from where the water travels west into the Peel Inlet.

The UWMS modelled the pre-development discharges from the site and this is further discussed in Section 3.

2.3.2 Flood mapping

The whole of the Development is within the 1% AEP floodplain of the Murray River, with the South Yunderup Floodway forming the northern boundary of the site and the remainder of the site mapped as flood fringe. Development levels within the site are required to be above the 1% AEP flood level.

Pre-development flood modelling was undertaken for the lower reaches of the Serpentine and Murray Rivers and the Peel Inlet / Harvey Estuary as part of the Floodplain Development Strategy (GHD 2010). Maximum 1% AEP water levels in the floodplain have been extracted from the model at various points along the edge of the development and are shown in Figure C.

To achieve a 0.5 m clearance above the 1% AEP flood level, a minimum development level in the east of 2.83 mAHD is proposed. In the western portion, the minimum development level reduces to 2.66 mAHD.

This means approximately 1 m to 3 m of sand fill is required over the Development area. This will also provide adequate clearance to the underlying shallow water table.

3 STORMWATER MANAGEMENT

3.1 Drainage strategy

As discussed in Section 1 significant changes to the development layout have occurred since the UWMS document was prepared. This section provides updated detailed stormwater management information relevant to the current designs for the remaining stages (Study Area).

The strategy has been prepared in accordance with the Decision Process for Stormwater Management in Western Australia (Department of Water and Environmental Regulation 2017) (Department of Water and Environmental Regulation 2017) and is based upon the approved UWMS.

The Study Area will effectively manage stormwater quantity and quality generated from the small (15 mm), minor (20% AEP), and major (1% AEP) rainfall events and will incorporate Water Sensitive Urban Design (WSUD) principles and best management practices. The water management design criteria and the manner of addressing these are outlined in Table 1.

Table 1: Drainage design criteria and management measures

Criteria	Management measures to address criteria
Ecological protection (15 mm)	• Lots will retain run-off from the small (15 mm) storm event within the lot boundary via interconnected soakwells. • Run-off from the first 15 mm of rainfall from road reserves will be managed as close-to-source as possible in median swales, rain gardens or bioretention basins in POS. • Median swales will be utilised where possible to encourage infiltration close to source. Flush kerbing or kerb breaks will be used to allow overland flow from directly adjacent road reserves to enter. • Rain gardens located on non-active frontages of corner lots to be considered where possible. • Median swales, bioretention basins and rain gardens will be underlain by biomedia or amended soil with a PRI of at least 10 to a depth of 300 mm.
Conveyance (20% AEP)	• A pit-and-pipe drainage system within the road reserves will be designed to convey up to and including the 20% AEP event to basins within the POS, ensuring roads remain passable in the minor storm event. • Run-off from events larger than the 15 mm event (including the 20% AEP event) will overtop the bioretention basins into turfed flood areas in the POS. This flood area will be available for passive recreation when it is not raining. • Run-off from events larger than the 15 mm event (including the 20% AEP event) discharges into a piped arterial drain which outfalls into an existing open channel at locations W05, W06 and W08 (Figure C).
Flood protection (1% AEP)	• Road reserves are to safely convey run-off from events above the 20% AEP event up to and including the 1% AEP storm event within the road carriageway. • Run-off from events up to and including the 1% AEP will overtop the bioretention basins into turfed flood areas in the POS. This flood area will be available for passive recreation when it is not raining. • Run-off from events up to and including the 1% AEP discharges into a piped arterial drain which outfalls into an existing open channel. • Finished lot levels are to be a minimum of 300 mm above the 1% AEP flood level of local drainage structures and a minimum of 500 mm above the 1% AEP flood level of the Murray River.
Mosquito management	• Stormwater structures will be designed so that retained stormwater will be infiltrated within 96 hours following storm events to prevent mosquito and midge breeding conditions.
Nutrient management	• The bioretention basin will be underlain by biomedia or amended soil with a PRI of at least 10 to a depth of 300 mm.

It should be noted that a UWMP is currently being prepared for Stages 15, 20-22, 24-25, 28-29 & 31-33 (RPS 2026). The stormwater management plan for the UWMP is provided in Appendix C for reference. The engineering drainage concept plan presented in Appendix D incorporates the stormwater modelling results from both that UWMP and the Study Area.

3.2 Changes to catchment and discharge rates

Due to changes in the structure plan and the adoption of a new drainage concept plan (Appendix D), modifications have been made to the predevelopment catchments originally defined in the UWMS (JDA 2008). Each post-development catchment in the new plan is now a combination of multiple pre-development catchments. Catchments 8, DOS, 10, and 11 are grouped as one post-development catchment, while catchments 12 and 14 form another, and catchment 16 remains separate. Figure D compares the pre and post catchment plans.

This reconfiguration has altered catchment boundaries and contributing areas. While some catchments like A, B, C, D, and a portion of E in the previous plan remain, the new grouping of catchments results in different spatial extents and hydrologic characteristics Although the catchment boundaries differ from those originally defined in the UWMS (JDA 2008), the final discharge points are consistent with the earlier plan. This means that while sub-catchment extents and contributing areas have changed, the locations where runoff exits the system have not.

To accurately reflect these updated drainage conditions, recalculations of peak discharge rates have been performed. The pro-rata rate for each pre-development catchment is defined as the peak flow from that catchment divided by its total catchment area. This rate represents the average peak flow contribution per hectare within the pre-development catchment and is used to proportionally estimate discharge rates for each contributing area.

The pro-rata rate for each pre-development catchment is defined as:

$$Prorata\ discharge\ rate(m^3/s/ha) = \frac{Predev\ Peak\ Flow(m^3/s)}{Predev\ catchment\ Area\ (ha)}$$

The estimated allowable post-development peak discharge for each contributing area is then calculated by scaling the post-development contributing area by this pro-rata rate:

$$Estimated\ Allowable\ Postdev\ Peak\ Discharge\left(\frac{\mathrm{m}^3}{\mathrm{s}}\right) = Postdev\ contributing\ area \times Prorata\ rate$$

Table 3 & Table 4 summarise the calculation results for each pre-development catchments' contribution to the respective post-development catchments.

Table 2: Pro-rata discharge rate calculation

Pre-dev Catchment	Pre-dev Catchment Area (ha)	Pre-dev Peak Flow (m³/s)	Pro-rata Rate (m3/s/ha)
A	5	0.24	0.048
B	3	0.15	0.050
C	55	1.65	0.030
D	5	0.22	0.044
E	34	1.05	0.031
Total	**102**	**3.31**	**-**

Table 3: Estimated allowable peak discharge rate in the 100 year ARI - 6 hour storm

Post-dev Catchment	Pre-dev Catchment	Post-dev Contributing Area (ha)	Pre-dev Pro-rata Rate ($m^3/s/ha$)	Estimated Allowable Post-dev Peak Discharge (m^3/s)	Total Estimated Post-dev Peak Discharge (m^3/s)
DOS	C	2.4	0.030	**0.072**	**0.153**
	E	2.6	0.031	**0.081**	
8	C	3.7	0.030	**0.111**	**0.235**
	E	4.0	0.031	**0.124**	
10	C	18.9	0.030	**0.567**	**0.629**
	A	1.3	0.048	**0.062**	
11	D	5	0.044	**0.220**	**0.556**
	C	4.6	0.030	**0.138**	
	E	6.4	0.031	**0.198**	
14	C	10.4	0.030	**0.312**	**0.379**
	A	1.4	0.048	**0.067**	
12	C	15.1	0.030	**0.453**	**0.453**
16	C	12	0.030	**0.360**	**0.635**
	A	2.6	0.048	**0.125**	
	B	3.0	0.050	**0.150**	
Total		**93.4**	**-**	**3.04**	**3.04**

The total pre-development catchment area (102 ha) represents the entire natural drainage system, as shown by the grey boundaries in Figure D. The post-development contributing area (93.4 ha), outlined in red in Figure D, includes only those areas that actively drain to the stormwater system after development.

This difference occurs because, after development, changes to flow paths and infrastructure mean not all pre-development areas continue to contribute runoff, resulting in smaller post-development contributing catchments.

3.3 Drainage modelling

Hydrologic and hydraulic modelling was undertaken using XPSWMM modelling software to size the drainage basins. Modelling was completed in accordance with the Australian Rainfall and Runoff (Ball, et al. 2019) methodology.

The post development stormwater catchments for the Study Area are shown in Figure C. Each catchment drains towards a bioretention basin located in the POS. These catchments and basins have been included in the current modelling exercise to capture the overall site runoff and drainage behaviour.

Land uses assumed in the modelling are also shown in Figure C. The subdivision layout and catchment boundaries outside the site boundary are indicative and may change in the future. All sub-catchments that discharge into the primary arterial drainage pipes have been incorporated into the model. The breakdown of land usage for each catchment area is provided in Table 4 below.

Table 4: Catchment area (ha) land usage

Catchment	Lots	Road reserve	POS	DOS	Wastewater Pump Station	Reserve	Total
DOS	-	-	-	5.00	-	-	**5.00**
8	4.664	2.285	0.733	-	-	-	**7.683**
10	9.666	6.222	4.114	-	0.182	-	**20.186**
11	9.461	4.511	1.978	-	-	-	**15.951**
12	7.253	3.580	4.244	-	-	-	**15.078**
14	7.101	3.645	0.986	-	-	-	**11.734**
16	9.365	4.306	3.844	-	-	0.059	**17.574**

3.3.1 Modelling parameters

The loss rates assumed for each type of land use within the model are provided in Table 5.

Table 5: Model loss rates

Land use	Initial loss (mm)	Continuing loss (mm/hr)	Manning's n
POS	5	2	0.03
Lots	14	4	0.1
Road – verge	8	2	0.025
Road – impervious	1	0	0.025
Wastewater Pump Station	10	3	0.03

Loss rates adopted for POS, lots and roads (verge and impervious) are consistent with the recent UWMP (RPS 2024). The loss rate for the wastewater pump station is based on the lots' loss rates, adjusted based on the assumption that the wastewater pump station is ~30% impervious.

The following infiltration rates were assumed for drainage storages:

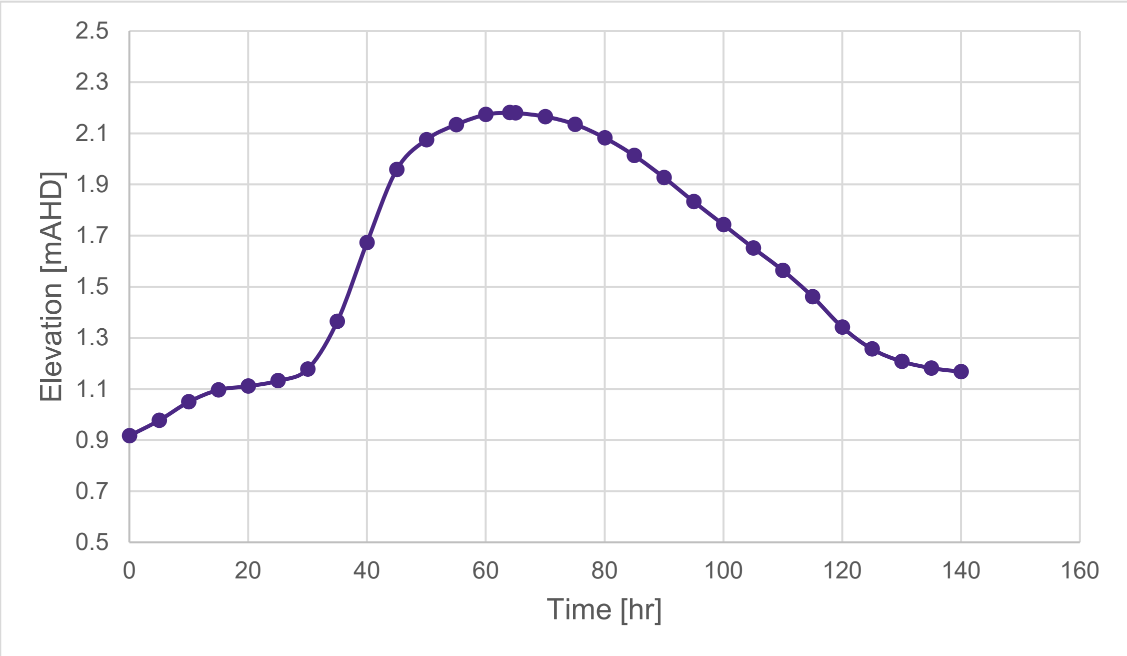
- 1 m/day in bioretention basins in POS
- 3 m/day in turfed flood areas in POS
- 3 m/day in median swales

An infiltration rate of 1 m/day was adopted for the bioretention basins in POS, consistent with the recent UWMP (RPS 2024) modelling. A higher infiltration rate of 3 m/day was adopted for the turfed flood areas and median swales due to the greater clearance to groundwater and free draining sand fill that will be imported to create these areas.

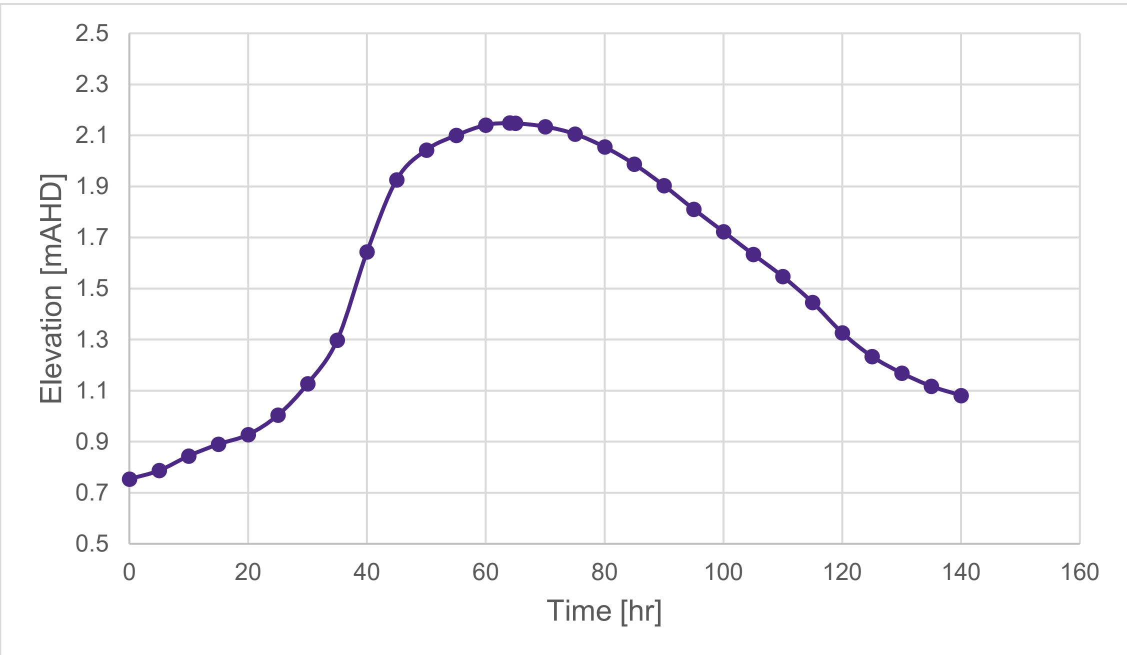
3.3.2 Tailwater levels

Discharge from the Study Area is via three outfall pipes to the Murray River (Figure C). These pipe outlets were modelled with free outfalls for the 15 mm and 20% AEP storm events, and with a stage hydrograph for the 1% AEP storm event to simulate water levels in the receiving Murray River during a flood event. A range of duration storm events were tested for the Murray flood study model. While short duration events lead to marginally higher peak water levels in some areas, the 36-h duration event generally produced the highest water levels. Accordingly, a 36-h duration was adopted for the design simulations.

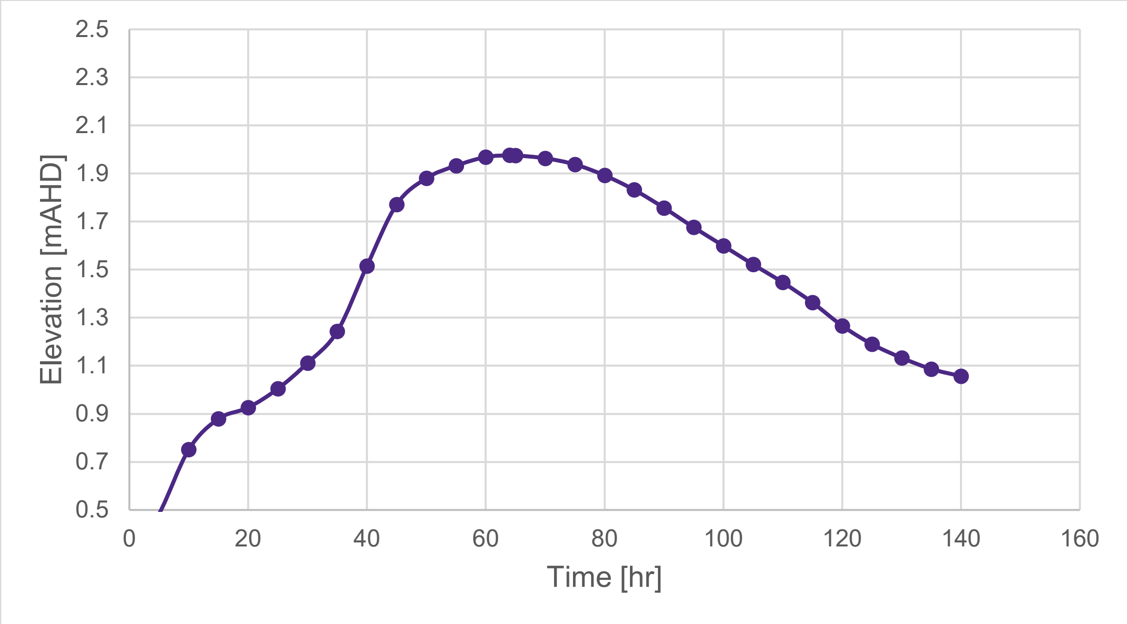
The tailwater levels from the Murray River flood study (GHD 2010) were used to inform the drainage modelling by providing boundary conditions for the hydraulic simulations. Specifically, the peak 1% AEP tailwater levels at key outfalls (W05, W06, and W08) were extracted from the Murray River flood study model and applied as stage hydrographs in the model to simulate water levels during flood events. The locations of the extracted flood levels are shown in Figure C and the stage hydrographs modelled at the outfalls are shown in Graphs 1, 2 and 3. The peak 1% AEP tailwater elevation at outfall W05 is 2.18 mAHD, W06 is 2.15 mAHD and W08 is 1.98 mAHD.



Graph 1: Murray River 1% AEP 36-hour stage hydrograph (tailwater level) at Outfall W05



Graph 2: Murray River 1% AEP 36-hour stage hydrograph (tailwater level) at Outfall W06



Graph 3: Murray River 1% AEP 36-hour stage hydrograph (tailwater level) at Outfall W08

3.3.3 Basins

Bioretention basins in the POS have been designed to retain the 15 mm rainfall event up to a nominal depth of 0.3 m. Larger events will be detained within the basin at deeper water depths and discharge via a bubble-in pit into a pipe network for offsite discharge. The lid invert of the bubble-in pit should be at or above the 1% AEP flood level in the Murray floodplain to ensure that back flooding does not occur and the basin has capacity to detain the runoff from the development during a storm event. Due to the 1% AEP flood levels and the proposed road levels in catchments 11 and 12, the maximum water depth within the basin is constrained. As such, basins 11 and 12 will have a 0.3 m deep main bioretention area which will overtop into a larger turfed flood area for attenuation of the 20% and 1% AEP events.

Basin locations are shown in Figure C. Modelled basin details and outlet invert levels are provided in Table 6 and modelling results in Table 7. Basins have been assumed to have side slopes of 1:6.

Table 6: Modelled basin details

Basin	DOS	8	10	11	12	14	16
Biobasin base invert (mAHD)	2.00	3.10	2.30	1.88	1.85	2.40	3.00
Biobasin base area (m^2)	490	640	1800	1250	1250	1000	1375
Flood tier invert (mAHD)	-	-	-	2.18	2.15	-	-
Flood tier base area* (m^2)	-	-	-	2250	2100	-	-
Outlet invert (mAHD)	2.30	3.40	2.60	2.18	2.15	2.70	3.30
15 mm							
Max water depth (m)	0.27	0.29	0.30	0.30	0.30	0.29	0.30
Top water level (mAHD)	2.27	3.39	2.60	2.18	2.15	2.69	3.30
Inundation area (m^2)	660	835	2134	1531	1422	1236	1587
Max volume (m^2)	156	216	584	414	380	321	428

Basin	DOS	8	10	11	12	14	16
20% AEP							
Critical duration (h)	4.5	4.5	3	3	3	3	4.5
Max water depth (m)	0.54	0.40	0.48	0.41	0.43	0.43	0.61
Top water level (mAHD)	2.54	3.50	2.78	2.29	2.28	2.83	3.61
Inundation area (m^2)	847	912	2346	2424	2263	1359	2016
Max volume (m^2)	355	308	983	678	708	501	1031
Peak discharge (m^3/s)	0.07	0.13	0.31	0.16	0.21	0.19	0.21
1% AEP							
Critical duration (h)	4.5	6	6	9	6	6	9
Max water depth (m)	0.82	0.86	0.86	0.53	0.62	0.62	0.95
Top water level (mAHD)	2.82	3.96	3.16	2.41	2.47	3.02	3.95
Inundation area (m^2)	1070	1284	2840	2620	2495	1542	2412
Max volume (m^2)	627	813	1989	984	1144	785	1772
Peak discharge (m^3/s)	0.15	0.17	0.49	0.48	0.43	0.33	0.53

* Refers to the total area at the invert of the flood tier, where stormwater overtops the bioretention basin and spills across a broader turfed flood area. Includes both the turfed flood area and bioretention basin area.

Grouping these catchments by their discharge locations produces the following summary, showing the estimated allowable peak discharges before development alongside the modelled peak discharges after development.

Table 7 : Modelled post development discharge rate in the 1% AEP - 6-hour storm

Discharge locations	Post-dev Catchments	Estimated Allowable Post-dev Peak Discharge (m^3/s)	Modelled Post-dev Peak Discharge (m^3/s)
Outfall W05	8, DOS, 10, 11	1.57	1.21
Outfall W06	12, 14	0.83	0.76
Outfall W08	16	0.64	0.50
Total		**3.04**	**2.47**

The comparisons indicate that the modelled post-development peak discharges are slightly lower than the estimated allowable post-development peak discharges at all outfall locations. This reflects effective management of runoff and successful implementation of drainage design measures to control peak flows in the post-development scenario.

Street-scale opportunities for increasing runoff infiltration and water quality treatment close-to-source should be investigated during preparation of the UWMP, including the use of median swales in road reserves and rain gardens located on non-active frontages of corner lots.

4 GROUNDWATER MANAGEMENT SUMMARY

The need for subsoil drainage system for the Study Area for groundwater management has not yet been determined nor designed; however, if deemed necessary, all specifications will be included in the engineering drawings and the corresponding UWMPs and the following strategy will be employed.

The key principle behind the groundwater management strategy for the Development Area is to maintain the existing groundwater hydrology and to protect buildings and infrastructure. Groundwater management objectives include:

- Maintain pre-development groundwater levels at key water dependent ecosystems.
- At a minimum, maintain the groundwater quality and if possible, improve the quality of water leaving the development area.
- Ensure adequate separation to the CGL for infrastructure protection.

The pre-development AAMGL at Austin Lakes was “capped” by the ground surface and the existing agricultural drains. With the filling of the development area, the groundwater levels can rise between 0.5m and 1m into the sand fill. To prevent problems of waterlogging, subsoil drains should be installed within road reserves in all areas where the depth of fill is less than two metres. The subsoil drains will consist of slotted pipes surrounded by graded aggregate bedding material.

The level at which subsoil drains are installed will be set according to the *Water Resource Considerations when Controlling Groundwater Levels in Urban Development* (Department of Water 2013). As specified in (Department of Water 2013), subsoil drain inverts will be set with consideration of:

- A free-flowing drainage outlet
- Infrastructure protection
- Groundwater quality
- Protection of water dependent ecosystems (WDEs)
- Catchment and nearby land use constraints

Subsoil drainage is generally not intended to lower or control groundwater levels to pre-development levels (subsoil drain inverts are at least 0.5 m above the AAMGL). Rather, it is proposed as a contingency to protect infrastructure from excessive groundwater level rise. The pre-development AAMGL (Figure B) showed a groundwater mound at 2.4 mAHD to the southeast of the Development that was not restricted by the natural surface. Areas with finished levels at or above 4.4 mAHD (i.e., 2 m above the pre-development mound) will have sufficient clearance to groundwater following any potential rise post-development and will not require subsoil drainage as a contingency.

The water flowing into the subsoil drains will be water that would previously have flowed across the site as drain flow or overland flow. Because the water will pass through several metres of adsorptive sand prior to being captured by the subsoil drains, its quality, particularly in terms of suspended solids and phosphorus, is expected to be significantly better than that of the water currently flowing in the drains.

5 OTHER CONSIDERATIONS

5.1 Post-development monitoring

Post-development monitoring commitments for existing stages have been outlined in previous reports and the respective UWMPs and were guided by the UWMS. These reports include:

- Austin Cove Estate Water Quality Monitoring Plan (Bayley Environmental Servicves 2009)
- Austin Cove Phase 2 UWMP (RPS 2010)
- Austin Lakes Stages 3-9 UWMP (JDA Consultant Hydrologists 2020a)
- Austin Lakes Stages 9-24 UWMP (RPS 2024)
- Austin Lakes Stages 15, 20-22, 24-25, 28-29 & 31-33 UWMP (RPS 2026) (In preparation)

Post-development monitoring programs for future stages will be detailed in the relevant UWMPs and are expected to be generally consistent with the monitoring programs outlined in the most recent reports detailed above. However, some variation is to be expected due to differences in the site requirements.

5.2 POS irrigation

A groundwater licence GWL163896(6) for 308,000 kL/yr from the Leederville aquifer is available for dust suppression, construction, irrigation of POS areas and verges, and additional water requirements of the estate. This volume is sufficient for current and future non-potable requirements.

6 CONCLUDING REMARKS

This document's intent is to provide sufficient information to support the resubmission of the LSP with regards to water management, specifically focussing on Study Area in the south-west of the Development.

The structure and drainage conditions at Austin Lakes have evolved significantly since the original UWMS (JDA 2008), necessitating updated calculations for peak discharge rates to accurately reflect the new drainage layout and catchment configurations. For the Study Area the post-development catchments are now combinations of multiple pre-development modelled catchments, although the final discharge points are the same. These changes have resulted in modifications to stormwater catchment boundaries and contributing areas, which have been incorporated into revised calculations of allowable pre-development peak discharges.

As detailed herein, the stormwater modelling has been revisited to document existing water management strategies and to provide guidance for future UWMPs' water management. This will assist in ensuring the development manages its water resources in a safe and environmentally sensitive manner. Critical discharge points have been modelled to achieve the overall drainage strategy and criteria, and drainage infrastructure requirements have been defined.

Post-development monitoring programs for future stages will be detailed in the relevant UWMPs and are expected to generally align with the monitoring requirements detailed in the most recent of the previous UWMPs to provide a consistent approach.

Since the UWMS was prepared, the proponent has obtained sufficient groundwater licence allocation to meet the Development's non-potable water needs.

This report should be referenced, along with the UWMS, for all future UWMPs and related water management documents for the Austin Lakes development site.

7 REFERENCES

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Figures:

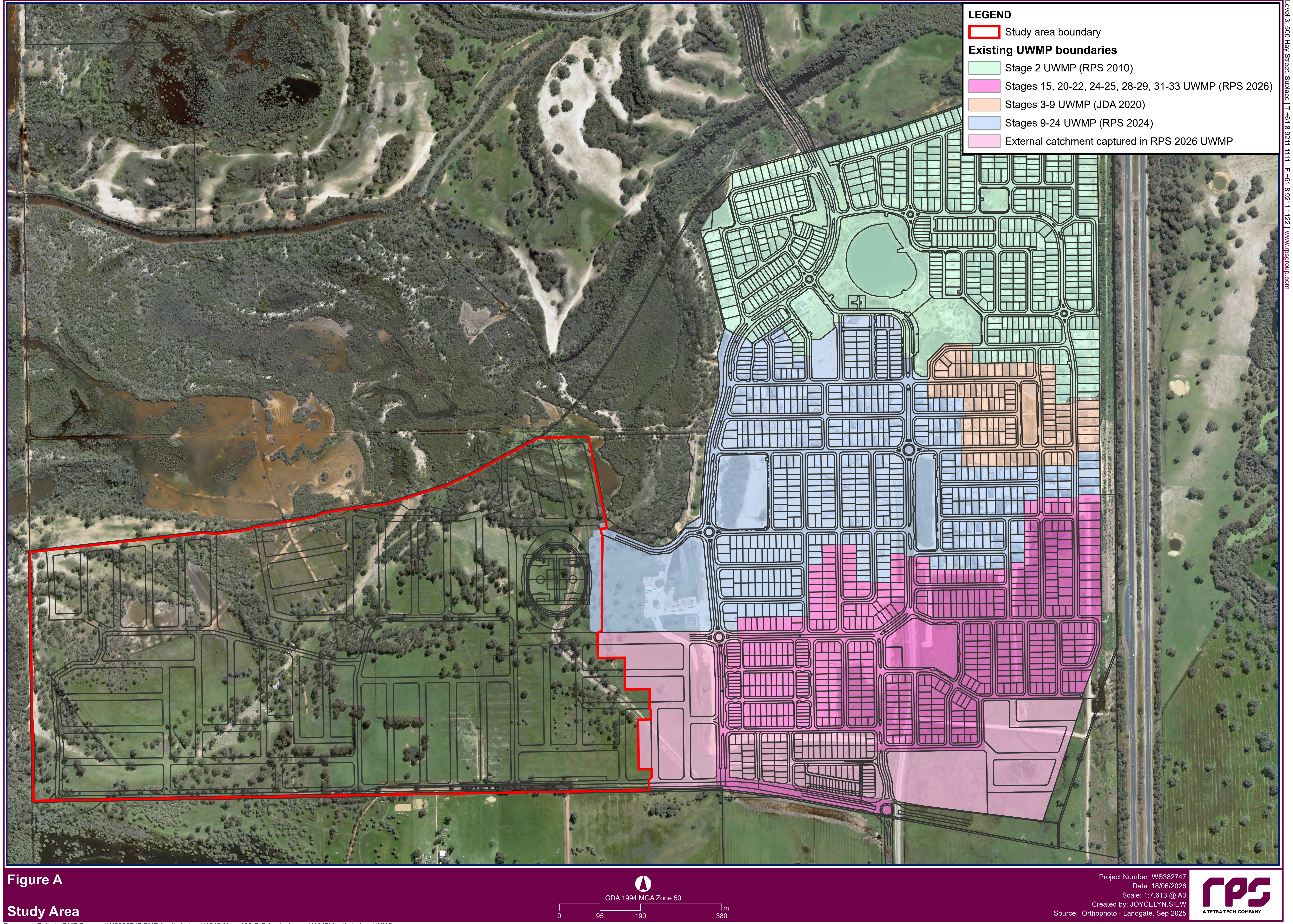

Figure A

Study Area

Project Number: WS382747
Date: 18/06/2026
Scale: 1:7,613 @ A3
Created by: JOYCELYN.SIEW
Source: Orthophoto - Landgate, Sep 2025

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Document Path: L:\BMP Property\WS382747 BMP Austin Lakes LWMS Memo\08 GIS\Austin Lakes LWMS\Austin Lakes LWMS.aprx

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Figure B

Pre-development AAMGL contours & Groundwater monitoring bores

GDA2020 MGA Zone 50

0 55 110 220 m

Project Number: WS382747
Date: 11/08/2025
Scale: 1:4,531 @ A3
Created by: LMV
Source: Orthophoto - Landgate, Jan 2024

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Document Path: \\eur.rpsgroup.com\pe-perth\Jobs\BMP Property\WS382747 BMP Austin Lakes LWMS Memo\08 GIS\WS382747_FigA_AAMGL_Rev0.mxd

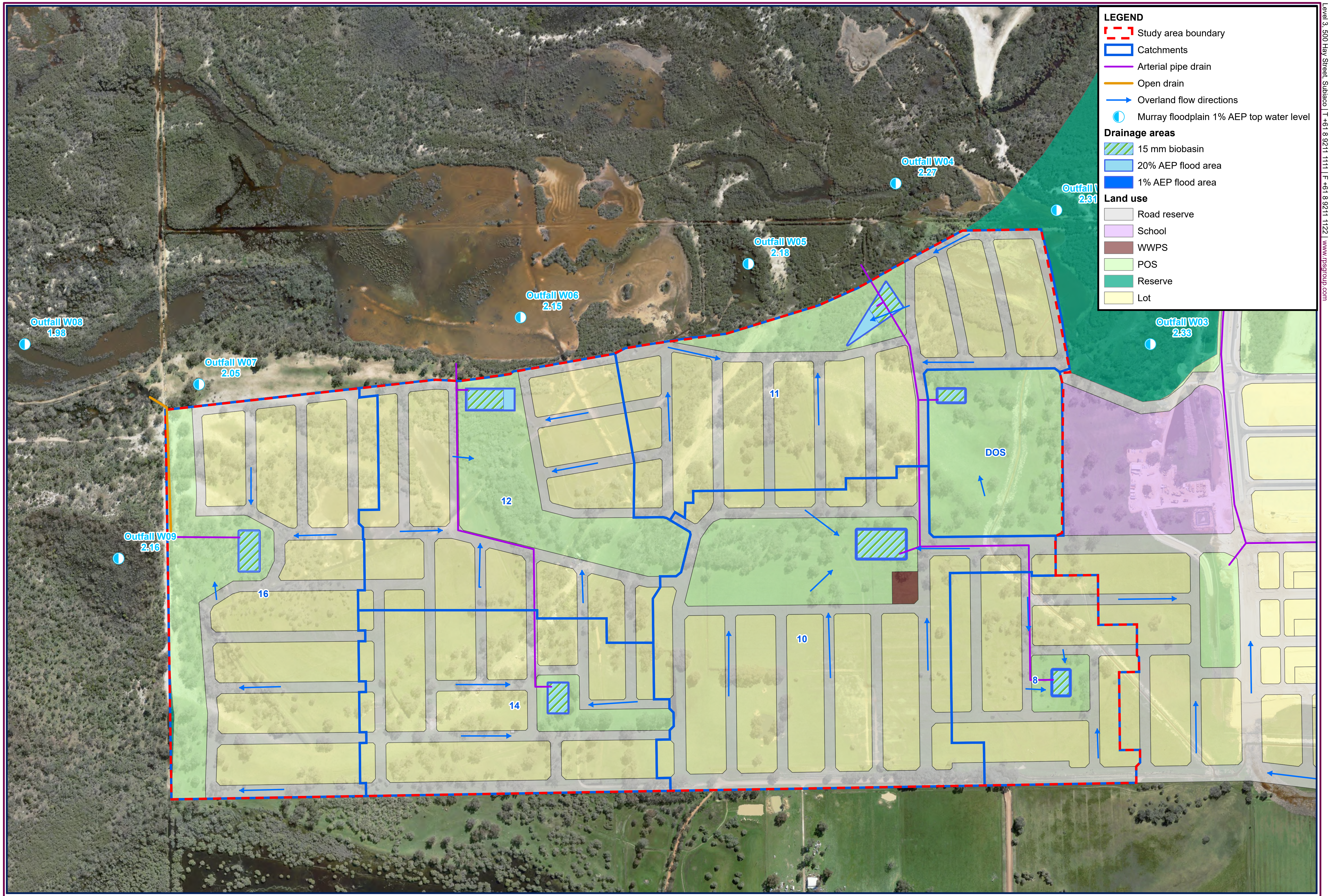

Figure C

Stormwater management plan

GDA 1994 MGA Zone 50

0 62.5 125 250 m

Project Number: WS382747
Date: 18/06/2026
Scale: 1:5,000 @ A3
Created by: JOYCELYN.SIEW
Source: Orthophoto - Landgate, Sep 2025; Murray Drainage Water Management Plan (GHD 2010) model

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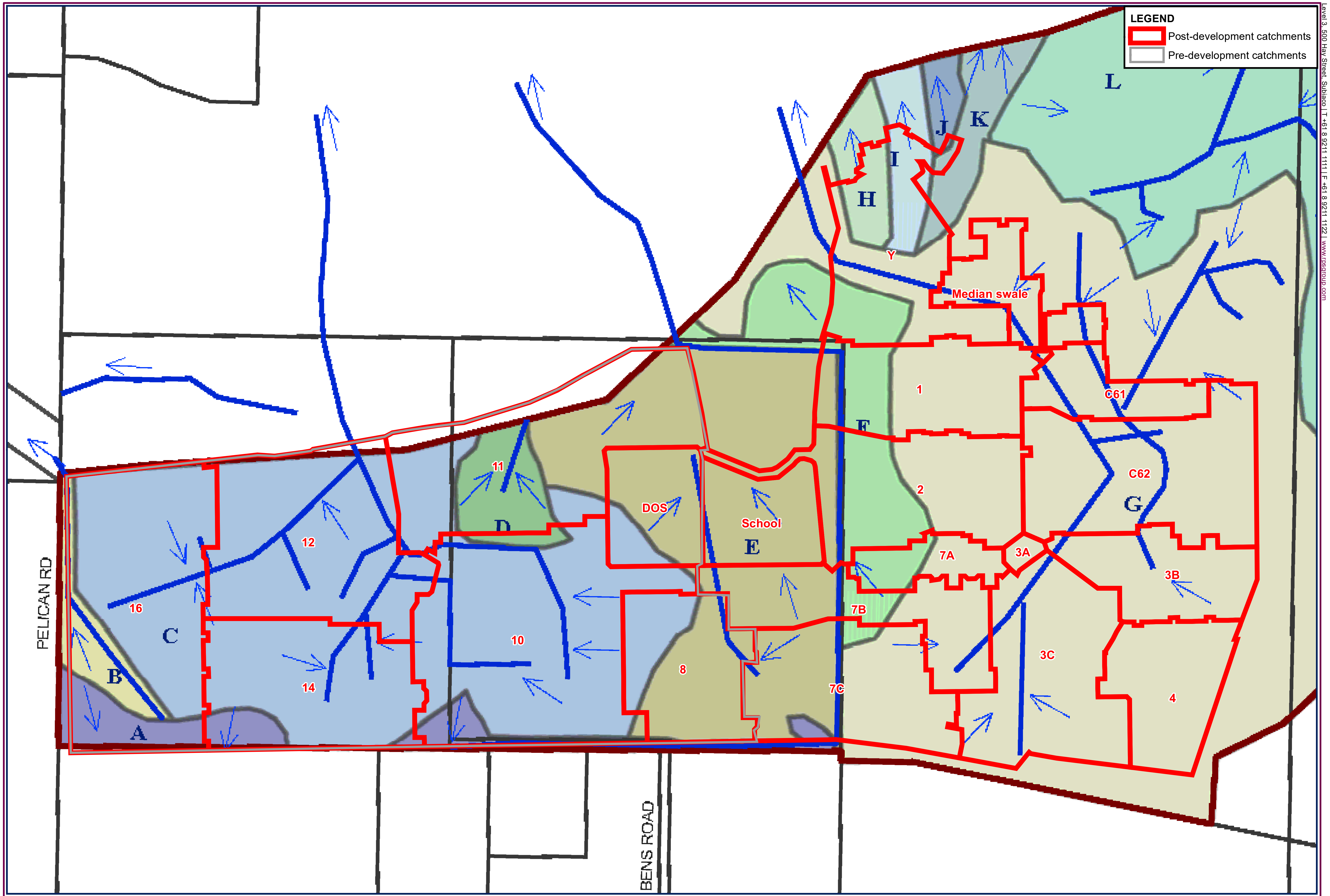

Figure D

Pre and Post-development catchment plan

GDA 1994 MGA Zone 50

0 90 180 360 m

Project Number: WS382747
Date: 11/08/2025
Scale: 1:7,054 @ A3
Created by:LMV
Source: Orthophoto - Landgate, Feb 2025

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Appendix A:
LSP concept plan

0 100 200 300 400 500m

CLE Town Planning + Design

DEVELOPMENT CONCEPT PLAN

Austin Lakes

plan no: **2054-744D-01**
date: 9 January 2026
scale: 1:7,500 @A3

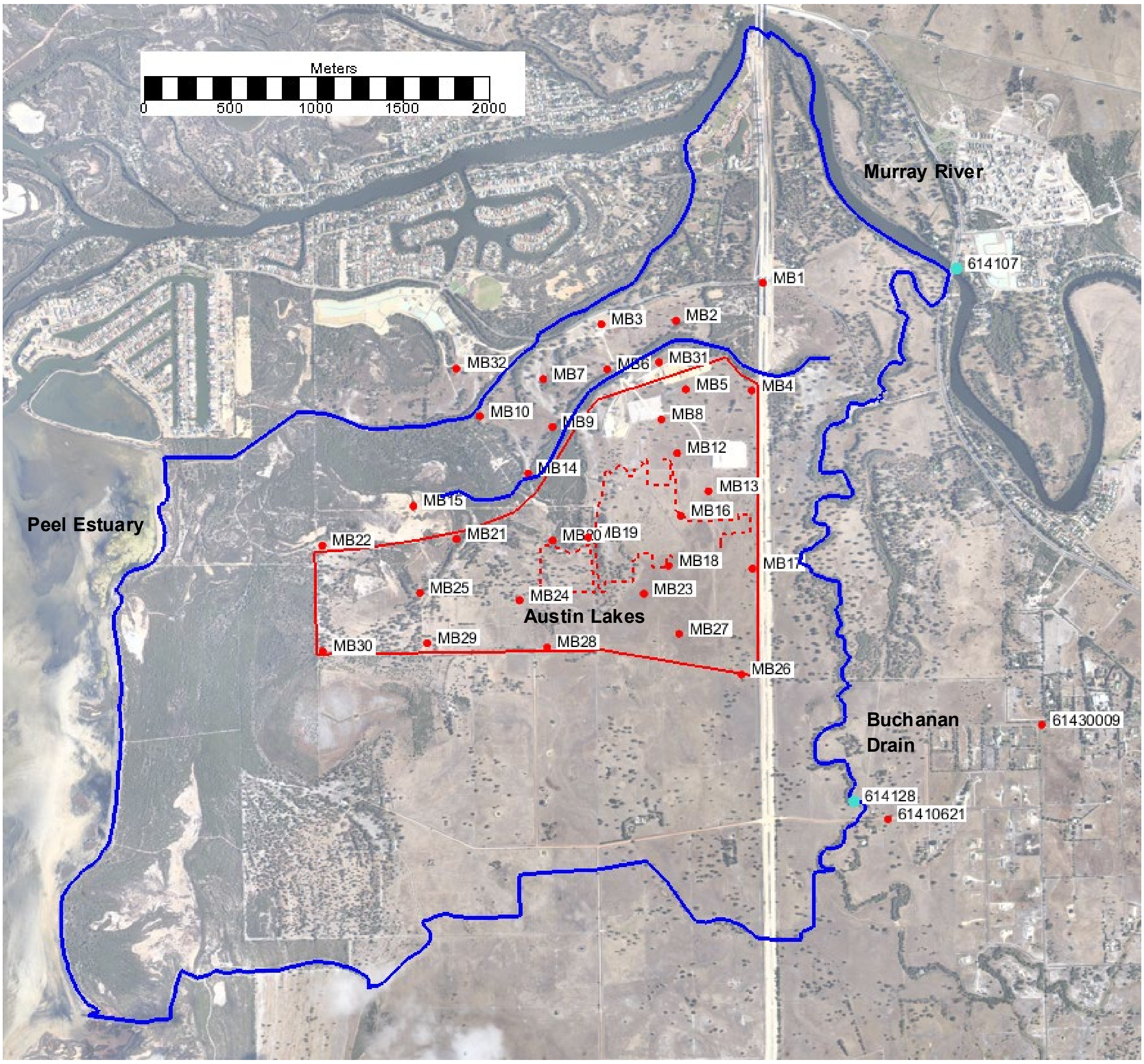
N

Appendix B:
AAMGL contour calcs

APPENDIX B: PRE-DEVELOPMENT AAMGL CALCULATIONS 2022

Monthly groundwater level monitoring was undertaken from 41 shallow bores at Austin Lakes and nearby DWER bores in 2006–2007. The pre-development AAMGL was calculated from the maximum 2007 groundwater levels that occurred in September. It was agreed with the Shire of Murray and the (then) DEC, that the AAMGL would be remodelled using all available data (including that from 2006, 2007 and 2008) in preparing Urban Water Management Plans for each stage of subdivision. Consequently, the AAMGL was re-calculated for this UWMP using groundwater levels from bore monitoring, surface water features, drainage lines and the topographic surface.

The short-term AAMGL over the entire Austin lakes site was calculated over the 2006–2007 monitoring period for the 41 private shallow monitoring bores within and in the vicinity of the site (Figure B-1). The long-term AAMGL (1988–2018) was calculated at the nearest relevant DWER bore (61430009) and compared to the short-term private bore monitoring period (2006–2007). This difference was used to provide an estimate of the long-term Austin Lakes bore AAMGL, as shown on Figure B-2.



Blue lines represent the surface water features and drainage lines used in the AAMGL calculation. Red dots are groundwater monitoring bores while light blue dots are surface water monitoring locations. The Austin Lakes site is bordered with solid red; the Stage 10-26 UWMP area is represented by dashed red.

Figure B-1: Bores used for AAMGL calculation

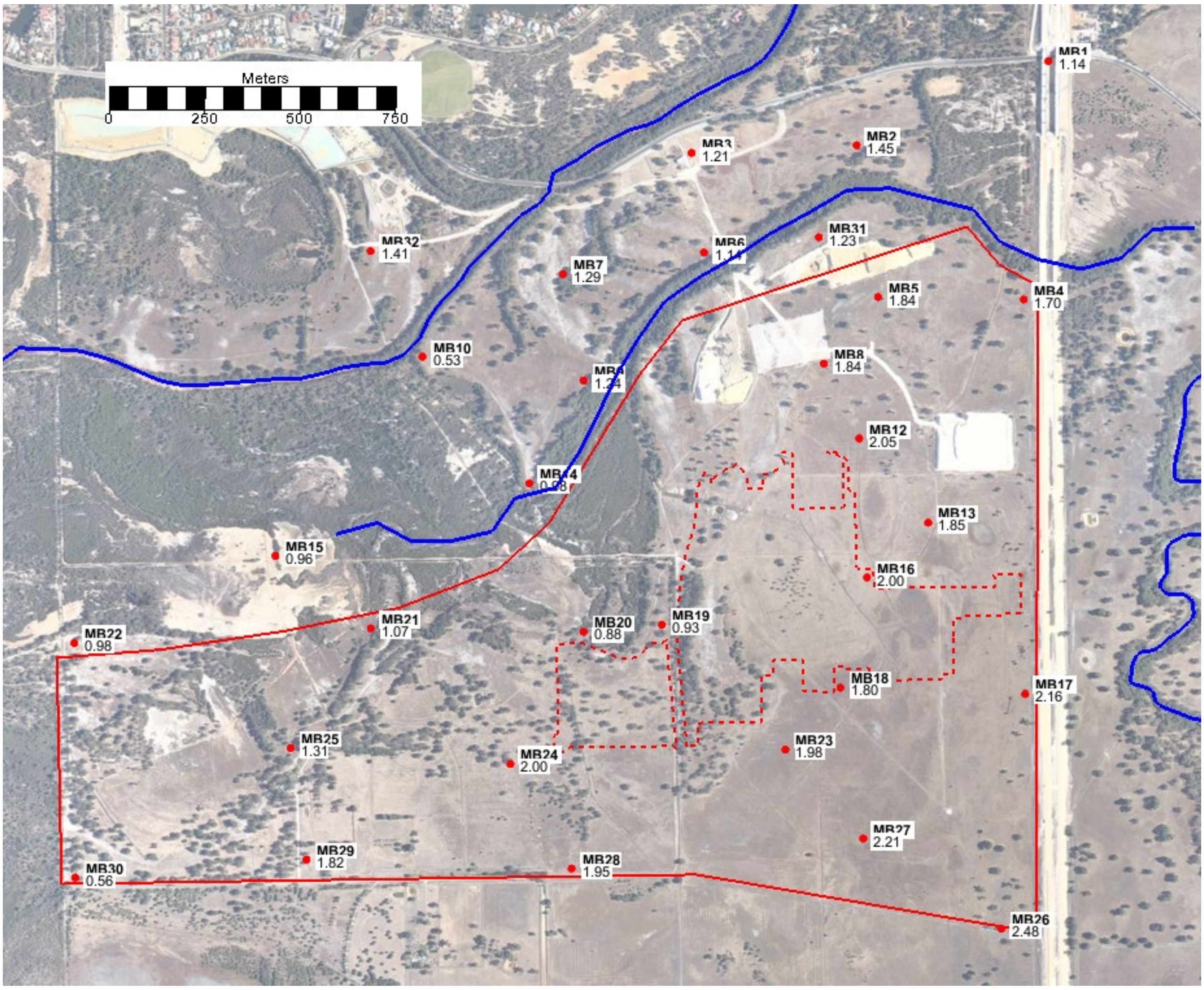
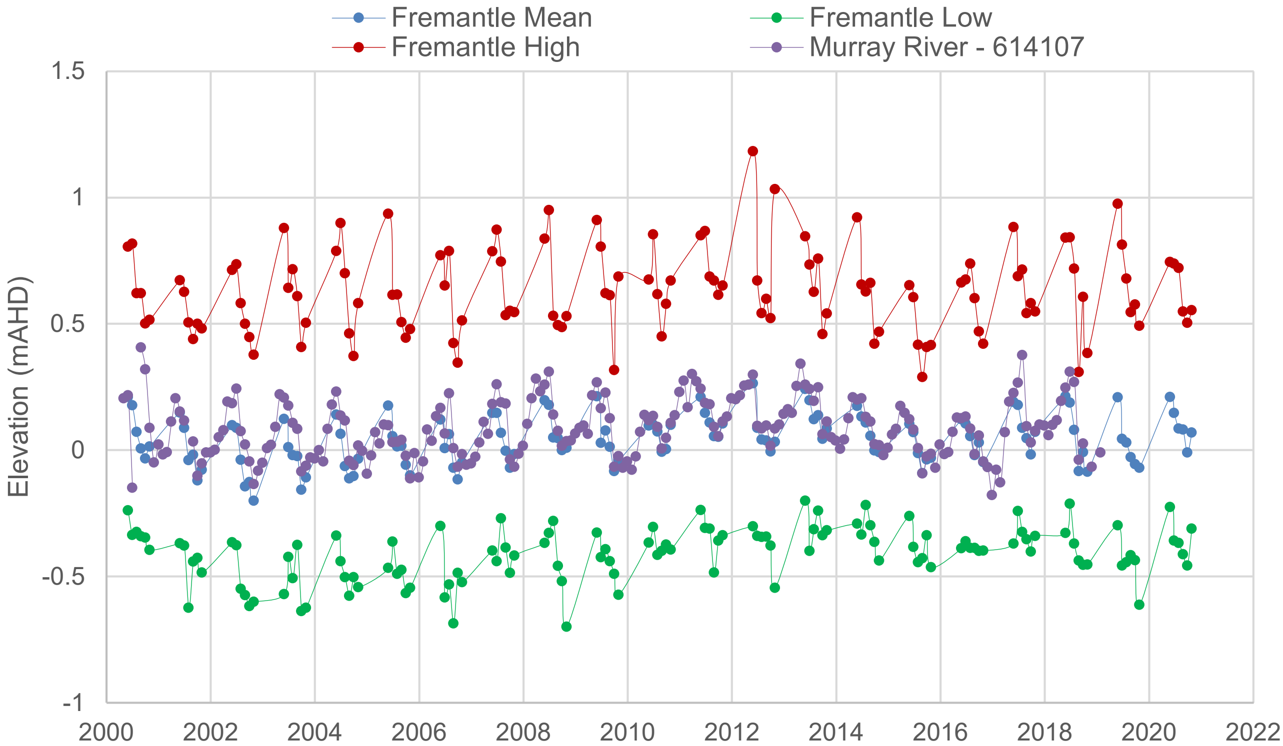


Figure B-2: Austin Lakes bore AAMGL

Surface water features and drainage lines were included in the AAMGL calculation. The mean monthly tide at Fremantle (nearest Bureau of Meteorology (BoM) location with long-term monthly data) was 0.04 m AHD (Graph B-1). Murray River (Site 614107), which is affected by tides in this area, was similar with an average of 0.09 m AHD (Figure B-1). For the AAMGL calculation, an elevation of 0.25 m AHD was applied to the Peel Estuary and 0.25–0.5 m AHD along the Murray River to take some groundwater resistance into account. The topographic surface was used for Buchanan Drain (east, Plate B-1), and the drains to the south of the site. The open drainage to the north of the site was assigned a water level of 1.0–1.5 m AHD as interpreted from topography. The topography used was from the Geoscience Australia LiDAR dataset, with values at 5 m spacings.



Graph B-1: Average monthly tide elevation for Fremantle (high, mean and low tides; Source: BoM, 2021) and Murray River Site 614107 (Source: DWER, 2021)

Plate B-1: 614128: Buchanan Drain – Beacham Farm (DWER, 2021)

The AAMGL was calculated using both the groundwater bore and assigned drain/surface water elevations. The interpolation process (kriging) showed that most of the Austin Lakes site had a depth to groundwater of <1 m. The AAMGL for large areas of the site were above land surface (Figure B-3). For these areas the land surface was assigned as the AAMGL, which resulted in the final AAMGL as shown on Figure B-4. The final AAMGL for the entire Austin Lakes development area ranges from ~ 1.0–2.5 m AHD and groundwater migrates to the north-west. The contours are irregular in shape due to the topographical constraint over large areas of the site. The Final AAMGL for the Stage 10–26 UWMP area ranges from ~ 1.0–1.9 m AHD (Figure B-5).

The 2021 estimated AAMGL is up to 0.6 m above the 2008 AAMGL in the south-central site area and up to 0.8 m below the previous AAMGL in the south-eastern site area (Figure B-6).

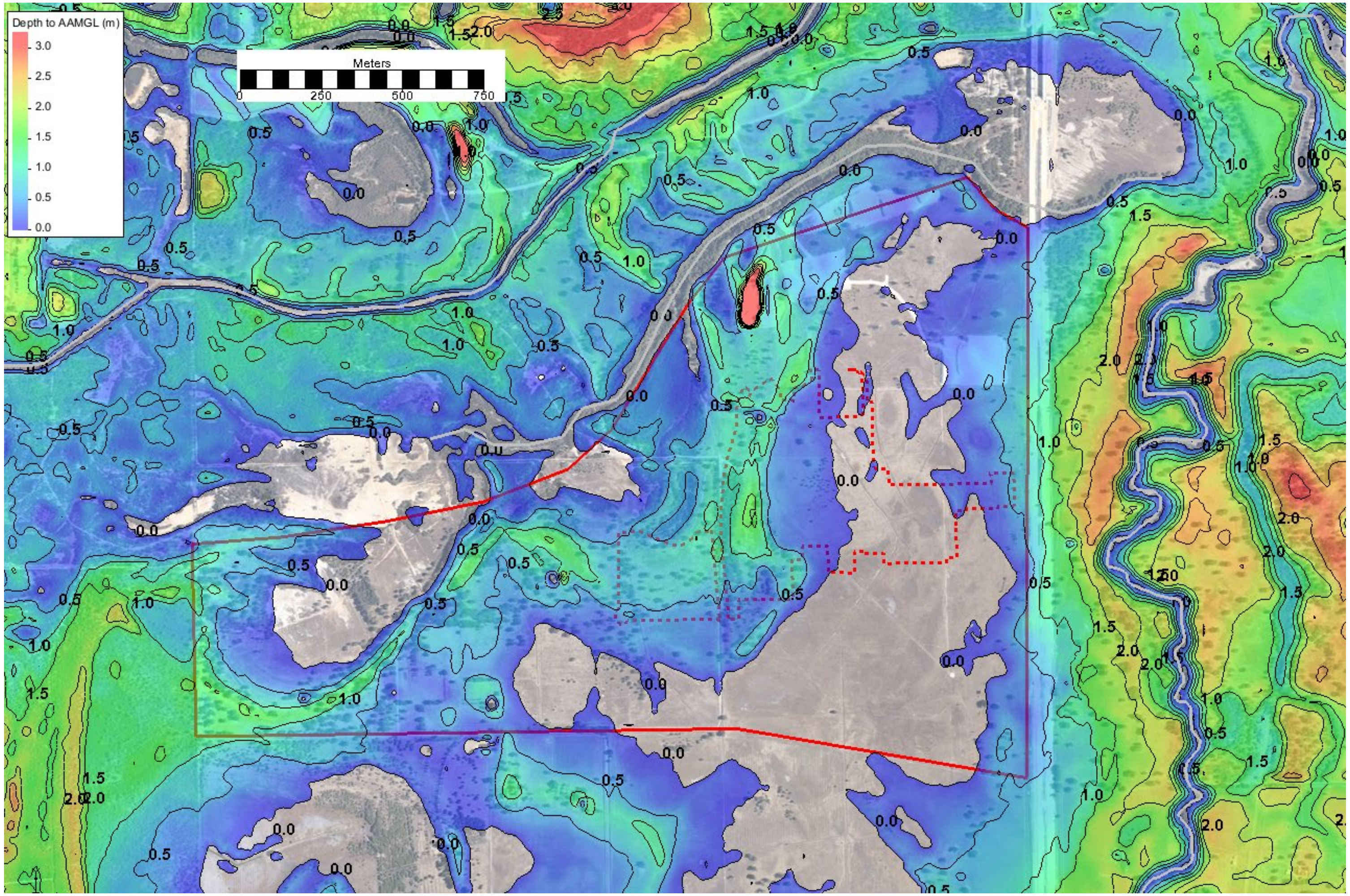


Figure B-3: Depth to AAMGL (m)

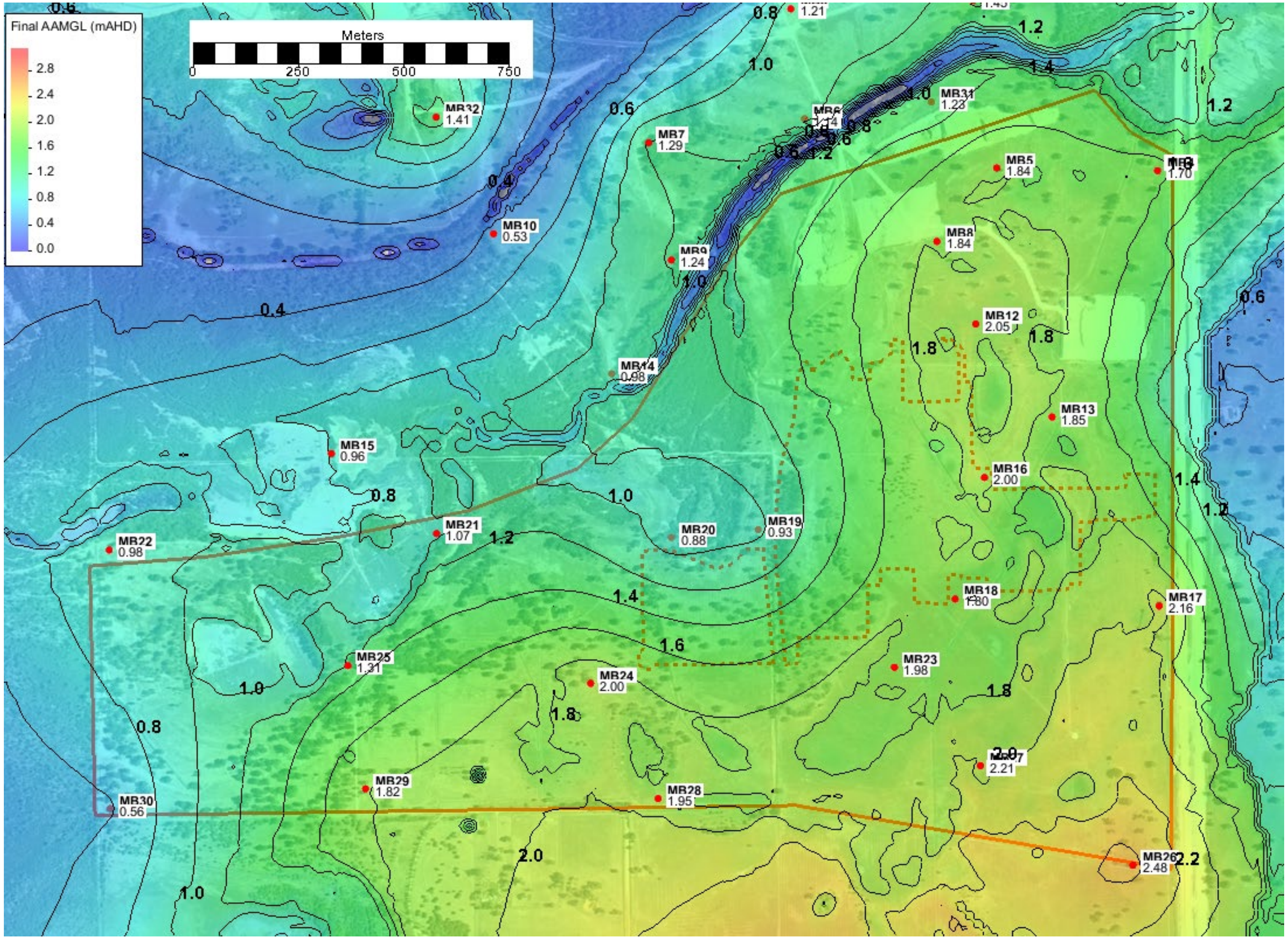


Figure B-4: Final AAMGL Austin Lakes (mAHD)

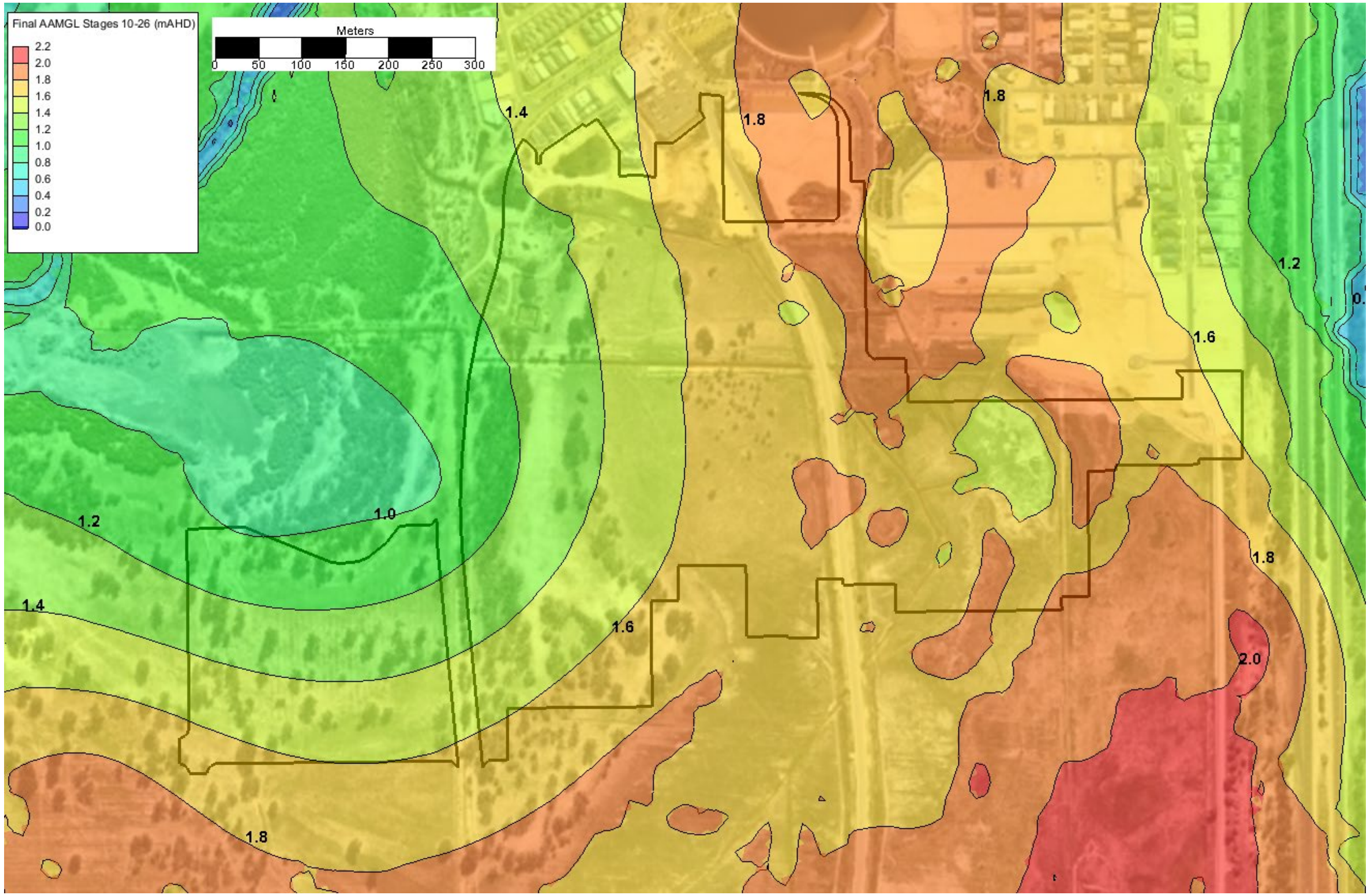
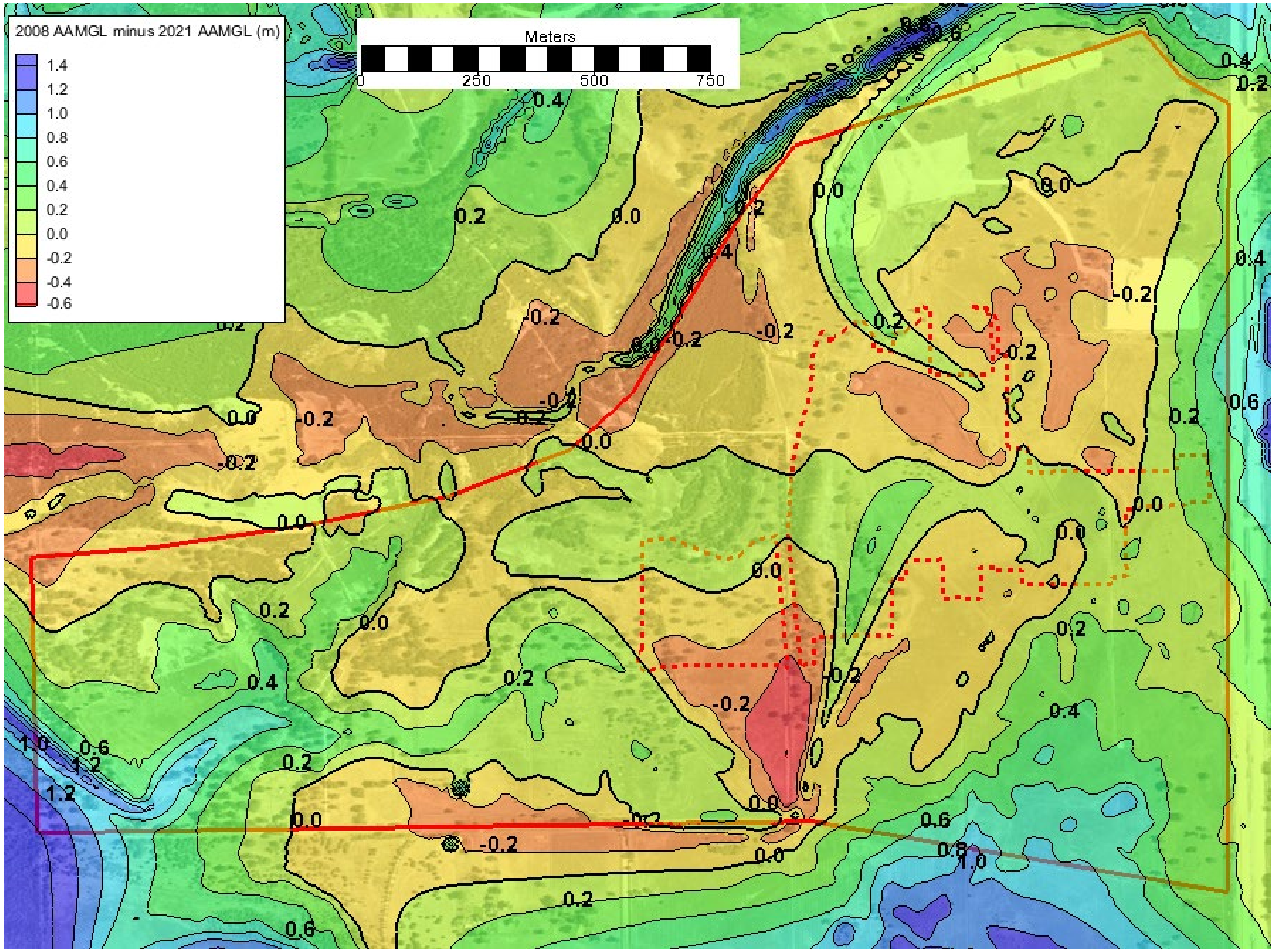


Figure B-5: Estimated Final AAMGL Stage 9–24 UWMP area



Red to yellow indicates the 2021 AAMGL is above the 2008 AAMGL while light green to blue areas are those where the 2021 AAMGL is lower.

Figure B-6: 2008 AAMGL minus 2021 AAMGL (m)

Appendix C:
Stormwater management plan – Stages 21-31

Figure D-1

Stormwater management plan (Stages 15, 20-22, 24, 25, 28, 29, 31-33 UWMP)

GDA 1994 MGA Zone 50

0 40 80 160 m

Project Number: WS375938
Date: 3/09/2025
Scale: 1:3,500 @ A3
Created by: joycelyn.siew
Source: Orthophoto - Landgate, Feb 2025

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Appendix D:
Drainage strategy concept

LEGEND

DESCRIPTION	SYMBOL
MAIN DRAINAGE PIPE	
EXISTING OPEN DRAIN	
15mm TWL	
20% AEP TWL	
1% AEP TWL	
INDICATIVE LOW POINT / OVERLAND FLOW TO POS	
CATCHMENT C61	
CATCHMENT C62	
CATCHMENT Y	
CATCHMENT MEDIAN SWALE	
CATCHMENT 1	
CATCHMENT 2	
CATCHMENT 3	
CATCHMENT 4	
CATCHMENT 7	
CATCHMENT 8	
CATCHMENT 10	
CATCHMENT 11	
CATCHMENT 12	
CATCHMENT 14	
CATCHMENT 16	

NOTE: ASSUMED THAT 15mm EVENT IS CONTAINED WITHIN 20% AEP EVENT

CATCHMENT Y

GROSS AREA ROADS = 3.55 ha
GROSS AREA POS = 0.30 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	1.65	1.65	1.65
PEAK STORAGE VOLUME (m3)	278	590	1542
TOP WATER LEVEL (m)	2.24	2.55 (520m3)	2.55 (520m3)
TOP WATER LEVEL AREA (m2)	1160	1210	1210

CATCHMENT 1

GROSS AREA ROADS = 2.31 ha
GROSS AREA POS = 2.05 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	1.65	1.95	1.95
PEAK STORAGE VOLUME (m3)	290	630	1740
TOP WATER LEVEL (m)	2.00	2.10	2.80
TOP WATER LEVEL AREA (m2)	1000	1690	2380

CATCHMENT 2

GROSS AREA ROADS = 3.76 ha
GROSS AREA POS = 2.05 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	1.95	2.25	2.25
PEAK STORAGE VOLUME (m3)	425	680	1880
TOP WATER LEVEL (m)	2.40	2.50	3.20
TOP WATER LEVEL AREA (m2)	1460	1740	2200

CATCHMENT 11

GROSS AREA ROADS = 4.51 ha
GROSS AREA POS = 1.81 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	1.88	2.18	2.18
PEAK STORAGE VOLUME (m3)	414	678	984
TOP WATER LEVEL (m)	2.18	2.29	2.41
TOP WATER LEVEL AREA (m2)	1531	2424	2620

CATCHMENT DOS

GROSS AREA ROADS = 0.00 ha
GROSS AREA POS = 5.00 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	2.00	2.27	2.27
PEAK STORAGE VOLUME (m3)	156	355	627
TOP WATER LEVEL (m)	2.27	2.54	2.82
TOP WATER LEVEL AREA (m2)	660	847	1070

CATCHMENT 12

GROSS AREA ROADS = 3.62 ha
GROSS AREA POS = 4.25 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	1.85	2.15	2.15
PEAK STORAGE VOLUME (m3)	380	708	1144
TOP WATER LEVEL (m)	2.15	2.28	2.47
TOP WATER LEVEL AREA (m2)	1422	2263	2495

CATCHMENT MEDIAN SWALE

GROSS AREA ROADS = 1.30 ha
GROSS AREA MEDIAN = 0.12 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	VARIES	VARIES	2.85
PEAK STORAGE VOLUME (m3)	94	277	293
TOP WATER LEVEL (m)	3.35	3.35(94m3)	3.35(94m3)
TOP WATER LEVEL AREA (m2)	610	860	860

CATCHMENT C61

GROSS AREA ROADS = 1.16 ha
GROSS AREA POS = 1.06 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	2.55	2.85	2.85
PEAK STORAGE VOLUME (m3)	180	265	530
TOP WATER LEVEL (m)	3.15	3.25	3.65
TOP WATER LEVEL AREA (m2)	620	710	800

CATCHMENT C62

GROSS AREA ROADS = 3.35 ha
GROSS AREA POS = 1.06 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	2.80	3.10	3.10
PEAK STORAGE VOLUME (m3)	470	750	1875
TOP WATER LEVEL (m)	3.30	3.40	4.10
TOP WATER LEVEL AREA (m2)	1560	1900	2450

CATCHMENT 16

GROSS AREA ROADS = 4.26 ha
GROSS AREA POS = 3.84 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	3.00	3.30	3.30
PEAK STORAGE VOLUME (m3)	428	1031	1772
TOP WATER LEVEL (m)	3.3	3.61	3.95
TOP WATER LEVEL AREA (m2)	1587	2016	2412

CATCHMENT 14

GROSS AREA ROADS = 3.53 ha
GROSS AREA POS = 0.99 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	2.40	2.69	2.69
PEAK STORAGE VOLUME (m3)	321	501	785
TOP WATER LEVEL (m)	2.69	2.83	3.02
TOP WATER LEVEL AREA (m2)	1236	1359	1542

CATCHMENT 10

GROSS AREA ROADS = 6.27 ha
GROSS AREA POS = 4.12 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	2.30	2.60	2.60
PEAK STORAGE VOLUME (m3)	584	983	1989
TOP WATER LEVEL (m)	2.60	2.78	3.16
TOP WATER LEVEL AREA (m2)	2134	2346	2840

CATCHMENT 8

GROSS AREA ROADS = 2.15 ha
GROSS AREA POS = 0.73 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	3.10	3.39	3.39
PEAK STORAGE VOLUME (m3)	216	308	813
TOP WATER LEVEL (m)	3.39	3.50	3.96
TOP WATER LEVEL AREA (m2)	835	912	1284

CATCHMENT 7

GROSS AREA ROADS = 7.68 ha
GROSS AREA POS = 0.99 ha

	7A	7B	7C	7A	7B	7C	7A	7B	7C
	15mm			20% AEP			1% AEP		
BASIN RL (m)	3.4/3.5	2.50	2.50	3.4/3.5	2.80		3.4/3.5	2.80	
PEAK STORAGE VOLUME (m3)	41	245	327	60	1184		98	4818	
TOP WATER LEVEL (m)	3.7/3.8	2.80	2.79	3.74/3.84	2.90		3.81/3.91	3.42	
TOP WATER LEVEL AREA (m2)	375	876	1256	466	6387		624	7577	

CATCHMENT 3

GROSS AREA ROADS = 5.04 ha
GROSS AREA POS = 1.58 ha

	3A	3B	3C	3A	3B	3C	3A	3B	3C
	15mm			20% AEP			1% AEP		
BASIN RL (m)	4.10	3.30	3.30	4.10	3.60		4.10	3.60	
PEAK STORAGE VOLUME (m3)	10	162	300	12	980		15	3999	
TOP WATER LEVEL (m)	4.37	3.58	3.59	4.39	3.71		4.41	4.26	
TOP WATER LEVEL AREA (m2)	91	662	1174	101	4764		116	6184	

CATCHMENT 4

GROSS AREA ROADS = 1.97 ha
GROSS AREA POS = 0.76 ha

	15mm	20% AEP	1% AEP
BASIN RL (m)	4.20	4.50	4.50
PEAK STORAGE VOLUME (m3)	183	287	1168
TOP WATER LEVEL (m)	4.48	4.56	5.04
TOP WATER LEVEL AREA (m2)	735	1562	2097

REV	DATE	DRN	CKD	APP	AMENDMENT
W	17.06.26	DMC	MC		ISSUED FOR INFORMATION
V	27.10.25	JAE	MMC	T. BOEKEMAN	ISSUED FOR INFORMATION
U	26.09.25	JAE	MMC	T. BOEKEMAN	ISSUED FOR INFORMATION
T	17.08.25	JAE	TB	T. BOEKEMAN	ISSUED FOR INFORMATION
S	01.08.25	JAE	MMC	T. BOEKEMAN	ISSUED FOR INFORMATION

N

1:2500 0m 50 100 150

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APPROVED: 20.09.23
DESIGNED: JAE
SCALE: 1:2500

PROJECT: AUSTIN LAKES (SOUTH YUNDERUP) - STRATEGIES

TITLE: DRAINAGE STRATEGY CONCEPT PLAN

WAPC No.: -
DRAWING No.: 6427-ST-700
REVISION: W
ORIGINAL SIZE: A1

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