Attachment 11.1.4

David Wills and Associates
Consulting Engineers

LOCAL WATER MANAGEMENT STRATEGY

LOT 500 BROCKMAN HIGHWAY, NANNUP

24208
REVISION C
JULY 2025

DOCUMENT CONTROL DATA

DWA David Wills and Associates Consulting Engineers	David Wills and Associates Unit 1/9 Shields Crescent Booragoon WA 6158 PO BOX 3084 Myaree WA 6158 Tel: (08) 9424 0900 www.dwaconsulting.com.au	**Title**	Local Water Management Strategy
		Author	AR
		Checked	BD
		Approved	BD
		Synopsis	This local water management strategy provides a sustainable solution for the water management and requirements for the proposed tourist development.

Reference: 24208
Client: Paul Meschiati and Associates Pty Ltd

Revision Table

Ver	Description	Date	Authorised
A	Draft	13/06/2025	BD
B	Issued for Approval	02/07/2025	BD
C	Minor amendments, Issued for Approval	03/07/2025	BD

Distribution Table

Date	Version	Distribution
13/06/25	A	Paul Meschiati, Andy Lochrie
02/07/25	B	Paul Meschiati, Andy Lochrie
03/07/25	C	Paul Meschiati, Andy Lochrie

CONTENTS

1 INTRODUCTION

David Wills and Associates have been engaged by Paul Meschiati and Associates Pty Ltd to undertake a Local Water Management Strategy (LWMS) for the proposed tourist development at Lot 500 Brockman Highway, Nannup.

The site is approximately 8.6 hectares and is bounded by Dunnet Road, Asplin Road and Brockman Highway. There is a creek which runs along the northeastern boundary, within the site. The creek discharged directly into Blackwood River, approximately 800m to the north.

This report addresses the requirements of the Shire of Nannup stated in their letter dated 3 February 2025 in response to the Draft Local Development Plan submission for the development, as well as the requirements of the Department of Water and Environmental Regulation (DWER).

An aerial view of the site is provided in Figure 1 below.

Figure 1: Aerial View of the Site, (Courtesy of Nearmap)

2 PROPOSED DEVELOPMENT

The site is proposed to be developed into a tourist resort, which includes a motel, backpackers' accommodation, 10 chalets, a restaurant, café, shops, and a reception centre. The tourist resort is designed with sustainability in mind, aiming to minimise its environmental impact through water conservation. It will also support the local community by promoting responsible tourism and protecting surrounding natural habitats.

An overview of the proposed development is provided below:

Figure 2: Proposed Development (Paul Meschiati and Associates)

The proposed Development Area is shown in green in Figure 3 below. The site contains an Aboriginal Heritage area, and a portion of the site is classified as "*Possibly contaminated – investigation required*" by DWER. These areas of the site will not be developed.

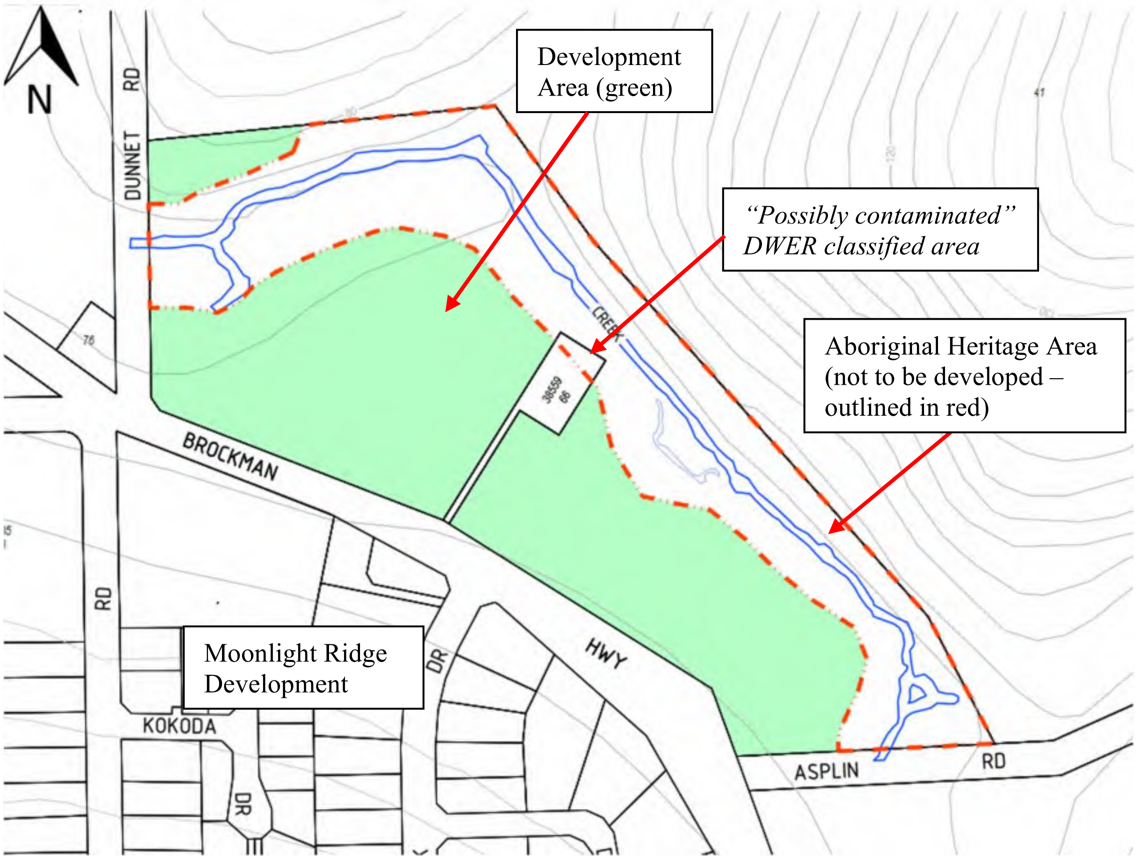

Figure 3: Development Area

3 LWMS DESIGN CRITERIA AND OBJECTIVES

This report is to address the requirements of the Shire of Nannup, including the requirements of a Local Water Management Strategy (LWMS) as defined by the Department of Water and Environmental Regulation (DWER).

The key points addressed are listed below:

- Demonstrate that the development can suitably manage water quantity and quality on site without creating off-site impacts
- Consider the capacity of the scheme water and sewerage disposal facilities in Nannup
- Review the impact of drainage from the Moonlight Ridge subdivision
- Possible implications and recommendations for the contaminated site classification over a portion of the site
- Minimise public risk
- Protect infrastructure and assets from flooding and inundation
- Maintain surface-water and ground water 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.

The following storm events will be assessed in order to achieve the above requirements.

- Small Storm Event – the first 15mm of rainfall inside the catchment;
- Major Storm Event – the 1% AEP (1 in 100 year) storm event of critical duration.
- Major Storm Event – the 1% AEP (1 in 100 year) pre-development flood overland flow from neighbouring properties.

4 PRE-DEVELOPED ENVIRONMENT

4.1 Current Land Use and Topography

The area proposed for development is consists of open grassed plains and is not being used for any specific purpose. Ground levels across the site range from approximately 68.0m AHD to 74.5m AHD. The land generally slopes at a gradient of approximately 3% toward the creek, with the highest point located at the southern end near Brockman Highway and the lowest point at the northern end of the site adjacent to the creek, following the natural fall of the land toward the watercourse.

A detailed feature survey was undertaken by Survcon Surveying Services in December 2022. The survey is included in the Appendix A of this report.

4.2 Location and Climate

Nannup experiences a Mediterranean climate with hot, dry summers and cool, wet winters. The town receives an average annual rainfall of approximately 950 to 1,000mm. According to the Bureau of Meteorology, the mean annual rainfall is approximately 915mm. In contrast, summers from December to February are typically very dry, often with minimal precipitation. The majority of the rainfall occurs between May and August during the wetter winter months.

The mean maximum temperature is approximately 20.8°, and the mean minimum temperature is approximately 9.4°, as listed by the Bureau of Meteorology Nannup weather station.

An extract from the Shire of Nannup is provided below outlining various recurrence rainfall events. These events are used as the basis for stormwater designs.

Attachment 1 - Rainfall intensity for Perth (applies to the Shire of Nannup)

OUTPUT IFD TABLE
Rainfall Intensity (mm/hr) for Perth

Duration	Average Recurence Interval (Years)							
	1	2	5	10	20	50	100	500
5m	59.35	78.17	102.62	119.02	142.65	177.59	207.44	290.89
6	55.19	72.60	95.01	110.00	131.62	163.54	190.77	266.70
7	51.74	67.99	88.74	102.57	122.56	152.02	177.10	246.93
8	48.82	64.08	83.44	96.31	114.92	142.32	165.62	230.37
9	46.30	60.72	78.88	90.92	108.37	134.01	155.79	216.21
10	44.09	57.77	74.90	86.23	102.66	126.78	147.25	203.94
11	42.13	55.16	71.38	82.08	97.63	120.42	139.74	193.17
12	40.38	52.83	68.24	78.39	93.15	114.76	133.07	183.63
13	38.81	50.73	65.42	75.08	89.13	109.70	127.10	175.09
14	37.38	48.83	62.87	72.08	85.50	105.13	121.71	167.41
15	36.07	47.10	60.55	69.36	82.21	100.97	116.82	160.45
16	34.88	45.51	58.42	66.87	79.19	97.18	112.37	154.11
17	33.77	44.04	56.47	64.58	76.43	93.71	108.28	148.31
18	32.75	42.69	54.66	62.46	73.87	90.50	104.52	142.97
20	30.93	40.26	51.43	58.69	69.32	84.79	97.81	133.48
25	27.27	35.43	45.02	51.21	60.32	73.53	84.62	114.87
30	24.52	31.80	40.22	45.63	53.62	65.17	74.85	101.16
35	22.36	28.95	36.47	41.28	48.41	58.70	67.29	90.59
40	20.61	26.64	33.45	37.79	44.23	53.51	61.25	82.18
45	19.15	24.73	30.96	34.90	40.79	49.25	56.29	75.30
50	17.93	23.11	28.86	32.48	37.90	45.68	52.15	69.56
55	16.87	21.73	27.06	30.42	35.44	42.65	48.63	64.70
60	15.96	20.53	25.51	28.63	33.32	40.03	45.60	60.53
75	13.85	17.80	22.06	24.72	28.73	34.47	39.21	51.92
90	12.32	15.82	19.56	21.89	25.42	30.45	34.60	45.73
2.0h	10.21	13.09	16.14	18.03	20.89	24.97	28.34	37.32
3	7.82	10.00	12.27	13.67	15.80	18.82	21.32	27.94
4	6.46	8.25	10.09	11.22	12.94	15.39	17.40	22.73
5	5.57	7.11	8.67	9.62	11.09	13.16	14.87	19.37
6	4.94	6.30	7.66	8.49	9.78	11.59	13.07	17.00
8	4.09	5.20	6.31	6.98	8.02	9.48	10.68	13.84
10	3.53	4.49	5.43	5.99	6.87	8.12	9.13	11.80
12	3.13	3.98	4.80	5.29	6.06	7.15	8.04	10.36
14	2.83	3.60	4.36	4.82	5.53	6.54	7.36	9.52
16	2.59	3.30	4.01	4.44	5.11	6.05	6.82	8.85
18	2.40	3.06	3.72	4.13	4.76	5.64	6.37	8.29
20	2.24	2.86	3.49	3.87	4.46	5.30	5.99	7.82
22	2.10	2.68	3.28	3.65	4.21	5.01	5.67	7.41
24	1.98	2.53	3.11	3.46	4.00	4.76	5.39	7.06
36	1.50	1.93	2.39	2.67	3.10	3.72	4.23	5.59
48	1.22	1.57	1.96	2.21	2.57	3.10	3.53	4.71
60	1.03	1.33	1.67	1.89	2.21	2.67	3.05	4.09
72	0.89	1.16	1.46	1.65	1.94	2.35	2.69	3.62

The critical storm recurrence interval for the design of the stormwater systems is the 1% Annual Exceedance Probability (AEP) storm of critical duration. This storm is also referred to as the 1 in 100 year storm of Average Recurrence Interval (ARI).

A summary table of various storm events using different terminology is provided below.

A storm listed as ARI refers to the average or expected number of years between a specific rainfall event. It is implicit in this definition to note that any one time period between events is random. A storm listed as AEP refers to the probability that a given rainfall event will be exceeded during the year. All storms in this report will be discussed as AEP storm events.

Table 1: Various Standard Storm Events

1 in x Storm Event	ARI (Annual Recurrence Interval)	AEP (%) Annual Exceedance Probability
1 in 1 year storm event*	1	63.2
1 in 2 year storm event	1.44	50
1 in 5 year storm event	4.48	20.0
1 in 10 year storm event	9.49	10
1 in 20 year storm event	20	5
1 in 50 year storm event	50	2
1 in 100 year storm event	100	1

4.3 Floodplains, Existing Catchments and Existing Drainage

The stormwater runoff from within the site discharges towards the creek, which then flows to the north of the site and across Dunnet Road. For large storm events, this flow eventually reaches the Blackwood River, approximately 800m downstream of the site.

The Blackwood River major floodplain extends within the western boundary of the site. The extent of the floodplain within the site is provide in Figure 4 below.

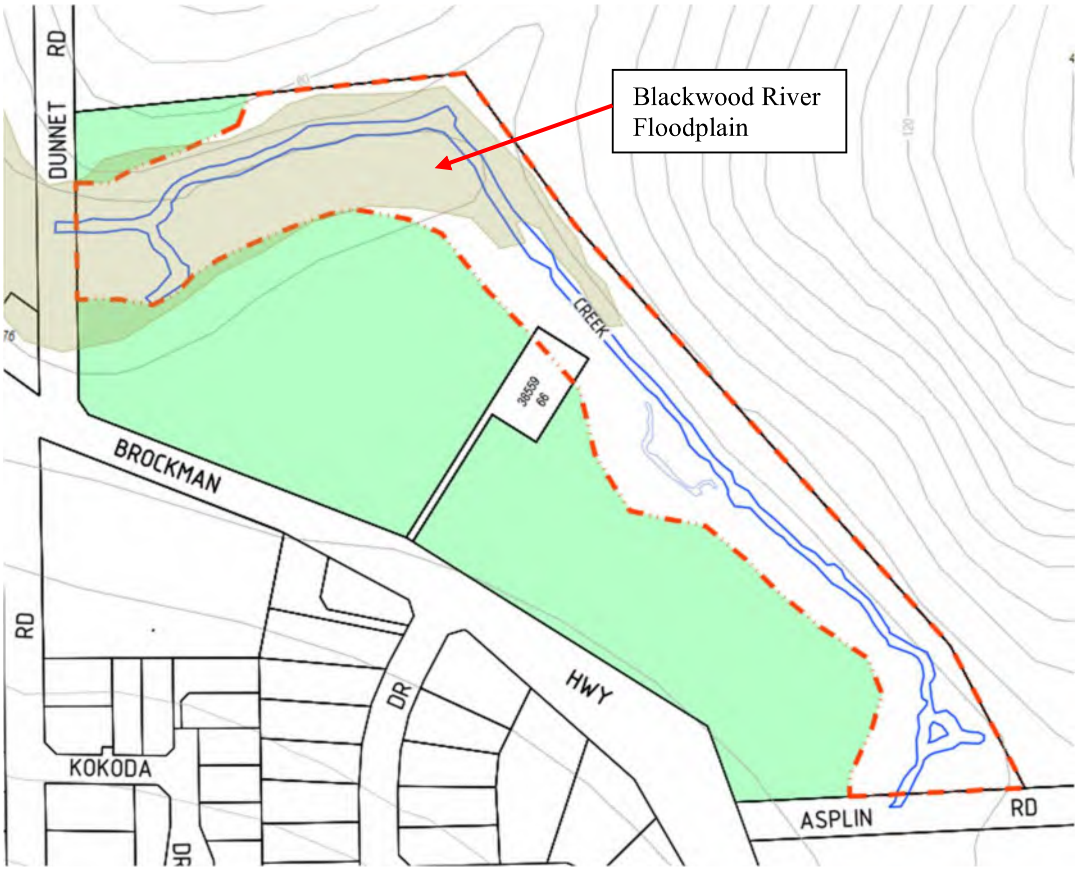

Figure 4: Blackwood River Floodplain

DWER have advised the following flood levels within the site, based on the Blackwood River Flood Study through Nannup:

- 1 in 25 AEP: 66.63m AHD
- 1 in 100 AEP: 68.18m AHD.

DWER have recommended a minimum habitable floor level of 68.7m AHD, i.e. 0.52m above the 1 in 100 AEP flood level.

The site contains an existing 600mm diameter stormwater drainage pipe and sump area which is utilised by the adjacent subdivision "Moonlight Ridge" as a stormwater discharge point, with an estimated catchment area of 7.97 hectares. During large storm events, the stormwater is discharged into the sump which overflows into the creek.

The 600mm diameter pipe and sump was historically used for a sewerage disposal, and therefore DWER have classed the area of the pipe and sump only as *"Possibly contaminated – investigation required"*.

As the pipe has been operating for many years as a stormwater drainage pipe for the neighbouring properties, both the pipe and sump will remain in place and continue to operate. There are no plans to modify either the pipe or the sump as part of this development.

The Shire of Nannup has acknowledged that there are ongoing issues with stormwater runoff originating from the Moonlight Ridge subdivision and are currently considering diverting the stormwater runoff entering the 600mm diameter pipe along Brockman Highway, towards Asplin Road or Dunnet Road, instead of through Lot 500 Brockman Highway. For the purposes of this LWMS, it is assumed that the pipe will remain in situ.

Overland flows from Brockman Highway, as well as from the western and eastern portions of Moonlight Ridge adjacent to the development site, enter the property and flow toward the creek.

The creek also conveys flows from adjacent catchment areas to the north, and from the adjoining creek extending southeast of the site, south of Asplin Road.

An External Catchment Area plan is provided in Appendix B.

4.4 Groundwater

DWER have indicated high water table levels from Lot 41, the area to the north and northeast of the site, with advice that groundwater may discharge into the creek from the uphill environment. Lot 41 contains steep slopes, with a surface of up to 85m above the creek area.

The creek provides a control point to the groundwater table in the area.

There is limited groundwater bore information for the Nannup region. Further investigation and assessment will be undertaken during the detailed design stage to better understand local groundwater conditions and inform the design process.

4.5 Geotechnical

The site soils are expected to consist of sands, clays and silts with a low infiltration rate. This has been cross checked with data from Landgate as shown below in Figure . The soil in the area is classified as "Brown loamy earth", allowing for an expected order of magnitude of permeability from the soil classification.

Figure 5 Soil Landscape Mapping (Landgate Soil Landscape DPIRD-076, 2025) "brown loamy earth"

Brown loamy earth
Friable red/brown loamy earth
Brown deep sand
Duplex sandy gravel

Permeability is estimated to be in the range of $3.5x10^{-6}$ to $1.4x10^{-5}$ $m/s/m^2$, based upon loamy earth. A geotechnical report is to be undertaken during detailed design stage, to confirm the soils and permeability, and confirm the proposed sizing of the swales and basins.

Due to the expected low infiltration of the natural surface, there is minimal change to stormwater if the site is further developed with a carpark and buildings as long as the swales are maintained.

4.6 Acid Sulphate Soils

Figure below displays the Acid Sulphate Soil risk map for Nannup. Acid Sulphate Soils present are indicated as "extremely low probability of occurrence" for this site by Data WA.

Figure 6: Acid Sulphate Soils Risk Map (Data WA, 2025)

4.7 Existing Water and Sewer

A 150mm diameter Polyvinyl Chloride (PVC) Class 12 water main runs along the southern verge of Brockman Highway, and a 14m long 150mm diameter PVC water main crossing is installed across Brockman Highway to service the site.

Gravity sewer runs along the southern verge of Brockman Highway, and crosses to the northern verge near Dunnet Road. Access Chamber 0083 is located adjacent to the site, with a 225mm diameter stub installed to provide a connection point to the site.

Figure 7 below shows the existing water and sewer adjacent to the site.

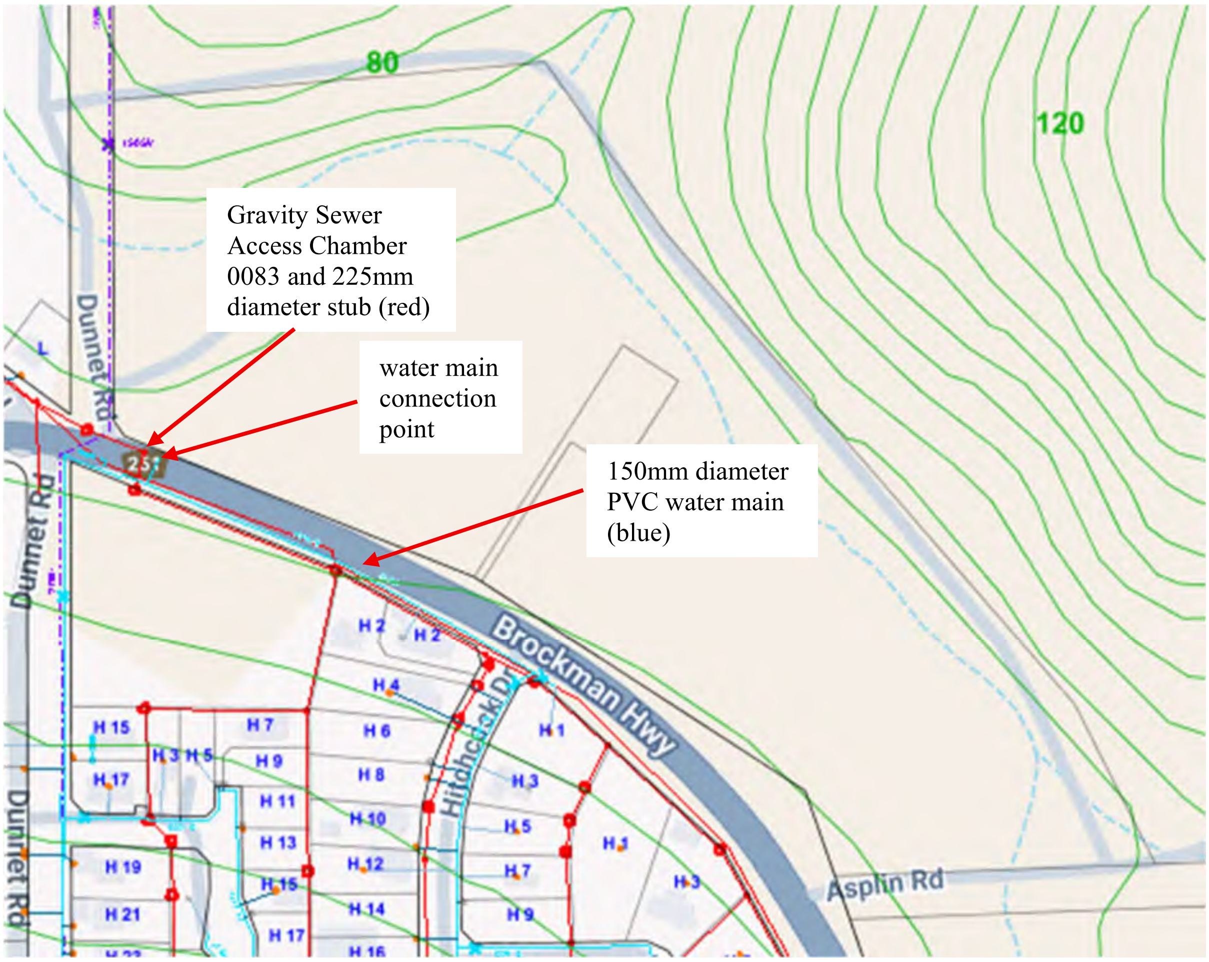

Figure 7: Existing water and sewer mains

5 WATER SUSTAINABILITY INITIATIVES

The development will utilise water-wise garden (Water Corporation, 2003) principles for lot gardens and landscaping and water efficient fixtures and appliances to ensure that the development minimises the use of water. These measures are further discussed in the following sections.

5.1 Service Connections

At the time of development, the requirements of the relevant Statutory Authorities will be met, encompassing elements such as water supply and wastewater disposal.

The development shall be fully serviced with a potable water connection and waste water connection, supplied by the Water Corporation.

In collaboration with the Water Corporation, arrangements will be made to secure and guarantee the presence of a suitable water supply, and sewerage services for the proposed development.

The estimated sewer design flows generated from the site are up to 43 kL/day. This estimation is based on the Department of Health guidelines for Non-residential premises. It is intended to connect to the existing 225mm diameter sewer stub connection in Access Chamber 0083 in Brockman Highway. The Water Corporation have confirmed there is capacity in the Nannup wastewater conveyance network and wastewater treatment plant for the proposed development.

The estimated peak daily demand for potable water is 15 kL/day, with an average daily demand of 5 kL/day. This demand is based on a maximum of 150 people using 100L per person per day, or an average of 50 people using 100L per person per day. This estimate assumes the use of rainwater tanks for garden irrigation. The Water Corporation has advised that the availability of potable water for the development is subject to confirmation and depends on groundwater licensing in the Nannup area.

To manage and reduce water demand, the development may be delivered in stages, depending on the volume of potable water available at the time of each stage. The Water Corporation will confirm potable water availability during the detailed design phase.

5.2 Stormwater Approach

Stormwater generated within the development will be captured and directed to garden beds at first instance, and then into either rock pitched swales or sealed pits, conveying water to basins.

The Shire of Nannup requires to detain the first 15mm of rainfall on site. The proposed basins are designed to detain at least the first 15mm of rainfall from the entire development area.

For storms beyond the first 15mm of rainfall, excess stormwater will flow from the basins and into the adjacent creek via dedicated swales or channels.

Overflow paths have been provided to convey runoff from neighbouring sites during up to a 1% AEP storm event. These overflow paths will be designed to accommodate these flows without relying on the development’s internal stormwater drainage system.

The roof runoff from the buildings will be captured by rainwater tanks, which will be used for watering the gardens.

5.3 Water-Efficient Fixtures and Appliances

Significant reductions in in-house water use can be achieved with the adoption of WEFA (water-efficient fixtures and appliances). Implementation of WEFA can result in between a 30% and 50% reduction in water use in residential dwellings as listed by Melbourne Water in a 2003 study.

The water conservation strategy proposes that all dwellings use WEFA. Water-efficient fittings will be implemented by the lot owner during building construction, while uptake of water-efficient appliances can be encouraged by state and local government rebates, as well as education from the proponent at the point of sale.

5.4 Water Wise Gardens

Reductions in water use for irrigation by employing water efficiency measures can significantly reduce the total water usage.

A variety of methods and approaches to limit water use will be considered, including any or all of the following:

- The adoption of water-wise plant species, with a focus on using local native water-wise species;
- Where required, existing site soil may be improved with soil conditioner certified to Australian Standard AS 4454 to a minimum depth of 150 mm where turf is to be planted and a minimum depth of 300 mm for garden beds;
- The irrigation system will be designed and installed in accordance with best-practice water efficiency principles, including the use of hydro-zoning strategies;
- The irrigation system will be fitted with weather-based irrigation controllers and/or soil moisture sensors;
- The number of turfed areas will be controlled while also being designed to meet patron needs;
- Garden beds will be mulched to a depth of 75 mm with a product certified to Australian Standard AS 4454;
- The landscape design will cater for efficient water requirements during garden maintenance. Implementation of an appropriate management and maintenance program for garden areas will be further detailed at the detailed design stage;
- Patrons will be provided with signage and educational literature explaining the resort's commitment to stormwater and environmental initiatives, encouraging guests to avoid littering, use refillable water bottles, and report spills.
- Rainwater tanks will be installed to capture roof runoff from the buildings, which will be used for garden irrigation, toilet flushing and laundry purposes.
- The use of an Aerobic Treatment Unit (ATU) may be requested at detailed design stage, which could re-use water for garden irrigation purposes. Approval for the ATU would be at the discretion of the Shire of Nannup and would provide an additional water saving method for the site.

5.5 Non-Structural Stormwater Management Measures

Several non-structural measures will also be implemented across the site to help reduce nutrient loads within stormwater runoff. These measures include:

- Street sweeping and regular cleaning of hard surfaces to prevent debris from entering the drains;
- Minimising fertiliser use to establish and maintain vegetation within garden areas and road verges;
- Use low-phosphorus fertilisers and minimal pesticides near drainage paths;
- Train staff in spill response and stormwater-friendly cleaning practices;
- Use of drought-tolerant turf and plant species that require minimal water and nutrients;
- Conduct routine inspections of drains, gutters, and natural waterways.

These measures will assist in achieving the required stormwater objectives.

6 STORMWATER MANAGEMENT STRATEGY

6.1 Design Approach

The design approach is to:

1. Allow a maximum discharge from the development to meet pre-development outflows from a 1 in 5 year ARI (18% AEP) storm event.
2. Retain the first 15mm of rainfall on site, before overflowing to the creek
3. Provide an overflow path to convey flows from the neighbouring sites for up to a 1% AEP storm event. These overflow paths will be designed so that a 1% AEP storm event can be conveyed through the site without affecting the development's stormwater drainage.

6.2 Pre-development flow meeting post-development flows from site

The pre-development flow calculation is based on the discharge from the Development Area of 3.88 hectares, located on the southern side of the creek.

The allowable outflow from the Development Area is based on pre-development flows. Incorporating a pre-development run-off co-efficient of 0.7 with a time of concentration of 22 minutes, with a rainfall intensity of 51.43 mm/hr for a 1 in 5 year ARI (18% AEP) storm event of critical duration, the maximum allowable outflow from the Development Area is 388 L/s.

6.3 Design Storm Event – First 15mm Rainfall

Stormwater generated within the development will be captured and directed to garden beds at first instance, where possible, through gaps in the kerbing. The garden beds will be set at 200mm below pavement level, which will provide storage for the stormwater runoff.

An overflow point will be constructed within the garden bed area, set at 100mm below the pavement level. Once the water reaches 100mm deep within the garden bed, it will overflow via the lower adjacent pavement, which will be graded to direct flow into gully pits with grated lids or rock pitched swales. A typical detail of the garden beds is provided in Drawing 24208-C03 in Appendix B.

From the rock pitched swales, the stormwater will be carried to five stormwater basins located throughout the site and adjacent to the creek.

In accordance with the Shire of Nannup requirements of detaining the first 15mm of rainfall on site, the proposed basins are designed to detain the first 15mm of rainfall from their corresponding catchment areas.

All buildings will be served with rainwater tanks, which will be used for watering the gardens, and, where required, toilet flushing and laundry. The rainwater tanks have been preliminarily sized based on garden irrigation demand. Final tank sizing will be confirmed during the detailed design stage. Stormwater runoff from the carpark is to be directed to garden beds and interconnected pits.

Table 1 below provides the required storage volume for the first 15mm of rainfall for the Development Area. These basins have been conservatively sized to include storage of roof runoff.

Table 2: Required Storage Volumes

Basin No.	*Catchment Area (m^2)*	*15mm Volume Required (m^3)*
1	3,913	59
2	2,615	39
3	12,592	189
4	11,545	173
5	8,154	122
Total	**38,819**	**582**

6.4 Design Storm Event – 1 in 100 year ARI (1% AEP)

For storms beyond the first 15mm of rainfall, this rainfall is not required to be retained on site, but will be directed from the basins to the creek via overland flow on rock pitched swales.

The 1 in 100 year ARI (1% AEP) overland flow path for the Development Area will be directed towards the basins.

The rock pitched swales are designed to convey the 1 in 100 year ARI (1% AEP) 6-minute duration storm event to the basins. The maximum longitudinal grade will be 0.67% (or 1 in 150) to keep the water velocity at 0.7m/s with a Froude number of 0.45 (a Froude number of greater than 1 indicates that the nature of the flow is turbulent and may result in erosion).

Rock "riffle" structures are to be installed if the longitudinal gradient is steeper than 0.67%. The height of these riffles are typically 350mm and spaced according to the longitudinal grade of the drain. In addition to the riffle structures, rock lining is recommended to be installed between the riffles to minimise scour and protect the bare soil.

The top water level within the basins will be set to the 1 in 100 year ARI (1% AEP) level with the outflows limited to meet the pre-development outflow of 388 L/s.

To control the outflow from the basins to the creek, a grated 1200mm diameter stormwater pit is to be installed within each basin with a 225mm diameter overflow pipe and orifice to control the outflow (invert levels and size are to be confirmed at the detailed design stage). The pit will have a grated lid set at 0.05m above the 15mm rainfall water level of the basin, and a maximum of 0.9m above the invert level of the basin, which will only allow stormwater from each basin to flow out once the water level in the basin reaches the level of the grate. A typical detail of the pit within the basin is provided in Drawing 24208 C02 in Appendix B.

The following volumes have been calculated for the 1 in 100 year ARI (1% AEP) storm event, with the outflows from the basin restricted to a maximum discharge from the Development Area to meet pre-development outflows from a 1 in 5 year ARI (18% AEP) storm event:

Table 3: Required Storage Volumes

Catchment Area No.	*Catchment Area (m^2)*	*1 in 100 year ARI Volume Required (m^3)*	*Outflow (L/s)*
1	3,913	45	39
2	2,615	30	26
3	12,592	145	126
4	11,545	133	115
5	8,154	93	82
Total	**38,819**		**388**

For this volume calculations, it is assumed that the basins will be empty for the 1 in 100 year ARI storm event. The volumes required for the 1 in 100 year ARI (1% AEP) storm event are less than the 15mm rainfall detention.

Scour protection will be provided at the downstream end of the 225mm diameter overflow pipe and along the bank of the basins to minimise erosion. The scour protection will be provided in the form of unmortared rocks on geofabric, planted with ground covers, shrubs and trees lining the sides of the outflow. The rock sizes and detailed scour protection design will be provided in the detailed design stage.

The 225mm diameter overflow pipe with have an upstream invert level set at approximately 0.5m below the grate to provide enough headwater depth above the upstream end of the pipe to limit the allowable discharge rate. This headwater depth is to be confirmed at detailed design stage for each basin, once the internal catchment areas are confirmed.

6.5 Upstream Surface Water Flows

As the site is located within a valley and contains a creek, neighbouring properties discharge stormwater runoff to the site during major storm events. The catchment areas contributing to the site are shown in the External Catchment Area plan 24208-C03 is provided in Appendix B and below:

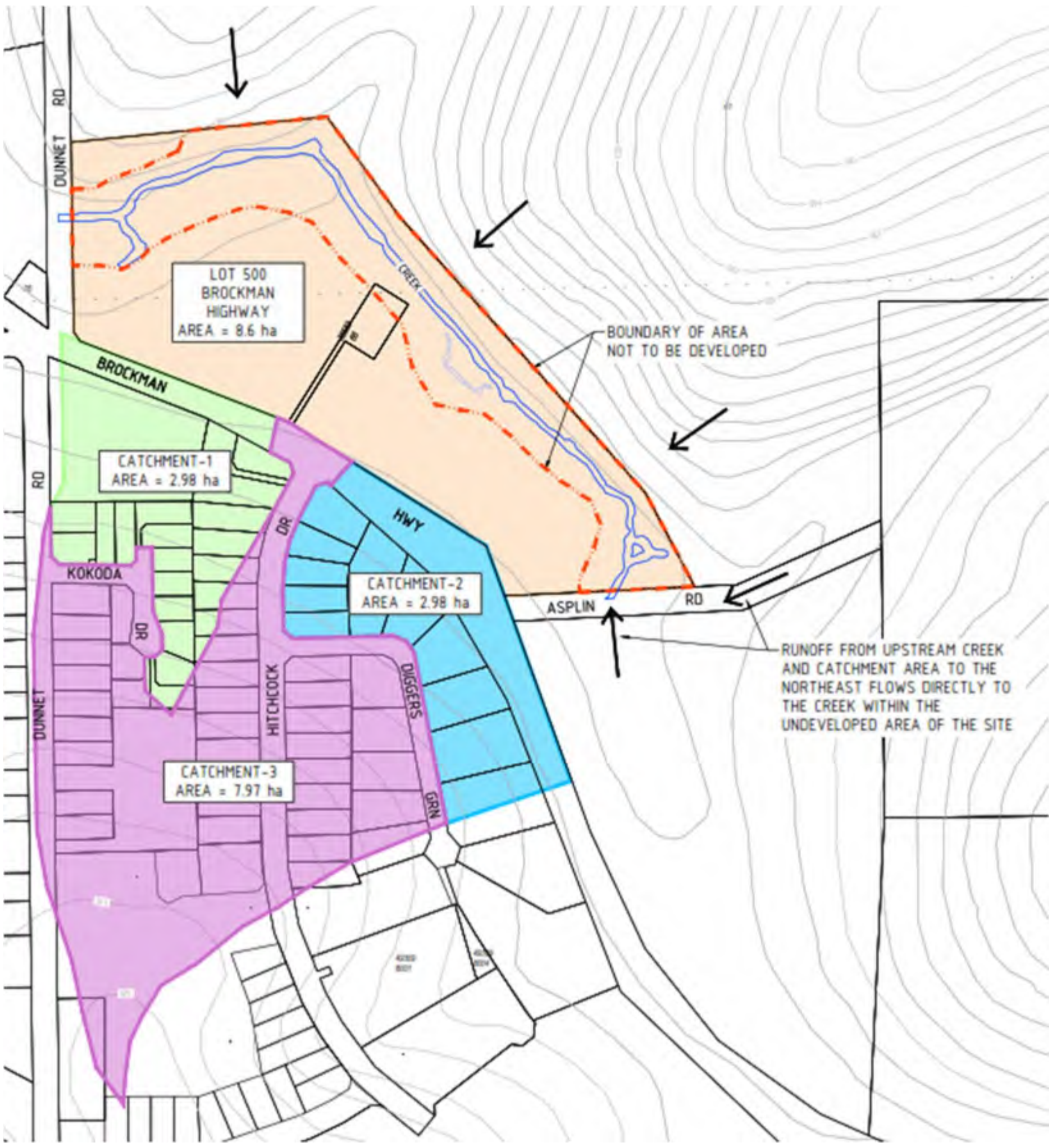

Figure 8: External Catchment Areas

The Shire of Nannup in their Local Planning Policy LPP2 "Stormwater Management and Connection" advises that overland flow from adjoining properties should address the 1% AEP pre-development flood regime for the catchment and be conveyed by suitable means to bypass the detention system.

An overflow path is allowed for as part of the design to convey flows from the neighbouring sites, up to a 1 in 100 year ARI (1% AEP) storm event. These overflow paths will be designed as a depression in the pavement so that a 1% AEP storm event can be conveyed through the site without using the development's stormwater drainage.

The overland flows will cross footpaths and roads. Additional rock protection can be installed within potential areas of scouring.

The following flow rates are estimated to be generated from these catchment areas for a 1% AEP storm event:

Table 4: Required Storage Volumes

Catchment Area No.	*Catchment Area (ha)*	*1% AEP overflow through Lot 500 (L/s)*
1 and 3	2.98 and 7.97	1350
2	2.98	680

If the Shire diverts stormwater from Moonlight Ridge away from Lot 500 Brockman Highway and instead channels it along Brockman Highway toward either Dunnet Road or Asplin Road, the open drain along Brockman Highway will be designed to accommodate the 1% AEP storm event. Depending on the chosen diversion route, one or more of the overflow paths currently proposed within the development may no longer be required. This will be reviewed at the detailed design stage, and is dependent upon the timing of the Shire works.

6.6 Water Quality Management:

To minimise erosion, the swales have been designed to be lined with rocks with a maximum longitudinal grade of 1 in 150, which will reduce the velocity of the water for a 1 in 100 year ARI (1% AEP) storm event to 0.7 m/s with a Froude number of 0.45 (a Froude number of greater than 1 indicates that the nature of the flow is turbulent and may result in erosion).

The swale batters are designed with a slope of 1 in 4 which is adequate to prevent erosion.

Hydrocarbons are unlikely to be an issue at this development site and would be less than stormwater runoff from public roads.

As well as providing storage, the interconnected pits, rock-lined swale and basin system allows suspended solids to settle out and the water will further reduce in velocity as it flows from one basin to the next, enabling settling out of the suspended silt particles more effectively before the stormwater flows out to the creek.

The water that flows into the 1200mm diameter drainage pit will flow out to the northern creek through a 225mm diameter pipe. A baffle will be installed within the pit and over the inlet of the 225mm diameter outflow pipe, which will minimise debris being discharged towards the northern creek.

To reduce the potential of larger debris from entering and blocking the drainage pit, a Webforge lid with maximum aperture of 50mm will be installed on the pit.

The maximum outflow from each of the basins are to be limited to a total of 388 L/s. Further details with regards to the diameter of the rocks, width and overall grade of the discharge point, will be provided in the detailed design, and will be designed to minimise erosion.

The site is to be graded towards the garden beds, rock pitched swales and basins, enabling watering of the plants during storm events. Once plants are established, the concentrated plant growth to the swale will strengthen the side slopes of the channel and reduce the velocity of stormwater entering the channel. This velocity reduction will reduce sediment movement through the channel and further reduce erosion of the channel walls.

It is proposed to plant all basins with a combination of local native sedges and rushes. Some species listed here include:

Table 5: Native Plants

Species	*Plant density*
Baumea	3-7 plants per square metre
Schoenoplectus	3-6 plants per square metre
Eleocharis	3-6 plants per square metre
Bolboshenous	8-10 plants per square metre
Juncus	8-10 plants per square metre
Corex	8-10 plants per square metre
Gahnia Trifida	3-6 plants per square metre

The specific plant species are dependent on availability during the time of planting.

Maintenance of the swales shall be managed by the developer. This shall be included as part of the regular maintenance activities conducted within the site.

During the construction, no debris or residue from the construction site shall be allowed to wash into the basins, swales or directly into the creek. Adequate care must also be taken by contractors to appropriately manage dust levels to avoid negatively affecting the nearby creek, and local flora and fauna.

6.7 Protect and Manage Water Bodies

DWER recommend a minimum habitable floor level of 68.7m AHD to provide adequate freeboard to the 1 in 100 AEP flood plain. Non-habitable developments do not require to be at this level.

DWER have also advised that due to the topography of the site, the proposed development will not be obstructive to major flows within the creek.

The Finished Floor Levels (FFL's) of all habitable buildings will meet the requirement of 68.7m AHD minimum. Concept design levels are shown on 24208-C-01 – Concept Stormwater Drainage plan included in Appendix B and will be confirmed during detailed design.

7 GROUNDWATER MANAGEMENT STRATEGY

There is limited groundwater bore information for the Nannup region. Further investigation and assessment will be undertaken during the detailed design stage to better understand local groundwater conditions and inform the design process.

DWER have indicated high water table levels from Lot 41, the area to the north and northeast of the site, with advice that groundwater may discharge into the creek from the uphill environment. Lot 41 contains steep slopes, with a surface of up to 85m above the creek area.

The creek will provide a control point to the groundwater table, as it acts as a natural drainage system. When groundwater levels rise, water can seep into the creek, lowering the water table in the surrounding land. Conversely, if the water level in the creek is higher than the groundwater, water can seep from the creek into the ground, raising the groundwater level. This interaction between surface water and groundwater creates a balance, meaning the creek helps regulate how much water is stored underground. The effect depends on the local geology, soil type, and how deep the water table is.

To preserve the natural hydrological and ecological function of the creek, the habitable buildings have been set back from the bottom of the bank of the creek by a minimum of 30m.

To manage high groundwater levels that may affect basements, foundations, or infrastructure, sub-surface drainage systems (e.g. subsoil drains) will be installed that safely discharge excess groundwater without altering natural creek baseflows. This requirement will be confirmed in the geotechnical investigation as part of the detailed design process.

The design of the Development Area incorporates landscaped areas where possible, promoting infiltration and reducing runoff to the creek, preserving groundwater recharge zones.

8 MONITORING

8.1 Funding

The site is owned by a single landowner and all funding will be provided by the landowner.

8.2 Construction Period

During the construction, no debris or residue from the construction site shall be allowed to wash into the creek. Adequate care must also be taken by contractors to appropriately manage dust levels to avoid negatively affecting the nearby creek, and local flora and fauna.

It is anticipated that the construction stage will require management of various aspects required for the construction of the development. These aspects include but are not limited to:

- Dust Management;
- Surface Runoff,
- Noise Management; and
- Traffic Management.

The management measures undertaken for construction management will be specifically addressed in a future Construction Management Plan (CMP).

8.3 Condition Monitoring

It is proposed that the overall condition of the development will be monitored on a bi-annual basis. This monitoring will be implemented after the completion of the civil and landscaping works and will continue for a period of two years.

A visual assessment will be undertaken to monitor the overall condition of the development, with the aim of ascertaining that the maintenance activities are achieving the overall management objectives for the development. The parameters that will be monitored include:

- Gross pollutants levels;
- Terrestrial weeds;
- Irrigation;
- Vegetation density;
- Vegetation is disease free or not infected by pests; and
- The condition of paths, benches, walkways and other infrastructure.

9 IMPLEMENTATION

The development of the LWMS has been undertaken to provide a clear structure within which future development that is consistent with the specified integrated water cycle management approach can occur.

9.2 Roles and Responsibility

This LWMS provides a framework that the proponent can utilise to assist in establishing stormwater management methods that have been based upon site-specific investigations, are consistent with relevant State and Local Government policies, and have been endorsed by the Shire of Nannup.

Due to the size of the proposed Development Area, it is possible for the development to be developed in a staged manner. It will be the responsibility of the proponent to prepare detailed designs and a supportive Stormwater Management Plan at each stage of development.

9.3 Review

The basin sizing will be confirmed during the detailed design phase once road pavement levels and building finished floor levels are finalised.

A detailed geotechnical report is required to be undertaken prior to detailed design, to confirm the presence of groundwater and permeability of the soils.

10 MAINTENANCE PLAN

Maintenance of the stormwater drainage system shall be managed by the Tourist Resort staff. This shall be included as part of the regular maintenance activities conducted within the site by the Tourist Resort staff.

10.1 Short Term Maintenance

Plants are suitably established and no longer require irrigation and are close to their mature height. This period is typically 18-24 months. Plants are to be regularly irrigated during the establishment period (18-24 months). Plants that fail to thrive during this period shall be replaced as required.

10.2 Long Term Maintenance

Table 2: Maintenance Tasks

Horticultural Tasks	
Pests and Diseases	Assess plants for disease, pest infection, stunted growth or senescent plants. Treat or replace as necessary. Reduced plant density reduces pollutant removal and infiltration performance. **Frequency - 3 monthly or as desired for aesthetics**
Maintain original plant densities	Infill planting -between 6 and 10 plants per square metre should be adequate (depending on species) to maintain a density where the plants' roots touch each other. Planting should be evenly spaced to help prevent scouring due to a concentration of flow. **Frequency - 3 monthly or as desired for aesthetics**
Weeds	It is important to identify the presence of any rapidly spreading weeds as they occur. The presence of such weeds can reduce dominant species distributions and diminish aesthetics. Weed species can also compromise the systems long term performance. Inspect for and manually remove weed species. Application of herbicide should be limited to a wand or restrictive spot sprayer. **Frequency - 3 monthly or as desired for aesthetics**

11 CONCLUSION

This Local Water Management Plan for the proposed Tourist Resort demonstrates a comprehensive approach to sustainable water use and stormwater management.

By incorporating strategies such as rainwater harvesting, efficient potable water use, and effective stormwater conveyance, the development aims to minimise its impact on local water resources and surrounding ecosystems.

Ongoing collaboration with the Water Corporation and adherence to groundwater licensing will ensure that water availability aligns with staged development.

For and on behalf of DWA Consulting Pty Ltd trading as David Wills and Associates

Prepared by:

Athena Rowcliffe
BEng MIEAust CPEng NER APEC Engineer IntPE(Aus)
Associate Director

Authorised by:

Barbara Dryhinicz
MScEng(Civil) MIEAust CPEng NER APEC Engineer IntPE(Aus)
Supervising Engineer

Encl:
Appendix A: Site Survey
Appendix B: DWA Drawing Set
Appendix C: DWA Stormwater Calculations

APPENDIX A: SITE SURVEY

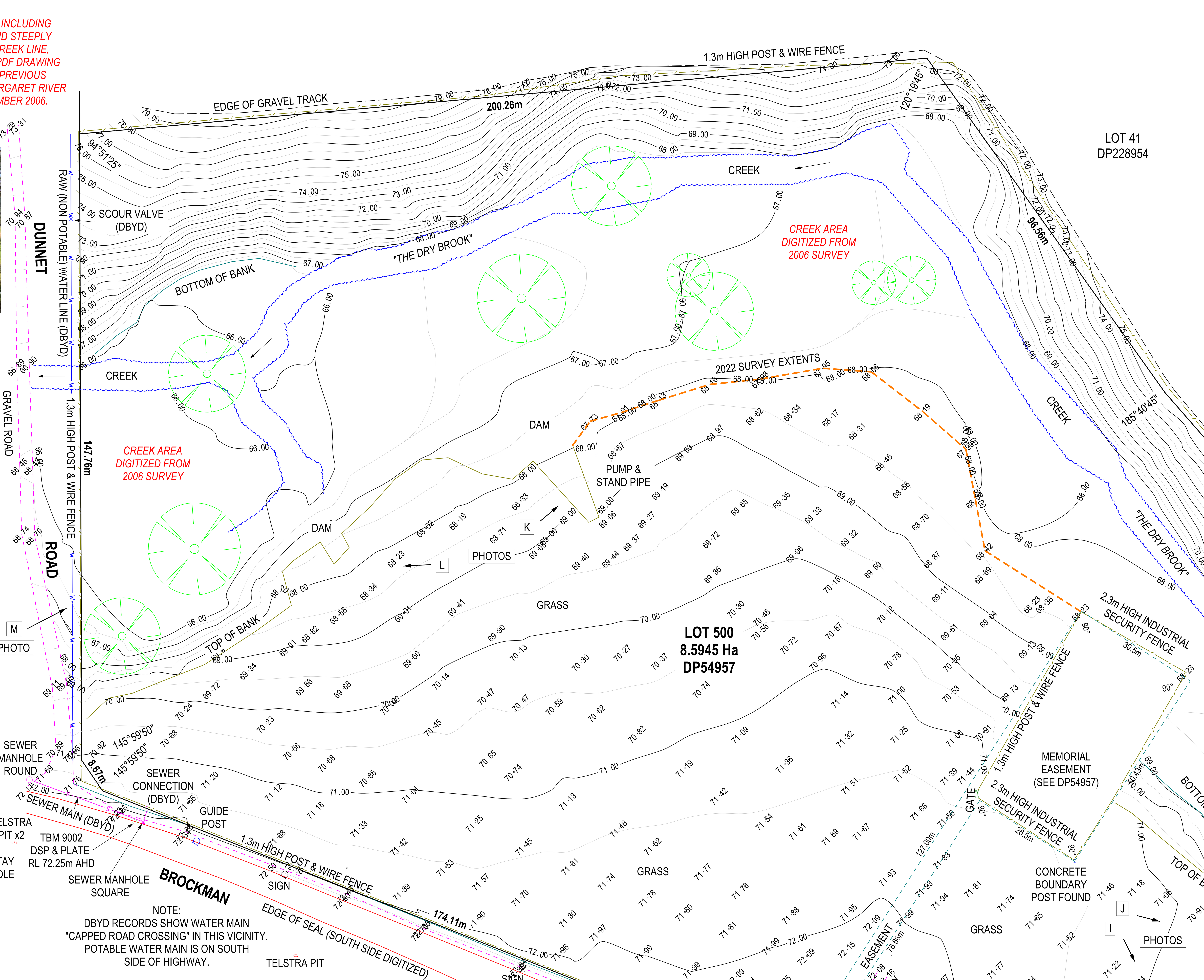


PHOTO 'M'


PHOTO 'J'


PHOTO 'I'


PHOTO 'L'


PHOTO 'K'

NOTES:
1. Limited boundary marks found. Boundary resurvey recommended if building on or close to boundary.
2. Datum is AHD established from SSM COLLIE 473 (RL 74.184m)
3. Above ground services located by survey. Underground services plotted from plans supplied by the relevant authorities. No liability is accepted for errors in underground service locations. All services to be located on site prior to any work being done.
4. No boundary marks found unless otherwise noted.
5. Contour interval is 0.5m.
6. PDF to be used in conjunction with DWG file supplied. Some point heights may have been omitted for clarity; see DWG file.

Rev.	Description	Drawn	Date	Checked
A	INITIAL ISSUE	TJ	19/12/22	CM

Scale: 1:500 A1 ORIG ALL DISTANCES IN METRES

0 5 10 15 20 25

Surveyor: GM
Survey date: 7/12/2022
Precal/Cad: N/A

The contents of this plan are date stated within the revision panel. All consultants and persons wishing to utilise this data should satisfy themselves of this plan's currency by contacting Survcon.

The boundaries depicted on this plan were not re-established as part of this survey, therefore this plan does not guarantee their accuracy. Re-establishment of the cadastral boundaries is recommended for any proposed works on or near existing boundaries.

N

FEATURE AND CONTOUR SURVEY
LOT 500 ON DEPOSITED PLAN 54957, BROCKMAN HIGHWAY, NANNUP

Client: **IDG RESORTS PTY LTD**

SURVEYING SERVICES
PO Box 365 Dunsborough WA 6281 Australia
Tel: (08) 9754 1188
Fax: (08) 9756 8000
mail@survcon.com.au
www.survcon.com.au

PROJ MNGR. Michael Riddle | DATUM COL94 AHD

9075_SS_A
JOB NUMBER TYPE REVISION

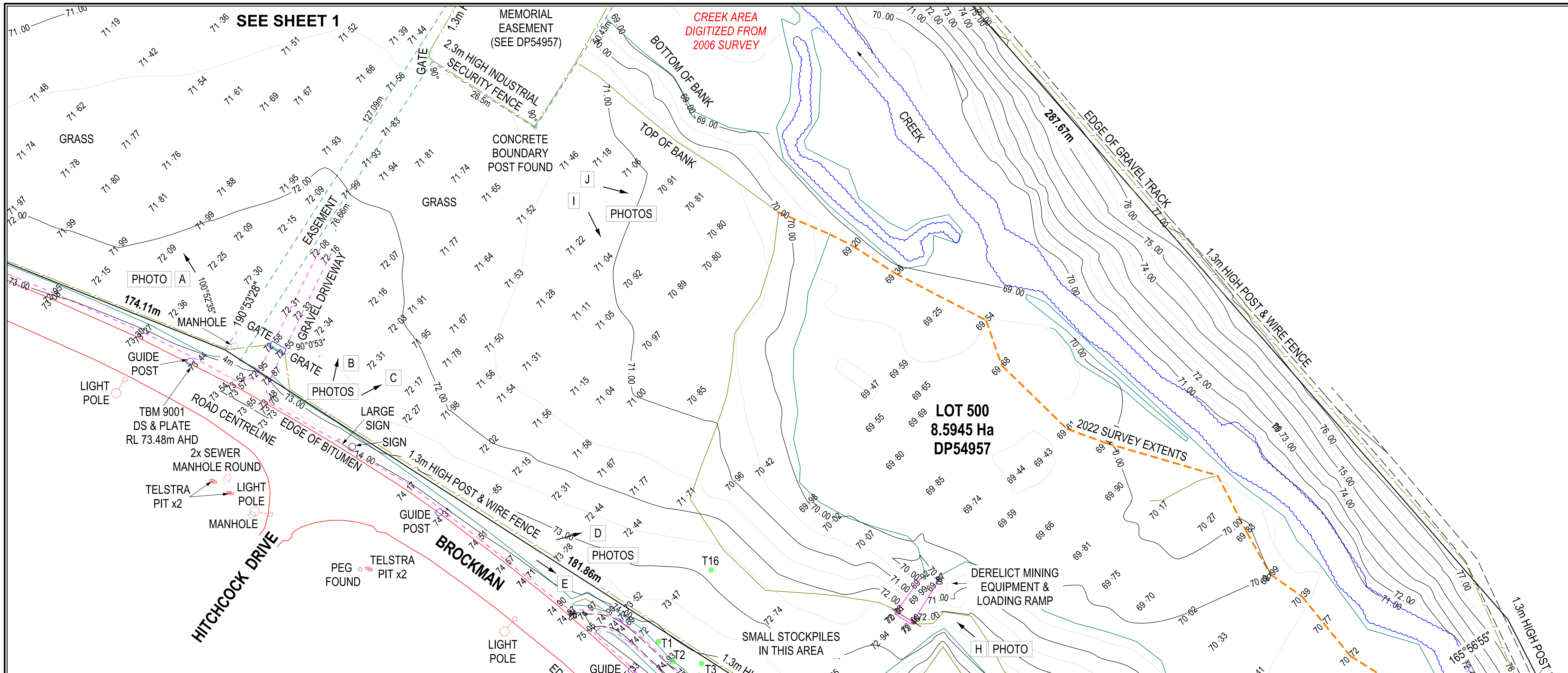


PHOTO 'H'


PHOTO 'G'


PHOTO 'F'


PHOTO 'A'


PHOTO 'B'


PHOTO 'C'

TREE ANNOTATION DETAIL

G = GUM
PEP = PEPPERMINT
M = MARRI

M 300 5 3
M: RED GUM/ MARRI
300: TRUNK 0.3m DIAMETER
5: HEIGHT 5m
3: CANOPY 3m RADIUS

TREE	DESCRIPTION
T1	G 1200 17 10
T2	G 500 13 8
T3	G 800 23 12
T4	G 700 17 12
T5	G 600 17 8
T6	G 800 22 13
T7	G 1500 32 17
T8	M 500 20 7
T9	M 1000 25 10
T10	M 1000 25 10
T11	M 600 23 9
T12	M 600 23 9
T13	G 900 20 14
T14	M 600 17 8
T15	M 600 17 8
T16	G 1200 25 15
T17	M 600 22 8
T18	M 1500 22 10

LEGEND

- DRAINAGE GULLY
- SIDE ENTRY PIT
- WATER HYDRANT
- SIGN
- GUIDE POST
- SEWER CONNECTION
- SEWER MANHOLE SQUARE
- SEWER MANHOLE ROUND
- POWER POLE
- TELSTRA PIT
- POWER DOME
- TREE
- 29.51 EXISTING SURFACE HEIGHT
- TRACK
- ROAD CENTRELINE
- EDGE OF GRAVEL
- RETAINING WALL
- EDGE OF SEAL
- FACE OF BUILDING
- EASEMENT
- FENCE
- CONCRETE EDGE
- BOTTOM OF BANK
- TOP OF BANK
- G GAS MAIN
- W WATER MAIN
- S SEWER MAIN
- CREEK EDGE
- EXTENT OF 2022 SURVEY


PHOTO 'D'


PHOTO 'E'

NOTES:
1. Limited boundary marks found. Boundary resurvey recommended if building on or close to boundary.
2. Datum is AHD established from SSM COLLIE 473 (RL 74.184m)
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4. No boundary marks found unless otherwise noted.
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6. PDF to be used in conjunction with DWG file supplied. Some point heights may have been omitted for clarity; see DWG file.

SHEET 2 OF 2

Rev.	Description	Drawn	Date	Checked
A	INITIAL ISSUE	TJ	19/12/22	CM

Scale: 1:500 A1 ORIG — ALL DISTANCES IN METRES — 0 5 10 15 20 25

Surveyor: GM
Survey date: 7/12/2022
Precal/Cad: N/A

The contents of this plan are date stated within the revision panel. All consultants and persons wishing to utilise this data should satisfy themselves of this plan's currency by contacting Survcon.

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LOT 500 ON DEPOSITED PLAN 54957, BROCKMAN HIGHWAY, NANNUP

Client: **IDG RESORTS PTY LTD**

Survcon SURVEYING SERVICES
PO Box 365 Dunsborough WA 6281 Australia
Tel: (08) 9754 1188
Fax: (08) 9756 8000
mail@survcon.com.au
www.survcon.com.au

PROJ MNGR.	Michael Riddle	DATUM	COL94 AHD

9075_SS2_A (JOB NUMBER, TYPE, REVISION)

Appendix B: DWA Drawing Set

LEGEND:

- CADASTRAL BOUNDARY
- EXISTING POST AND WIRE FENCE
- EXISTING OH POWER AND POLE
- EXISTING RAW POTABLE WATER LINE
- EXISTING Ø600 STORMWATER DRAINAGE PIPE SERVING ADJACENT DEVELOPMENT
- EXISTING GRAVITY SEWER MAIN
- EXISTING SEWER PRESSURE MAIN
- EXISTING WATER MAIN
- EXISTING FENCE
- EXISTING TREES
- EXISTING ABORIGINAL HERITAGE AREA
- EXISTING FLOOD PLAIN ZONE
- PROPOSED ROCK PITCHED SWALE WITH RIFFLES
- PROPOSED LANDSCAPING
- PROPOSED SHALLOW LANDSCAPED AREA
- PROPOSED STORMWATER BASIN WITH HIGH LEVEL OVERFLOW TO CREEK
  - DETAIN 15mm OF STORMWATER RUNOFF FROM CONTRIBUTING CATCHMENT AREA
  - MAX. DEPTH 0.9m
  - SIDE SLOPES AT 1:6
- PROPOSED STORMWATER PIT
- OVERFLOW PATH FROM NEIGHBOURING SITES
- FLOW PATH WITHIN DEVELOPMENT AREA
- INDICATIVE RETAINING WALL
- PROPOSED STORMWATER PIPE
- A PROPOSED RAINWATER TANK - 75kL
- B PROPOSED RAINWATER TANK - 150kL
- C PROPOSED RAINWATER TANK - 250kL

DESIGN DATA

- GROSS DEVELOPMENT CATCHMENT AREA FROM SOUTHERN SIDE OF CREEK = 38800m²
- MAXIMUM GROUNDWATER LEVEL = TO BE CONFIRMED WITH GEOTECHNICAL INVESTIGATION BEFORE DETAILED DESIGN STAGE.
- THE STORMWATER DRAINAGE SYSTEM HAS GENERALLY BEEN DESIGNED BASED ON PRE-DEVELOPMENT FLOWS = POST- DEVELOPMENT MAXIMUM OUTFLOW OF 388 L/s FROM BASINS TO CREEK:
  15mm RAINFALL TO BE RETAINED ON SITE,
  REQUIRED STORAGE VOLUME=582m^3
- MINIMUM BASIN STORAGE REQUIRED:

BASIN NO.	1	2	3	4	5
REQUIRED VOLUME (m^3)	59	39	189	173	122
PROVIDED VOLUME (m^3)	65	47	190	185	152

DWER MAJOR RIVER FLOOD LEVELS:

1 IN 25 AEP = 66.63m AHD
1 IN 100 AEP= 68.18m AHD

MINIMUM FINISHED FLOOR LEVEL (FFL) = 68.7m AHD
FFL'S ARE INDICATIVE ONLY AND SUBJECT TO DETAILED DESIGN

metres
0 20 40 60 80 m
1:1000
scales quoted apply to original drawing scale

A1

FOR INFORMATION ONLY

REV	DATE	ISSUE / REVISION DESCRIPTION	DRN	CH DRN	DES ENG	AUTH
A	22/05/2025	ISSUED FOR INFORMATION	JS	DA	AR	AR
B	10/06/2025	ISSUED FOR INFORMATION	JS	DA	AR	AR
C	02/07/2025	ISSUED FOR INFORMATION	JS	DA	AR	AR
D	03/07/2025	ISSUED FOR INFORMATION - TANKS LOCATION MODIFIED	JS	DA	AR	AR

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DRAWING NUMBER	DRAWING TITLE / DESCRIPTION

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CLIENT INFORMATION

PAUL MESCHIATI AND ASSOCIATES

DWA
David Wills and Associates
Consulting Engineers

Office:
Unit 13/16 Brodie-Hall Drive
BENTLEY WA 6102
Mail:
PO Box 7077
KARAWARA LPO WA 6152
Phone (08) 9424 0900
Fax (08) 9330 3133
E-mail dwa@dwaconsulting.com.au
ABN 93 622 377 011

PROJECT INFORMATION

LOCAL WATER MANAGEMENT STRATEGY
LOT 500, CNR BROCKMAN HIGHWAY AND DUNNET ROAD, NANNUP

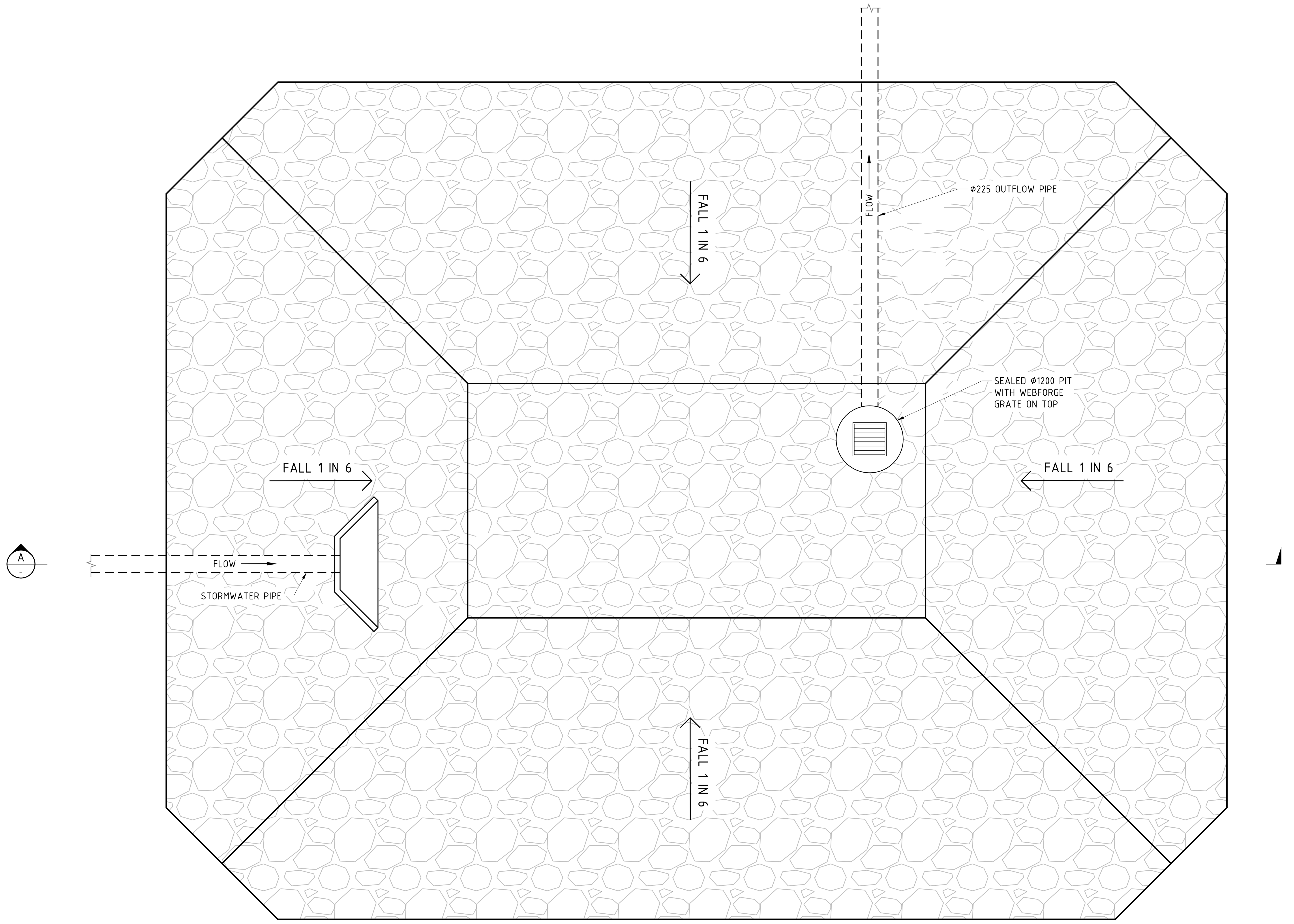
CONCEPT STORMWATER DRAINAGE

AUTHORISED BY: A. Rowcliffe 03/07/2025
Athena Rowcliffe BE MIEAust CPEng NER

CLIENT REF ---
SCALE 1:1000 @A1
SHEET SIZE A1
DRAWING No. 24208-C-01
REV D

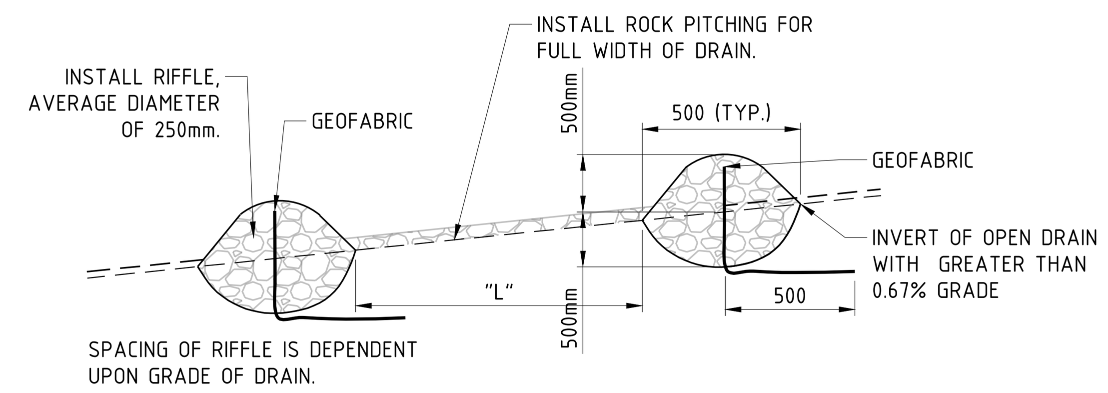
NOTES:

1. THE LONGITUDINAL GRADE OF OPEN DRAIN TO BE GRADED AT 0.67% (OR 1 IN 150) MAXIMUM. IF THIS IS NOT ACHIEVABLE THEN THE OPEN DRAINS SHALL HAVE RIFFLE STRUCTURES INSTALLED.
2. DIMENSIONS SPECIFIED ARE APPROXIMATE ONLY AND SHOULD BE REVIEWED AT DETAILED DESIGN STAGE.
3. OPEN DRAINS ARE DESIGNED FOR A 1 IN 100 YEAR ARI (1%) STORM EVENT.
4. MANNING'S 'n' = 0.04 ROCK PITCHED SWALES.
5. RUNOFF COEFFICIENT = 0.8



TYPICAL BASIN DETAIL

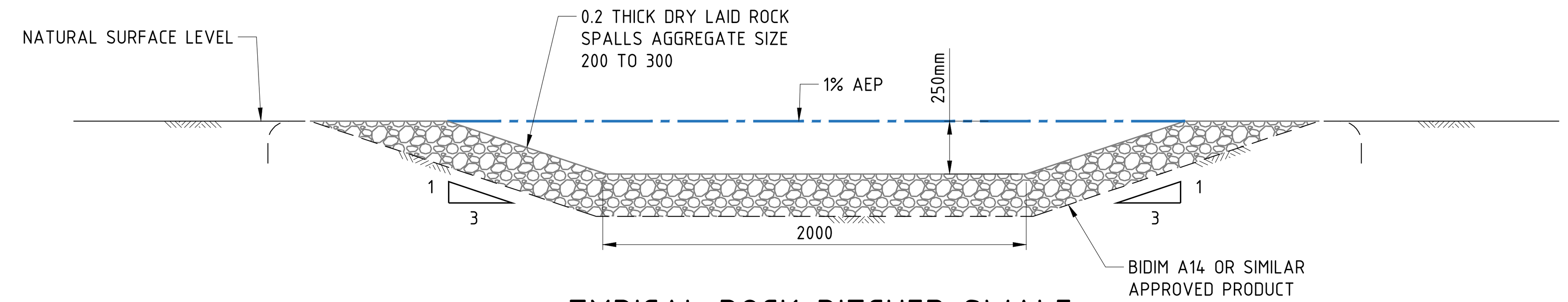
SCALE 1:50



DRAIN GRADE	SPACING OF RIFFLE "L"
0.67 % TO 2%	EVERY 28m
2 % TO 5%	EVERY 11m
5 % TO 10%	EVERY 5.5m
10 % TO 15%	EVERY 3.6m

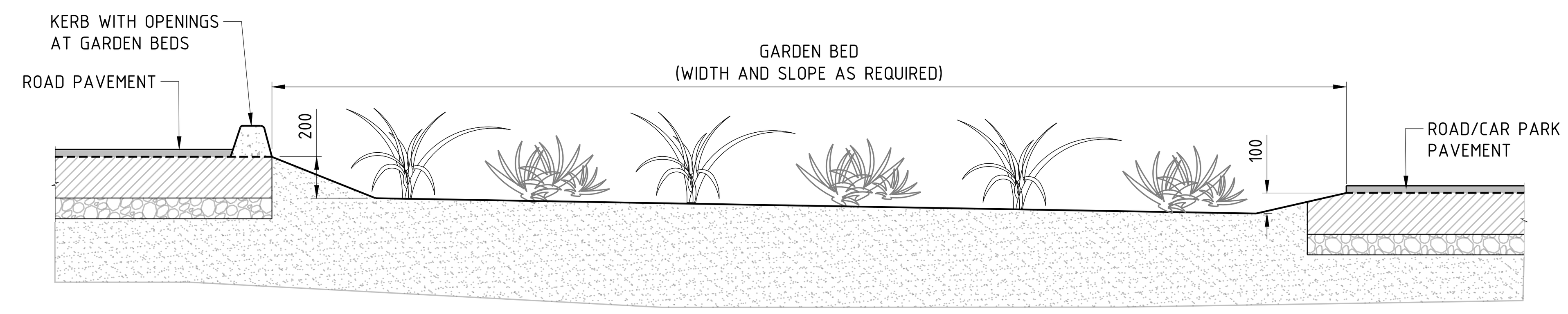
TYPICAL LONGSECTION OF OPEN DRAIN
STEEPER THAN 0.67% LONGITUDINAL

SCALE : N.T.S.



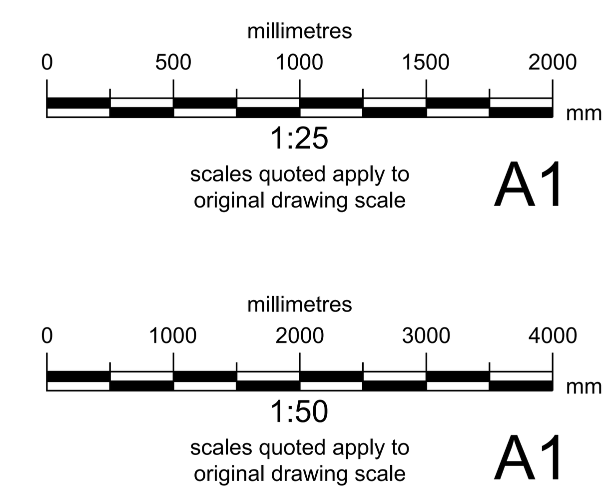
TYPICAL ROCK PITCHED SWALE

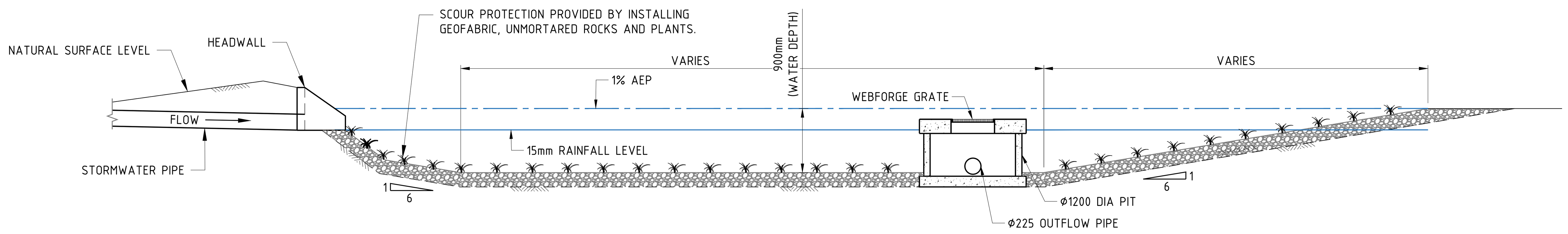
SCALE 1:25



TYPICAL GARDEN BED

SCALE 1:25





SECTION A TYP.

SCALE 1:50

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A	11/06/2025	ISSUED FOR INFORMATION	JS	DA	AR	AR
B	02/07/2025	ISSUED FOR INFORMATION	JS	DA	AR	AR

ISSUE/REVISIONS

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PAUL MESCHIATI AND ASSOCIATES

DWA
David Wills and Associates
Consulting Engineers

Office:
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BENTLEY WA 6102
Mail:
PO Box 7077
KARAWARA LPO WA 6152
Phone (08) 9424 0900
Fax (08) 9330 3133
E-mail dwa@dwaconsulting.com.au
ABN 93 622 377 011

PROJECT INFORMATION

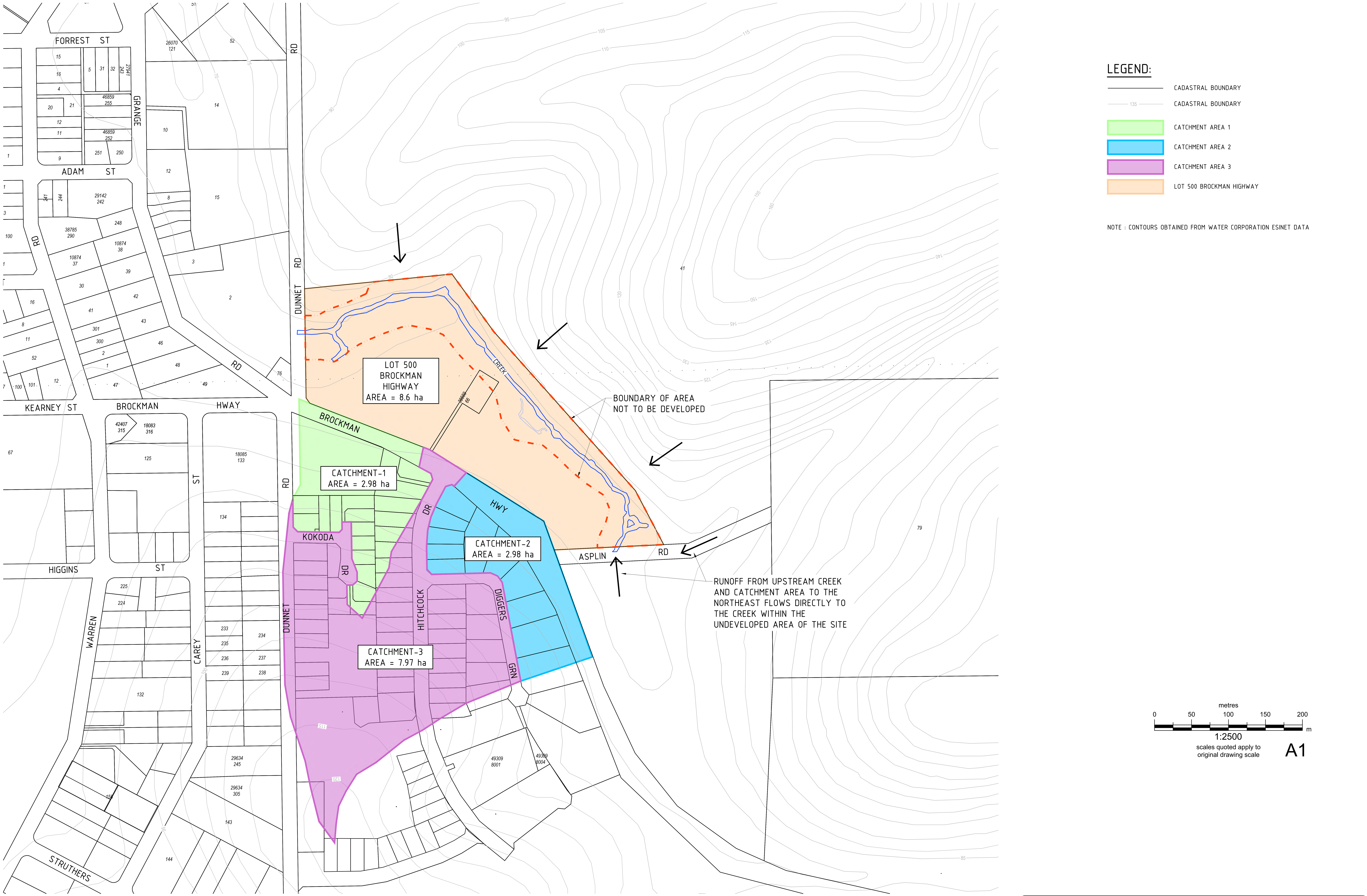
LOCAL WATER MANAGEMENT STRATEGY
LOT 500, CNR BROCKMAN HIGHWAY AND DUNNET ROAD, NANNUP

STORMWATER DETAILS PAGE

AUTHORISED BY:
A. Rowcliffe 02/07/2025
Athena Rowcliffe BE MIEAust CPEng NER

CLIENT REF ---
SCALE AS SHOWN @A1
SHEET SIZE A1

DRAWING No. 24208-C-02
REV B



CATCHMENT AREA PLAN

SCALE 1:2500

FOR INFORMATION ONLY

REV	DATE	ISSUE / REVISION DESCRIPTION	DRN	CH DRN	DES ENG	AUTH
A	02/07/2025	ISSUED FOR INFORMATION	DA	JS	AR	AR

ISSUE/REVISIONS

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PROJECT INFORMATION

LOCAL WATER MANAGEMENT STRATEGY
LOT 500, CNR BROCKMAN HIGHWAY AND DUNNET ROAD, NANNUP

EXTERNAL CATCHMENT AREAS

AUTHORISED BY:
A. Rowcliffe 02/07/2025
Athena Rowcliffe BE MIEAust CPEng NER

CLIENT REF --- SCALE AS SHOWN @A1

SHEET SIZE A1

DRAWING No. 24208-C-03 REV A

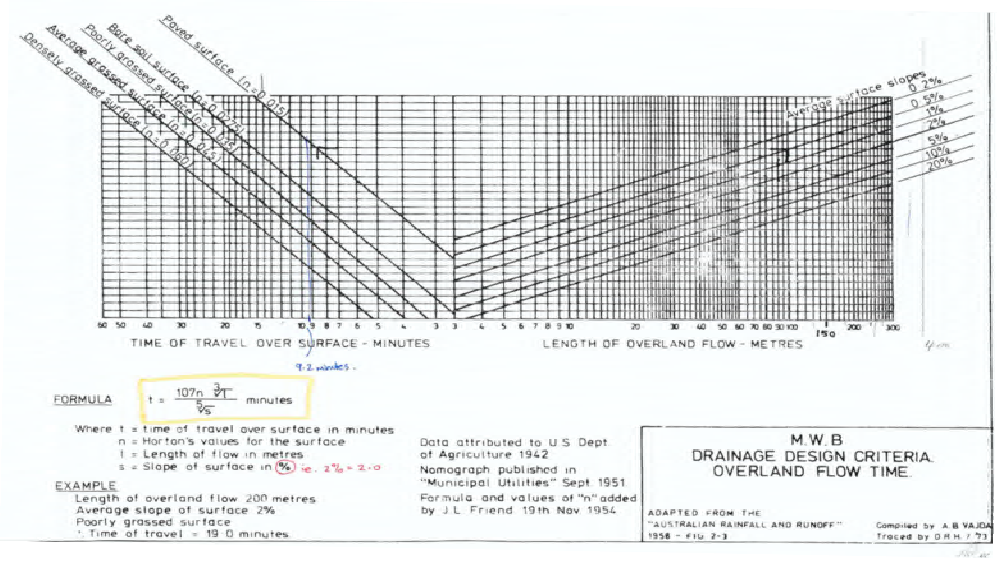
APPENDIX C: DWA STORMWATER CALCULATIONS

Client: PM Architects			
Project: Lot 500 Brockman Highway, Nannup			
Job No: 24259		Sheet: 1	Of: 1
By: AR	Date: 02/07/2025	Checked: AR	Date: 02/07/2025
Subject: Stormwater Basin Design			

Site pre-development flow (into creek from southern side) = 38,800 m^2

C (runoff co-efficient) = 0.7 (clays assumed)

TIME OF CONCENTRATION CALCULATOR		
Horton's value (see graph)	0.045	
Length of flow	175	m
Slope of surface	3	%
Time of concentration	21.6	minutes



T of C = 22 mins

Intensity for 1 in 5 year ARI storm event of critical duration = 51.43 mm/hr

Predevelopment Flow, or Maximum Allowable Discharge = **388 L/s**

Basin Sizing

Basin No.	*Catchment Area*	*15mm Rainfall - Volume Required*	*Volume Provided (refer Basin 1 Calc Sheet)*	*Allowable Outflow for storm events greater than 15mm rainfall*
	m2	*m3*		*L/s*
1	3,913	59	65	39
2	2,615	39	47	26
3	12,592	189	190	126
4	11,545	173	185	115
5	8,154	122	152	82
TOTAL	**38,819**	**582**	**639**	**388**

David Wills and Associates
Consulting Engineers

Overland Flows from Neighbouring Properties - Refer DWG 24208 C03 for Catchment Areas

Catchment Areas 1 and 3

Existing 600mm diameter pipe through property
Grade = 1:59.3 = 0.0169
K = 0.6mm (old concrete pipe)

Capacity Q = 850 L/s (pipe flowing full)

Catchment Area 3 (into 600 pipe) = 7.97 ha

L =	565	m
S =	8%	
n =	0.035	
T of C =	20	mins
I (1 in 100, 20 min duration)	97.81	mm/hr
Q =	1520	L/s

Catchment Area 1 (into 600 pipe) = 2.98 ha

T of C =	15	mins
I (1 in 100, 15 min duration)	116.82	mm/hr
Q =	680	L/s

Overflow once pipe reaches capacity =	1350	L/s

Catchment Area 2

Catchment Area 2 = 2.98 ha

T of C =	15	mins
I (1 in 100, 13 min duration)	116.82	mm/hr
Q =	680	L/s

DWA
David Wills and Associates
Consulting Engineers

Basin Volume Calculator

Job No	**24259**
Location	**Lot 500 Brockman Highway, Nannup - BASIN 1**
Date	**Jul-25**

Inputs

Overall width (m)	W =	14	m
Overall length (m)	L =	14	m
Corner radius top (m)	R =	2.5	m
Input batter slopes	S =	1 in 6	1 in X
Overall depth (m)	D =	0.900	m
Base RL (m)	H =	68.50	m

Area analysis

At TWL (sq.m)	A_{TWL} =	190.63	m^2
At base (sq.m)	A_{base} =	3.02	m^2

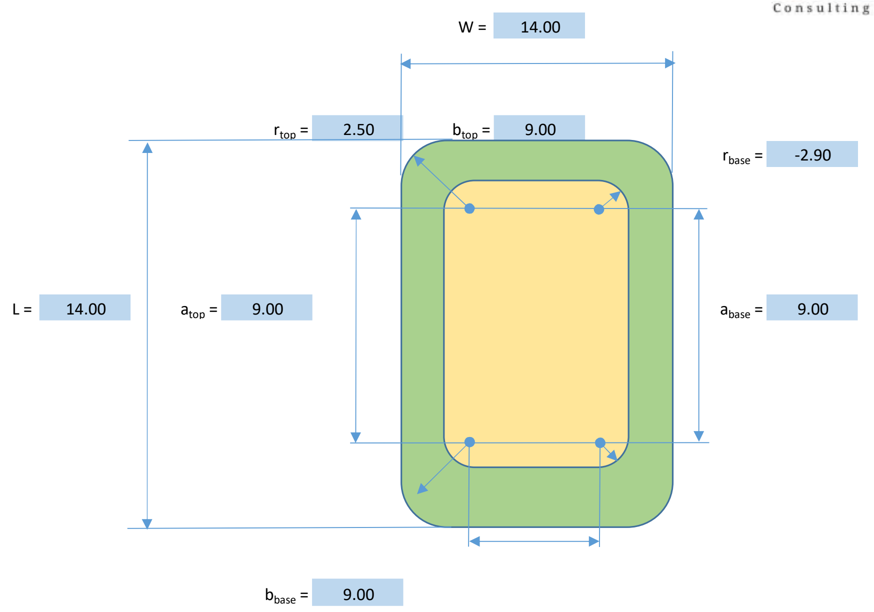
Outflows

Infiltration rate (m/day)	k =	0.00	m/day	
Outflow on base (L/s)	Q =	-	L/s	0
Emptying time (hr)	t	-	hr	

Volumes

Total depth (%)	Depth (m)	r (m)	Plan area (m^2)	Volume to TWL (m^3)	RL (m)
0%	0.000	-2.900	3.02	0.0	68.500
5%	0.045	-2.630	8.05	0.2	68.545
10%	0.090	-2.360	13.54	0.7	68.590
15%	0.135	-2.090	19.48	1.4	68.635
20%	0.180	-1.820	25.89	2.3	68.680
25%	0.225	-1.550	32.75	3.4	68.725
30%	0.270	-1.280	40.07	4.9	68.770
35%	0.315	-1.010	47.84	6.6	68.815
40%	0.360	-0.740	56.08	8.7	68.860
45%	0.405	-0.470	64.77	11.0	68.905
50%	0.450	-0.200	73.93	13.8	68.950
53%	0.477	-0.038	79.64	15.6	68.977
60%	0.540	0.340	93.60	20.4	69.040
65%	0.585	0.610	104.13	24.4	69.085
70%	0.630	0.880	115.11	28.7	69.130
75%	0.675	1.150	126.55	33.6	69.175
78%	0.699	1.294	132.84	36.3	69.199
85%	0.765	1.690	150.81	44.7	69.265
90%	0.810	1.960	163.63	51.0	69.310
95%	0.855	2.230	176.90	57.9	69.355
100%	0.900	2.500	190.63	65.3	69.400

15mm rainfall volume required = 59 m3 ok



$$Volume = \frac{d}{3} \times [(Top\ Area + Base\ Area) + (Top\ Area \times Base\ Area)^{0.5}]$$

Basin Volume Calculator

Job No	**24259**
Location	**Lot 500 Brockman Highway, Nannup - BASIN 2**
Date	**Jul-25**

Inputs

Overall width (m)	W =	10	m
Overall length (m)	L =	12	m
Corner radius top (m)	R =	1	m
Input batter slopes	S =	1 in 4	1 in X
Overall depth (m)	D =	0.900	m
Base RL (m)	H =	68.50	m

Area analysis

At TWL (sq.m)	A_{TWL} =	119.14	m^2
At base (sq.m)	A_{base} =	7.64	m^2

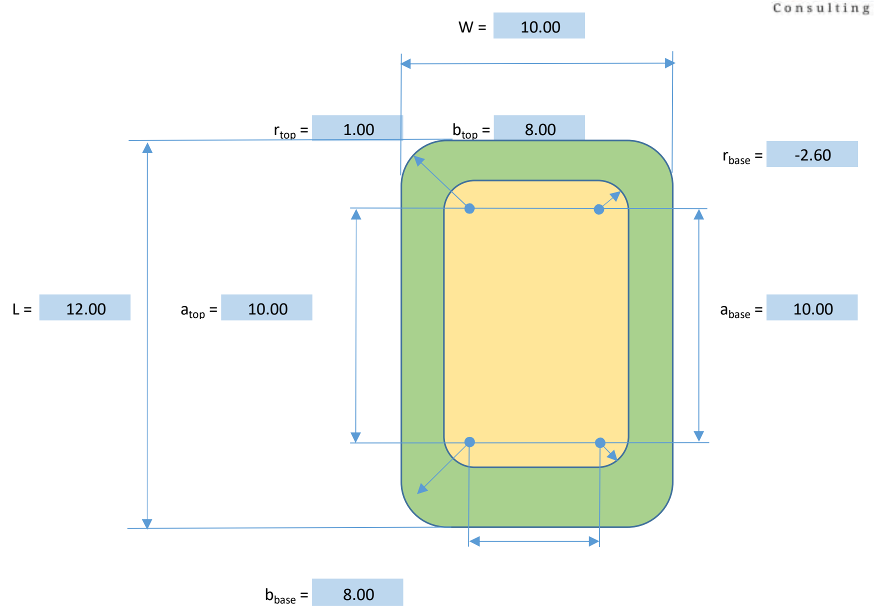
Outflows

Infiltration rate (m/day)	k =	0.00	m/day	
Outflow on base (L/s)	Q =	-	L/s	0
Emptying time (hr)	t	-	hr	

Volumes

Total depth (%)	Depth (m)	r (m)	Plan area (m^2)	Volume to TWL (m^3)	RL (m)
0%	0.000	-2.600	7.64	0.0	68.500
5%	0.045	-2.420	11.28	0.4	68.545
10%	0.090	-2.240	15.12	1.0	68.590
15%	0.135	-2.060	19.17	1.8	68.635
20%	0.180	-1.880	23.42	2.7	68.680
25%	0.225	-1.700	27.88	3.8	68.725
30%	0.270	-1.520	32.54	5.0	68.770
35%	0.315	-1.340	37.40	6.5	68.815
40%	0.360	-1.160	42.47	8.2	68.860
45%	0.405	-0.980	47.74	10.1	68.905
50%	0.450	-0.800	53.21	12.2	68.950
53%	0.477	-0.692	56.59	13.5	68.977
60%	0.540	-0.440	64.77	17.0	69.040
65%	0.585	-0.260	70.85	19.8	69.085
70%	0.630	-0.080	77.14	22.9	69.130
75%	0.675	0.100	83.63	26.2	69.175
78%	0.699	0.196	87.18	28.1	69.199
85%	0.765	0.460	97.22	33.7	69.265
90%	0.810	0.640	104.33	37.9	69.310
95%	0.855	0.820	111.63	42.3	69.355
100%	0.900	1.000	119.14	47.1	69.400

15mm rainfall volume required = 173 m3 ok



$$Volume = \frac{d}{3} \times [(Top\ Area + Base\ Area) + (Top\ Area \times Base\ Area)^{0.5}]$$

Basin Volume Calculator

Job No	**24259**
Location	**Lot 500 Brockman Highway, Nannup - BASIN 3**
Date	**Jul-25**

Inputs

Overall width (m)	W =	12	m
Overall length (m)	L =	41	m
Corner radius top (m)	R =	2.5	m
Input batter slopes	S =	1 in 6	1 in X
Overall depth (m)	D =	0.900	m
Base RL (m)	H =	69.50	m

Area analysis

At TWL (sq.m)	A_{TWL} =	486.63	m^2
At base (sq.m)	A_{base} =	29.02	m^2

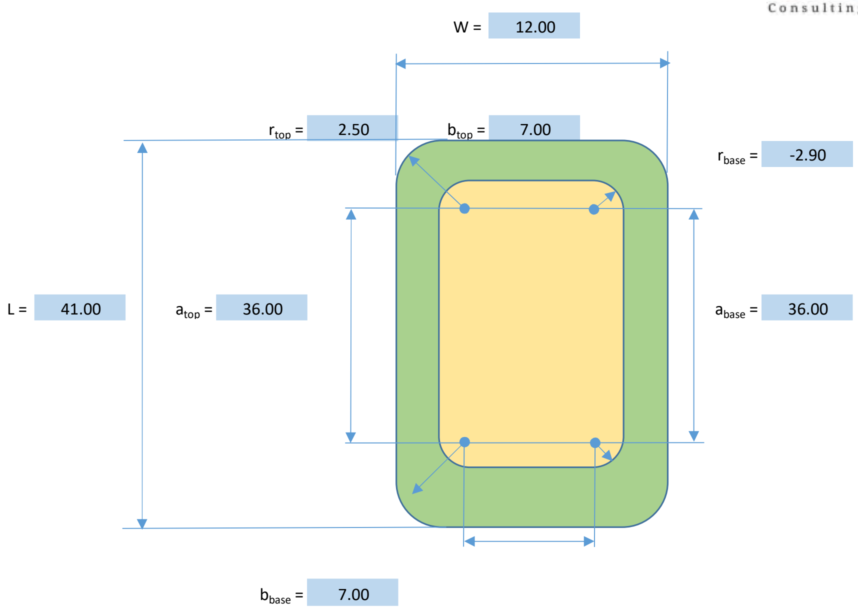
Outflows

Infiltration rate (m/day)	k =	0.00	m/day	
Outflow on base (L/s)	Q =	-	L/s	0
Emptying time (hr)	t	-	hr	

Volumes

Total depth (%)	Depth (m)	r (m)	Plan area (m^2)	Volume to TWL (m^3)	RL (m)
0%	0.000	-2.900	29.02	0.0	69.500
5%	0.045	-2.630	47.55	1.7	69.545
10%	0.090	-2.360	66.54	4.2	69.590
15%	0.135	-2.090	85.98	7.4	69.635
20%	0.180	-1.820	105.89	11.4	69.680
25%	0.225	-1.550	126.25	16.2	69.725
30%	0.270	-1.280	147.07	21.7	69.770
35%	0.315	-1.010	168.34	28.1	69.815
40%	0.360	-0.740	190.08	35.2	69.860
45%	0.405	-0.470	212.27	43.2	69.905
50%	0.450	-0.200	234.93	52.0	69.950
53%	0.477	-0.038	248.74	57.7	69.977
60%	0.540	0.340	281.60	72.2	70.040
65%	0.585	0.610	305.63	83.6	70.085
70%	0.630	0.880	330.11	96.0	70.130
75%	0.675	1.150	355.05	109.3	70.175
78%	0.699	1.294	368.54	116.7	70.199
85%	0.765	1.690	406.31	138.7	70.265
90%	0.810	1.960	432.63	154.9	70.310
95%	0.855	2.230	459.40	172.1	70.355
100%	0.900	2.500	486.63	190.3	70.400

15mm rainfall volume required = 189 m3 ok



$$Volume = \frac{d}{3} \times [(Top\ Area + Base\ Area) + (Top\ Area \times Base\ Area)^{0.5}]$$

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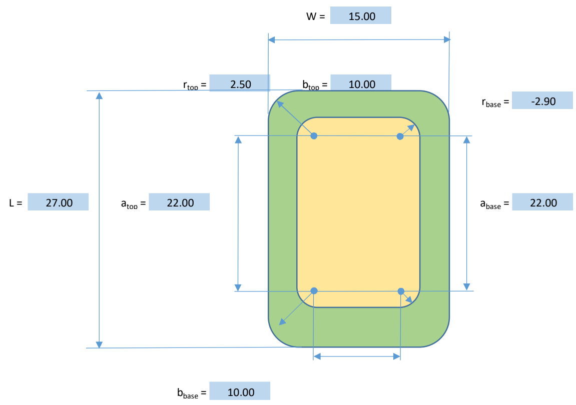
Basin Volume Calculator

Job No	**24259**
Location	**Lot 500 Brockman Highway, Nannup - BASIN 4**
Date	**Jul-25**



$$Volume = \frac{d}{3} \times [(Top\ Area + Base\ Area) + (Top\ Area \times Base\ Area)^{0.5}]$$

Inputs

Overall width (m)	W =	15	m
Overall length (m)	L =	27	m
Corner radius top (m)	R =	2.5	m
Input batter slopes	S =	1 in 6	1 in X
Overall depth (m)	D =	0.900	m
Base RL (m)	H =	70.00	m

Area analysis

At TWL (sq.m)	A_{TWL} =	399.63	m^2
At base (sq.m)	A_{base} =	60.82	m^2

Outflows

Infiltration rate (m/day)	k =	0.00	m/day	
Outflow on base (L/s)	Q =	-	L/s	0
Emptying time (hr)	t	-	hr	

Volumes

Total depth (%)	Depth (m)	r (m)	Plan area (m^2)	Volume to TWL (m^3)	RL (m)
0%	0.000	-2.900	60.82	0.0	70.000
5%	0.045	-2.630	73.41	3.0	70.045
10%	0.090	-2.360	86.46	6.6	70.090
15%	0.135	-2.090	99.96	10.7	70.135
20%	0.180	-1.820	113.93	15.5	70.180
25%	0.225	-1.550	128.35	20.8	70.225
30%	0.270	-1.280	143.23	26.8	70.270
35%	0.315	-1.010	158.56	33.3	70.315
40%	0.360	-0.740	174.36	40.6	70.360
45%	0.405	-0.470	190.61	48.5	70.405
50%	0.450	-0.200	207.33	57.1	70.450
53%	0.477	-0.038	217.57	62.6	70.477
60%	0.540	0.340	242.12	76.4	70.540
65%	0.585	0.610	260.21	87.1	70.585
70%	0.630	0.880	278.75	98.7	70.630
75%	0.675	1.150	297.75	111.0	70.675
78%	0.699	1.294	308.08	117.8	70.699
85%	0.765	1.690	337.13	138.0	70.765
90%	0.810	1.960	357.51	152.8	70.810
95%	0.855	2.230	378.34	168.4	70.855
100%	0.900	2.500	399.63	184.9	70.900

15mm rainfall volume required = 173 m3 ok

DWA
David Wills and Associates
Consulting Engineers

Basin Volume Calculator

Job No	**24259**
Location	**Lot 500 Brockman Highway, Nannup - BASIN 5**
Date	**Jul-25**

Inputs

Overall width (m)	W =	15	m
Overall length (m)	L =	23	m
Corner radius top (m)	R =	2.5	m
Input batter slopes	S =	1 in 6	1 in X
Overall depth (m)	D =	0.900	m
Base RL (m)	H =	70.00	m

Area analysis

At TWL (sq.m)	A_{TWL} =	339.63	m^2
At base (sq.m)	A_{base} =	44.02	m^2

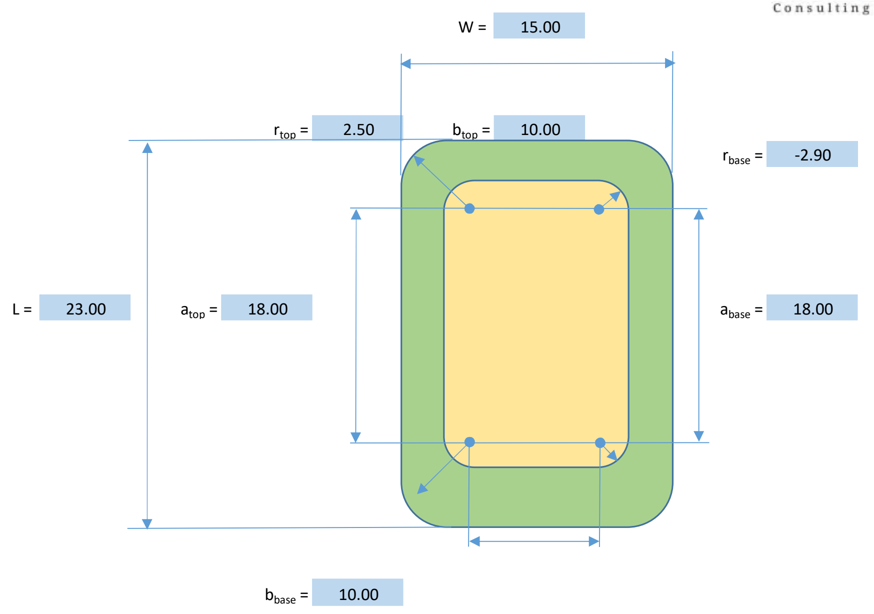
Outflows

Infiltration rate (m/day)	k =	0.00	m/day	
Outflow on base (L/s)	Q =	-	L/s	0
Emptying time (hr)	t	-	hr	

Volumes

Total depth (%)	**Depth (m)**	**r (m)**	**Plan area (m^2)**	**Volume to TWL (m^3)**	**RL (m)**
0%	0.000	-2.900	44.02	0.0	70.000
5%	0.045	-2.630	54.45	2.2	70.045
10%	0.090	-2.360	65.34	4.9	70.090
15%	0.135	-2.090	76.68	8.0	70.135
20%	0.180	-1.820	88.49	11.7	70.180
25%	0.225	-1.550	100.75	15.9	70.225
30%	0.270	-1.280	113.47	20.5	70.270
35%	0.315	-1.010	126.64	25.8	70.315
40%	0.360	-0.740	140.28	31.5	70.360
45%	0.405	-0.470	154.37	37.9	70.405
50%	0.450	-0.200	168.93	44.9	70.450
53%	0.477	-0.038	177.88	49.4	70.477
60%	0.540	0.340	199.40	60.7	70.540
65%	0.585	0.610	215.33	69.6	70.585
70%	0.630	0.880	231.71	79.1	70.630
75%	0.675	1.150	248.55	89.4	70.675
78%	0.699	1.294	257.72	95.1	70.699
85%	0.765	1.690	283.61	112.0	70.765
90%	0.810	1.960	301.83	124.5	70.810
95%	0.855	2.230	320.50	137.7	70.855
100%	0.900	2.500	339.63	151.8	70.900

15mm rainfall volume required = 122 m3 ok



$$Volume = \frac{d}{3}\times[(Top\ Area + Base\ Area\ ) + (Top\ Area \times Base\ Area)^{0.5}]$$

David Wills and Associates
Consulting Engineers

Rainwater Tank Design - Preliminary

Avg rainfall over last 30 yrs for Nannup: 841 mm per year

Building No. (Ref PM Architects Plan)	*Building*	*Roof Area*	*75% of roof area*	*Total Vol for avg annual storage*	*Garden Area Req'd for Irrigation*	*Water usage for each building*	*Tank Size (total)*	*Diameter*	*Height*
		m^2	*m^2*	*m^3*	*m^2*	*kL/yr*	*kL*	*m*	*m*
12	Chalets (western) x 6	160	120	101	100	75	4 x 75	6.7	2.2
13	Chalets (eastern) x 4	160	120	101	100	75	2 x 75	6.7	2.2
5	Workshop Maintenance/Storage	183	137	115	100	75	250	6.7	2.2
4	Managers Residence	202	152	127	100	75			
6	2 Staff accommodation units	127	95	80	100	75			
2	Tourist Shops	604	453	381	100	75	75	6.7	2.2
10	Utility building	67	50	42	100	75	75	6.7	2.2
3	40 Bed lodge	440	330	278	300	225	250	12	2.2
11	25 Room Motel block	503	377	317	300	225	250	12	2.2
11	25 Room Motel block (eastern only)	503	377	317	200	150	2 x 75	6.7	2.2
1	Main Reception/Restaurant	612	459	386	200	150	2 x 75	6.7	2.2
7 & 9	Gym/Activity	309	232	195	200	150	150	9.4	2.2

Irrigation usage based on DWER irrigation volume estimate for 1,000m^2 of lawn = 7,500kL/ha per year, used during November to March
Does not include usage from toilet flushing or laundry (determined at detailed design stage)