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ISO 9001 Certified Quality Management Systems
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Stormwater Management Plan

For

Proposed Battery Project at Kiewa Valley Hwy, Baranduda VIC 3691.

May 2024

Our Ref: 22219

Level 1, 135 Fryers Street, Shepparton, Vic, 3630
Telephone (03) 5820 7700 Facsimile (03) 5822 4878

Document Ref: 22219_R_SWMP_rev3_090524

TABLE OF CONTENTS

1 Introduction

1.1 Background

This report has been prepared on behalf of Birdwood Energy Pty Ltd to support the drainage conditions of a planning application for a proposed battery project in Kiewa Valley Highway, Baranduda.

The subject land is bounded by Kiewa Valley Highway to the West, Baranduda Drive to the South, Lot 1&2 of PS406394 to the East, middle creek to the North with an approximate area of 45.85 ha in total. The subject land is in the Industrial Zone (IN1Z), as per Wodonga Council.

A proposal has been made to use approximately 17 ha of the subject land as a battery energy storage facility as shown in Fig 1 and this report discusses the storm water management for the proposed project.

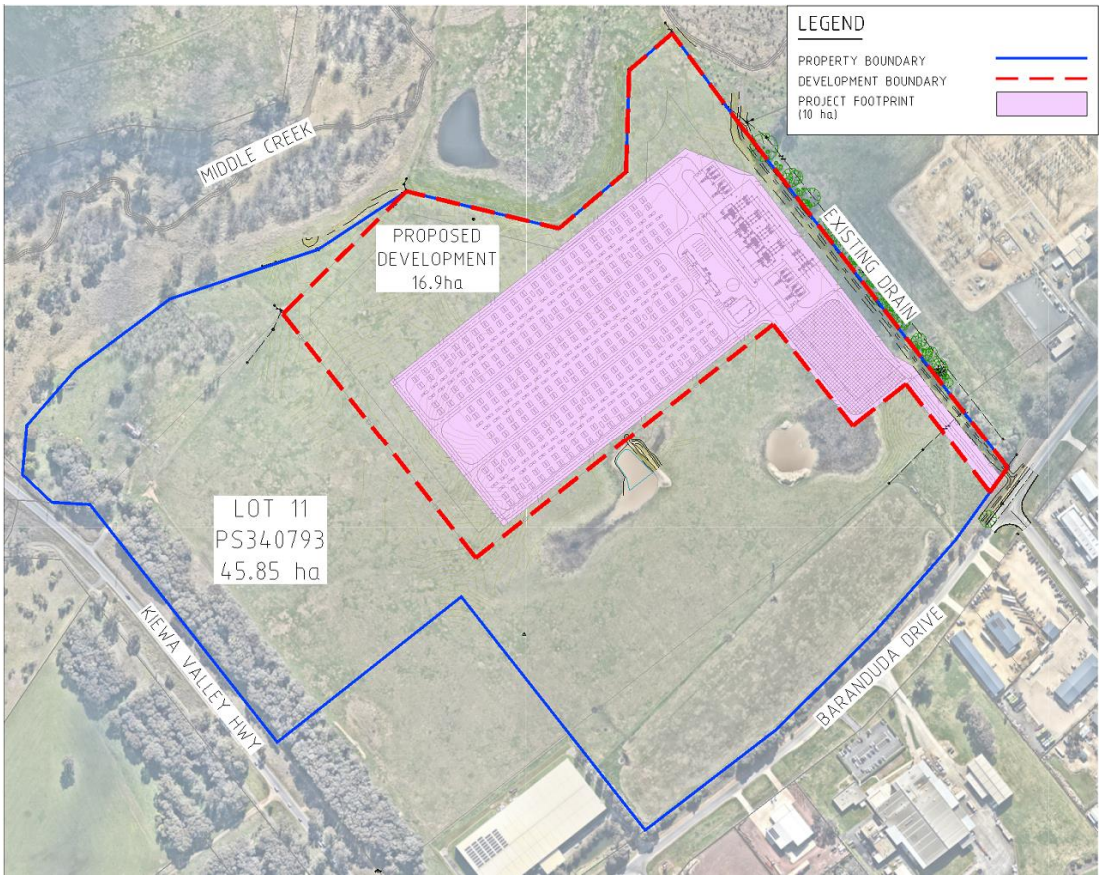

Figure 1- Aerial View of the Site

1.2 Aim of the Report

The purpose of this report is to provide a drainage strategy for the site, with consideration of the existing overland flow paths, stormwater retention, stormwater discharge, impact on neighbouring properties, and how the site is impacted in larger rainfall events.

2 Existing Site Drainage

2.1 Existing Site Conditions

The subject site is generally slopes in a north-eastern direction and mainly discharging into an open drain along the eastern boundary. It is understood that the overland flow from the site ultimately find its way to the Middle Creek. The site is largely undeveloped paddock and the property is currently vacant.

Figure 2- Existing Conditions Plan

2.2 Existing Stormwater Retention

The existing discharge from the site was calculated using Kinematic Wave equation as 708 litres/sec.

The existing onsite stormwater retention for the subject land has been calculated using the 100-year ARI retention spreadsheet for Baranduda with a runoff co-efficient of 0.2. The total stormwater retention storage required for the subject land is 2261m^3. Refer Appendix 3 for detailed calculations.

There are two existing dams located outside the proposed development area. Currently the existing retention requirement is predominantly provided by these dams and the open drain along eastern boundary. The proposed development site drainage and retention will be contained within proposed development boundaries and wholly independent of the rest of the property.

3 Proposed Drainage

3.1 Allowable Site Discharge

Allowable site discharge shall be limited to the pre-development runoff from the site which is calculated as 708 l/s. (See Appendix 3).

3.2 Runoff Coefficient

The following runoff coefficients were used to derive an overall weighted coefficient for the post-development.

Battery Storage Footprint

Even though the battery storage containers will have impermeable roof areas, considering the allowance for stormwater runoff under the containers and permeable space between containers will allow water to infiltrate into the ground. Hence it can be assumed that the battery container area will have an overall runoff coefficient of 0.5.

Considering 0.9 coefficient for the proposed hardstand areas (laydown, access roads) and 0.5 for battery container areas, a common runoff coefficient for the proposed project footprint was estimated to be 0.75.

Accordingly, the overall post development runoff coefficient was calculated found to be 0.32 as per below table.

Location	Area (ha)	C Value
Proposed Project Footprint	9.52	0.75
Balance area	36.33	0.2
Total	**45.85**	**0.31**

3.3 Stormwater Retention

The Stormwater retention requirement for the post development scenario was calculated using the volumetric runoff coefficient of 0.31 and the pre-development discharge rate of 708 l/s.

Using the 100-year ARI retention spreadsheet for Baranduda, the retention requirement was calculated as 4256m^3. (See Appendix 3 for detailed calculations)

Effective retention requirement as part of the proposed works was calculated to be 1995 m^3 as per below table.

Pre-development Storage Requirement	2261 m^3
Post Development Storage Requirement	4256 m^3
Effective storage requirement as per proposed development	**1995 m^3**

3.4 Minor Flow System

Minor Drainage system consist of shallow v-drains to avoid nuisance water in the battery container areas and cut-off drain along the western end of the proposed development to redirect the upstream runoff away from the development. Existing open drain along eastern boundary is the main point of site discharge.

Runoff from more than 80% of the project footprint is captured into the proposed retention basin and the balance area will drain to the existing open drain.

The extent of the minor drainage work is shown on the concept drainage plan in Appendix 2.

3.5 Major Flow System

Since the overall lay of the land will not be altered by the proposed development, the major overland flow path will remain unchanged.

Indicative flow paths are shown in Figure 2.

The proposed retention basin is designed for the major flow system (100-year ARI).

3.6 Neighbouring Property

It is understood that in order to facilitate the battery project, a new extension is proposed in the neighbouring Wodonga Terminal Station (Ausnet). All drainage work associated with these proposed Ausnet works should be designed, approved and constructed in accordance with Ausnet drainage standards and Wodonga City Councilõs Infrastructure Design Manual guidelines. Portion of the connection infrastructure within the development may also be designed to Ausnet standards (where more onerous than other applicable regulations).

4 Conclusion

The existing site conditions such as overland flow path and site discharge will not be significantly affected by the proposed development. Proposed retention facility will overcompensate the possible effects of the proposed works and it will ensure that downstream and neighbouring properties will not be impacted.

5 Appendices

5.1 Appendix 1: Existing Conditions Plan

ADVERTISED PLAN

Legend

- Major Contour (Interval 1.0m)
- Minor Contour (Interval 0.20m)
- Fence Line
- Gate
- Edge of Concrete / Concrete Kerb
- Edge of Bitumen
- Centre Line of Bitumen
- Top of Bank
- Toe of Bank
- Edge of Water
- Overhead Electricity Line
- Temporary Bench Mark (TBM)
- Tree
- Dead Tree
- Sign
- Gate
- Fence Post
- Electricity Pole with Light
- Existing Surface Level
- Bitumen Area
- Dam

TBM Star Picket Placed RL:170.845

TBM Star Picket Placed RL:169.855

TBM Spike Placed RL:169.59

TBM Rivet Placed in Kerb RL:170.10

TBM Star Picket Placed RL:171.96

Sewer Manhole

Side Entry Pits

Side Entry Pits

Notes

Every endeavour has been taken to locate visible services, however, theres is no guarantee that all existing services are shown or located exactly on this plan. Positions and levels of these services should be proven on site before the commencement of any works.

Data is on MGA2020 Co-ordinate & Bearing datum based on GNSS observations to Baranduda PM 24 & TBM's on site. Data is on Ground Distances (not scaled).

Heights are to the Australian Height Datum (AHD) based on GNSS observations to Baranduda PM 24 (RL: 172.635).

For the purposes of plan clarity, some levels may not be displayed on this plan, however, they are visible in model space of this 'DWG'.

No responsibility is taken by Chris Smith & Associates, as to the location of underground services located in the survey. The client should investigate these matters to ensure they do not effect the possible development or project to be undertaken.

These notes are an integral part of the plan.

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REVISION		DATE	ZONE

MGA2020 ZONE 55

0 15 30 60

Scale 1:1500 @ A1

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Designed		
Drawn	Nick Dunham	17th March 2023
Checked	Nicholas Nightingale	27th March 2023
Approved		

Birdwood Energy Pty Ltd.
Battery Energy Storage System

Kiewa Valley Highway
Baranduda, VIC 3691

Plan of Existing Conditions as of the 16th March 2023

Drawing No. 22219/01 **Rev. 0**

Sheet No. 1 of 1 2221901r0.dwg

 A1

5.2 Appendix 2: Concept Drainage Plan

EXISTING DRAIN

MAIN ACCESS

DRAIN TYPE B

BASIN OUTFALL (1IB L/s)

LAYDOWN AREA

PROPOSED RETENTION BASIN 2,200m³

25m

110m

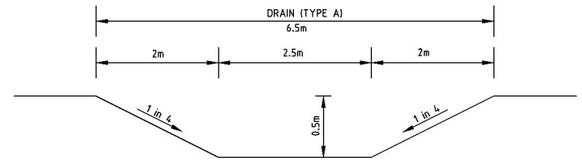
PROPOSED BATTERY STORAGE FACILITY 10ha

CUT-OFF DRAIN (TO REDIRECT OVERLAND FLOW FROM UPSTREAM)

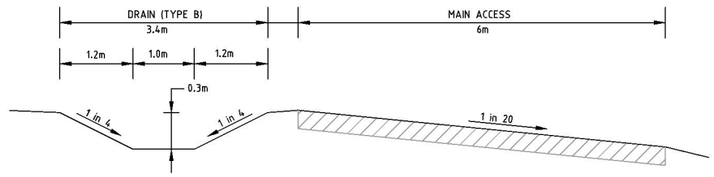
D

LEGEND

- TITLE BDY
- FENCE LINE
- PROPOSED ROAD
- STORMWATER DRAINAGE
- OPEN DRAIN
- RETENTION BASIN



TYPICAL CROSS SECTION - CUT-OFF DRAIN
NOT TO SCALE



TYPICAL CROSS SECTION - MAIN ACCESS
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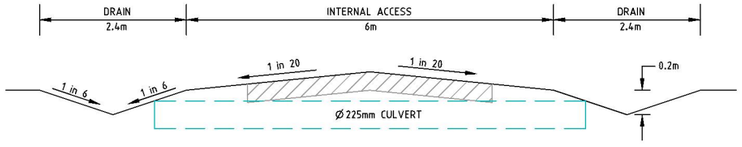

TYPICAL CROSS SECTION - INTERNAL ACCESS
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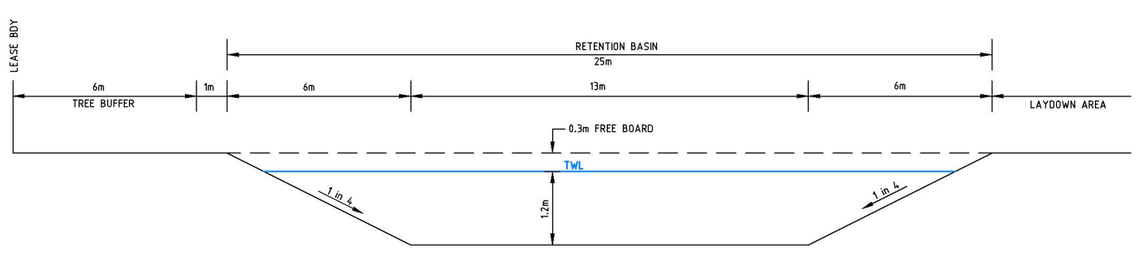

TYPICAL CROSS SECTION - RETENTION BASIN
NOT TO SCALE

1	REVISED SITE LAYOUT	02-02-24	
REVISION		DATE	ZONE

ADVERTISED PLAN

0 10 20 40

Scale 1:1000 @ A1

Chris Smith & ASSOCIATES PTY LTD

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Designed
Drawn Sahan Dinesh Oct 2023
Checked Tom Kerrins Oct 2023
Approved

Birdwood Energy Pty Ltd.
Battery Energy Storage System
Kiewa Valley Highway
Baranduda, VIC 3691
Concept Drainage Plan
Layout Plan
Drawing No. 22219-D01 **Rev. 1**
Sheet No. 1 of 1 22219_D01.dwg
A1

5.3 Appendix 3: Drainage Calculations

Project Kiewa Valley Hwy, Baranduda
Job No. 22219
Date Oct-22

CALCULATION TO DETERMINE EXISTING RUNOFF RATE

The Kinematic Wave Equation

$t=6.94\,(L.n^*)^{0.6} / I^{0.4}\ S^{0.3}$
where t is overland flow time (minutes)
L is flow path length (m)
n is a surface roughness or retardance coefficient*
I is rainfall intensity (mm/h)
and S is slope (m/m)

Surface Roughness or Retardance Factors

Surface Type	***Roughness Coefficient n****
Concrete or Ashphalt	*0.010 - 0.013*
Bare Sand	*0.010 - 0.016*
Graveled Surface	*0.012 - 0.030*
Bare Clay-Loam Soil (eroded)	*0.012 - 0.033*
Sparse Vegetation	*0.053 - 0.130*
Short Grass Prairie	*0.100 - 0.200*
Lawns	*0.170 - 0.480*

$$t = \frac{6.94(\mathbf{Ln^*})^{0.6}}{\mathbf{I}^{0.4}\,\mathbf{S}^{0.3}}$$

n*= 0.15 (short grass prairie (high), see table above)
L= 575
S= 0.00661

AHD at HP 172.3
AHD at LP 168.5

$tI^{0.4}$= 453.712 Find I for ARI event 100
t= 120.000
I= 27.797

Predevelopment Runoff Rate

A- Site Area= 45.85 Ha
C-runoff coefficient (existing) = 0.2

$$Q = \frac{CIA}{3600}$$

Q= 0.708 m3
Q= 708.1 L/s being the allowable discharge from the site

SUMMARY OF RETENTION CALCULATIONS (PRE-DEVELOPMENT)

Client : **Birdwood Energy**

Project : **Kiewa Valley Hwy, Baranduda**

Ref. No. : **22219**

Temporal Rainfall Pattern data for A.R.I. >30 years.			
Catchment area.		45.85	*ha*
Volumetric runoff coefficient.		0.20	
Design A.R.I.		100	Years
Diameter of outfall discharge pipe.		300	mm
Hydraulic gradient of pipe.	*1 in*		
Pipe roughness coefficient 'k'.			mm
Discharge rate.		708.0	l/sec

ADVERTISED PLAN

Duration		30min			60min			120min			180min			360min			720min			1440min			*Adopted Cumulative Equivalent Intensity mm/hr	Cumulative Runoff CIA*(dt) /360 m^3	Cumulative Outflow 708 l/s	Excess m^3
Intensity			77.1 mm/hr			47.4 mm/hr			28.1 mm/hr			20.6 mm/hr			12.4 mm/hr			7.7 mm/hr			4.93 mm/hr						
Interval min.		%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.				
0																							0			
60					100	47.40	47.40	78.4	44.06	44.06	65.4	40.42	40.42	35.9	26.71	26.71	18.9	17.46	17.46	9.6	11.36	11.36	47.40	4346.58	2548.80	1797.78
120								21.6	12.14	56.20	22.9	14.15	54.57	27.5	20.46	47.17	28.6	26.43	43.89	22.8	26.98	38.34	56.20	5153.54	5097.60	55.94
180	Pattern										11.7	7.23	61.80	14.7	10.94	58.11	8.0	7.39	51.28	14.1	16.68	55.02	61.80	5667.06	7646.40	-1979.34
240														10.8	8.04	66.14	8.9	8.22	59.51	6.9	8.16	63.18	66.14	6065.18	10195.20	-4130.02
300														6.8	5.06	71.20	5.4	4.99	64.50	5.1	6.03	69.22	71.20	6529.11	12744.00	-6214.89
360														4.3	3.20	74.40	8.2	7.58	72.07	4.1	4.85	74.07	74.40	6822.48	15292.80	-8470.32
420																	6.5	6.01	78.08	6.5	7.69	81.76	81.76	7497.31	17841.60	-10344.29
480																	4.4	4.07	82.14	4.4	5.21	86.97	86.97	7974.71	20390.40	-12415.69
540																	4.1	3.79	85.93	1.9	2.25	89.21	89.21	8180.86	22939.20	-14758.34
600																	2.7	2.49	88.43	3.4	4.02	93.24	93.24	8549.76	25488.00	-16938.24
660	Rainfall																2.5	2.31	90.74	2.8	3.31	96.55	96.55	8853.55	28036.80	-19183.25
720																	1.8	1.66	92.40	2.1	2.48	99.03	99.03	9081.40	30585.60	-21504.20
780																				2.5	2.96	101.99	101.99	9352.65	33134.40	-23781.75
840																				3.8	4.50	106.49	106.49	9764.95	35683.20	-25918.25
900																				1.5	1.77	108.26	108.26	9927.70	38232.00	-28304.30
960																				1.7	2.01	110.27	110.27	10112.15	40780.80	-30668.65
1020																				1.0	1.18	111.46	111.46	10220.65	43329.60	-33108.95
1080																				0.8	0.95	112.40	112.40	10307.45	45878.40	-35570.95
1140	Temporal																			1.4	1.66	114.06	114.06	10459.35	48427.20	-37967.85
1200																				1.1	1.30	115.36	115.36	10578.70	50976.00	-40397.30
1260																				0.9	1.06	116.43	116.43	10676.34	53524.80	-42848.46
1320																				0.7	0.83	117.26	117.26	10752.29	56073.60	-45321.31
1380																				0.4	0.47	117.73	117.73	10795.69	58622.40	-47826.71
1440																				0.5	0.59	118.32	118.32	10849.94	61171.20	-50321.26

* Used for plotting of Unit Area Envelope.

For 100 Year ARI

Maximum Retardation for no outflow condition = **10849.94 m^3**

Maximum Retardation for given outflow = **2260.64 m^3**

Outflow 300 mm dia. @ 1 in

SUMMARY OF RETENTION CALCULATIONS (POST-DEVELOPMENT)

Client : **Birdwood Energy**

Project : **Kiewa Valley Hwy, Baranduda**

Ref. No. : **22219**

Temporal Rainfall Pattern data for A.R.I. >30 years.			
Catchment area.		45.85	*ha*
Volumetric runoff coefficient.		0.31	
Design A.R.I.		100	Years
Diameter of outfall discharge pipe.		300	mm
Hydraulic gradient of pipe.	*1 in*		
Pipe roughness coefficient 'k'.			mm
Discharge rate.		708.0	l/sec

	Area	C
Proposed development	9.525 ha	0.75
Balance area	36.33 ha	0.2
	45.85	
Volumetric Coefficient		0.31

Duration		30min			60min			120min			180min			360min			720min			1440min			*Adopted Cumulative	Cumulative		Excess m^3
Intensity			77.1 mm/hr			47.4 mm/hr			28.1 mm/hr			20.6 mm/hr			12.4 mm/hr			7.7 mm/hr			4.93 mm/hr			Runoff	Outflow	
Interval min.		%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	Equivalent Intensity mm/hr	CIA*(dt) /360 m^3	708 l/s	
0																							0			
60					100	47.40	47.40	78.4	44.06	44.06	65.4	40.42	40.42	35.9	26.71	26.71	18.9	17.46	17.46	9.6	11.36	11.36	47.40	6737.20	2548.80	4188.40
120								21.6	12.14	56.20	22.9	14.15	54.57	27.5	20.46	47.17	28.6	26.43	43.89	22.8	26.98	38.34	56.20	7987.99	5097.60	2890.39
180	Pattern										11.7	7.23	61.80	14.7	10.94	58.11	8.0	7.39	51.28	14.1	16.68	55.02	61.80	8783.94	7646.40	1137.54
240														10.8	8.04	66.14	8.9	8.22	59.51	6.9	8.16	63.18	66.14	9401.04	10195.20	-794.16
300														6.8	5.06	71.20	5.4	4.99	64.50	5.1	6.03	69.22	71.20	10120.13	12744.00	-2623.87
360														4.3	3.20	74.40	8.2	7.58	72.07	4.1	4.85	74.07	74.40	10574.84	15292.80	-4717.96
420																	6.5	6.01	78.08	6.5	7.69	81.76	81.76	11620.83	17841.60	-6220.77
480																	4.4	4.07	82.14	4.4	5.21	86.97	86.97	12360.80	20390.40	-8029.60
540																	4.1	3.79	85.93	1.9	2.25	89.21	89.21	12680.33	22939.20	-10258.87
600																	2.7	2.49	88.43	3.4	4.02	93.24	93.24	13252.12	25488.00	-12235.88
660	Rainfall																2.5	2.31	90.74	2.8	3.31	96.55	96.55	13723.01	28036.80	-14313.79
720																	1.8	1.66	92.40	2.1	2.48	99.03	99.03	14076.17	30585.60	-16509.43
780																				2.5	2.96	101.99	101.99	14496.61	33134.40	-18637.79
840																				3.8	4.50	106.49	106.49	15135.67	35683.20	-20547.53
900																				1.5	1.77	108.26	108.26	15387.93	38232.00	-22844.07
960																				1.7	2.01	110.27	110.27	15673.83	40780.80	-25106.97
1020																				1.0	1.18	111.46	111.46	15842.00	43329.60	-27487.60
1080																				0.8	0.95	112.40	112.40	15976.54	45878.40	-29901.86
1140	Temporal																			1.4	1.66	114.06	114.06	16211.99	48427.20	-32215.21
1200																				1.1	1.30	115.36	115.36	16396.98	50976.00	-34579.02
1260																				0.9	1.06	116.43	116.43	16548.33	53524.80	-36976.47
1320																				0.7	0.83	117.26	117.26	16666.06	56073.60	-39407.54
1380																				0.4	0.47	117.73	117.73	16733.33	58622.40	-41889.07
1440																				0.5	0.59	118.32	118.32	16817.41	61171.20	-44353.79

* Used for plotting of Unit Area Envelope.

For 100 Year ARI

Maximum Retardation for no outflow condition = **16817.41 m^3**

Maximum Retardation for given outflow = **4256.13 m^3**

Outflow 300 mm dia. @ 1 in

Client : **Birdwood Energy Pty Ltd**
Project : **Kiewa Valley Hwy, Baranduda**
Ref. No. : **22219**

1% AEP Retentiion Requirement

Pre development	2261	m^3
Post Development	4256	m^3
Effective retention to be provided as part of the proposed works	1995	m^3

Retention Basin Capacity

Side A			Excavated Depth	1.5	m
Top	110	m	Side Slope	1 in	4
Water Level	107.6	m	Freeboard	0.3	m
Base	98	m	Depth of Water	1.2	m
Side B					
Top	25	m			
Water Level	22.6	m			
Base	13	m	CAPACITY	2224	m^3
			EXCAVATED VOLUME	3018	m^3

Allowable Discharge Rate (Proposed Retention Basin)

Total Site Area	45.85	ha
Pre-development discharge	708	l/s
Effective catchment of the retention basin	7.67	ha
Allwable discharge from retention basin	118	l/s