03/02/2021

Project Number: 200639

STORMWATER MANAGEMENT REPORT

at

NARROMINE WEST SOLAR FARM | 1570 DANDALOO ROAD NARROMINE

for

PROVIDENCE ASSET GROUP

Project No. 200639

Revision: B – Reissued for DA

TABLE OF CONTENTS

1. Introduction

DRB Consulting Engineers (DRB) were engaged by Providence Asset Group Pty Ltd to undertake a Stormwater Management Plan for the proposed Narromine West Solar Farm, located across LOT 2221 DP 1101864 Dandaloo Road, Narromine NSW.

This report will provide commentary on the impact the proposed development will have on the existing site with regard to stormwater quantity.

It should be noted that, this report has been prepared to a level suitable for Development Application only.

This report should be read in conjunction with the Concept Stormwater Management plans 200639/CIV01-03.

2. Site Description & Proposed Development

The site is located at Dandaloo Road, Narromine. The site is located on the northern side of Dandaloo Road and is identified as Lot 2221 DP 1101864.

The proposed Narromine West Solar Farm will be located in the south-western portion of the site, known as the Investigation Area (IA).

At the time of this investigation, the IA was a vacant rural parcel of land approximately 15 Ha in area. The IA was considered to be flat with site slopes of approximately 0.1%. However, an analysis of the site and the surrounding area showed that the fall was in a southeast to northwest direction.

1570 Dandaloo Road Narromine had an existing watercourse running adjacent to the northern boundary. During rainfall events, surface runoff from the IA would sheet flow towards the existing watercourse.

Figure 1 below shows the existing site and investigation area.

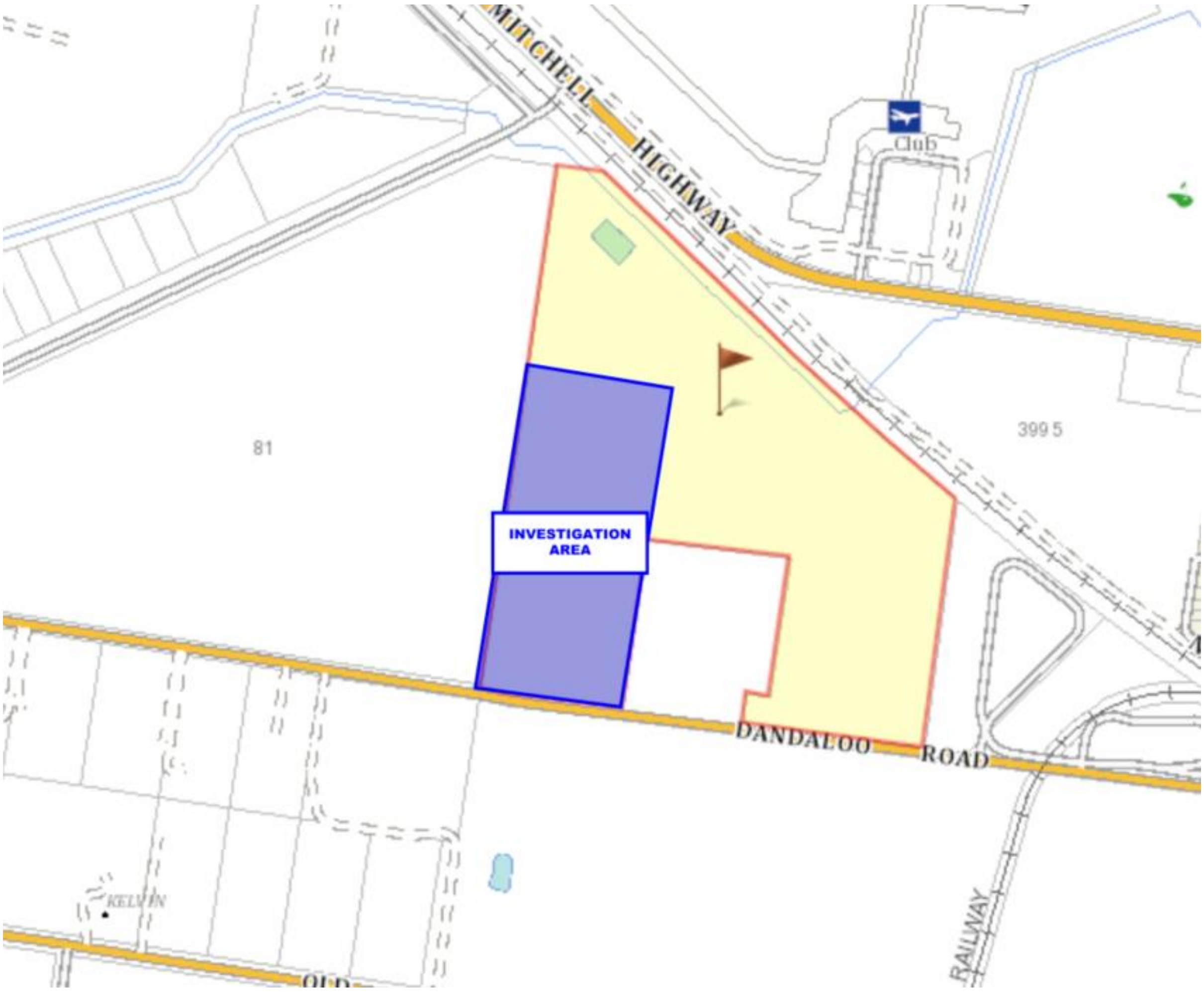

Figure 1 – Existing Site Boundaries

The proposed Solar Farm layout can be seen in Figure 2 below.

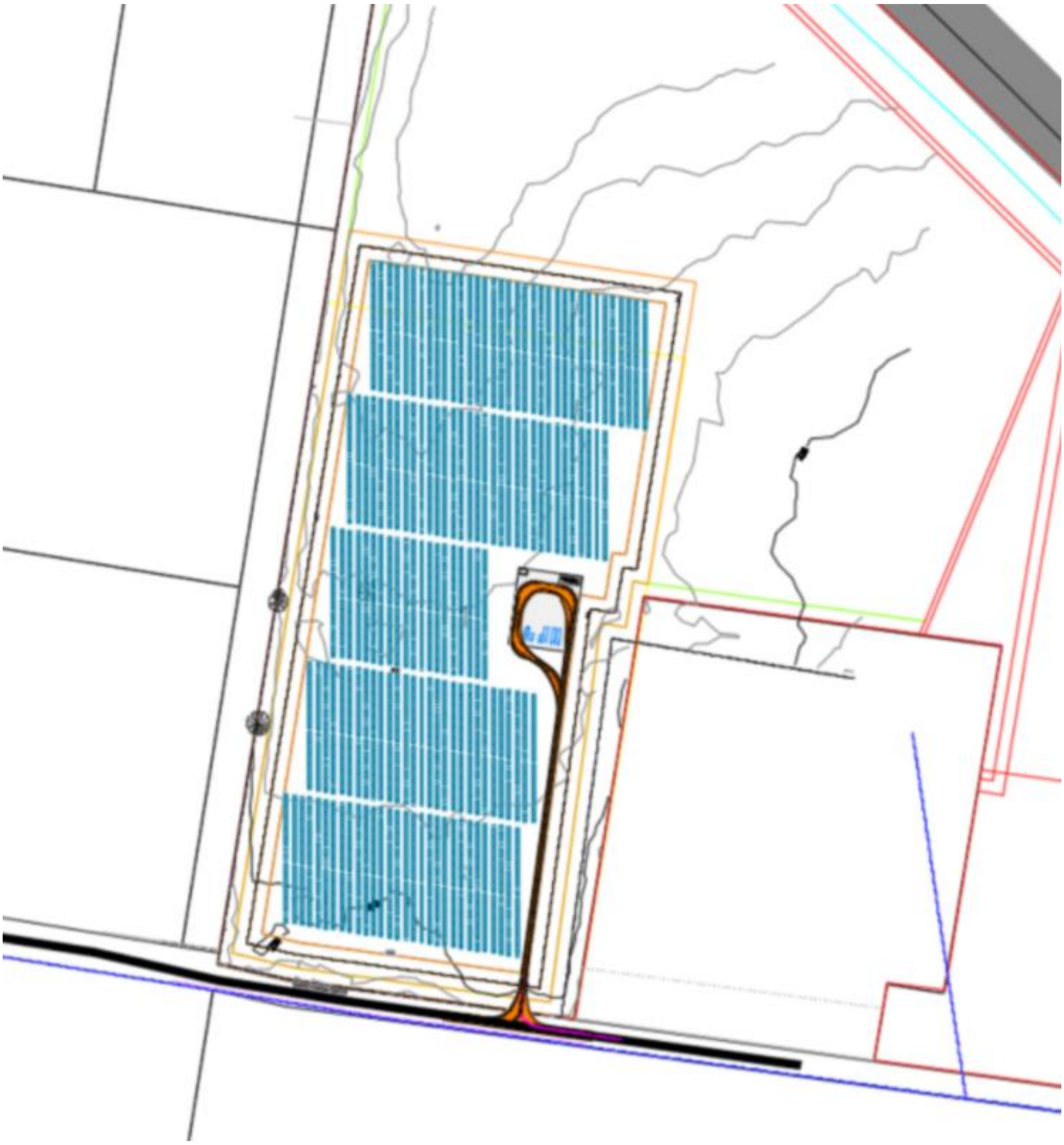

Figure 2 – Proposed Solar Farm

3. Council Requirements

A review of Narromine Shire Council's Development Plan did not provide guidance on developments of this nature. As such, based on previous experience of design of solar farms, we propose to:

- *Limit the Post-Development flow rates from the proposed development to the Pre-Development flow rates for all storm events up to and including the 1 in 100 year storm event.*

Furthermore, the site must discharge legally without causing nuisance flows onto neighbouring properties.

4. Water Quantity Analysis (Onsite Stormwater Detention)

4.1. Overview

The proposed development area has been split into two separate catchments for the assessment of Stormwater Quantity; the Photovoltaic Array stage and the Gravel / Hardstand catchments. Figure 3 below shows the proposed catchment boundaries.

Figure 3 – Proposed Catchment Boundaries

4.2. *Photovoltaic Array*

The Photovoltaic Array will consist of 147 x Ground Mounted Single Axis Trackers. The array structure will be steel pile supported and will have approximately 600mm clearance above the existing ground surface.

4.2.1. *Pre-Development Peak Flows*

The catchment characteristics for the Pre-Development catchment area can be seen in Table 1 below:

Construction Stage	***Parameter***	
Photovoltaic Array Catchment Pre-Development	Sub-Catchment Area	94,229.5 m^2
	Percentage Impervious	0 %
	Flowpath Length	551 m
	Flowpath Slope	0.1 %
	Retardance Coefficient 'n'	0.075

Table 1 – Existing Catchment Parameters

A DRAINs model was developed to determine the pre-development peak flow rates. The DRAINs model used the *ARR 2019 Initial loss - Continuing loss (IL-CL) hydrological model* and 2016 IFD data. The Hydrological model parameters were determined using the ARR data hub and can be seen in Figure 4 below.

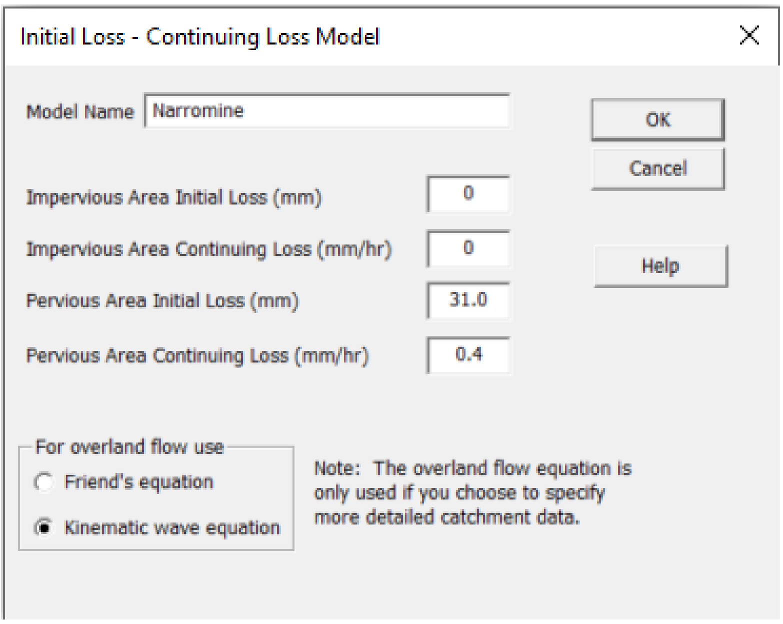

Figure 4 – Hydrological Model Parameters

The model was developed for the 1 EY (Exceedances per year), 10% AEP (Annual Exceedance Probability) and 1% AEP events and analysed the following storm durations.

5 minutes	45 minutes	9 hours
10 minutes	1 hour	12 hours
15 minutes	2 hours	18 hours
20 minutes	3 hours	24 hours
25 minutes	4.5 hours	
30 minutes	6 hours	

The Results of the DRAINs model can be seen below in Table 2.

Construction Stage	***Storm Event (Exceedance Probability / Annual Exceedance Probability)***	***Peak Flow***
Photovoltaic Array Catchment Pre-Development	1EY	0.079 m^3/s
	10% AEP	0.379 m^3/s
	1% AEP	0.888 m^3/s

Table 2 – Pre-Development Peak Flow

4.2.2. Post-Development Peak Flows

The Post-Development site conditions can be summarised below:

(i) The proposed arrays will be at varying angles, however, in a worst-case runoff scenario, it is assumed the arrays are horizontal to the existing ground surface level.
(ii) Runoff from the proposed arrays will fall immediately on to the untouched natural ground surface.
(iii) The pervious area under the arrays will not receive direct rainfall, however, it will be available for both initial and continuing loss for the runoff of the array immediately upslope.

The catchment characteristics for the Post-Development catchment area can be seen in Table 3 below:

Construction Stage	***Parameter***	
Photovoltaic Array Catchment Post-Development	Sub-Catchment Area	94,229.5 m^2
	Percentage Impervious	36.1 %
	Flowpath Length	551 m
	Flowpath Slope	0.1 %
	Retardance Coefficient ‘n’	0.075

Table 3 – Proposed Development Catchment Parameters

To replicate the proposed site conditions and consider the available pervious areas located underneath the proposed arrays, the Pervious Area Initial and Continuing Loss was factored up by 1.565. This allowed the total pervious area to be included in the assessment.

The Hydrological model parameters used in the Post-Development model can be seen in Figure 5 below.

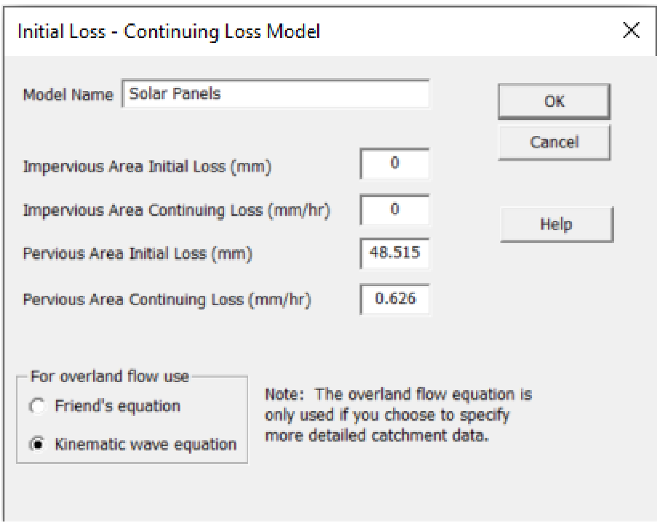

Figure 5 – Hydrological Model Parameters

The Results of the DRAINs model can be seen below in Table 4.

Construction Stage	***Storm Event (Exceedance Probability / Annual Exceedance Probability)***	***Pre-Development Peak Flow***	***Post-Development Peak Flow***	***Difference***
Photovoltaic Array Catchment 1 Post-Development	1EY	0.079 m^3/s	0.069 m^3/s	- 0.010 m^3/s
	10% AEP	0.379 m^3/s	0.297 m^3/s	- 0.082 m^3/s
	1% AEP	0.888 m^3/s	0.709 m^3/s	- 0.179 m^3/s

Table 4 – Post-Development Peak Flow

4.2.3. Conclusion

By discharging the runoff from proposed Photovoltaic Array's directly to the existing ground surface and maintaining the existing natural surface levels and travel paths the proposed development area catchment limited the increase to peak runoff to negligible values, and reduced the peak runoff during the 1% AEP.

4.3. *Gravel / Hardstand Area*

The Gravel / Hardstand Area includes the proposed roads, gravel laydown area and temporary buildings located within the Investigation Area.

It is proposed that runoff from this area will captured within a roadside swale used to convey these flows to a new above ground onsite stormwater detention basin. The basin will then reduce flows to the pre-development levels.

4.3.1. *Pre-Development Peak Flows*

The catchment characteristics for the Pre-Development catchment area can be seen in Table 5 below:

Catchment	***Parameter***	
Pre-Developed	Sub-Catchment Area	4,724.8 m^2
	Percentage Impervious	0 %
	Flowpath Length	114 m
	Flowpath Slope	0.2 %
	Retardance Coefficient 'n'	0.075

Table 5 – Existing Catchment Parameters

A DRAINs model was developed to determine the pre-development peak flow rates. The DRAINs model used the *ARR 2019 Initial loss - Continuing loss (IL-CL) hydrological model* and 2016 IFD data. The Hydrological model parameters were determined using the ARR data hub (see Figure 4 above) and was developed for the 1 EY (Exceedances per year), 10% AEP (Annual Exceedance Probability) and 1% AEP events.

The Results of the DRAINs model can be seen below in Table 6.

Catchment	***Storm Event (Exceedance Probability / Annual Exceedance Probability)***	***Combined Peak Flow***
Pre-Developed	1EY	0.009 m^3/s
	10% AEP	0.053 m^3/s
	1% AEP	0.120 m^3/s

Table 6 – Pre-Development Peak Flow

4.3.2. *Post-Development Peak Flows*

The Post-Development site conditions can be summarised below:

(i) The proposed gravel roads and hardstand areas will be assumed to be impervious.
(ii) A retardance coefficient of 0.013 was adopted for both the proposed gravel road and hardstand area.
(iii) The runoff from the impervious area was treated as sheet flow along the proposed levels before being captured within a new roadside swale and conveyed to the proposed above ground onsite detention basin.

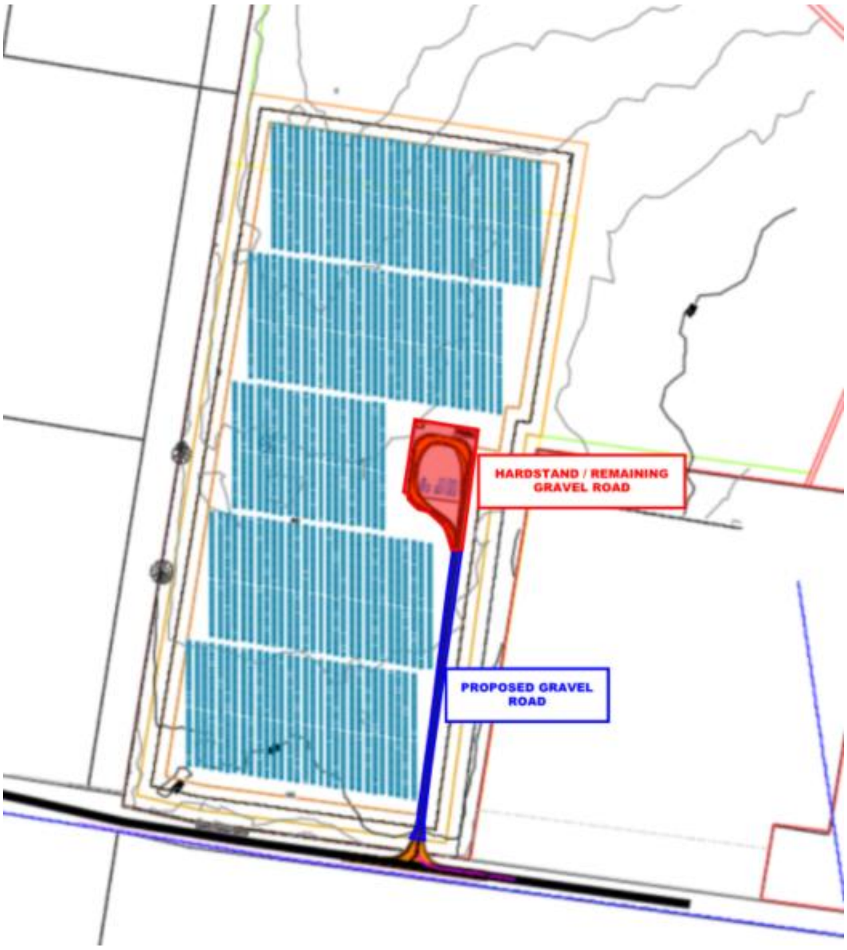

Figure 5 – Post-Development Catchment Boundaries

The catchment characteristics for the Post-Development catchment area can be seen in Table 7 below:

Catchment	***Parameter***	
Hardstand / Remaining Gravel Road	Sub-Catchment Area	3,865.10 m^2
	Percentage Impervious	90.55 %
	Flowpath Length	4 m
	Flowpath Slope	0.5 %
	Retardance Coefficient ‘n’	0.013
Proposed Gravel Road	Sub-Catchment Area	861.50 m^2
	Percentage Impervious	100 %
	Flowpath Length	4 m
	Flowpath Slope	0.5 %
	Retardance Coefficient ‘n’	0.013

Table 7 – Proposed Development Catchment Parameters

The Gravel / Hardstand Catchment drained directly into an above ground Onsite Stormwater Detention Basin. The Basin characteristics can be seen in Table 8 below.

OSD Basin	
Basin Invert	237.59m AHD
Basin – Top of Bank	237.89m AHD
Low flow pipe diameter	150mm
Low flow pipe invert	237.59m AHD
Orifice Diameter	115mm
Base of Weir Width	0.70 m
Base of Weir Level	237.78m AHD
Top of Weir Width	2.90 m
Top of Weir Level	237.89 AHD
Basin Volume	140 m^3

Table 8 – Proposed OSD Basin Characteristics

The Results of the DRAINs model can be seen below in Table 9.

Storm Event	***Pre-Dev. Peak Flow***	***Post-Dev. Peak Flow***	***Post-Dev. Peak Flow - Mitigated***	***Difference***	***Top Water Level***
1EY	0.009 m^3/s	0.092 m^3/s	0.009 m^3/s	0.000 m^3/s	237.78m AHD
10% AEP	0.053 m^3/s	0.177 m^3/s	0.053 m^3/s	0.000 m^3/s	237.84m AHD
1% AEP	0.120 m^3/s	0.288 m^3/s	0.113 m^3/s	- 0.007 m^3/s	237.89m AHD

Table 9 – Post-Development Peak Flow

It is noted that the existing dam and volume will be maintained with the proposed OSD low flow located at the existing dam water level/overflow.

4.3.3. Conclusion

By discharging the runoff from proposed Gravel / Hardstand Area through the proposed OSD basin, the Post-development peak flows for the entire Investigation Area are reduced back to the Pre-development peak flow values.

DRB
CONSULTING ENGINEERS

5. Conclusion

The stormwater drainage strategy for the proposed Narromine West Solar Farm at Dandaloo Road, Narromine can be summarised as:

(i) All impervious runoff from the proposed Photovoltaic Arrays will discharge to the existing ground surface where the natural flow regime will be maintained.

(ii) Runoff from the proposed gravel/hardstand area catchment will be conveyed via sheet flow and the proposed roadside swale to the proposed above ground onsite stormwater detention basin.

(iii) Discharge from the above ground onsite stormwater detention basin will be limited to the pre-development flow rates.

Provided the above stormwater drainage philosophy is adopted for the site, the proposed Narromine West Solar Farm will limit the Post-Development peak flows to Pre-Development flow rates for the 1 EY, 10% AEP and 1% AEP events.

Should you require any further advice or clarification of any of the above, please do not hesitate to contact us.

Yours faithfully
DRB CONSULTING ENGINEERS PTY LIMITED

Mathew McNamara
BEng (Civil) Hons MIE Aust