21/04/2021

Project Number: 210747

STORMWATER MANAGEMENT REPORT

at

AMAROO SOLAR FARM | MOREE

for

PROVIDENCE ASSET GROUP

Project No. 210747

Revision: A – Issued 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 Amaroo Solar Farm, located within Lot 392 DP 751780 Amaroo Road, Moree, 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 210747/CIV01-03.

2. Site Description & Proposed Development

The site is located at Amaroo Drive, Moree. The site is located at the western end of Amaroo Drive and is identified as Lot 392 DP 751780.

The proposed Amaroo Solar Farm will be located in the central west portion of the site, which will be hence forth known as the Investigation Area (IA) seen in Figure 1 below.

At the time of this investigation the IA was a vacant rural parcel of land approximately 14.9 Ha in area. The IA had a good grass coverage and sloped from the southeast to the northwest at slopes of approximately 0.3%.

During rainfall events, surface runoff from the IA would sheet flow towards the north western corner and exit the site.

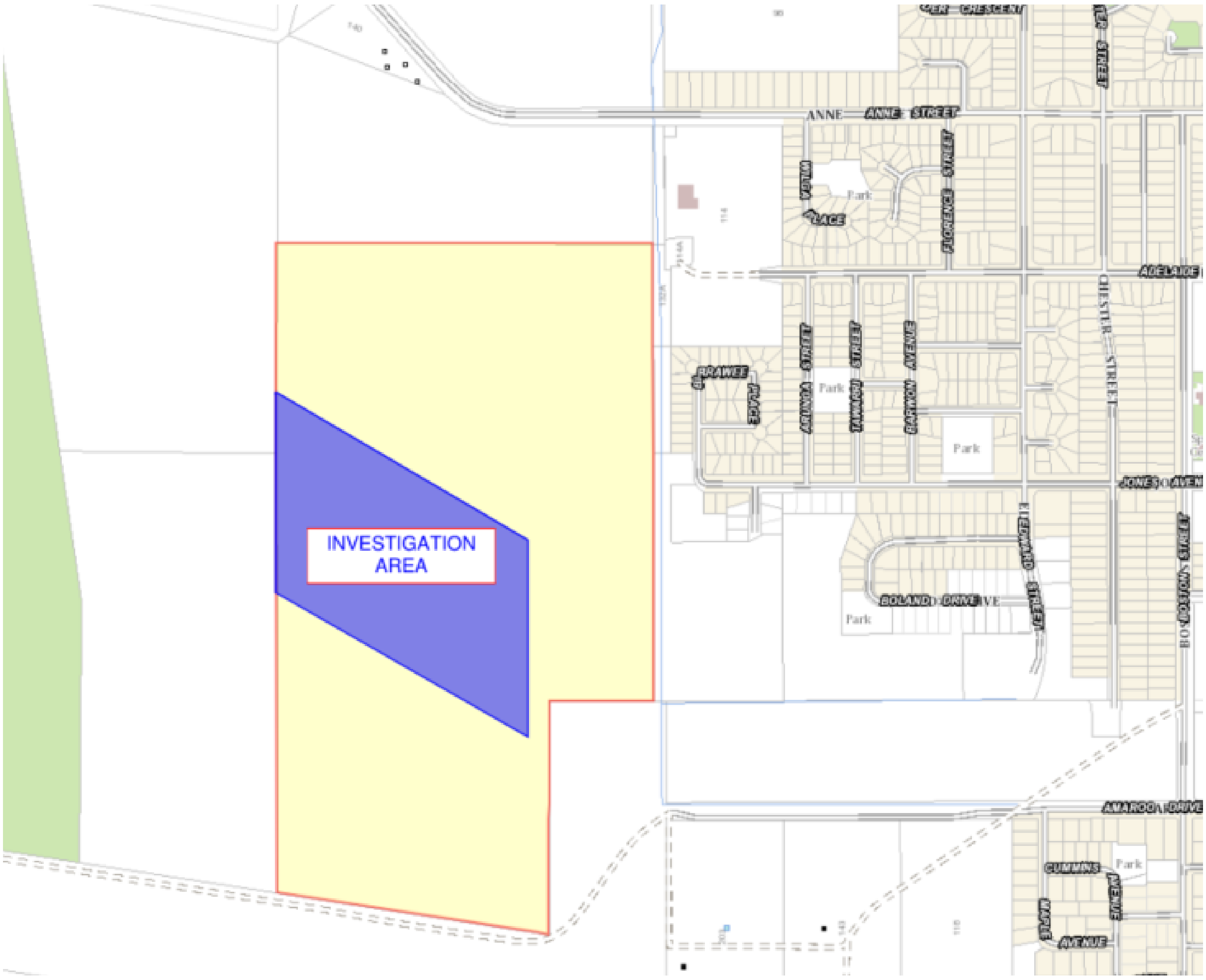

Figure 1 – Existing Site Boundaries & Investigation Area (IA)

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

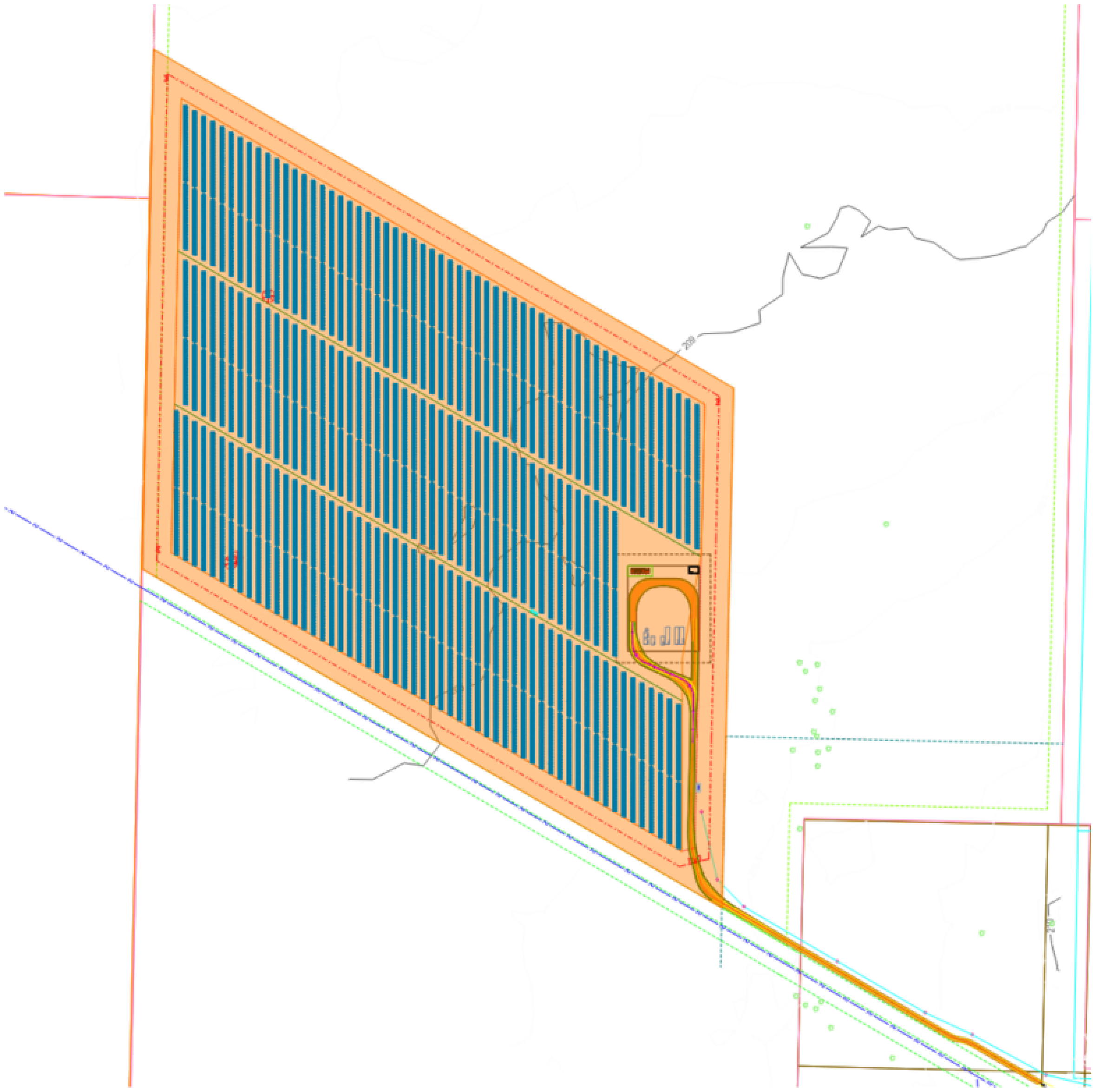

Figure 2 – Proposed Solar Farm

3. Council Requirements

A review of Moree Plains 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% AEP 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.

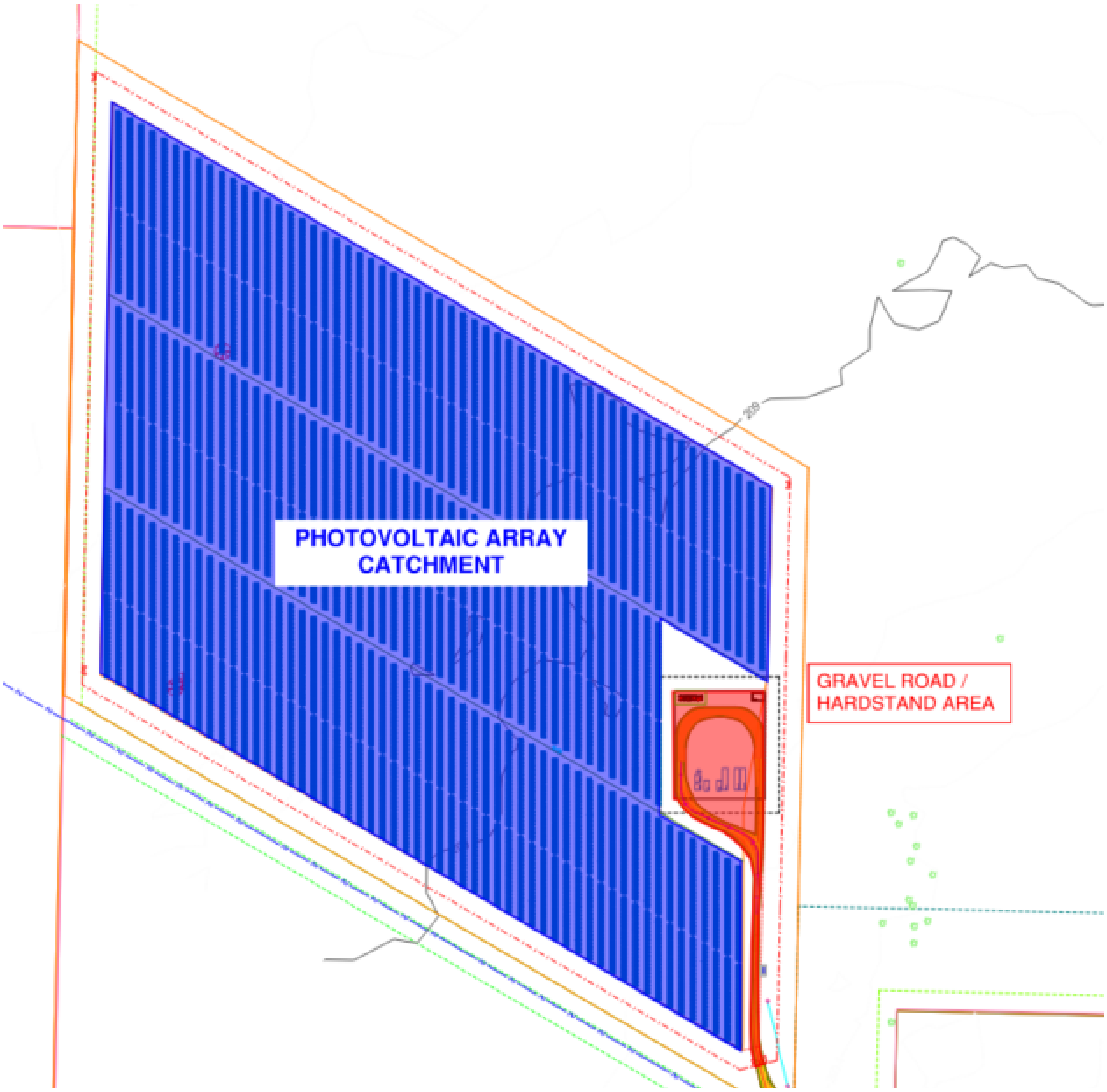

Figure 3 – Proposed Catchment Boundaries

4.2. Photovoltaic Array

The Photovoltaic Array will consist of 161 x Ground Mounted Single Axis Trackers. The array structure will be steel pile supported and will have a minimum 600mm ground clearance from the lowest edge of the module, when the tracker is at full rotation.

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	109,061.60 m^2
	Percentage Impervious	0 %
	Flowpath Length	626.5 m
	Flowpath Slope	0.3 %
	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.

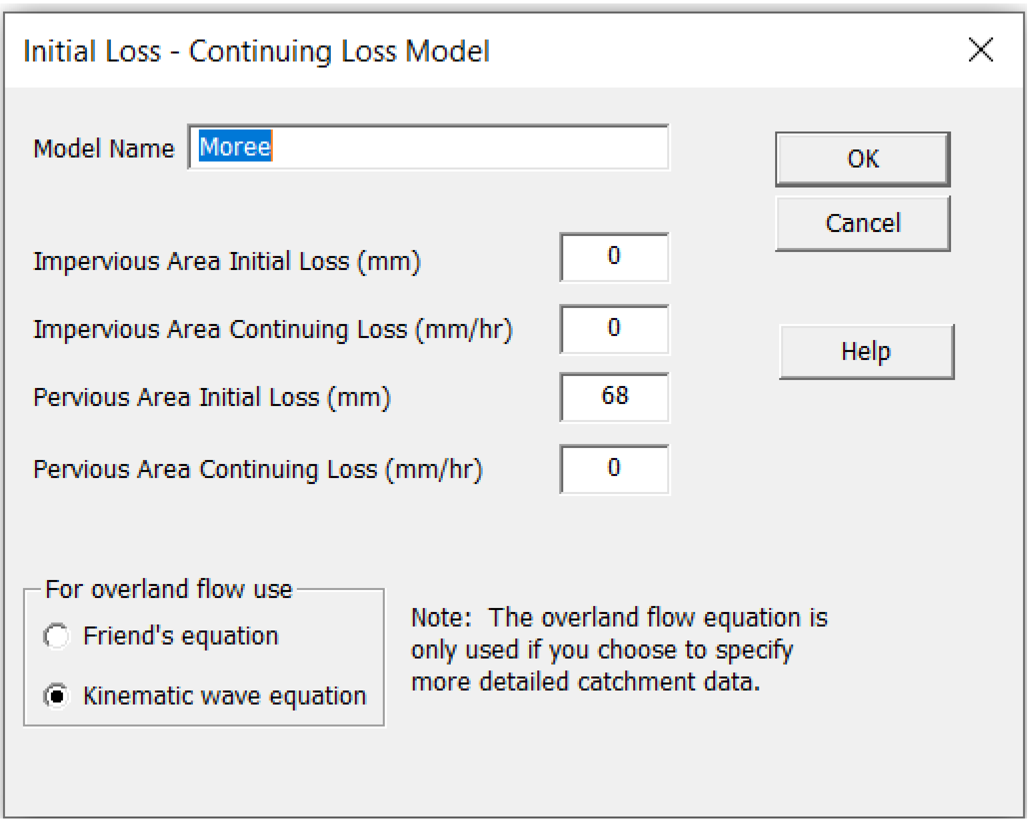

Figure 4 – Hydrological Model Parameters

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	0.000 m^3/s
	10% AEP	0.434 m^3/s
	1% AEP	1.090 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	109,061.60 m^2
	Percentage Impervious	33.8 %
	Flowpath Length	626.5 m
	Flowpath Slope	0.3 %
	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 <u>1.55</u>. 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.

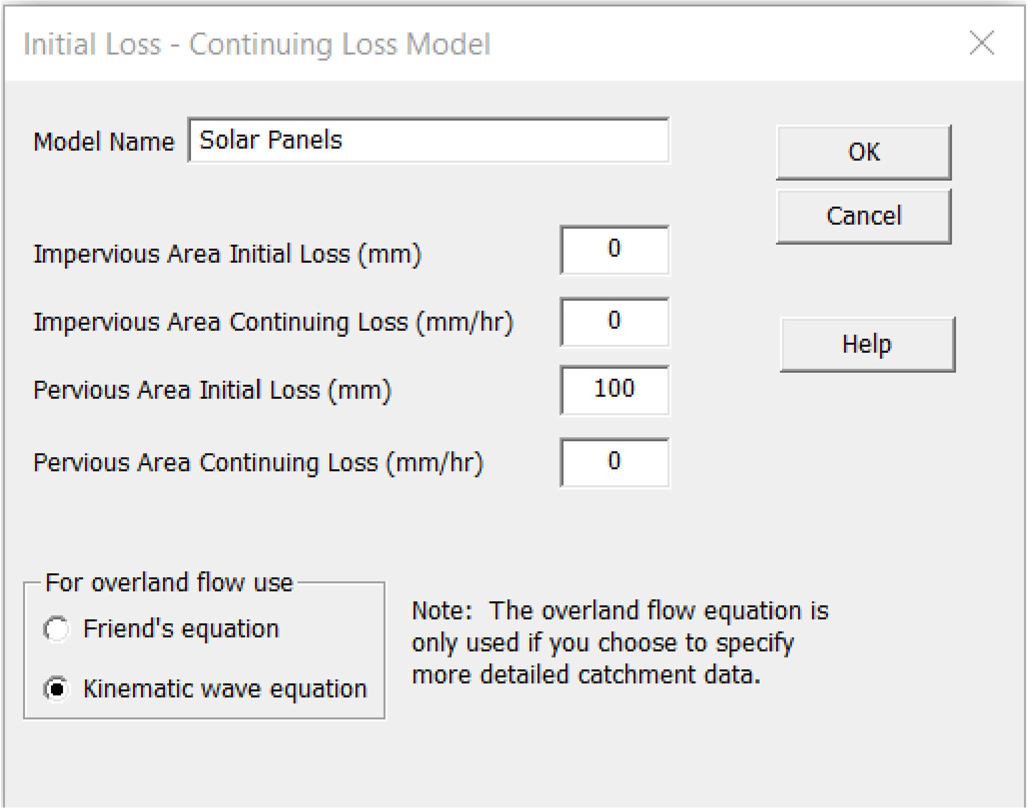

Figure 5 – Hydrological Model Parameters

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	0.000 m³/s	0.000 m³/s	0.000 m³/s
	10% AEP	0.434 m³/s	0.325 m³/s	-0.109 m³/s
	1% AEP	1.090 m³/s	0.876 m³/s	-0.214 m³/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 EY, 10% AEP and 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 be captured within a roadside swale used to convey these flows to a new above ground onsite stormwater detention basin. The basin will store runoff, reducing 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	6,581.70 m^2
	Percentage Impervious	0.0 %
	Flowpath Length	140 m
	Flowpath Slope	0.3 %
	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), 20% AEP (Annual Exceedance Probability), 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	0.000 m^3/s
	20% AEP	0.028 m^3/s
	10% AEP	0.060 m^3/s
	1% AEP	0.147 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.

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	6,581.70 m^2
	Percentage Impervious	68 %
	Flowpath Length	140 m
	Flowpath Slope	0.3 %
	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	209.08m AHD
Basin – Top of Bank	209.38m AHD
Low flow pipe diameter	150mm
Low flow pipe invert	209.08m AHD
Base of Weir Width	1.0m
Base of Weir Level	209.30m AHD
Top of Weir Width	5.0m
Top of Weir Level	209.38m AHD
Basin Volume	210.00 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	0.000 m^3/s	0.082 m^3/s	0.015 m^3/s	0.015 m^3/s	209.24m AHD
20% AEP	0.028 m^3/s	0.130 m^3/s	0.019 m^3/s	-0.009 m^3/s	209.29m AHD
10% AEP	0.060 m^3/s	0.161 m^3/s	0.045 m^3/s	-0.015 m^3/s	209.33m AHD
1% AEP	0.147 m^3/s	0.282 m^3/s	0.123 m^3/s	-0.024 m^3/s	209.38m AHD

Table 9 – Post-Development Peak Flow

Note that for the 1 EY, the system does not reduce the Post-development peak flows back to the Pre-development peak flow values. For this site it is deemed impractical to reduce the post-development flow to match the pre-development flow of 0.000 m^3/s. Therefore, the 20% AEP storm event was added as a minor storm to be used in-lieu if the 1 EY. This ensures that the Post-development peak flows are reduced back to Pre-Development peak flow for lower flows in minor storms.

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.

5. Conclusion

The stormwater drainage strategy for the proposed Amaroo Solar Farm at Amaroo Drive, Moree 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 proposed 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 Amaroo Solar Farm will limit the Post-Development peak flows to Pre-Development peak flow rates for 20% AEP, 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