

23/03/2020

Project Number: 190284

STORMWATER MANAGEMENT REPORT

at

MANILLA SOLAR FARM | 4133 MANILLA ROAD MANILLA

for

PROVIDENCE ASSET GROUP c/- KDC Pty Ltd

Project No. 190284

Revision: B – DA Submission

TABLE OF CONTENTS

1.	Introduction	3
2.	Site Description & Proposed Development	4
3.	Pre-Lodgement Meeting and Council Correspondence	6
4.	Water Quantity Analysis	7
4.1.	<i>Overview</i>	7
4.2.	<i>Photovoltaic Array</i>	8
4.2.1.	<i>Pre-Development Peak Flows</i>	8
4.2.2.	<i>Post-Development Peak Flows</i>	9
4.2.3.	<i>Conclusion</i>	10
4.3.	<i>Gravel / Hardstand Area</i>	11
4.3.1.	<i>Pre-Development Peak Flows</i>	11
4.3.2.	<i>Post-Development Peak Flows</i>	12
4.3.3.	<i>Conclusion</i>	12
5.	Conclusion	13

1. Introduction

DRB Consulting Engineers (DRB) were engaged by KDC Pty Ltd, on behalf of Providence Asset Group to undertake a Stormwater Management Plan for the proposed Manilla Solar Farm, located at 4133 Manilla Road Manilla.

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. Additional information and/or reports may need to be developed prior to lodgement of the Construction Certificate submission.

This report should be read in conjunction with the Concept Stormwater Management plans 190284/CIV01-03.

2. Site Description & Proposed Development

The site is located at 4133 Manilla Road, Manilla. The site is located on the western side of Manilla Road and is identified as Lot A DP 442930. The Lot is split through the middle by the Tamworth to Barraba Railway Line, running south to north.

The proposed Manilla Solar Farm will be located to the west of the railway line, and therefore, this investigation is limited to this western portion of the site.

At the time of this investigation, the investigation area (IA) was a vacant rural parcel of land approximately 21.8 Ha in area. The IA had a good grass coverage and sloped from the southeast to the northwest at slopes of approximately 0.7 – 1.0%.

The IA was bordered to the west by Greenhatch Creek. During rainfall events, surface runoff from the IA would sheetflow across the site and discharge over the northwestern corner boundary to Greenhatch Creek.

Figure 1 below shows the existing site and investigation area.

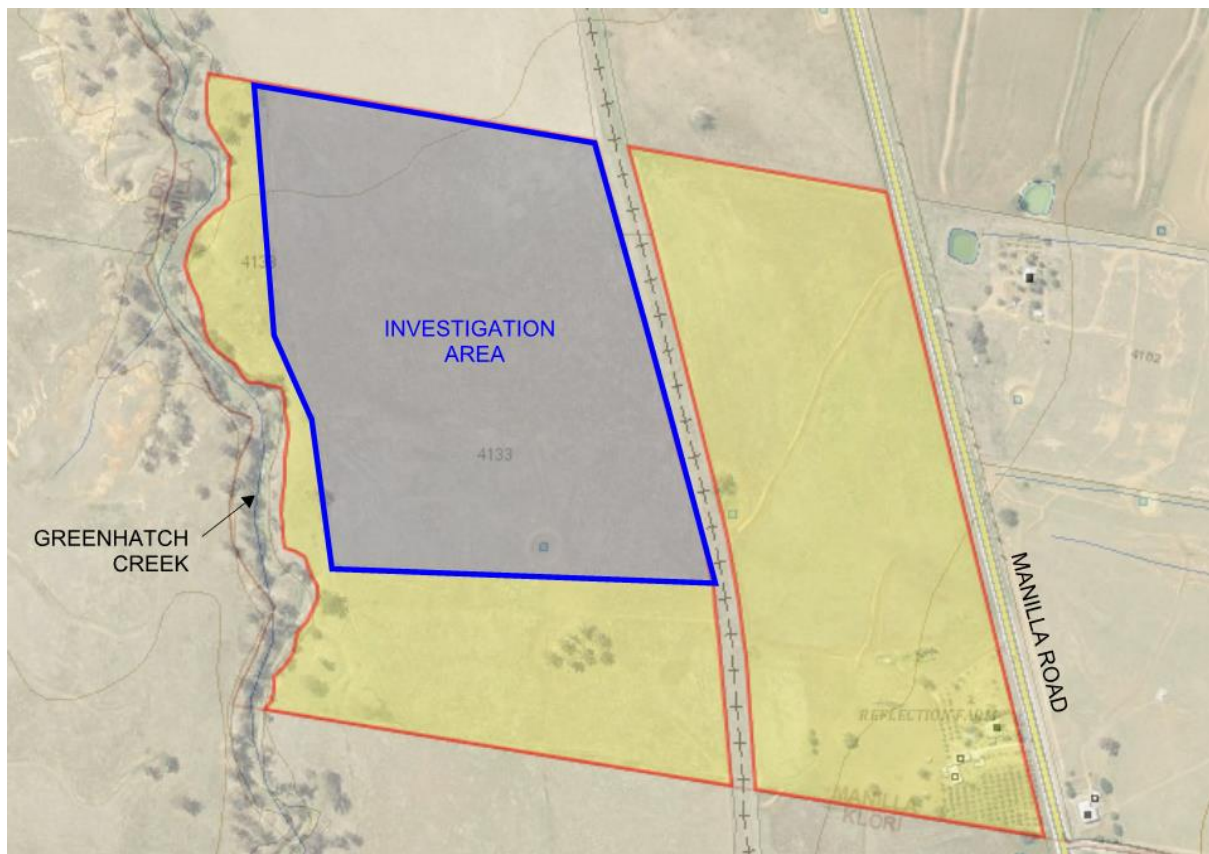


Figure 1 – Existing Site Boundaries

It is proposed that the Manilla Solar be constructed within the Investigation Area. The proposed Solar Farm layout can be seen in Figure 2 below.

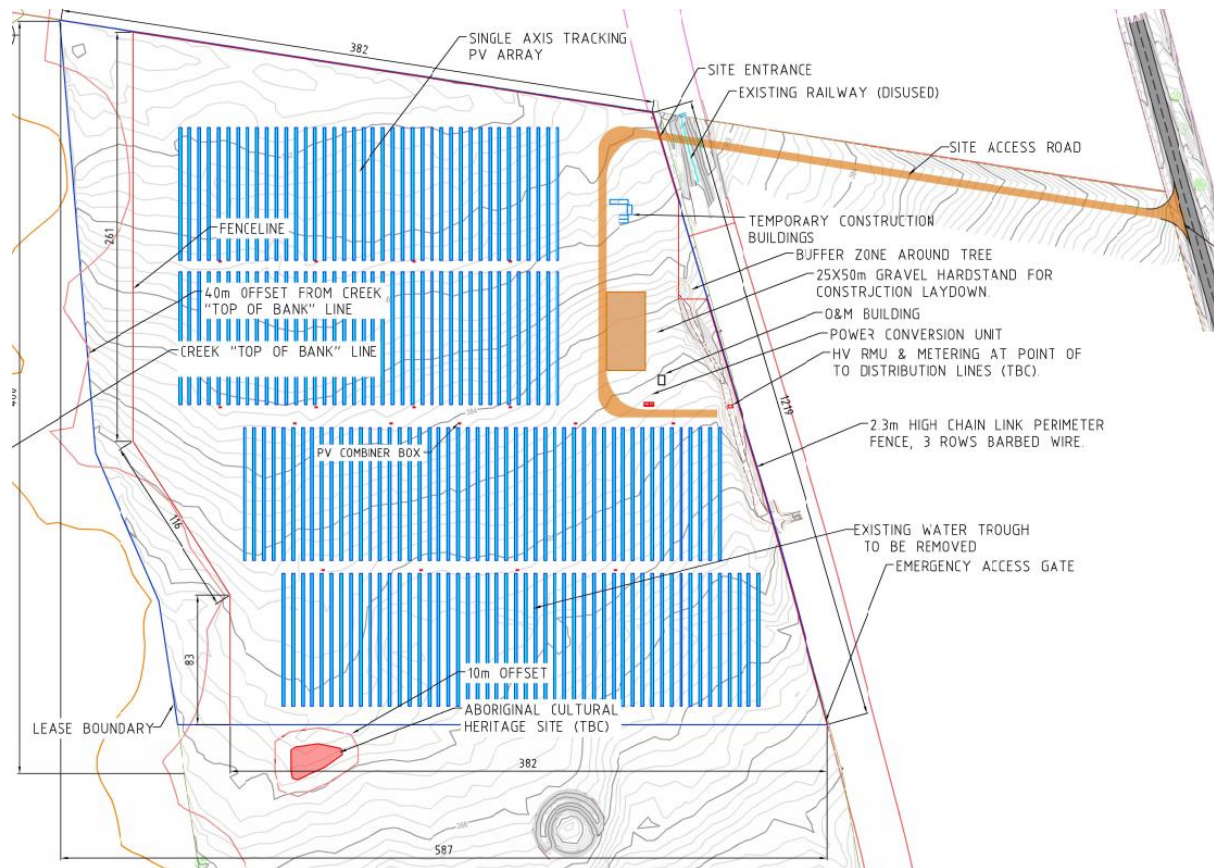


Figure 2 – Proposed Solar Farm

3. Pre-Lodgement Meeting and Council Correspondence

A Pre-Lodgement Meeting was undertaken with Tamworth Regional Council, and further discussions were undertaken over the phone with Tamworth Regional Council's Development Engineers. The following items relevant to the civil aspects of this project were discussed:

- *The proposed development must detain stormwater runoff using a Detention Basin, and the Basin outlet must be designed to bring the discharge rate Post-Development back to Pre-Development flow rates.*

4. Water Quantity Analysis

4.1. Overview

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

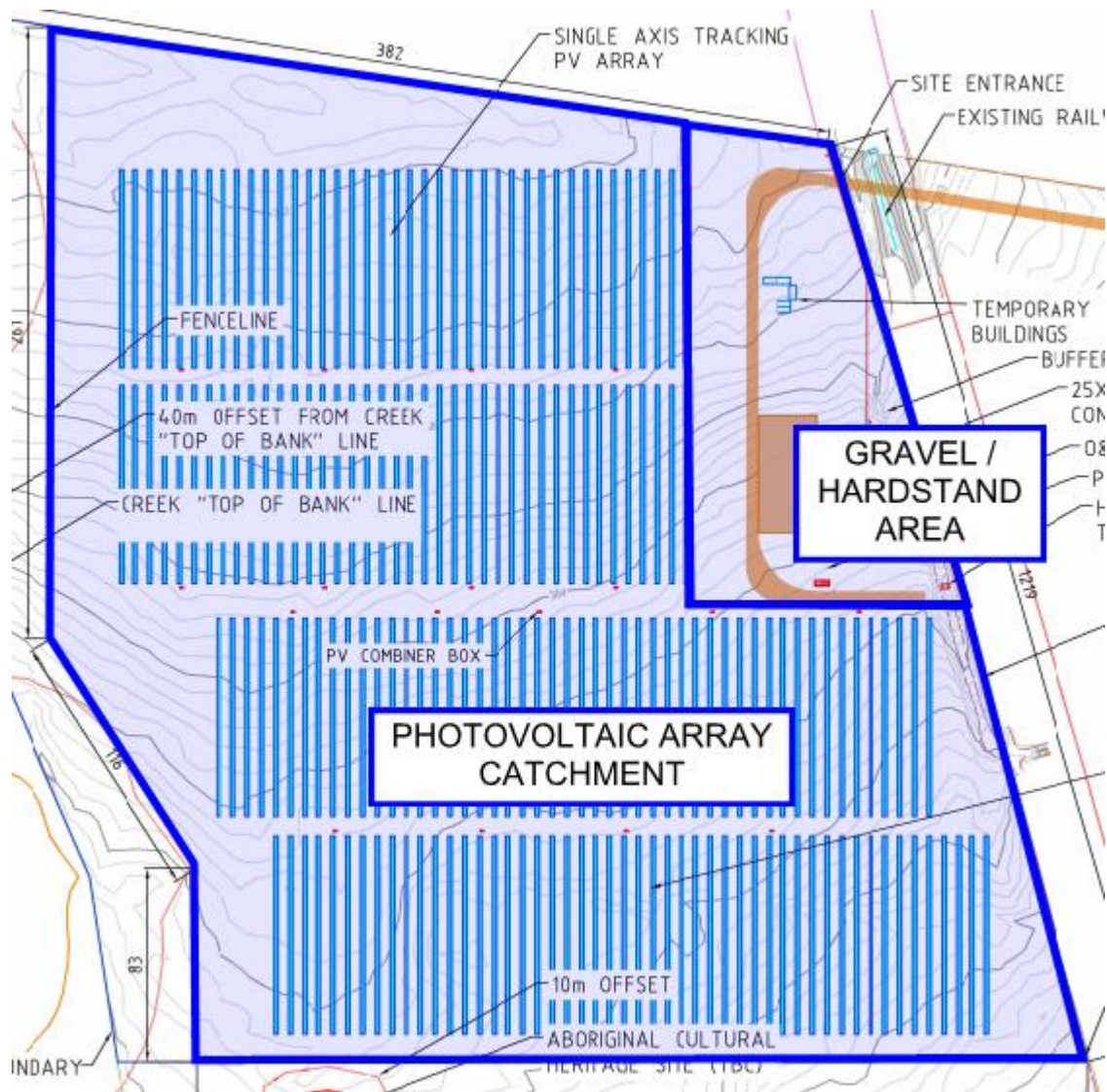


Figure 3 – Proposed Catchment Boundaries

4.2. Photovoltaic Array

The Photovoltaic Array will consist of 180 x Ground Mounted Single Axis Trackers. The Arrays will be pole mounted and will have approximately 600mm clearance above the existing ground surface.

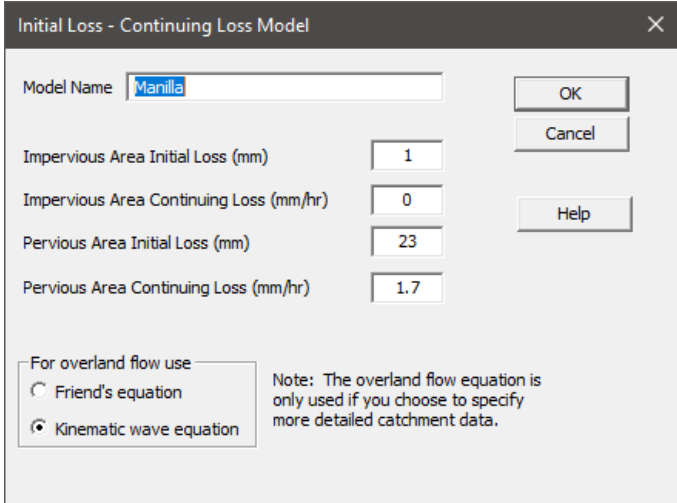
4.2.1. Pre-Development Peak Flows

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

Parameter	
Sub-Catchment Area	203,870 m ²
Percentage Impervious	0 %
Flowpath Length	717 m
Flowpath Slope	0.91 %
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.



Initial Loss - Continuing Loss Model

Model Name:

Impervious Area Initial Loss (mm):

Impervious Area Continuing Loss (mm/hr):

Pervious Area Initial Loss (mm):

Pervious Area Continuing Loss (mm/hr):

For overland flow use:

☐ Friend's equation

☒ Kinematic wave equation

Note: The overland flow equation is only used if you choose to specify more detailed catchment data.

OK, Cancel, Help

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

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

Storm Event (Exceedance Probability / Annual Exceedance Probability)	Peak Flow
1EY	0.279 m ³ /s
10% AEP	1.040 m ³ /s
1% AEP	2.620 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:

Parameter	
Sub-Catchment Area	203,870 m ²
Percentage Impervious	12.9 %
Flowpath Length	717 m
Flowpath Slope	0.91 %
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 1.15. This allowed the initial and continuing loss of 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.

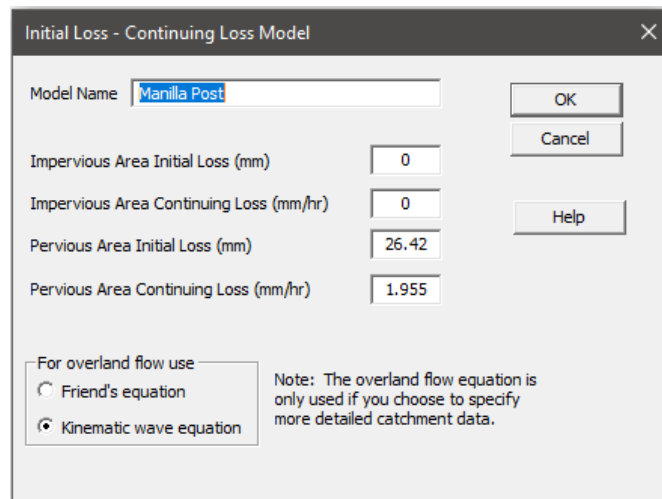


Figure 5 – Hydrological Model Parameters

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

Storm Event (Exceedance Probability / Annual Exceedance Probability)	Pre-Development Peak Flow	Post-Development Peak Flow	Difference
1EY	0.279 m ³ /s	0.252 m ³ /s	- 0.027 m ³ /s
10% AEP	1.040 m ³ /s	1.000 m ³ /s	- 0.040 m ³ /s
1% AEP	2.620 m ³ /s	2.480 m ³ /s	- 0.140 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 will not increase peak runoff.

It should be noted that, the modelling strategy outlined in Section 4.2.2 above, is an approximation only, and as such, the reductions in peak flow outlined in Table 4 above will not be used in the assessment of the Gravel / Hardstand Area.

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 generally follow the existing contours, with road side swales capturing and conveying these flows to a new above ground onsite stormwater detention basin.

Due to the sites flat grades, a small portion of the Gravel / Hardstand catchment, will bypass the proposed basin, however, these bypass flows are included in the post-development flow calculations.

4.3.1. Pre-Development Peak Flows

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

Parameter	
Sub-Catchment Area	13,385 m ²
Percentage Impervious	0 %
Flowpath Length	193 m
Flowpath Slope	1.20 %
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.

Storm Event (Exceedance Probability / Annual Exceedance Probability)	Peak Flow
1EY	0.031 m ³ /s
10% AEP	0.139 m ³ /s
1% AEP	0.331 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) As the hardstand areas were immediately discharged to existing pervious surfaces, the time of concentration from the pre-development flow paths was maintained.
- (iii) Due to the sites flat grades, a small portion of the catchment bypassed the proposed basin.

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

Catchment	Parameter	
Post Development	Sub-Catchment Area	12,885 m ²
	Percentage Impervious	23.48 %
	Flowpath Length	193 m
	Flowpath Slope	1.20 %
	Retardance Coefficient 'n'	0.075
Bypass	Sub-Catchment Area	499.3 m ²
	Percentage Impervious	100 %
	Flowpath Length	32 m
	Flowpath Slope	0.625 %
	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	382.30m AHD
Basin – Top of Bank	382.65m AHD
Weir Width	4m
Weir Level	382.53m AHD
Basin Volume	187.00m ³
Outlet Pipe (@ base)	150mm diam

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 - Bypass	Post-Dev. Peak Flow - Basin	Post-Dev. Peak Flow - Total	Difference	Top Water Level
1EY	0.031 m ³ /s	0.011 m ³ /s	0.019 m ³ /s	0.030 m ³ /s	- 0.001 m ³ /s	382.52m AHD
10% AEP	0.139 m ³ /s	0.021 m ³ /s	0.116 m ³ /s	0.137 m ³ /s	- 0.002 m ³ /s	382.59m AHD
1% AEP	0.331 m ³ /s	0.033 m ³ /s	0.292 m ³ /s	0.325 m ³ /s	- 0.006 m ³ /s	382.65m AHD

Table 9 – Post-Development Peak Flow

4.3.3. Conclusion

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

5. Conclusion

The stormwater drainage strategy for the proposed Manilla Solar Farm at 4133 Manilla Road, Manilla 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 grass-lined swales to the proposed above ground onsite stormwater detention basin.
- (iii) Discharge from the above ground onsite stormwater detention basing will be limited to the pre-development flow rates.

Provided the above stormwater drainage philosophy is adopted for the site, the proposed Manilla 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



ECOLOGICAL ASSESSMENT REPORT

FOR

PROPOSED SOLAR FARM

AT

4133 MANILLA ROAD, MANILLA, NSW

Prepared for: Providence Asset Group
c/- KDC

March 2020

AEP Ref: 2026

EXECUTIVE SUMMARY

The proposed development is for the establishment of a Solar Photovoltaic (PV) Power Generating Plant including inverter station located at 4133 Manilla Road, Manilla NSW. Additional infrastructures include the construction of a gravel access road and improved access from Manilla Road, a construction laydown area, a detention basin to manage stormwater runoff as well as a 2.3m high perimeter fence.

At the request of KDC on behalf of Providence Asset Group (the client), Anderson Environment & Planning (AEP) have undertaken necessary investigations to inform the production of a 5-part test assessment report addressing the proposed development.

The subject site is approximately 15.7ha and is currently used for cattle grazing. The vegetation present onsite largely consists of degraded native grassland with very low floristic diversity and a high incidence of exotic species.

The proposed development will not require the entire removal of vegetation within the Subject Site. The proposal will result in the removal of approx. 0.52ha of native vegetation, the majority related to the establishment of auxiliary infrastructure such as access road, construction laydown area and stormwater detention basin. Vegetation located within the rows of solar panels will not be entirely removed as part of the proposed development. The construction of the solar panels will require some trenching for the installation of cables covering approximately 0.06ha.

This EAR reveals that the development is unlikely to have any significant impacts on any threatened species potentially occurring onsite. No threatened species were recorded during our surveys.

This assessment has been undertaken with reference to the *Environmental Planning and Assessment Act 1979* (EP&A Act) as well as the *NSW Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Assessment under the Biodiversity Offset Scheme determined no threshold is triggered and the '5-part test' determined that no significant impacts upon threatened entities listed under the NSW BC Act are likely to occur if mitigation measures are implemented. Consideration of the EPBC Act revealed that impacts on Matters of National Environmental Significance are unlikely to occur.

Assessment under the *Koala Habitat Protection SEPP 2019* revealed that the site does constitute 'Core Koala Habitat' as defined within the policy. No evidence of Koala activity was found, nor is the site known for Koala presence or breeding and as such does not constitute 'Core Koala Habitat' (CKH) as defined by the SEPP. As such, no further provision of the policy would apply to the site.

General recommendations are included for consideration to minimise localised impacts on biodiversity in general as a result of the proposed activity.

Contents

1.0	Introduction.....	1
2.0	Site Particulars	2
3.0	Proposed Development	4
4.0	Scope and Purpose.....	6
5.0	Study Certification and Licencing.....	7
6.0	Methods.....	8
6.1	Literature Review	8
6.2	Field Survey	9
7.0	Results.....	12
7.1	Database Searches.....	12
7.2	Flora	23
7.3	Vegetation Communities	23
7.4	Threatened Plants	26
7.5	Habitat Assessment	26
7.6	Fauna	26
8.0	Biodiversity Offsets Scheme Thresholds	28
9.0	5-Part Test Assessment	29
10.0	SEPP Koala Habitat Protection 2019 Assessment	32
11.0	EPBC Act Assessment	33
12.0	Recommendations	36
13.0	References.....	38

Tables

Table 1 – Field Survey Periods	11
Table 2 – Threatened Species Appraisal	18
Table 3 – BOS Clearing Trigger Thresholds	28

Figures

Figure 1 – Site Location	3
Figure 2 – Proposed Development	5
Figure 3 – Vegetation Map and Survey Efforts	25

Appendices

Appendix A – Flora Species List	
Appendix B – Expected Fauna Species List	
Appendix C – Author CVs	

1.0 Introduction

At the request of KDC on behalf of Providence Asset Group (the client), Anderson Environment & Planning (AEP) have undertaken necessary investigations to inform the production of a 5-part test assessment report addressing the proposed development.

The proposal is for the establishment of a Solar Photovoltaic (PV) Power Generating Plant, the construction of an access road as well as a detention basin located at 4133 Manilla Road, Manilla NSW. The solar farm will subsequently be connected to the *Essential Energy* grid in Manilla.

This report is specifically intended to indicate the likelihood of the proposed development having a significant impact on threatened species or ecological communities. In this regard, the report aims to recognise the relevant requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act), the *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Potential ecological impacts on native species in general are also considered, as are recommendations for minimising any impacts within the scope of the development.

2.0 Site Particulars

- **Address** – 4133 Manilla Road, Manilla, NSW.
- **LGA** – Tamworth Regional Council.
- **Title Details** – Lot A DP442930.
- **Subject Site** – Area directly impacted by the proposal totalling approx. 15.7ha. This encompasses land located within the proposed fenced area and include the easement where access from Manilla Road will be established
- **Study Area** – Subject site and surrounding habitat totalling approx. 30.4ha.
- **Zoning** – Under the *Tamworth Regional Local Environment Plan 2010*, the Study Area is zoned RU1 – Primary Production.
- **Current Land Use** – The allotment is currently used for cattle grazing but also possesses a dwelling and associated farm sheds as well as an orchard.
- **Surrounding Land Use** – The site is surrounded by pasture land.

Figure 1 depicts the extent of the Study Area overlain on an aerial photograph of the locality.

Disclaimer: While all reasonable care has been taken to ensure the information shown on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

Legend

 Cadastre
 Study Area



0 500 1000 1500 2000 m



Note:
1. Boundaries are not survey accurate
2. Do not scale off the plan



AEP

Figure 1 - Site Location

Date: Mar 2020

Location: Manilla Road, Manilla NSW

Client: Providence Asset Group

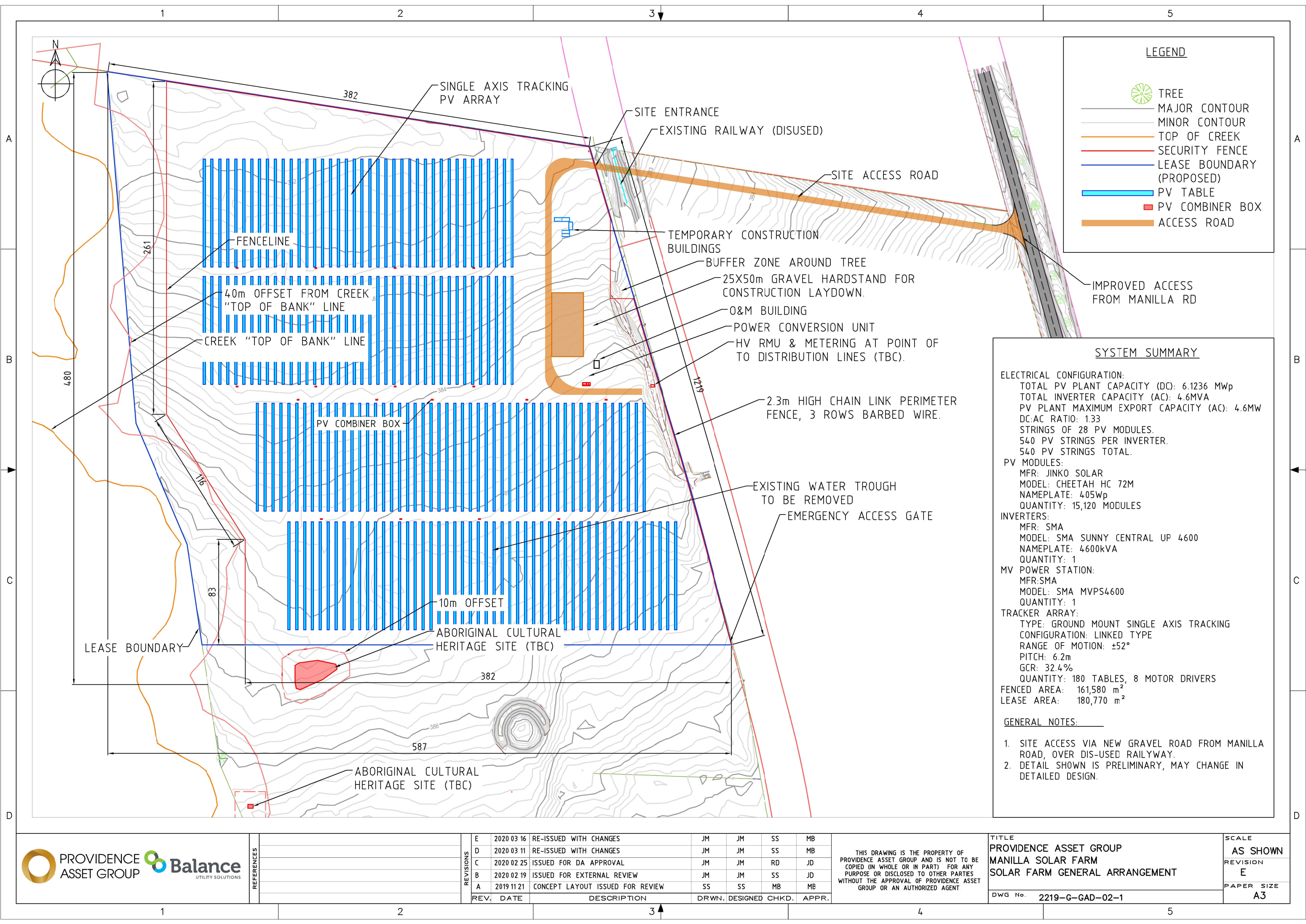
AEP ref: 2026

3.0 Proposed Development

The proposal is for the establishment of a Solar Photovoltaic (PV) Power Generating Plant including inverter station. Additional infrastructures include the construction of a gravel access road and improved access from Manilla Road, a construction laydown area, a detention basin to manage stormwater runoff as well as a 2.3m high perimeter fence. The solar panels will be installed via a driven steel H-beam without the requirement for pre-boring. Vegetation located within the rows of solar panels will only be partially impacted through trenching for the installation of cables and disturbance associated with the driving of the steel H-beams.

The proposed development will not require the entire removal of vegetation within the Subject Site. The proposal will result in the removal of approx. 0.52ha of native vegetation, the majority related to the establishment of auxiliary infrastructure. A breakdown of the proposed development footprint is as follow:

- Access road – 0.29ha;
- Stormwater detention basin - 0.0355ha;
- Construction laydown area - 0.13ha;
- Trenching - 0.06ha; and
- Steel H-beam – 0.0035ha.



LEGEND

TREE

MAJOR CONTOUR

MINOR CONTOUR

TOP OF CREEK

SECURITY FENCE

LEASE BOUNDARY (PROPOSED)

PV TABLE

PV COMBINER BOX

ACCESS ROAD

SYSTEM SUMMARY

ELECTRICAL CONFIGURATION:
TOTAL PV PLANT CAPACITY (DC): 6.1236 MWp
TOTAL INVERTER CAPACITY (AC): 4.6MVA
PV PLANT MAXIMUM EXPORT CAPACITY (AC): 4.6MW
DC:AC RATIO: 1.33
STRINGS OF 28 PV MODULES.
540 PV STRINGS PER INVERTER.
540 PV STRINGS TOTAL.

PV MODULES:
MFR: JINKO SOLAR
MODEL: CHEETAH HC 72M
NAMEPLATE: 405Wp
QUANTITY: 15,120 MODULES

INVERTERS:
MFR: SMA
MODEL: SMA SUNNY CENTRAL UP 4600
NAMEPLATE: 4600kVA
QUANTITY: 1

MV POWER STATION:
MFR:SMA
MODEL: SMA MVPS4600
QUANTITY: 1

TRACKER ARRAY:
TYPE: GROUND MOUNT SINGLE AXIS TRACKING
CONFIGURATION: LINKED TYPE
RANGE OF MOTION: ±52°
PITCH: 6.2m
GCR: 32.4%
QUANTITY: 180 TABLES, 8 MOTOR DRIVERS

FENCED AREA: 161,580 m²
LEASE AREA: 180,770 m²

GENERAL NOTES:

1. SITE ACCESS VIA NEW GRAVEL ROAD FROM MANILLA ROAD, OVER DIS-USED RAILWAY.
2. DETAIL SHOWN IS PRELIMINARY, MAY CHANGE IN DETAILED DESIGN.

REV. DATE		DESCRIPTION	DRWN.	DESIGNED	CHKD.	APPR.

REVISIONS	E	2020 03 16	RE-ISSUED WITH CHANGES	JM	JM	SS	MB
	D	2020 03 11	RE-ISSUED WITH CHANGES	JM	JM	SS	MB
	C	2020 02 25	ISSUED FOR DA APPROVAL	JM	JM	RD	JD
	B	2020 02 19	ISSUED FOR EXTERNAL REVIEW	JM	JM	SS	JD
	A	2019 11 21	CONCEPT LAYOUT ISSUED FOR REVIEW	SS	SS	MB	MB
REV.		DATE	DESCRIPTION	DRWN.	DESIGNED	CHKD.	APPR.

THIS DRAWING IS THE PROPERTY OF PROVIDENCE ASSET GROUP AND IS NOT TO BE COPIED (IN WHOLE OR IN PART) FOR ANY PURPOSE OR DISCLOSED TO OTHER PARTIES WITHOUT THE APPROVAL OF PROVIDENCE ASSET GROUP OR AN AUTHORIZED AGENT

TITLE		SCALE
PROVIDENCE ASSET GROUP MANILLA SOLAR FARM SOLAR FARM GENERAL ARRANGEMENT		AS SHOWN
DWG No. 2219-G-GAD-02-1		REVISION E
		PAPER SIZE A3

SCALE	
AS SHOWN	
REVISION E	
PAPER SIZE A3	

4.0 Scope and Purpose

Investigations were carried out on site and via literature / database searches to gather information required to adequately address Section 5A of the EP&A Act (known as the “5 Part Test”).

Also afforded consideration were the Commonwealth EPBC Act 1999, State BC Act 2016, relevant State Environmental Planning Policies (SEPPs) and the Local Land Services Act 2013.

The assessment approach was tailored to undertake sufficient works to ensure that legislative requirements were met relating to threatened species and native species in general for the proposed specific development. This has been achieved via background research and literature review, database searches, consultation, targeted ecological fieldwork and mapping, detailed habitat assessment, and ultimately impact assessment consideration against the type and form of development proposed.

Impact assessment was undertaken with due reference to the DECC *Threatened Species Assessment Guidelines* (2007).

Specifically, the scope of this study is to:

- Identify vascular plant species occurring within the site, including any threatened species listed under the BC Act or EPBC Act;
- Identify and map the extent of vegetation communities within the site, including any Threatened Ecological Communities (TECs) listed under the BC Act or EPBC Act;
- Identify any fauna species, including threatened and migratory species, and populations or their habitats, which occur within the site and are known to occur in the wider locality;
- Assess the potential of the proposed development to have a significant impact on any threatened species, populations or ecological communities (or their habitats) identified from the site; and
- Describe measures to be implemented to avoid, minimise, manage or monitor potential impacts of the proposal.

In addition to the survey work conducted within the site boundary and its immediate surrounds, consideration has been afforded to the wider locality, via database searches within 10km of the site and via appreciation of habitat areas that may be linked ecologically to the site.

5.0 Study Certification and Licencing

This report was written by Yann Buissiere BEnvMgt, and reviewed by Ian Benson BEng (Civil) & GradDipSc (Ecology) (BAAS: 18147)

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence SL101313;
- Animal Research Authority (Trim File No: 14/600(2)) issued by NSW Agriculture; and
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 14/600(2)) issued by NSW Agriculture.

Certification:

As the principal author, I, Ian Benson, make the following certification:

- The results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the Survey Area;
- Commonwealth, state and local government policies and guidelines formed the basis of project surveying methodology, unless specified departures from industry standard guidelines are justified for scientific and/or animal ethics reasons; and
- All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the *Animal Research Act 1995*, *National Parks and Wildlife Act 1974* and the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.

Principal Author and Certifier:



Ian Benson

Principal Ecologist

Anderson Environment & Planning

25 March 2020

6.0 Methods

The field surveys for the site have been prepared and performed with due recognition of the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft (DEC 2004), and also more contemporary standards relating to Amphibians (DECC 2009) and Threatened Plants (OEH 2016).

The size of the site, the type of native vegetation and habitats remaining, the status of existing and proposed surrounding land use, and the level and type of habitat linkages to other proximate bushland areas were considered in formulating the methodology employed and described below.

The assessment approach was tailored to undertake sufficient works to ensure that legislative requirements were met relating to threatened species and native species in general for the proposed specific development.

To ensure a robust impact assessment approach, where any potential doubt remained over species impact, presence within the study area was assumed to ensure a conservative approach was employed.

6.1 Literature Review

Main information sources reviewed included:

- Aerial Photograph Interpretation (API) of the site and surrounding locality;
- Review of regional mapping for the site prepared as part of the *Border Rivers Gwydir / Namoi Regional Native Vegetation Mapping*, NSW Office of Environment and Heritage (2015);
- Department of Environment and Climate Change (2007). *Threatened Species Assessment Guidelines – The assessment of significance*. DECC, Sydney, August 2007
- *NSW Guide to Surveying Threatened Plants*, NSW Office of Environment and Heritage (2016);
- OEH Threatened Species, Populations and Ecological Communities website (<https://www.environment.nsw.gov.au/threatenedSpeciesApp/>) and
- Collective knowledge gained from previous ecological survey and assessment in the area over the past 20 years.

In addition, database searches were carried out, namely:

- Review of flora and fauna records held by the NSW Office of Environment & Heritage (OEH) Atlas of NSW Wildlife within a 10km radius of the site (accessed November 2019); and

- Review of flora and fauna records held by the Commonwealth Department of Energy and Environment (DoEE) Protected Matters Search within a 5km radius of the site (accessed November 2019).

6.2 Field Survey

6.2.1 Vegetation Communities

Vegetation was surveyed utilising a variety of methods, as outlined below.

- Review of regional mapping for the site prepared as part of the *Border Rivers Gwydir / Namoi Regional Native Vegetation Mapping*, NSW Office of Environment and Heritage (2015);
- Aerial Photo interpretation (API) to identify any notable variations within the site;
- Consultation of 1:25,000 topographic map series for the area;
- Study area inspection to ground truth the unit(s) identified by API; and
- Confirmation of the vegetation map unit occurred via identification of dominant species in community structural layers.

Due to a lack of shrub and over-storey layer, the final derived vegetation map is based on dominant species present in the ground layers. Dominant species composition, structural and physical attributes were all considered when assigning the vegetation community that corresponded best to the vegetation present within the Subject Site.

Consideration was given to potential for the derived vegetation communities to constitute Endangered Ecological Communities (EECs) as listed under the BC Act and/or EPBC Act. Floristic composition, geomorphological characteristics and geographical extent were important considerations in this process.

6.2.2 Flora

A general flora survey was undertaken to produce a flora species list for the Study Area, to search specifically for threatened flora species known from the wider area, and to gather data necessary to both derive vegetation community type(s) and to meet relevant survey guidelines. Such works included:

- Identification of all vascular plant species encountered during fieldwork. Study area coverage was systematic to ensure all key points of the study area were checked, and the Random Meander Technique (Cropper 1993) was also utilised to maximise species encountered. A full list of all flora species recorded during fieldwork is included as **Appendix A**.

In addition, four (4) plots were undertaken using the Biodiversity Assessment Method (BAM) to aid the determination of a vegetation community and to provide baseline data in case the proposed development reached the clearing threshold. BAM plot floristic results are provided in **Appendix A**.

6.2.3 Habitat

An assessment of relative habitat values present within the study area was carried out. This assessment focused primarily on the identification of specific habitat types and resources within the study area favoured by known threatened species from the region. The assessment also considered the potential value of the study area (and surrounding areas) for all major guilds of native flora and fauna.

The assessment was based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

In particular, focus was put on documenting the presence of key habitat features such as tree hollows. Hollows are an important resource utilised by a variety of forest fauna, and are particularly relevant for several of the likely key threatened species in this locality. Vertebrate and invertebrate species use hollows as diurnal or nocturnal shelter sites, for rearing young, feeding, thermoregulation, and to facilitate ranging behaviour and dispersal.

Tree hollows were recorded and mapped within the study area utilising the method of tree hollow identification set by the BioBanking field plot methodology (OEH, Feb 2009), namely:

“A hollow is only recorded if: (a) the entrance can be seen; (b) the minimum entrance width is at least 5 cm across; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); and (d) the hollow is at least 1 m above the ground (this omits hollows in cut stumps or at the base of trees)”.

6.2.4 Fauna

Fauna survey has been carried out utilising techniques as outlined below. Fauna survey work was undertaken with reference to relevant guidelines and to add additional information to the generated Expected Fauna Species List (**Appendix B**).

6.2.4.1 Avifauna Surveys

The presence of avifauna within the site was carried out via incidental diurnal observations during all other phases of fieldwork. Birds were identified by direct observation or by recognition of calls or distinctive features such as nests, feathers, etc. In addition, two bird surveys were undertaken at dusk and dawn for a total of 30min each by one (1) ecologist totalling one-person hour.

6.2.4.1 Herpetofauna Surveys

Specific herpetofauna (frog and reptile) searches were carried out following a rainfall event by one (1) ecologist in areas of appropriate habitat. Such habitat included areas of thicker vegetation, in ground litter, near and under fallen timber, around piles of refuse, and wet / damp areas within the creekline directly west of the Subject Site.

Physical frog searches were augmented by call recognition. Any calls unable to be clarified in the field were recorded for later comparison with commercially available recordings. Opportunistic encounters during all other phases of fieldwork were also noted.

6.2.4.1 Spotlighting

Spotlighting was undertaken by one ecologist over one night via the use of a 100-Watt hand-held spotlight. In total approx. 2 hours of spotlighting was conducted on the site. Given the habitat present within the Study Area, and the highly degraded nature of the vegetation present, it is considered that a comprehensive survey was achieved, with all areas covered on foot.

6.2.4.2 Incidental Observations & Secondary Indications

Incidental records of any fauna species observed during fieldwork were noted. This included opportunistic sightings of secondary indications (scratches, scats, diggings, tracks, etc.) of any resident or migratory species. Searches were also conducted for whitewash, regurgitation pellets and prey remains from owls, chewed fruit remains from frugivorous birds, etc.

6.2.5 Survey Dates, Times & Activity

Table 1 – Field Survey Periods

Date	Time	Field Activity	No. of Persons on Site
26/11/2019	11:30 – 15:30	Flora survey, habitat assessment incidentals	1
	19:00 – 22:00	Bird survey, Stagwatch, spotlighting, amphibian search	
27/11/2019	8:00 – 11.30	Bird survey, 4 BAM plots	1

The above survey methodology is considered to provide sufficient understanding of the biodiversity of the site and wider study area given the highly disturbed nature of the subject site and the lack vegetation assemblages therein.

In addition, by applying rigorous habitat assessment to more mobile species within OEH Atlas records within the locality, it was ensured that all possible use of the site and wider study area by notable species was considered, and hence accommodated within subsequent biodiversity assessment and management recommendations.

7.0 Results

7.1 Database Searches

Searches were undertaken of databases within a 10km radius of the site as per OEH (BC Act listings) & DoEE (EPBC Act listings) (**Table 2**). Note that any records considered erroneous, historic only, or obviously of no relevance to the site in regards to habitat (e.g. seabirds, marine species etc.) have been omitted.

The potential for the listed threatened species to occur within the site is considered below. Detailed ecological profile descriptions of species can be found at:

<https://www.environment.nsw.gov.au/threatenedSpeciesApp/>

Table 2 – Threatened Species Appraisal

Scientific Name (records within 10km)	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
Threatened Ecological Communities				
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland		CE	CE	Not present within the Subject Site
New England Peppermint (<i>Eucalyptus nova-anglica</i>) Grassy Woodlands		CE	CE	Not present within the Subject Site
Weeping Myall Woodlands		E	E	Not present within the Subject Site
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland		E	CE	The vegetation present within the Subject Site is commensurate with the derived native grassland associated with this EEC. Under the EPBC Act, the derived Native Grassland is also listed. Subject Threatened Ecological Community
Flora				
<i>Cadellia pentastylis</i>	Ooline	V	V	There appears to be a strong correlation between the presence of Ooline and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sand. There are no records of the species in the locality. The species was not detected during field survey. The Subject Site lacks a shrub and canopy layer and habitat onsite is not suitable for the species. Therefore, the species is unlikely to occur onsite.
<i>Callistemon pungens</i>	-	-	V	Habitats range from riparian areas dominated by <i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> to woodland and rocky shrubland. There are no records of the species in the locality. The species was not detected during field survey and the Subject Site lacks suitable habitat for the species. Therefore, the species is unlikely to occur onsite.
<i>Commersonia procumbens</i>	-	V	V	Grows in sandy sites, often along roadsides. Recorded in <i>Eucalyptus dealbata</i> and <i>Eucalyptus sideroxylon</i> communities, <i>Melaleuca uncinata</i> scrub, under mallee eucalypts with a <i>Calytrix tetragona</i> understorey, and in a recently burnt Ironbark and Callitris area. Also, in <i>Eucalyptus fibrosa</i> subsp. <i>nubila</i> , <i>Eucalyptus dealbata</i> , <i>Eucalyptus albens</i> and <i>Callitris glaucophylla</i> woodlands north of Dubbo. There are no records of the species in the locality. The species was not detected during field survey and the Subject Site lacks suitable habitat for the species. Therefore, the species is unlikely to occur onsite.
<i>Dichanthium setosum</i> (1)	Bluegrass	V	V	Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. Associated species include <i>E. albens</i> , <i>E. melanophloia</i> , <i>E. melliodora</i> , <i>E. viminalis</i> , <i>Myoporum debile</i> , <i>Aristida ramosa</i> , <i>Themeda</i>

Scientific Name (records within 10km)	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
				<i>triandra</i>, <i>Poa sieberiana</i>, <i>Bothriochloa ambigua</i>, <i>Medicago minima</i>, <i>Leptorhynchus squamatus</i>, <i>Lomandra aff. longifolia</i>, <i>Ajuga australis</i>, <i>Calotis hispidula</i> and <i>Austrodanthonia</i>, <i>Dichopogon</i>, <i>Brachyscome</i>, <i>Vittadinia</i>, <i>Wahlenbergia</i> and <i>Psoralea</i> species. The species was not detected during field surveys. There is one record 4km south of the Subject Site. Due to high level of disturbance including ongoing grazing, habitat onsite is considered marginal for the species. Additionally, the species was not detected during field surveys and it is unlikely to occur within the Subject Site.
<i>Digitaria porrecta</i> (4)	Finger Panic Grass	E	-	The most frequently recorded associated tree species are <i>Eucalyptus albens</i> and <i>Acacia pendula</i>. Common associated grasses and forbs in NSW sites include <i>Austrostipa aristiglumis</i>, <i>Enteropogon acicularis</i>, <i>Cyperus bifax</i>, <i>Hibiscus trionum</i> and <i>Neptunia gracilis</i>. There are four records 4km south of the Subject Site. Due to high level of disturbance including ongoing grazing, habitat onsite is considered marginal for the species. Additionally, the species was not detected during field surveys and it is unlikely to occur within the Subject Site.
<i>Euphrasia arguta</i>	-	CE	CE	Historic records of the species noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers. There are no records of the species in the locality. The species was not detected during field survey and the Subject Site lacks suitable habitat. Therefore, the species is unlikely to occur onsite.
<i>Homopholis belsonii</i>	Belson's Panic	E	V	Grows in dry woodland (e.g. Belah) often on poor soils, although sometimes found in basalt-enriched sites north of Warialda and in alluvial clay soils. Due to high level of disturbance, habitat onsite is considered marginal for the species. Additionally, there are no record of the species within the locality and it is unlikely to occur within the Subject Site.
<i>Prasophyllum</i> sp. <i>Wybong</i>	Leek-orchid	-	CE	Known to occur in open eucalypt woodland and grassland. Due to high level of disturbance, habitat onsite is considered marginal for the species. Additionally, there are no record of the species within the locality and it is unlikely to occur within the Subject Site.
<i>Thesium australe</i>	Austral Toadflax	V	V	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Due to high level of disturbance, habitat onsite is considered marginal for the species. Additionally, there are no record of the species within the locality and it is unlikely to occur within the Subject Site.
<i>Tylophora linearis</i>	-	V	E	Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of <i>Eucalyptus fibrosa</i>, <i>E. sideroxylon</i>, <i>E. albens</i>, <i>Callitris endlicheri</i>, <i>Callitris glaucophylla</i> and <i>Allocasuarina luehmannii</i>. There are no records of the species in the locality. The species was not detected during field survey and the Subject Site lacks suitable habitat. Therefore, the species is unlikely to occur onsite.

Scientific Name (records within 10km)	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
Birds				
<i>Anthochaera phrygia</i>	Regent Honeyeater			The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. There are no records of the species within the locality. The Subject Site does not provide suitable habitat and the species is unlikely to occur.
<i>Circus assimilis</i> (1)	Spotted Harrier	V	-	Occurs in grassy open woodland including <i>Acacia</i> and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. There is one record of the species within the locality. The species or stick nests were not detected during surveys; however, the Subject Site provides potential foraging habitat for the Spotted Harrier. SUBJECT SPECIES
<i>Erythrotriorchis radiatus</i>	Red Goshawk	CE	V	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, <i>Melaleuca</i> swamp forest and riparian <i>Eucalyptus</i> forest of coastal rivers. There are no records of the species within the locality. The Subject Site does not provide suitable habitat and the species is unlikely to occur.
<i>Grantiella picta</i>	Painted Honeyeater	V	V	Inhabits Boree/ Weeping Myall (<i>Acacia pendula</i>), Brigalow (<i>A. harpophylla</i>) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i>. There are no records of the species within the locality. The Subject Site does not provide suitable habitat and the species is unlikely to occur.
<i>Hieraaetus morphnoides</i> (2)	Little Eagle	V	-	Occupies open eucalypt forest, woodland or open woodland, Sheoak or <i>Acacia</i> woodlands and riparian woodlands. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. There are 2 records of the species within the locality. The species or stick nests were not detected during field surveys. The Subject Site does not provide nesting habitat; however, potential suitable foraging habitat is available onsite and the species can potentially utilize the Subject Site as part of a wider foraging range. SUBJECT SPECIES
<i>Glossopsitta pusilla</i> (1)	Little Lorikeet	V	-	Forages primarily in the canopy of open <i>Eucalyptus</i> forest and woodland, yet also finds food in <i>Angophora</i>, <i>Melaleuca</i> and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.

Scientific Name (records within 10km)	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
				There is only one record of the species within the locality. The Subject Site lacks trees and foraging habitat is not available; Therefore, the species is unlikely to occur onsite.
<i>Stagonopleura guttata</i> (1)	Diamond Firetail	V	-	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. There is one record of the species within the locality. The Subject Site may provide suitable foraging habitat and the species is likely to occur. SUBJECT SPECIES
<i>Lathamus discolour</i>	Swift Parrot	E	CE	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany Eucalyptus robusta, Spotted Gum Corymbia maculata, Red Bloodwood C. gummiifera, Forest Red Gum E. tereticornis, Mugga Ironbark E. sideroxylon, and White Box E. albens. There are no records of the species within the locality. The Subject Site does not provide suitable habitat and the species is unlikely to occur.
<i>Artamus cyanopterus cyanopterus</i> (2)	Dusky Woodswallow	V	-	Species was not found onsite during fieldwork. The site does not include suitable habitat for the species to forage or nest. The species is highly unlikely to occur on site. In addition to that, the proposal does not include the clearing of vegetation or habitat. There are two records of the species within the locality. The species was not detected during field surveys. Habitat onsite is considered marginal and the species is unlikely to occur.
Mammals				
<i>Phascolarctos cinereus</i>	Koala	V	V	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. The Subject Site is devoid of trees. Scattered eucalypt trees occur in the surrounding areas; however, most of the locality is made of grazing land and there are no records of the species. The Subject Site does not provide suitable habitat and the species is unlikely to occur onsite.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (Petrochelidon ariel), frequenting low to mid-elevation dry open forest and woodland close to these features. Found in well-timbered areas containing gullies. There are no records of the species within the locality. The Subject Site does not provide suitable habitat and the species is unlikely to occur.

Scientific Name (records within 10km)	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
<i>Dasyurus maculatus</i> (1)	Spotted-tailed Quoll	V	E	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. There is only one record of the species within the locality. The Subject Site only provides marginal foraging habitat and the species is unlikely to occur.
<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat,	V	V	Inhabits a variety of vegetation types, including mallee, bull oak <i>Allocasuarina luehmannii</i> and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark. There are no records of the species within the locality. The Subject Site does not provide suitable habitat and the species is unlikely to occur. In addition, the only dead hollow-bearing tree was stagwatched but failed to detect the species.
<i>Petaurus norfolcensis</i> (3)	Squirrel Glider	V	-	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. There are three records of the species within the locality. However, the Subject Site does not provide suitable habitat and the species is unlikely to occur.
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. There are no records of the species within the locality. The Subject Site does not provide suitable habitat for the species and it is unlikely to occur onsite.
<i>Pteropus poliocephalus</i> (1)	Grey-headed Flying-fox	V	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. There is only one record of the species within the locality. The Subject Site does not provide suitable habitat for the species and it was not detected during fieldwork. Therefore, the species is unlikely to occur onsite.
Reptiles				
<i>Aprasia parapulchella</i>	Pink-tailed Legless Lizard	V	V	Inhabits sloping, open woodland areas with predominantly native grassy ground layers, particularly those dominated by Kangaroo Grass (<i>Themeda australis</i>). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. There are no records of the species within the locality. The Subject Site does not provide suitable habitat and the species is highly unlikely to occur on site.
<i>Uvidicolus sphyrurus</i>	Border Thick-tailed Gecko	V	V	Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understorey. There are no records of the species within the locality. The Subject Site does not provide suitable habitat and the species is highly unlikely to occur on site.

Table Key - Status (BC Act & EPBC Act): CE: Critically Endangered; E: Endangered; V: Vulnerable (#): Denotes the number of Atlas records with a 10km radius of the subject site

From the above, three (3) species have been identified as being likely to utilize the Subject Site as part of their local home range and be potentially affected by the proposed development.

- *Circus assimilis* (Spotted Harrier);
- *Hieraetus morphnoides* (Little Eagle); and
- *Stagonopleura guttata* (Diamond Firetail).

A 5-Part Test has been prepared for the above-mentioned species.

7.2 Flora

Flora surveys have resulted in the identification of 43 species of vascular plant within the Study Area including 15 exotic species. All tree species and most shrubs species were found within the riparian corridor outside of the development footprint. The vegetation within the Subject Site was generally less diverse and presented a higher level of weed cover with only 17 native species present.

The vegetation present within the Subject Site is dominated by two species of native grasses: *Aristida ramosa* (Purple Wiregrass) and *Austrostipa* sp. (the species could not be identified due to a lack of reproductive material). Other native species present include the shrubs *Atriplex semibaccata* (Creeping Saltbush) and *Maireana microphylla* (Bluebush) and the forbs *Zaleya galericulata* (Hogweed), *Wahlenbergia communis* (Tufted Bluebell) and *Einadia hastata* (Saltbush).

Exotic species present include several species listed as “Priority weeds for the North West” under the *Biosecurity Act 2015*. These are

- *Senecio madagascariensis* (Fireweed)
- *Opuntia* spp. (Prickly Pears)
- *Lycium ferocissimum* (African Boxthorn)

A complete list of species found on site is presented in **Appendix A**.

The proposed development has the potential to exacerbate the spread of exotic weeds onsite through clearing and soil disturbance. This issue can reduce the integrity of the retained vegetation as well as within the surrounding areas. As such, recommendations are outlined in **Section 12** to address this issue.

7.3 Vegetation Communities

Fieldwork was conducted to ground-truth regional vegetation mapping. The Border Rivers Gwydir / Namoi Regional Native Vegetation Mapping (2015) conducted by the NSW Office of Environment and Heritage identifies the vegetation present within the Subject Site as non-native. In addition, the riparian vegetation directly west is mapped as Blakely's Red Gum - Yellow Box

grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion.

Fieldwork revealed that the vegetation present within the Subject Site consists of a highly degraded grassland, probably derived from the vegetation community present in surrounding areas including Blakely's Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion. Approx. 28.4ha of this native grassland is present within the Study Area.

In addition, approx. 2ha of Blakely's Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion is present within the Study Area, mostly located within the riparian corridor. While this community is listed Endangered under the BC Act and Critically Endangered under the EPBC Act, none of it is present within the development footprint. However, indirect impacts have been considered as part of this assessment.

Due to the ongoing drought, vegetation cover was sparse at the time of the survey and it was noted that grasses were being heavily grazed. In addition, the degraded grassland occurs within the Subject Site in a highly disturbed state with a high incidence of exotic species and poor floristic diversity. A vegetation map for the site is shown in **Figure 3**.



Plate 1 - Vegetation within the Subject Site

Disclaimer: While all reasonable care has been taken to ensure the information shown on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

Legend

-  Study Area
-  Subject Site
-  Hollow-bearing Tree
-  Flora Survey Track
-  Nocturnal Survey Track
-  BAM Plot

Vegetation Communities

-  Native Grassland - Degraded
-  Blakely's Red Gum - Yellow Box Grassy Tall Woodland



AEP

Figure 3 - Vegetation and Survey Effort

Date: Mar 2020

Location: Manilla Road, Manilla NSW

Client: Providence Asset Group

AEP ref: 2026

7.4 Threatened Plants

No flora species listed threatened under the BC Act or EPBC Act have been identified within the Subject Site.

7.5 Habitat Assessment

The Subject Site offers very limited habitat features for native fauna as outlined below.

- **Hollows** – One hollow-bearing dead stag was identified within the Subject Site containing five small (entrance 5-10cm wide) and four medium (entrance 10-20cm wide) but no fauna was identified as utilizing it during Stagwatch. An additional four hollow-bearing trees were identified within the wider Study Area. While no resident fauna was detected at the time of field surveys, it is possible that the hollows present will be in use during construction.
- Note that the hollow-bearing stag located within the development footprint is not proposed to be removed and a buffer zone will be established around it.
- **Trees** – The Subject site does not contain any trees. Within the wider Study Area, scattered trees are present, especially within the riparian corridor of Greenhatch Creek.
- **Shrubs and grasses** – The vegetation present within the Subject Site is comprised entirely of grassland and possesses only scattered shrubs. Due to the ongoing drought, grass cover is also sparse.
- **Watercourses** – There are no water courses and only one dam present within the Subject Site. However, due to ongoing drought, the dam was devoid of water at the time of field surveys. Greenhatch Creek is located directly west of the Subject Site.
- **Patch size / connectivity** – The Subject Site is entirely made of grassland vegetation and surrounding land use is grazing land. The riparian vegetation of Greenhatch Creek, directly west of the site may provide connectivity to larger tracts of bushland further south.

In summary, the study area provides very little suitable habitat for native fauna.

7.6 Fauna

Surveys to date have identified 15 fauna species within the Study Area including two (2) mammals, two (2) amphibians and 11 bird species. Of those 15 species, two (2) are not native: European Brown Hare (*Lepus capensis*) and Common Myna (*Acridotheres tristis*). None of the fauna species recorded are listed threatened under the State or Federal legislations.

An Expected Fauna Species List has been generated for the site and is included in **Appendix B**. All fauna species recorded during fieldwork are noted therein.



Plate 2 - Hollow-bearing dead stag located within the northern part of the Study Area

8.0 Biodiversity Offsets Scheme Thresholds

Under the BC Act and associated regulation, the Biodiversity Offset Scheme (BOS) will be triggered if the following occurs:

- Clearing of native vegetation exceeds thresholds set out in clause 7.2 of the BC Regulations;
- Clearing of native vegetation takes place on Biodiversity Values Mapped land where a subdivision is involved; or
- Clearing of native vegetation creates significant impacts as evaluated by the 5-part test.

Table 3 sets out the clearing thresholds.

Table 3 – BOS Clearing Trigger Thresholds

Minimum lot size of land	Area of clearing
Less than 1 hectare	0.25 hectare or more
Less than 40 hectares but not less than 1 hectare	0.5 hectare or more
Less than 1,000 hectares but not less than 40 hectares	1 hectare or more
1,000 hectares or more	2 hectares or more

Under the Tamworth Regional Local Environment Plan (LEP 2010), the minimum lot size for the subject land is 400ha. This equates to an area of 1ha or more that must be cleared to trigger the BOS. The proposed development will not trigger the BOS clearing threshold as approx. 0.52ha of native vegetation will be impacted by the proposal.

The Biodiversity Values Map (BV Map) identifies land with high biodiversity value, as defined by the BCR. The BV Map shows that the site is not mapped as containing BV Land. Greenhatch Creek directly west of the Subject Site is mapped as BV Land. The proposed development has been designed outside of the riparian corridor and this assessment takes into account potential indirect impact on Greenhatch Creek.

In addition, historical aerial imagery revealed that the land within the Subject Site has been cleared before 1990. As such, it is considered under Part 5A of the Local Land Services Act 2013 (LLS Act) as Category 1 Exempt Land and clearing of native vegetation can occur without needing approval.

9.0 5-Part Test Assessment

Section 7.3 of the BC Act, lists five factors that must be taken into account in determining the significance of potential impacts of proposed activities on threatened species, populations, ecological communities and/or their habitats as listed within the BC Act.

The 5-part test is used to determine whether there is likely to be a significant impact, and thus whether a Species Impact Statement (SIS) is required to accompany a development application.

For the purposes of the 5-part test assessment, the **Subject Site** is the area directly affected by the proposed development.

(a) *in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*

No threatened plants were recorded within the Subject Site, noting that some species have not been suitably surveyed to seasonal guidelines. However, it is clear that, due to the highly disturbed nature of the vegetation present, very limited potential occurs within the Subject Site. Impact would be to any resident fauna that may be present and are likely to be disturbed by the proposed development, mainly:

- *Circus assimilis* (Spotted Harrier);
- *Hieraaetus morphnoides* (Little Eagle); and
- *Stagonopleura guttata* (Diamond Firetail).

Birds of Prey (Spotted Harrier and Little Eagle)

Suitable foraging habitat is available within the Subject Site; however, these species are highly mobile and due to the proximity of equally if not more favourable habitat in the surrounding areas it is unlikely that there will be significant impacts to these species. Due to the sparse vegetation present as well as disturbed nature of the site, the Subject Site represent marginal habitat for these species. These species may utilise the site for foraging, although limited resources are available and no nesting sites are present. It is unlikely that any individual of these species will be impacted by the proposal and as such it is considered highly unlikely that the local occurrence of the species would be placed at risk of extinction from the proposed development.

Diamond Firetail

Suitable foraging habitat is available within the Subject Site; however, this species is fairly mobile and due to the proximity of equally, if not more favourable habitat in the surrounding areas it is unlikely that there will be significant impacts to this species. Due to the sparse vegetation present as well as disturbed nature of the site, the Subject Site represent marginal habitat for this species. The species may utilise the site for foraging, although limited resources are available and no nesting sites are present. It is unlikely that the local occurrence this species will be impacted by the proposal to the extent that it will be placed at risk of extinction should the development go ahead.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

The vegetation present onsite consists of disturbed grassland, probably derived from the vegetation community present in surrounding areas including Blakely's Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion. This degraded grassland occurs in a highly disturbed state with a high incidence of exotic species and poor floristic diversity. While the ecological community is listed endangered under the BC Act, the native grasslands derived from this community are not covered by the scientific determination.

(c) in relation to the habitat of a threatened species, population or ecological community:

- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

The proposed development involves the removal or modification of a small amount of native vegetation that is found within the Subject Site in a highly disturbed state with a high incidence of exotic species and poor floristic diversity. This vegetation offers marginal habitat resources for a small number of native species, including the threatened species listed above.

- (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The proposed development involves the removal or modification of a small amount of native vegetation that is found within the Subject Site in a highly disturbed state with a high incidence of exotic species and poor floristic diversity. The proposed development will contribute a negligible amount to habitat loss as a result of native vegetation clearing. No vegetation will be isolated as a result of works within the Subject Site and the proposal will not add to habitat fragmentation within the locality.

- (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The habitat present is not considered likely to be of significance for long term survival of the threatened species listed above.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

No Area of Outstanding Biodiversity Value would be affected by the proposal.

(e) whether the action proposed constitutes or is part of a key threatening process or is likely to increase the impact of a key threatening process

The proposed development has potential to contribute to the following KTPs:

Anthropogenic Climate Change

The amount of atmospheric carbon stored by grassland vegetation is negligible and therefore, the proposed development will not contribute to the processes causing Anthropogenic Climate Change. It is not considered the contribution to this KTP in this instance is of a notable magnitude. Furthermore, the proposed development will provide renewable energy directly reducing the impact of Anthropogenic Climate Change.

- *Infection of frogs by amphibian chytrid causing the disease chytridiomycosis*

There is potential for the proposal to inadvertently introduce chytrid into the site through contaminated machinery or equipment. It is recommended that appropriate hygiene controls are put in place for all construction related activity to limit such potential. Such controls should be detailed within a Construction Environmental Management Plan (CEMP).

*Infection of native plants by *Phytophthora cinnamomi**

There is potential for the proposal to inadvertently introduce *Phytophthora cinnamomi* into the site through contaminated machinery or equipment, which may lead to infection and degradation of adjacent vegetation areas. As such, it is recommended that appropriate hygiene controls are put in place for all work to limit such potential. Such controls should be detailed within a CEMP.

Invasion and spread of aggressive weed species (several listed).

Parts of the site already support numerous weed species including 'Priority Weeds for the north west. The proposed development has the potential to exacerbate the weed problem in the area through machinery or equipment during the construction phase. Weed propagules can attach to equipment and machinery and be spread around the site and adjacent areas. Appropriate controls should be put in place to limit the potential to exacerbate this KTP. Such controls should be detailed within a Weed Management Plan or Vegetation Management Plan (VMP).

Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae.

There is potential for the proposed development to contribute to this KTP during the construction phase as spores of the rust fungi can be carried by equipment and machinery. A CEMP should be prepared for the proposed works outlining appropriate hygiene protocols. If such controls are implemented, the risk for the proposed development to contribute to this KTP will be minimized.

10.0 SEPP Koala Habitat Protection 2019 Assessment

State Environmental Planning Policy (Koala Habitat Protection) 2019 came into force on the 1st of March 2020, and repeals the previous State Environmental Planning Policy No. 44 – Koala Habitat Protection. This Policy aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to support a permanent free-living population over their present range and reverse the current trend of koala population decline.

Tamworth Regional Council does possess a Koala Plan of Management, therefore, the Koala Habitat Protection SEPP applies to the Subject Site

Inquiry of the Koala Development Application Map revealed that while some vegetation surrounding the Subject Site is considered Koala Habitat, there is none within the development footprint.

Atlas search revealed that there are no records of Koalas within a 10km radius of the Subject Site. Vegetation survey has not identified the presence of any Schedule 2 listed species of Koala feed trees within the subject site and none will be affected by the proposed development as the totality of the vegetation that will be modified consists of grasses, forbs and small shrubs.

In addition, land use within the Subject Site and surrounding areas is farmland and not considered Core Koala Habitat. The riparian vegetation directly west of the Subject Site may provide foraging opportunities and for movement of Koalas within the locality; however, no direct or indirect impact should occur should the proposed development go ahead.

As a result, further assessment of under the SEPP Koala Habitat Protection is not required.

11.0 EPBC Act Assessment

A search was conducted in November 2019 of Matters of National Environmental Significance (MNES) as relevant to the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act). The following MNES are considered in this assessment.

World Heritage Properties:

The site is not a World Heritage area and is not in close proximity to any such area.

National Heritage Places:

The site is not a National Heritage Place and does not contain any matters of national heritage.

Wetlands of International Significance (declared Ramsar wetlands):

The site is not proximate to any wetlands of international significance.

Great Barrier Reef Marine Park:

The site is not part of, or within close proximity to, the Great Barrier Reef Marine Park.

Commonwealth Marine Areas:

The site is not part of, or within close proximity to, any Commonwealth Marine Area.

Threatened Ecological Communities:

The Protected Matters search identified the following Threatened Ecological Communities as potentially occurring within the Subject Site:

- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland;
- New England Peppermint (*Eucalyptus nova-anglica*) Grassy Woodlands;
- Weeping Myall Woodlands; and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

The vegetation onsite could potentially constitute a native grassland, probably derived from the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland vegetation community listed as Critically Endangered under the Act. However, this vegetation within the Subject Site is highly disturbed with a high incidence of exotic species and poor floristic diversity.

Under the Act, a significant impact is an action that is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- *reduce the extent of an ecological community*

The proposal will result in the removal of 0.52ha of highly disturbed vegetation. Given its poor condition and the small area to be impacted, this is not considered significant in relation to the extent of this vegetation community.

- *fragment or increase fragmentation of an ecological community,*

The proposal is located within wider area of farmland and will not result in further fragmentation of this ecological community.

- *adversely affect habitat critical to the survival of an ecological community*

Given its poor condition and small area to be impacted, the vegetation present within the Subject Site is not considered critical to the survival of this ecological community.

- *“modify or destroy” abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community’s survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns*

The proposed development will not modify or destroy abiotic factors within the Subject Site surrounding areas. Given the small amount of vegetation to be impacted, it is unlikely to result in major changes in hydrological patterns. In addition, exclusion of cattle should limit soil compaction and result in decreased nutrient loads onsite and within the adjacent creek.

- *cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species*

Vegetation cover and floristic diversity is low within the Subject Site and no substantial change in species composition is expected to occur as a result of the proposed development. The exclusion of cattle however, should benefit native plant cover and diversity through decreased nutrient loads and pressure from grazing to the extent that native species will be able to recover and spread within the Subject site.

- *cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – assisting invasive species, that are harmful to the listed ecological community, to become established, or – causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community*

The proposed development will not cause substantial reduction in the quality and integrity of the derived native grassland present onsite. The vegetation to be impacted is relatively small (0.52ha), lacks floristic diversity and is in general poor condition. The exclusion of cattle should decrease nutrient loads entering the site and local waterways. Exotic species are present within the Subject Site including several Priority Weeds for the north west. There is potential for the proposed development to exacerbate their spread. However, appropriate weed control should be put in place during and after construction to ensure these species do not colonize further areas. A Vegetation Management Plan (VMP) should be produced to address these issues. If such



controls are implemented, the risk that invasive species pose to the integrity of the vegetation present should be minimized.

- *interfere with the recovery of an ecological community.*

The proposed development will not interfere with recovery of the community present onsite. The exclusion of cattle and control of invasive weed species will benefit the native vegetation present and aid its recovery

Threatened Species:

No EPBC Act listed threatened species were recorded within the Subject Site.

Migratory Species:

A number of EPBC listed migratory species have some potential to visit the site on an irregular basis. However, it is not considered that the proposed development is likely to significantly affect the availability of potential habitat for such mobile species, or disrupt migratory patterns.

EPBC Act Assessment Conclusion:

Consideration of the EPBC Act revealed that impacts on Matters of National Environmental Significance are unlikely to occur. While 0.52ha of vegetation will be modified within the Subject Site, the Critically Endangered listed Grassland derived from the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland vegetation community should benefit from the proposed development.

12.0 Recommendations

General recommendations are made for consideration to mitigate potential impacts on local biodiversity as a result of the proposed development. The following mitigation measures are required to be incorporated into the Construction Environmental Management Plan (CEMP) and Vegetation Management Plan (VMP) for proposed works to minimise localised impacts on biodiversity:

Water quality and hydrology

- Erosion and sedimentation controls are to be put in place to limit offsite movement of soils into Greenhatch Creek;
- An Erosion and Sedimentation Control Plan (ESCP) should be prepared for the proposed development following guidelines from Landcom (2004);
- Best practice erosion and sedimentation controls should be put in place to limit offsite movement of materials into the surrounding areas; and
- Erosion and sedimentation controls should be checked daily and maintained in working order especially after rain events.

Protection of potentially occurring native fauna

- The removal of the hollow-bearing stag should be undertaken under the supervision of a qualified ecologist. While no resident fauna was detected during stagwatch, it is possible that some of the hollows present will be in use when construction start.
- While four hollow-bearing trees are present within the Study Area, the proponent should approach council to identify whether the removal of the hollow-bearing stag should be offset with the installation of nestboxes and discuss appropriate location within the adjacent riparian vegetation.
- Should unexpected fauna be encountered during clearing or construction work, a local wildlife rescue organisation should be contacted immediately.
- Any displaced native fauna should be relocated in vegetation adjacent to the site or within the locality; and
- Any injured fauna should be taken to a local veterinarian clinic.

Protection and management of retained vegetation

- A Weed Management Plan should be prepared for the clearing of the Subject Site addressing issues such as the potential for weed propagules to be carried within and outside of the site by workers and machinery;
- The vegetation to be retained should be fenced off and signs installed to notify workers of its sensitive nature; and

- Equipment should be cleaned thoroughly and disinfected before entering and exiting site to prevent weed and disease introduction such as *Phytophthora cinnamomi* (Root-rot fungus), Myrtle Rust and others.

Management of vegetation post-work

- The Weed Management Plan should be prepared to address the issue of exotic weeds present onsite; especially species listed as 'Priority Weeds for the North West' that have the potential to spread to surrounding areas as a result of the proposed development;
- Effective weed control should be used on site, ensuring that appropriate methods are used to eliminate and dispose of highly competitive weeds; and
- If manual or mechanical techniques for the removal of weeds is selected, all weed material and propagules should be taken offsite and disposed of appropriately in a waste treatment facility where composting is undertaken.

13.0 References

- Cropper, S (1993) *Management of Endangered Plants*. CSIRO Publishing, Collingwood, Victoria.
- DECC (2009) *Threatened species survey and assessment guidelines: field survey methods for fauna – amphibians*. Department of Environment and Climate April 2009
- Department of Environment and Climate Change (2007) *Threatened Species Assessment Guidelines – The assessment of significance*. DECC, Sydney, August 2007.
- Department of Environment and Conservation (2004) *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*. Working Draft. NSW Department of Environment and Conservation 2004.
- DoEE (2019) *Protected Matters Search*. Accessed November 2019. Department of Environment, Canberra, ACT.
- Harden, G. (ed) (2000) *Flora of New South Wales, Volume 1. Revised edition*. UNSW, Kensington, NSW.
- Harden, G. (ed) (2002) *Flora of New South Wales, Volume 2. Revised edition*. UNSW, Kensington, NSW.
- Harden, G. (ed) (1992) *Flora of New South Wales, Volume 3*. UNSW, Kensington, NSW.
- Harden, G. (ed) (1993) *Flora of New South Wales, Volume 4*. UNSW, Kensington, NSW.
- Landcom (2004). *Managing Urban Stormwater: Soils and Construction* 4th edition. New South Wales Government, Parramatta, NSW.
- OEH (2019) *Atlas of NSW Wildlife*. Accessed November 2019. NSW Office of Environment & Heritage.
- OEH (2015) *Border Rivers Gwydir / Namoi Regional Native Vegetation Mapping*, Version 1.5, NSW Office of Environment and Heritage (2015);
- OEH (2019) *Threatened Species, Populations and Ecological Communities website*. (<https://www.environment.nsw.gov.au/threatenedSpeciesApp/>).
- OEH (2016). *NSW Guide to Surveying Threatened Plants*. State of NSW and Office of Environment and Heritage, Sydney.
- Pizzey, G (2012) *The Field Guide to the Birds of Australia*. Ninth Edition, Harper Collins Publishers.



Robinson, L (2003) *Field Guide to the Native Plants of Sydney*. Revised Third Edition. Kangaroo Press.

Strahan, R (2004) *The Mammals of Australia*. New Holland Publishers.

Tyler, M.J., and Knight, F. (2011) *Field Guide to the Frogs of Australia*. Revised Edition. CSIRO Publishing.

Wilson, S. And Swan, G (2003) *A Complete Guide to Reptiles of Australia*. Reed New Holland Publishers.



Appendix A – Flora Species List

FLORA SPECIES LIST

The following list includes all species of vascular plants observed on site during fieldwork. It should be noted that such a list cannot be considered comprehensive, but rather indicative of the flora present on the site. It can take many years of flora surveys to record all of the plant species occurring within any area, especially plant species that are only apparent in some seasons such as Orchids.

A number of species cannot always be accurately identified during a brief survey, generally due to a lack of suitable flowering and/or fruiting material. Any such species are identified as accurately as possible, and are indicated in the list as thus:

- specimens that could only be identified to genus level are indicated by the generic name followed by the abbreviation “sp.”, indicating an unidentified species of that genus;
- specimens for which identification of the genus was uncertain are indicated by a question mark (“?”) placed in front of the generic, which is followed by the abbreviation “sp.” and;
- specimens that could be accurately identified to genus level, but could be identified to species level with only a degree of certainty are indicated by a (“?”) placed in front of the epithet.
- Numbers refer to estimated percentage foliage cover within the plots per the Biodiversity Assessment Method (BAM). Species without numbers have been recorded within the Study Area but are not present within the BAM Plots.

Authorities for the scientific names are not provided in the list. These follow the references outlined below.

Harden, G. (ed) (2000). *Flora of New South Wales, Volume 1*. Revised edition. UNSW, Kensington, NSW.

Harden, G. (ed) (2002). *Flora of New South Wales, Volume 2*. Revised edition. UNSW, Kensington, NSW.

Harden, G. (ed) (1992). *Flora of New South Wales, Volume 3*. UNSW, Kensington, NSW.

Harden, G. (ed) (1993). *Flora of New South Wales, Volume 4*. UNSW, Kensington, NSW.

Names of families and higher taxa follow a modified Cronquist System (1981).

Introduced species are indicated by an asterisk “*”.

Threatened species listed under the *Biodiversity Conservation Act 2016* (BC Act) or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are indicated in **bold font** and marked as:

(V) = Vulnerable Species listed under the BC Act 2016

(E) = Endangered Species listed under the BC Act 2016

(EV) = Vulnerable Species listed under the EPBC Act 1999

(EE) = Endangered Species listed under the EPBC Act 1999

Family	Scientific Name	Common Name	Plot 1	Plot 2	Plot 3	Plot 4
Aizoaceae	<i>Zaleya galericulata</i>	Hogweed	0.5	0.5	0.2	0.1
Anacardiaceae	<i>Schinus areira</i> *	Pepper Tree				
Asteraceae	<i>Carthamus lanatus</i> *	Saffron Thistle	0.1	0.1	0.1	
Asteraceae	<i>Centaurea solstitialis</i> *	St Barnaby's Thistle		0.1	0.1	
Asteraceae	<i>Senecio madagascariensis</i> *	Fireweed				
Asteraceae	<i>Vittadinia cuneata</i> var. <i>hirsuta</i>	-	0.1			
Boraginaceae	<i>Echium vulgare</i> *	Viper's Bugloss		0.1	0.1	
Brassicaceae	<i>Hirschfeldia incana</i> *	Hairy Brassica	0.1	0.1	0.1	0.1
Brassicaceae	<i>Lepidium africanum</i> *	Common Peppergrass	0.1	0.1	0.1	0.1
Cactaceae	<i>Opuntia aurantiaca</i> *	Tiger Pear				
Cactaceae	<i>Opuntia stricta</i> *	Prickly Pear				
Campanulaceae	<i>Wahlenbergia communis</i>	Tufted Bluebell	0.1			
Chenopodiaceae	<i>Atriplex semibaccata</i>	Creeping Saltbush				1
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	0.1	0.1		
Chenopodiaceae	<i>Einadia polygonoides</i>	-				0.2
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush	0.5	0.5		0.5
Convolvulaceae	<i>Polymeria longifolia</i>	-	0.1			0.1
Cupressaceae	<i>Callitris glaucophylla</i>	White Cypress Pine				
Cyperaceae	<i>Bolboschoenus medianus</i>	-				
Fabaceae	<i>Acacia decora</i>	Western Silver Wattle				
Fabaceae	<i>Acacia salicina</i>	Cooba				
Fabaceae	<i>Medicago</i> sp.*	A Medic		0.1	0.1	
Geraniaceae	<i>Pelargonium inodorum</i>	Wild Geranium		0.1	0.1	1
Lomandraceae	<i>Lomandra longifolia</i>	Spiky-headed Mat-rush				
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida	0.1		0.1	
Malvaceae	<i>Sida rhombifolia</i> *	Paddy's Lucerne	0.1	0.1	0.1	
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple				

Family	Scientific Name	Common Name	Plot 1	Plot 2	Plot 3	Plot 4
Myrtaceae	<i>Eucalyptus albens</i>	White Box				
Myrtaceae	<i>Eucalyptus conica</i>	Fuzzy Box				
Oleaceae	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	Velvet Mock Olive				
Oxalidaceae	<i>Oxalis perennans</i>	-		0.1		
Plantaginaceae	<i>Plantago lanceolata</i> *	Ribwort				
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	40	35	40	30
Poaceae	<i>Austrostipa</i> sp.?	A Speargrass				5
Poaceae	<i>Cynodon dactylon</i>	Common Couch	0.1	0.1	0.5	
Poaceae	<i>Poaceae</i> sp.?	-	0.2	0.5	0.1	0.2
Polygonaceae	<i>Rumex conglomeratus</i> *	Clustered Dock	0.1	0.1	0.1	
Primulaceae	<i>Lysimachia arvensis</i> *	Scarlet Pimpernel				
Pteridaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Poison Rock Fern	0.1			
Rosaceae	<i>Rubus parvifolius</i>	Native Raspberry				
Solanaceae	<i>Lycium ferocissimum</i> *	African Boxthorn				
Typhaceae	<i>Typha orientalis</i>	Cumbungi				
Verbenaceae	<i>Verbena gaudichaudii</i>	Verbena		0.1	0.1	



Appendix B – Expected Fauna Species List

EXPECTED FAUNA SPECIES LIST

The following list includes fauna species that could be reasonably expected to occur on the study site at some point, given site attributes and location.

“●” – species observed or indicated by scats, tracks etc. on, over or near the site during recent surveys by AEP (2019).

* - Introduced species

? - Unconfirmed record, anecdotal records, etc.

A – NSW Atlas of Wildlife record of threatened species for the site.

Threatened species listed under the *Biodiversity Conservation Act 2016* (BC Act) or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are indicated in **bold font**.

Family	Scientific Name	Common Name	Present onsite
Amphibians			
Myobatrachidae	<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog	
Myobatrachidae	<i>Limnodynastes fletcheri</i>	Long-thumbed Frog	•
Myobatrachidae	<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog	
Hylidae	<i>Litoria caerulea</i>	Green Tree Frog	
Hylidae	<i>Litoria peronii</i>	Peron's Tree Frog	•
Reptiles			
Gekkonidae	<i>Nebulifera robusta</i>	Robust Velvet Gecko	
Gekkonidae	<i>Underwoodisaurus milii</i>	Thick-tailed Gecko	
Pygopodidae	<i>Delma plebeia</i>	Leaden Delma	
Pygopodidae	<i>Delma tincta</i>	Excitable Delma	
Pygopodidae	<i>Lialis burtonis</i>	Burton's Snake-lizard	
Scincidae	<i>Anomalopus leuckartii</i>	Two-clawed Worm-skink	
Scincidae	<i>Carlia tetradactyla</i>	Southern Rainbow-skink	
Scincidae	<i>Cryptoblepharus virgatus</i>	Cream-striped Shinning-skink	
Scincidae	<i>Ctenotus robustus</i>	Robust Ctenotus	
Scincidae	<i>Egernia striolata</i>	Tree Skink	
Scincidae	<i>Lerista muelleri</i>	Wood Mulch-slider	
Scincidae	<i>Lygisaurus foliorum</i>	Tree-base Litter-skink	
Scincidae	<i>Morethia boulengeri</i>	South-eastern Morethia Skink	
Scincidae	<i>Tiliqua scincoides</i>	Eastern Blue-tongue	
Agamidae	<i>Pogona barbata</i>	Bearded Dragon	
Varanidae	<i>Varanus varius</i>	Lace Monitor	
Typhlopidae	<i>Anilius proximus</i>	Proximus Blind Snake	
Typhlopidae	<i>Anilius wiedii</i>	Brown-snouted Blind Snake	
Elapidae	<i>Brachyurophis australis</i>	Coral Snake	
Elapidae	<i>Demansia psammophis</i>	Yellow-faced Whip Snake	
Elapidae	<i>Furina diadema</i>	Red-naped Snake	
Elapidae	<i>Parasuta dwyeri</i>	Dwyer's Snake	
Elapidae	<i>Pseudonaja textilis</i>	Eastern Brown Snake	

Family	Scientific Name	Common Name	Present onsite
Elapidae	<i>Vermicella annulata</i>	Bandy-bandy	
Birds			
Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck	
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck	
Columbidae	<i>Geopelia striata</i>	Peaceful Dove	
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon	
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth	
Apodidae	<i>Hirundapus caudacutus</i>	White-throated Needletail	
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican	
Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle	
Accipitridae	<i>Circus assimilis</i>	Spotted Harrier	
Accipitridae	<i>Hieraaetus morphnoides</i>	Little Eagle	
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced heron	•
Falconidae	<i>Falco berigora</i>	Brown Falcon	
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel	
Charadriidae	<i>Vanellus miles</i>	Masked Lapwing	
Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	
Cacatuidae	<i>Eolophus roseicapillus</i>	Galah	•
Cacatuidae	<i>Nymphicus hollandicus</i>	Cockatiel	
Psittacidae	<i>Aprosmictus erythropterus</i>	Red-winged Parrot	
Psittacidae	<i>Glossopsitta concinna</i>	Musk Lorikeet	
Psittacidae	<i>Glossopsitta pusilla</i>	Little Lorikeet	
Psittacidae	<i>Platycercus eximius</i>	Eastern Rosella	•
Psittacidae	<i>Psephotus haematonotus</i>	Red-rumped Parrot	
Psittacidae	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	
Cuculidae	<i>Cacomantis pallidus</i>	Pallid Cuckoo	
Alcedinidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	
Alcedinidae	<i>Todiramphus sanctus</i>	Sacred Kingfisher	
Coraciidae	<i>Eurystomus orientalis</i>	Dollarbird	
Climacteridae	<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	

Family	Scientific Name	Common Name	Present onsite
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren	•
Acanthizidae	<i>Acanthiza reguloides</i>	Buff-rumped Thornbill	
Acanthizidae	<i>Gerygone olivacea</i>	White-throated Gerygone	
Acanthizidae	<i>Smicrornis brevirostris</i>	Weebill	
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote	
Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote	
Meliphagidae	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	
Meliphagidae	<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater	
Meliphagidae	<i>Manorina melanocephala</i>	Noisy Miner	•
Meliphagidae	<i>Philemon citreogularis</i>	Little Friarbird	
Meliphagidae	<i>Philemon corniculatus</i>	Noisy Friarbird	
Meliphagidae	<i>Ptilotula fuscus</i>	Fuscous Honeyeater	
Meliphagidae	<i>Ptilotula penicillatus</i>	White-plumed Honeyeater	
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	
Campephagidae	<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	
Campephagidae	<i>Lalage sueurii</i>	White-winged Triller	
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler	
Artamidae	<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	
Artamidae	<i>Cracticus nigrogularis</i>	Pied Butcherbird	•
Artamidae	<i>Cracticus tibicen</i>	Australian Magpie	•
Artamidae	<i>Cracticus torquatus</i>	Grey Butcherbird	
Artamidae	<i>Strepera graculina</i>	Pied Currawong	
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail	
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	•
Phasianidae	<i>Coturnix ypsilophora</i>	Brown Quail	•
Corvidae	<i>Corvus coronoides</i>	Australian Raven	
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark	
Monarchidae	<i>Myiagra inquieta</i>	Restless Flycatcher	
Megaluridae	<i>Cincloramphus mathewsi</i>	Rufous Songlark	

Family	Scientific Name	Common Name	Present onsite
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow	
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird	
Estrildidae	<i>Stagonopleura guttata</i>	Diamond Firetail	
Sturnidae	<i>Acridotheres tristis</i>	Common Myna	•
Threskiornithidae	<i>Threskiornis spinicollis</i>	Straw-necked ibis	•
Mammals			
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	
Leporidae	<i>Lepus europaeus*</i>	European Brown Hare	•
Dasyuridae	<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	
Petauridae	<i>Petaurus norfolcensis</i>	Squirrel Glider	
Acrobatidae	<i>Acrobates pygmaeus</i>	Feathertail Glider	
Phalangeridae	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	
Macropodidae	<i>Macropus giganteus</i>	Eastern Grey Kangaroo	•
Macropodidae	<i>Macropus robustus</i>	Common Wallaroo	
Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	
Vespertilionidae	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	
Muridae	<i>Mus musculus</i>	House Mouse	
Canidae	<i>Vulpes vulpes</i>	Fox	



Appendix C – Author CVs

Yann Buissiere

Curriculum Vitae

Yann works with AEP in the role of Ecologist. Over the past 10 years, he has developed extensive experience in restoration ecology and land management including flora and fauna pest management, fire hazard reduction and community engagement.

Qualifications

- Diploma of Conservation and Land Management, TAFE (2013)
- Bachelor of Resources and Environmental Management, Macquarie University (2008)

Further Education & Training (select summary)

- Advanced Plant Identification (University of New South Wales)
- NSW Class C Driver's Licence.
- Operate and Maintain a Four-Wheel Drive Vehicle and undertake Winch Recovery
- Work Health & Safety White Card
- First Aid Certificate
- Vertebrate Pest Control
- Local Control Authority Officer – Biosecurity Act 2015
- Working Safely at Heights

Fields of Special Competence

- Vegetation community and weed mapping.
- Ecological field surveys including habitat assessment, hollow bearing tree surveys, bird surveys and fauna trapping.
- Botanical surveys including vegetation monitoring, targeted threatened flora search and undertaking BAM plots.
- Bush regeneration and habitat restoration
- Planning and undertaking fire hazard reduction work
- Feral animal control

Relevant Employment History

2019 - Current	Ecologist (botanist) Anderson Environment & Planning, Newcastle
2018 - 2019	Ecologist (botanist) Kleinfelder, Newcastle
2015 - 2018	Bushland Team Coordinator Northern Beaches Council (formerly Manly Council)
2010 - 2015	Project Manager/Team Leader Australian Bushland Restoration, Sydney
2010 - 2013	Bushcare Supervisor Mosman Council
2008 - 2010	Bush regenerator Australian Bushland Restoration, Sydney

IAN BENSON

Curriculum Vitae

Ian works with AEP in the role of Principal Ecologist. He is an experienced field ecologist, bird watcher and a regular participant in wader surveys. Ian has previously had a successful career as a project manager with a local geotechnical engineering firm. His background in project management and soil sciences combined with his ecological knowledge is utilised in a diverse array of applications in his current role.

Qualifications

- Graduate Diploma in Science (Ecology) University of New England (2014)
- Bachelor Engineering (Civil) University of Newcastle (2008)

Further Education & Training (select summary)

- Biobank and Biocertification Assessors Training Course
- Advanced Plant Identification (University of New South Wales)
- NSW Class C Driver's Licence. Experienced 4WD operator
- Occupational Health & Safety Training
- Rail Industry Worker
- ARTC Safety Induction for Contractors (NSW)
- ARTC Hunter Bulk Terminal Induction

Fields of Special Competence

- Biobanking & Biodiversity Offset Commissions – initial scoping and feasibility, BAM impact assessments and BDAR reporting, biobank calculations, Stewardship site creation
- Detailed knowledge of environmental legislation and approval pathways
- Ecological field survey and habitat assessment covering terrestrial and aquatic flora and fauna. Experienced in camera trap methods particularly targeting cryptic and difficult to identify mammal species.
- Highly proficient at avifauna surveys, including challenging wetland and shorebird environs
- Project Management
- Soil science

Professional Affiliations / Memberships (past / present)

- Hunter Bird Observers Club (HBOC)
- Australasian Seabird Group
- Graduate Member of The Institution of Engineers Australia in the Civil College

Relevant Employment History

2019-Current Principal Ecologist
Anderson Environment & Planning, Newcastle

Currently employed by Anderson Environment & Planning in the role of Principal Ecologist overseeing a team of 15 professional ecology staff and all aspects of the business including training and management of field and office staff undertaking ecology and bushfire works to assist in the provision of consulting services to land, property, mining industry, legal and government sectors. Covering ecological, project management, environmental, planning services, advices, strategy and representation.

2018-2019 Senior Ecologist
Anderson Environment & Planning, Newcastle

2016-2018 Ecologist
Anderson Environment & Planning, Newcastle

2012-2016 Project Manager
Douglas Partners, Newcastle

As a project manager with Douglas Partners I was responsible for proposal and tender preparation, planning, implementation and reporting of geotechnical and geo-environmental investigations for a broad range of projects including site classification, foundations, pavements, bridges and slope stability. I was required to liaise with clients regarding project requirements, project goals and deadlines. I was responsible for the development and implementation of Work Health and Safety Plans as well as Environmental Plans and documentation. This included the development of safe work procedures, safety inspections on site and implementing improved safety procedures with staff. I was responsible for ensuring projects were completed on time and on budget whilst meeting the clients' expectations and achieving quality assurance standards.

2008-2012 Geotechnical Engineer
Douglas Partners, Newcastle

As a geotechnical engineer for Douglas Partners I was involved in the planning and implementation of geotechnical investigations for a wide range of development in the Hunter Valley area. I was primarily involved in site supervision of geotechnical investigations using drilling rigs for boreholes, truck mounted cone penetration testing and test pit excavations using excavators and backhoes. My role also included site inspections involving the assessment of conditions for piles, piers and shallow footings. I also undertook site walkovers for assessment of mine subsidence and slope stability.

2007-2008 Undergraduate Geotechnical Engineer
Douglas Partners, Newcastle

Whilst an undergraduate engineer with Douglas Partners I experienced a broad range of practice areas and developed a diverse range of engineering skills.

Relevant Ecological Experience

2013 - Current Bird Surveyor
Hunter Bird Observers Club

Volunteer survey work for Hunter Bird Observers Club for regular wader and water bird counts and Tomago and Kooragang Island.

2017 – Current Birddata Moderator
Birdlife Australia

Volunteer moderating and vetting bird surveys from *Birdata* which is the Birdlife Australia Atlas to ensure a robust database for both the Hunter Valley and Central Coast reporting areas totalling approximately 5000 surveys per year.



TRAFFIC IMPACT ASSESSMENT

**SOLAR PHOTOVOLTAIC (PV) POWER GENERATING FARM
& ASSOCIATED SUPPORTIVE INFRASTRUCTURE**

**LOT A IN DP 442930
4133 MANILLA ROAD, MANILLA**

PREPARED FOR: PROVIDENCE ASSET GROUP

MARCH 2020

19/161

**TRAFFIC IMPACT ASSESSMENT
PROVIDENCE ASSET GROUP****SOLAR PHOTVOLTAIC (PV) POWER FARM
LOT A IN DP 442930
4133 MANILLA ROAD MANILLA**

Intersect Traffic Pty Ltd (ABN: 43 112 606 952)

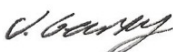
Address:16 Mount Harris Drive
Maitland Vale NSW 2320
PO Box 268
East Maitland NSW 2323**Contact:**(Mob) 0423 324 188
Email: jeff@intersecttraffic.com.au**QUALITY ASSURANCE**

This document has been prepared, checked and released in accordance with the Quality Control Standards established by Intersect Traffic Pty Ltd.

Issue	Date	Description	By
A	22/01/20	Draft	JG
B	07/02/20	Traffic Data / Edit	JG
C	03/03/20	Final Proof	JG
D	03/03/20	Approved	JG
E	19/03/20	Client Amendments / Approved	JG
F	27/03/20	Client Amendments / Approved	JG

Copyright © Intersect Traffic Pty Ltd

This document has been authorised by


Date 27th March 2020**Disclaimer**

This report has been prepared based on the information supplied by the client and investigation undertaken by Intersect Traffic Pty Ltd & other consultants. Recommendations are based on Intersect Traffic's professional judgement only and whilst every effort has been taken to provide accurate advice, Council and any other regulatory authorities may not concur with the recommendations expressed within this report. This document and the information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that for which it was supplied by Intersect Traffic Pty Ltd. Intersect Traffic makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information.

Confidentiality Statement

All information, concepts, ideas, strategies, commercial data and all other information whatsoever contained within this document as well as any and all ideas and concepts described during the presentation are provided on a commercial in confidence basis and remain the intellectual property and Copyright of Intersect Traffic Pty Ltd and affiliated entities.

CONTENTS

1.0 INTRODUCTION	1
2.0 SITE DESCRIPTION	2
3.0 EXISTING ROAD NETWORK	4
MANILLA ROAD	4
4.0 ALTERNATE TRANSPORT MODES	5
5.0 DEVELOPMENT PROPOSAL	6
6.0 TRAFFIC IMPACTS	6
6.1 – TRAFFIC GENERATION AND TRIP DISTRIBUTION	6
6.2 – ROAD CAPACITY	8
6.3 – INTERSECTION CAPACITY	9
6.4 ACCESS ASSESSMENT	9
7.0 ON-SITE CAR PARKING	10
8.0 ALTERNATE TRANSPORT MODES	10
9.0 CONCLUSIONS	11
10.0 RECOMMENDATION	11

ATTACHMENTS

ATTACHMENT A	DEVELOPMENT PLANS
ATTACHMENT B	TRAFFIC COUNT DATA

FIGURES

<i>Figure 1 – Site Location</i>	2
<i>Figure 2 – Tamworth Buslines – Route 443</i>	5

PHOTOGRAPHS

<i>Photograph 1 – Development site</i>	3
<i>Photograph 2 – Existing dwelling and main vehicular access – 4133 Manilla Road</i>	3
<i>Photograph 3 – Manilla Road near the site.</i>	4



1.0 INTRODUCTION

Intersect Traffic Pty Ltd (Intersect Traffic) has been engaged by KDC Pty Ltd on behalf of Providence Asset Group to prepare a traffic impact assessment report for a proposed Solar Photovoltaic (PV) Power Farm (up to 5MW) on Lot A DP 442930 – 4133 Manilla Road, Manilla.

The proposed development involves installation of solar panel banks, off-load area, inverter and AC combiner area, HV switchboard area, MV power station area, 22 KV powerline to Manilla sub-station, on-site car parking and temporary construction office. Vehicular access to the site will be via a new access road through an easement from the site to Manilla Road along the northern boundary of the site. The development concept plans are shown in **Attachment A**.

This report is required to support a development application to Tamworth Regional Council and allow the Council to assess the proposal in respect of its impact on the local and state road network.

This report presents the findings of the traffic and parking assessment and includes the following:

1. An outline of the existing situation near the site.
2. Assessment of the additional traffic generated by the proposal and its impact on the local road network.
3. Review of the adequacy of the proposed vehicular access to the site.
4. Review of the suitability and provision of on-site car parking through assessment against Council and Australian Standards requirements.
5. Presentation of conclusions and recommendations.

2.0 SITE DESCRIPTION

The subject site is shown in **Figure 1** below. It is located on the western side of Manilla Road, Manilla approximately 600 metres north of Melrose Lane and approximately 3.6 kilometres south-east of Manilla. The site currently contains agricultural paddocks and a dwelling that is not within the development area.

The property has the formal title of Lot A in DP 442930, 4133 Manilla Road, Manilla and the development area for the proposal is approximately 18.1 hectares. The site is currently zoned RU1 – Primary Production pursuant to the Tamworth Regional LEP (2010).

The existing main vehicular access to the site is provided at Manilla Road via a single width rural access crossing though another unformed rural access crossing exists approximately 125 metres north of the main vehicular access to the site. These accesses are approximately 635 metres and 510 metres south of the proposed access to the development site. **Photograph 1** below shows the existing development site from Manilla Road while **Photograph 2** shows the existing dwelling and main vehicular access to the site.



Figure 1 – Site Location



Photograph 1 – Development site



Photograph 2 – Existing dwelling and main vehicular access – 4133 Manilla Road

3.0 EXISTING ROAD NETWORK

Manilla Road

Manilla Road is a classified state road (MR63) with its primary function to connect the sub regions of Wialda, Manilla, Barraba, Bingara through to Tamworth as well as provide vehicular access to properties along its length. As such it is a sub-arterial road and transport route in the area commonly known as the Fossicker's Way. As a sealed rural sub-arterial road, Manilla Road is under the care and control of NSW Roads and Maritime Services (RMS) but with assistance from Tamworth Regional Council.

Near the site, Manilla Road is a two-lane two-way sealed rural road with a 9-metre wide sealed carriageway consisting of 3.5 metre wide travel lanes and 1 metre wide sealed shoulders. Near the site, the speed zoning is 100 km/h and at the time of inspection Manilla Road was observed to be in excellent condition as shown in **Photograph 3** below.



Photograph 3 – Manilla Road near the site.

4.0 ALTERNATE TRANSPORT MODES

Tamworth Buslines runs a public transport bus service between Tamworth and Manilla (Route 443) that runs past the site as shown in the bus route map in **Figure 2** below. This service only runs two services (one in each direction in both the AM and PM peak) Monday to Friday with the nearest bus stop to the site being in Manilla at Rotary Park (Manilla Street), approximately 3.5 km north-west of the site and therefore would be of little use to the proposed development during both operational and construction periods. School service's are also provided to Manilla which could be used to access the site by arrangement with the bus company however the service is limited to a single morning and afternoon service on school days only and therefore would also be of very little use to the proposed development.

As a rural area, there are no pedestrian footpaths within the local road network. Pedestrians are generally required to utilise the grass verges and road shoulders when walking in the area.

There are no off-road or on-road cycleway paths within the local road network. Cyclists are required to utilise the road verge or the road pavement and share travel lanes with other vehicles when cycling in the area.

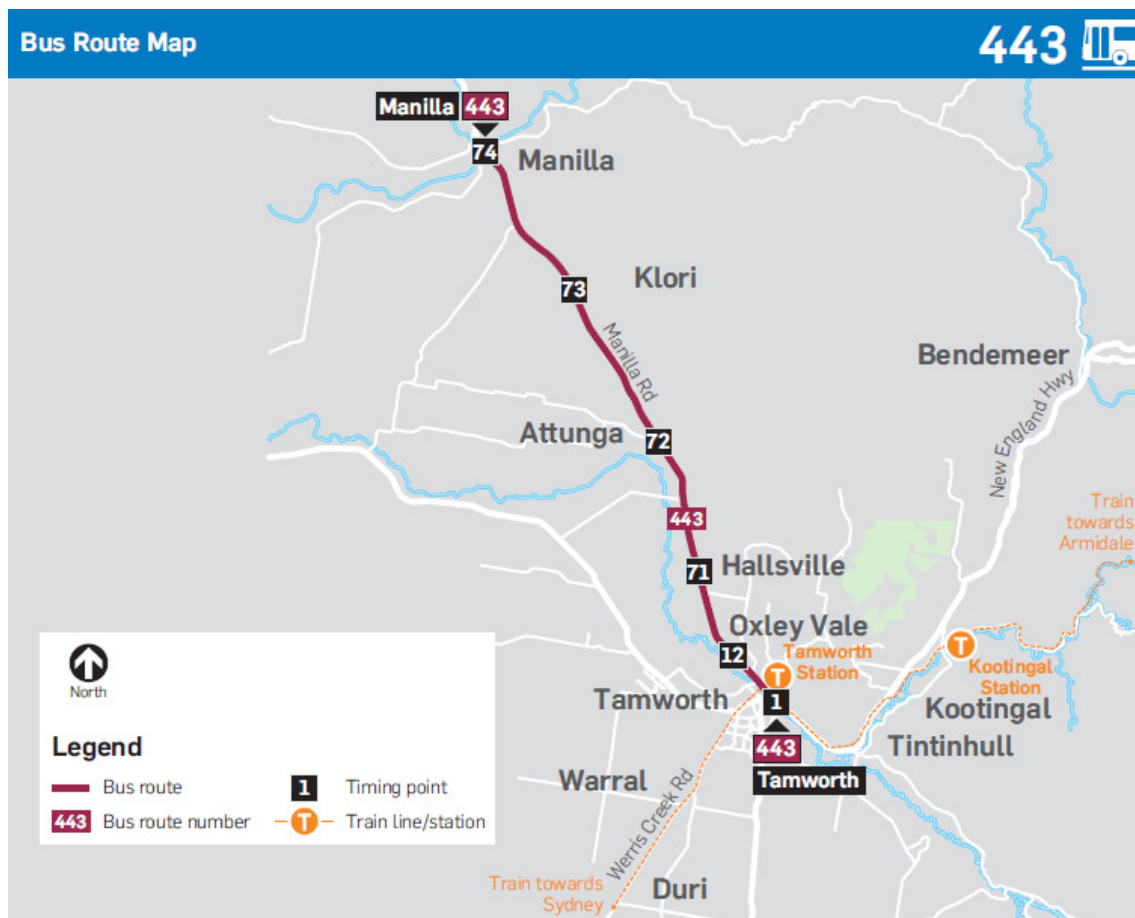


Figure 2 – Tamworth Buslines – Route 443

5.0 DEVELOPMENT PROPOSAL

The proposed development involves the construction of a Solar Photovoltaic (PV) Power Farm on the site. The development concept plans are shown in **Attachment A** with the specific works involved in the expansion listed below:

- ◆ Installation of temporary construction office and amenities.
- ◆ Installation of Solar Panel arrays.
- ◆ Earthworks for hardstand and construction lay-down areas as well as internal roads and parking area.
- ◆ Installation of inverters, transformers and switchgear.
- ◆ Construction of 5 metre wide gravel access road from Manilla Road and access crossing from the property boundary to edge of pavement.
- ◆ Construction of security fence and entrance gate; and
- ◆ Drainage and landscaping to Tamworth Regional Council requirements.

The development will require a team of construction employees for a period of up to 6 months working 7 am to 6 pm Monday to Friday and 8 am to 1 pm Saturdays. Technicians will visit the site during operations on a needs basis for general maintenance and repairs.

A new industrial class vehicular access will be constructed from Manilla Road to the site along the northern boundary of the site, over the old disused railway line (easement required). The majority of traffic movements associated with the development will occur during the construction of the solar farm. Traffic movements generated by the operation of the development would include a single staff light vehicle movement associated with maintenance inspections on a weekly basis and specific maintenance work which would be short term and infrequent. Deliveries during construction works would be expected to be within rigid and articulated vehicles. More detail on construction traffic is provided later in this report.

6.0 TRAFFIC IMPACTS

6.1 – Traffic Generation and Trip Distribution

The RMS publication “*Guide to Traffic Generating Developments (2002)*” provides advice on the traffic generating potential of different land uses. However this document does not cover Solar Farms therefore determining traffic generation is reliant on advice from the applicant regarding construction and operation of the development.

From an operational perspective traffic generation is expected to be minimal with only regular weekly maintenance inspections carried out. Therefore based on 1 visit per day, a peak hour traffic generation of 2 vehicle trips per hour (vtph) has been assumed for this assessment. There may be times when specific maintenance tasks have to be undertaken but these will be infrequent, short-term and undertaken under a construction traffic management plan for the work.

Construction traffic estimates for the development are as follows based on the advice provided in **Attachment C**.

- ◆ Construction employees on-site – Maximum 30 transported in up to 10 light vehicles per day arriving between 6 am and 7 am and departing between 6 pm and 7 pm.
- ◆ Deliveries – Mainly heavy rigid vehicles and articulated vehicles (AV) and possibly B-Doubles may also access the site. Maximum – 8 per day but average of 5 per day between 10 am and 4 pm. Whilst these are likely to mostly arrive outside the peak hour traffic generation periods associated with the arrival and departure of employees, logistically there

- could be occurrences when due to circumstances out of the control of the contractor a delivery may arrive during a peak hour period.
- ◆ Other vehicles – Some earthworks plant may be required on-site as well as concrete agitators and road base material deliveries during construction of the access. It would be expected a maximum frequency of 3 deliveries within a peak hour is assumed.
 - ◆ Construction period – 4 to 6 months.

The likely peak hour traffic generation which will occur in the AM peak coinciding with employees arriving on site and in the PM peak coinciding with employees leaving the site is calculated below. It is also noted deliveries involve 2 trips with an inbound trip and an outbound trip.

AM peak = 10 inbound employees + 3 x 2 roadworks and other plant + 1 x 2 deliveries = 18 vtph (14 inbound and 4 outbound).

PM peak = 10 outbound employees + 3 x 2 roadworks and other plant + 1 x 2 deliveries = 18 vtph (14 outbound and 4 inbound).

It is expected that the distribution of trips will be 80 % south to and from Tamworth and 20 % north to and from Manilla. Therefore the additional traffic on Manilla Road would be split 14 vtph Manilla Road south and 4 vtph Manilla Road north.

Existing traffic volumes on Manilla Road were recorded using traffic classifiers which were installed by Northern Transport Planning and Engineering on behalf of Intersect Traffic at a location adjacent to the site for a week-long period between Wednesday 11th December 2019 and Tuesday 17th December 2019.

The classifiers determined that the peak hour two-way traffic volumes on Manilla Road in the AM and PM periods during this period were.

- ◆ 247 vtph – 8 am – 9 am – Tuesday 17th December 2019; and
- ◆ 232 vtph – 3 pm to 4 pm – Friday 13th December 2019.

As the construction period is only 4 to 6 months and operational traffic is minimal there is need to assess the impact of the development on future traffic as is generally required by NSW RMS within traffic impact assessments. The classifier count summary sheets are provided in **Attachment B** while the classifier count also determined an average heavy vehicle percentage of approximately 7%.



6.2 – Road Capacity

Table 4.5 of the RMS publication “RTA’s Guide to Traffic Generating Developments” provides some guidance on likely levels of service being experienced on two-lane two-way rural roads for different terrain types. This table is reproduced below:

Table 4.5
peak hour flow on two-lane rural roads (veh/hr)
(Design speed of 100km/hr)

Terrain	Level of Service	Percent of Heavy Vehicles			
		0	5	10	15
Level	B	630	590	560	530
	C	1030	970	920	870
	D	1630	1550	1480	1410
	E	2630	2500	2390	2290
Rolling	B	500	420	380	310
	C	920	780	650	570
	D	1370	1140	970	700
	E	2420	2000	1720	1510
Mountainous	B	340	230	180	150
	C	600	410	320	280
	D	1050	680	500	400
	E	2160	1400	1040	820

The data for Table 4.5 assumes the following criteria:

- terrain level with 20% no overtaking.
- rolling with 40% no overtaking.
- mountainous with 60% no overtaking.
- 3.7 m traffic lane width with side clearances of at least 2m.
- 60/40 directional split of traffic.

Source: - RTA’s Guide to Traffic Generating Developments (2002)

In determining the capacity of Manilla Road from this table the following has been considered:

- ◆ The terrain level for the area surrounding the site is considered to satisfy the criteria for level terrain.
- ◆ 10% heavy vehicle traffic on the road has been assumed: and
- ◆ A Level of Service (LoS) C is considered the acceptable level of service for a rural road and a LoS C exists up to the threshold for a LoS D.

On this basis, the likely mid-block two-way road capacity for Manilla Road is approximately 1,480 vph.

From the two-way mid-block peak hour traffic data and traffic generation figures reported in **Section 6.1**, it can be seen that the AM and PM peak hour traffic volumes on Manilla Road during construction of the Solar Farm are still well below the existing capacity threshold of 1,480 vph. The addition of up to 14 vph therefore will not cause the capacity threshold to be reached. It can therefore be concluded that the proposed development will not adversely impact on the local and state road network efficiency as the road network has sufficient spare two-way mid-block capacity to cater for the development.

6.3 – Intersection Capacity

Based on the traffic volume data collected for the project, it has been determined that even during construction and post development, traffic volumes on the local and state road network are less than the traffic volume thresholds identified within Austroads *Guide to Traffic Management Part 6 – Intersections, Interchanges and Crossings*, reproduced below. The Guide states that if traffic volumes are not above these thresholds, then uninterrupted flow conditions can be assumed and little or no delay will be experienced by motorists at these intersections. No further intersection analysis is then required.

Major road type ¹	Major road flow (vph) ²	Minor road flow (vph) ³
Two-lane	400	250
	500	200
	650	100
Four-lane	1000	100
	1500	50
	2000	25

Source: - Austroads *Guide to Traffic Management – Part 6: Intersections, Interchanges and Crossings* (2010).

Peak traffic volumes on all intersections along Manilla Road, including the site access intersection will remain with major road flows less than 400 vtpd post development therefore all the intersections will remain operating with uninterrupted flow conditions with little if any delay for motorists. This also means that no special lane treatments are required at the proposed site access and a normal heavy duty rural access would be sufficient for the development.

Overall it can be concluded that the proposed Solar Farm at the site will not adversely impact on the efficiency and effectiveness of the local and state road network.

6.4 Access Assessment

As the proposed access to the development services a user class 1 (long term) car parking facility with less than 25 car spaces fronting an arterial road it is required to be a category 1 access (Table 3.1 of *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking*). Table 3.2 of the Standard then specifies a category 1 access facility as a combined entry / exit between 3.0 to 5.5 metres wide. The proposed entrance width at the combined entry / exit access at Manilla Road will need to be a minimum 12.5 metres wide to cater for the swept turning paths for delivery vehicles during construction stage to satisfy the requirements of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking* and Australian Standard *AS2890.2-2002 Parking Facilities – Part 2 Off-street commercial vehicle facilities*.

Sight distance at the proposed access was observed to be in excess of 300 metres in each direction therefore complies with the requirements of Figure 3.2 of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking* (160 metres desirable for 100 km/h) as well as Austroads *Guide to Road Design – Part 4A – Unsignalised and signalised intersections - Table 3.2* (265 metres for 100 km/h) for safe intersection sight distance.

It is therefore concluded that the proposed site access is suitably located and satisfactory for use for the Solar Farm as it can comply with the requirements of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking* and Australian Standard *AS2890.2-2002 Parking Facilities – Part 2 Off-street commercial vehicle facilities*.

7.0 ON-SITE CAR PARKING

On-site car parking for the proposal is required to comply with the Industrial Development controls and Appendix A of the Tamworth Regional Council DCP (2010). Adopting the industrial development rates for this project the relevant on-site car parking provision during the operation of the Solar Farm is.

- ◆ 1 space per 75 m² or 1 space per 2 employees whichever is greater.

With only 1 employee engaged in the day to day operation of the Solar Farm the development is only required to provide 1 on-site car parking space under the DCP requirements. However it is the responsibility of the applicant to also provide sufficient on-site car parking for construction employees during the duration of the construction of the development for the development to comply with the car parking objectives of the DCP. The site plan shows provision of a car parking area providing up to 20 spaces, which is in excess of the expected traffic generation from employees to the site as well as being in excess of the Industrial land use requirements of the Tamworth Regional Council DCP (2010). With significant overflow parking areas also on site it is considered reasonable to conclude the development provides sufficient on-site car parking that complies with the objectives and controls related to car parking required within the Tamworth Regional Council DCP (2010).

A review of the car parking plans indicates the car parking area would comply with the requirements of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking* with parking bay sizes 2.4 m x 5.4 m and aisle widths of 5.8 metres. Therefore the on-site car parking is considered suitable for the development ensuring all vehicle movements to and from the site off Manilla Road will be undertaken in a forward direction.

8.0 ALTERNATE TRANSPORT MODES

The proposed development will not generate any increase in public transport demand during both the construction and operational phases of the development. Therefore there is no nexus for the provision of new services or improved infrastructure resulting from the development. Similarly, the development will not generate any additional pedestrian or cycle traffic therefore no nexus exists for the provision of additional pedestrian paths or cycle ways near the site.



9.0 CONCLUSIONS

This traffic and parking assessment for the proposed Solar Photovoltaic (PV) Power Farm (up to 5MW) on Lot A DP 442930 – 4133 Manilla Road, Manilla has determined the following:

- ◆ The development during construction will generate up to an additional 18 vehicle movements to and from the site during the weekday AM and PM peak periods but only 2 vtpd during the operation of the Solar Farm.
- ◆ The existing peak traffic volumes on the local road network are well below the two-way mid-block capacity threshold of 1,480 vtpd for Manilla Road (Level of Service C) and will remain below these thresholds during the construction and operation of the development.
- ◆ All intersections along the main transportation route along Manilla Road will continue to operate with uninterrupted flow conditions with little if any delay to motorists post development and through to beyond 2030.
- ◆ Therefore, the additional construction and operational traffic generated by this development will not adversely impact on the efficiency or effectiveness of the local and state road network.
- ◆ The proposed site access is suitable for use for construction and operation of the development being compliant with Australian Standards and Austroads requirements.
- ◆ There is sufficient area on-site to accommodate the expected peak parking demand generated by the development during both construction and operation with the provision of an AS2890.1-2004 compliant car park for approximately 20 spaces as proposed and the numerous overflow parking areas on the site.
- ◆ The proposed development will not generate any increase in public transport demand therefore no nexus exists for the provision of new services or improved infrastructure resulting from the development. Similarly, the development will not generate any additional pedestrian or cycle traffic therefore no nexus exists for the provision of additional pedestrian paths or cycle ways near the site.

10.0 RECOMMENDATION

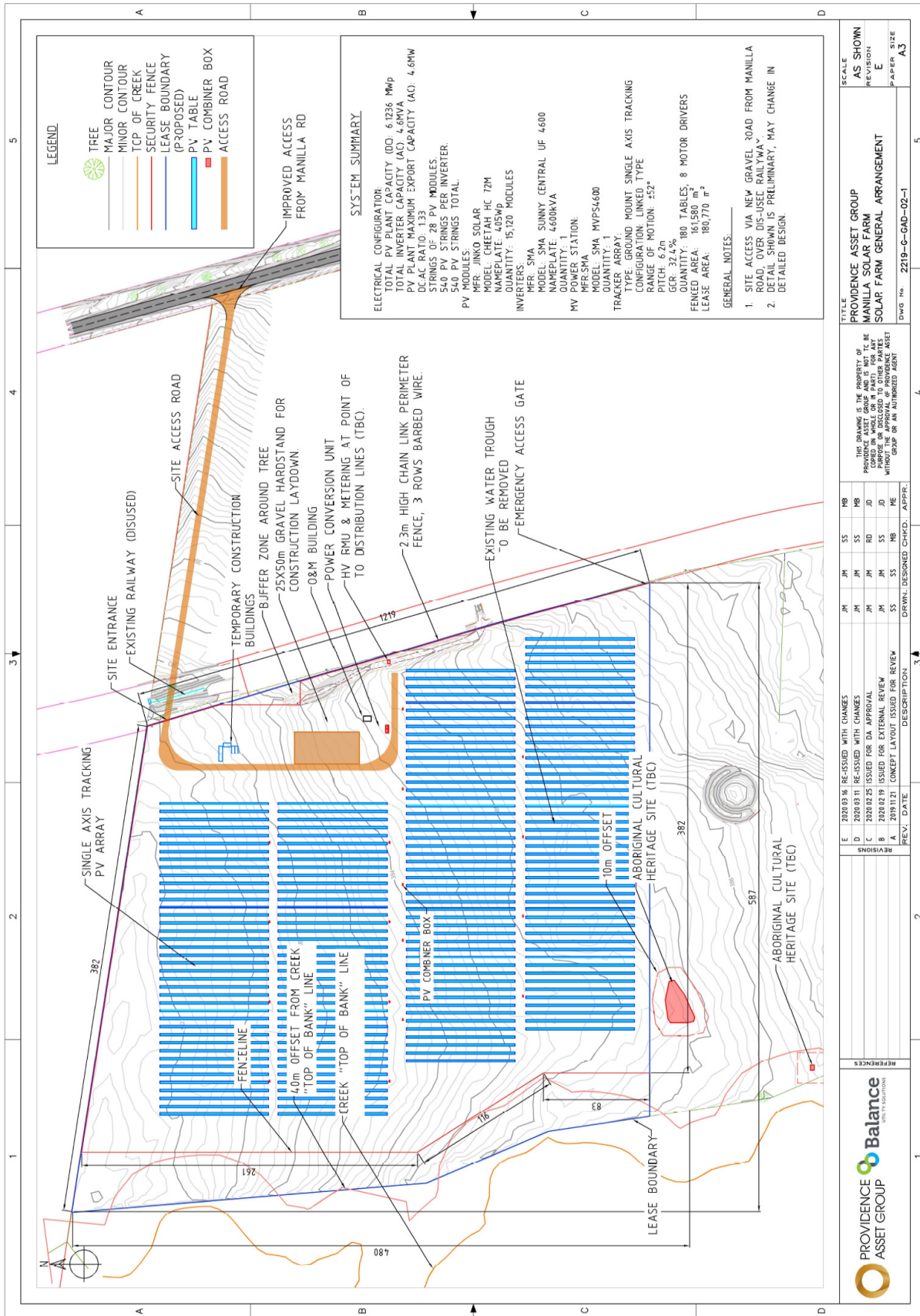
Having carried out this traffic and parking assessment for the proposed Solar Photovoltaic (PV) Power Farm (up to 5MW) on Lot A DP 442930 – 4133 Manilla Road, Manilla, it is recommended that the proposal can be supported from a traffic impact perspective as the development will not adversely impact on the local road network and complies with all relevant requirements of Tamworth Regional Council, Austroads, Australian Standards and NSW RMS.

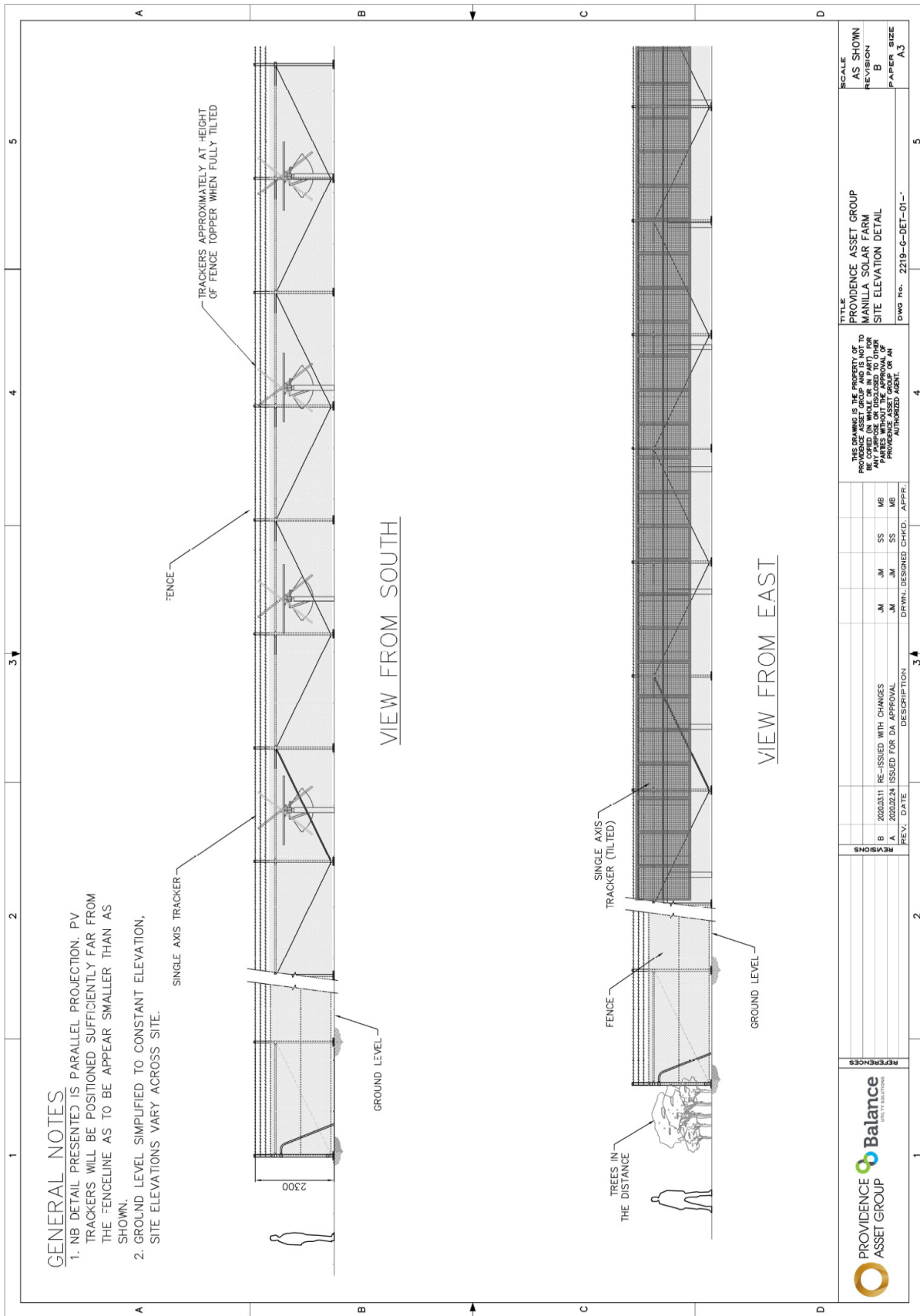


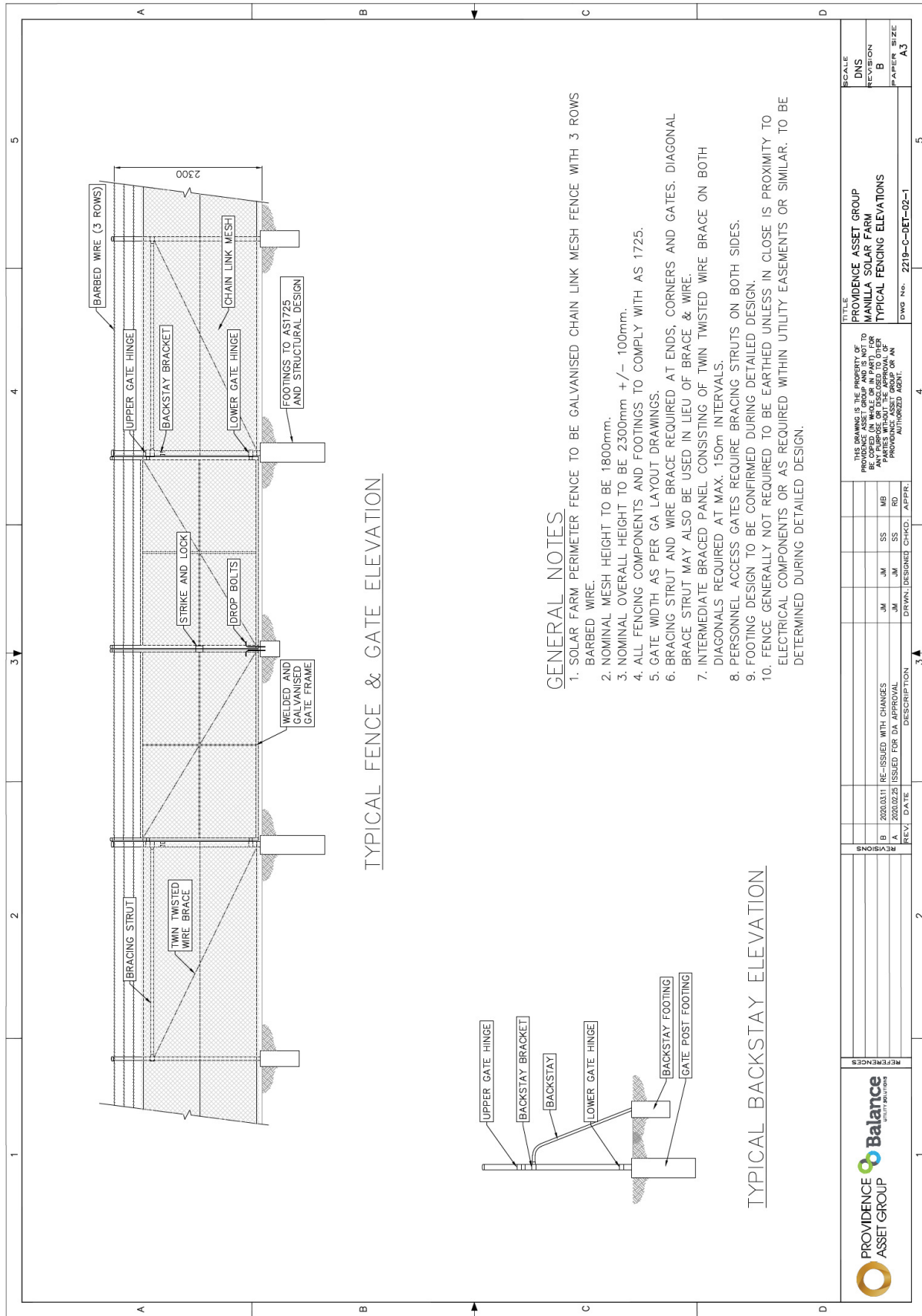
JR Garry BE (Civil), Masters of Traffic
Director
Intersect Traffic Pty Ltd

ATTACHMENT A

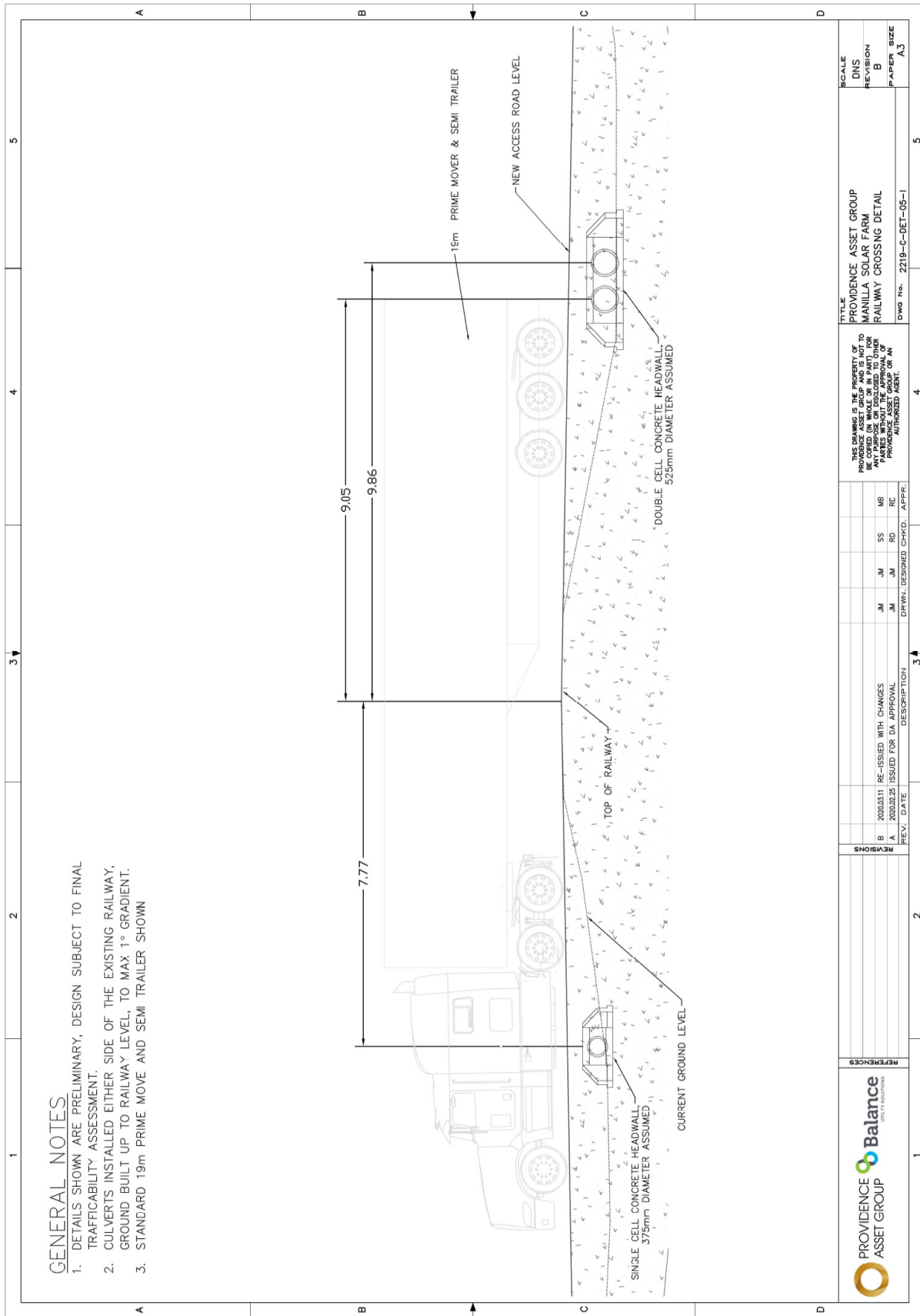
DEVELOPMENT PLANS

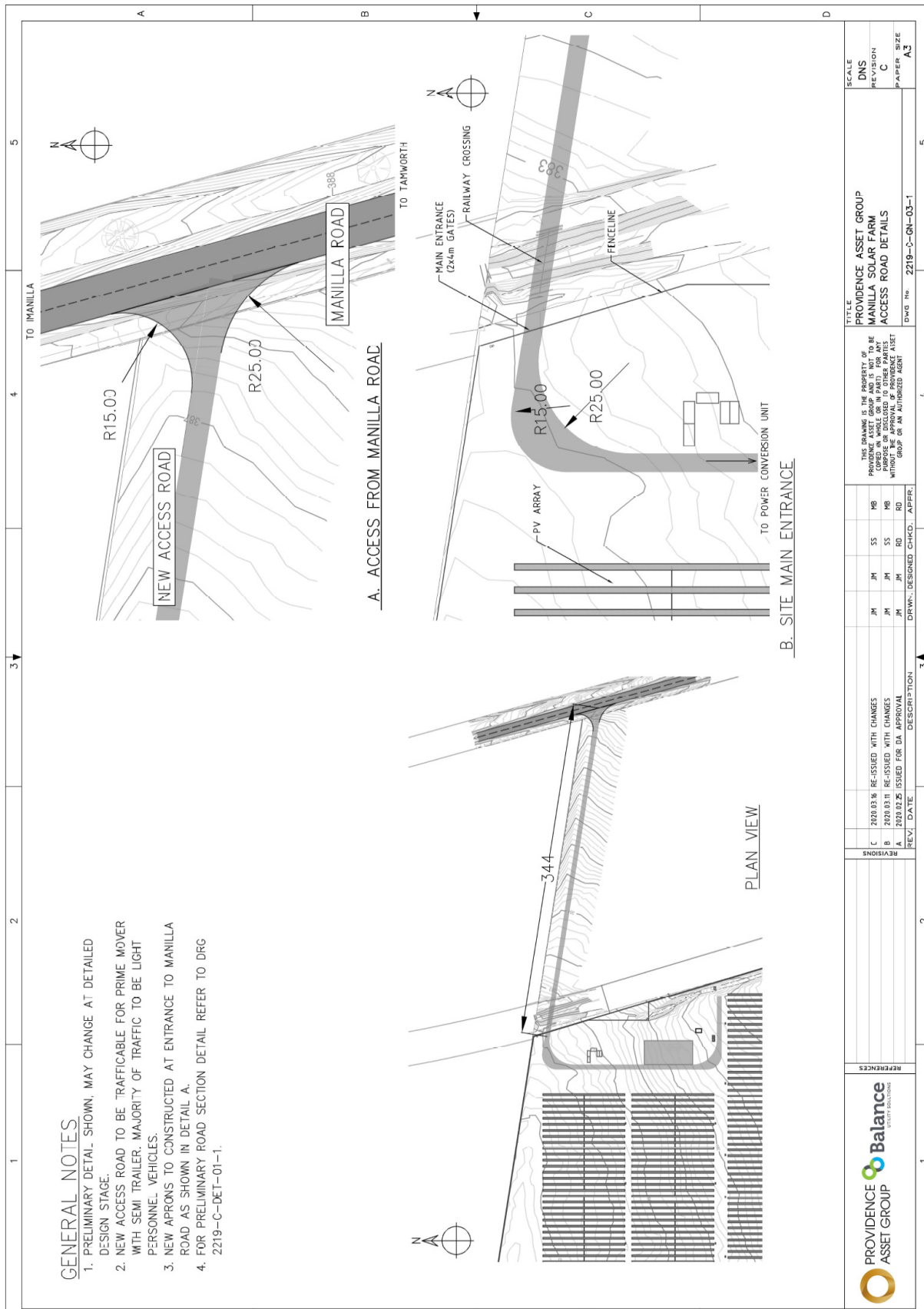


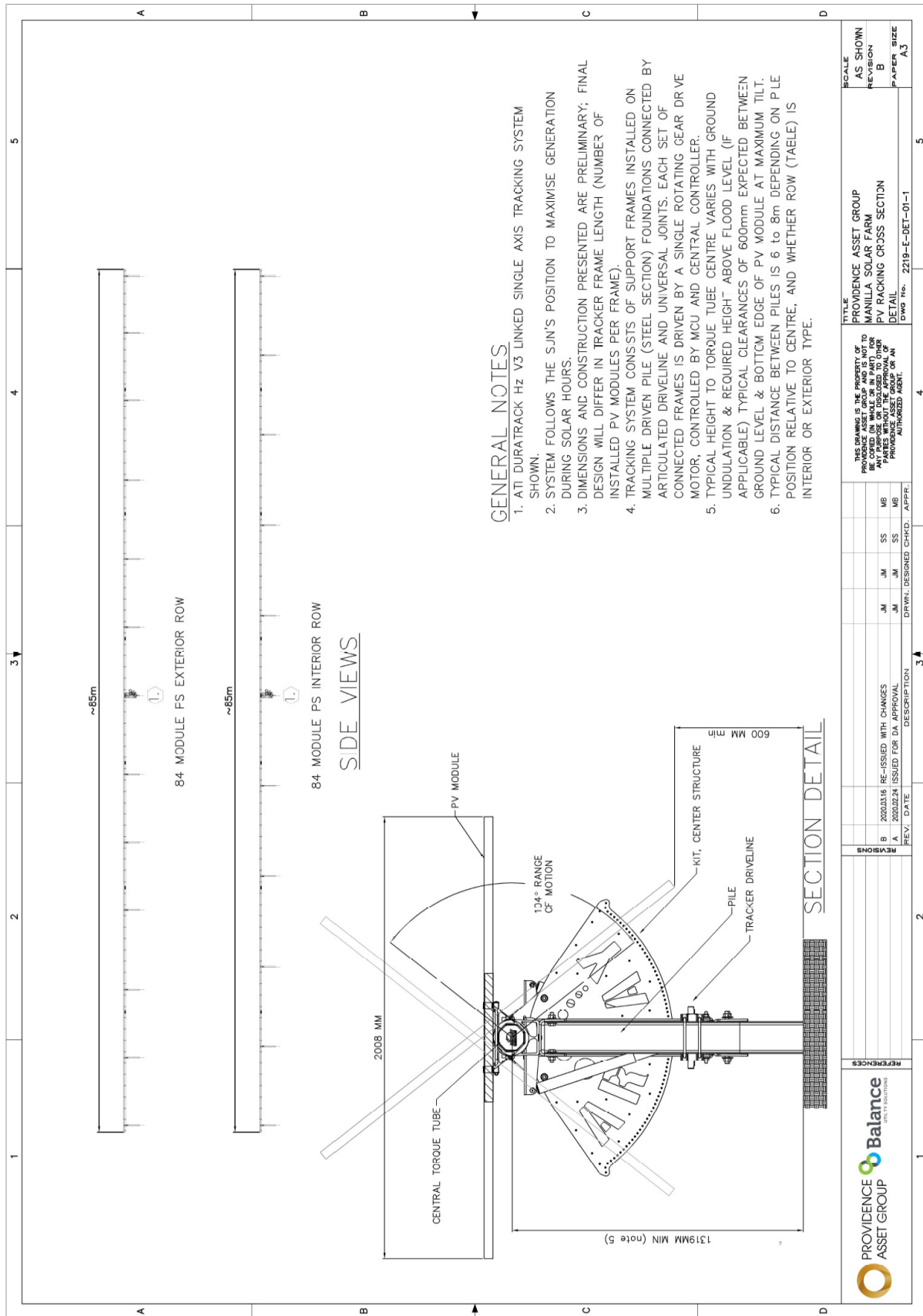


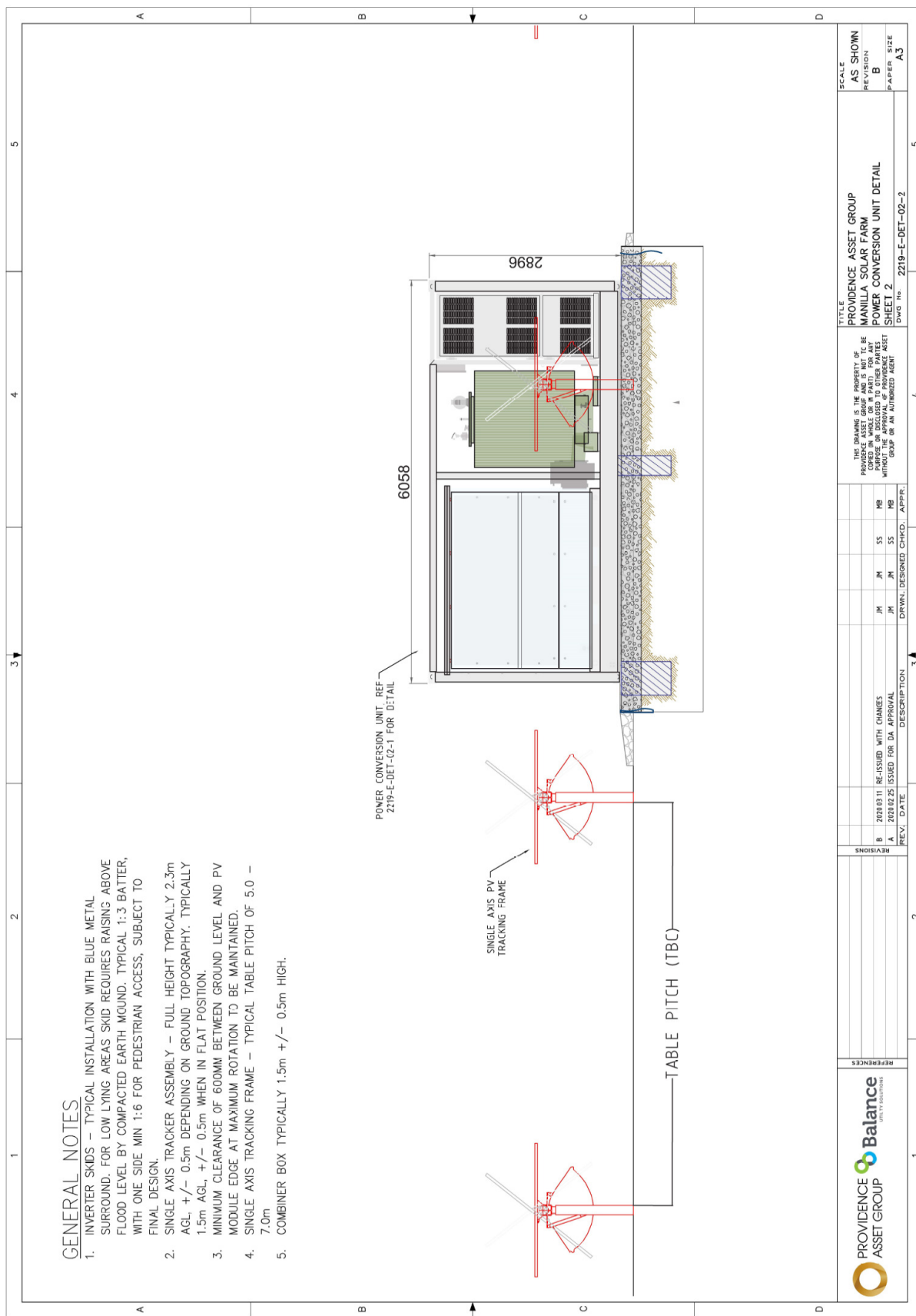










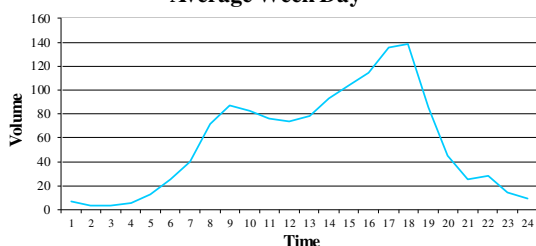


ATTACHMENT B

TRAFFIC COUNT DATA

Site 1 4133 Manilla Rd [80]
Northbound

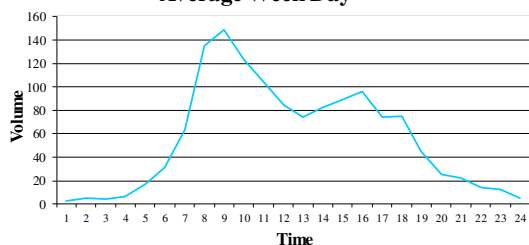
Day Time	Wed 11/12/19	Thu 12/12/2019	Fri 13/12/2019	Sat 14/12/2019	Sun 15/12/2019	Mon 16/12/2019	Tue 17/12/2019	W/Day Ave.	W/End Ave.	7 Day Ave
0:00	9	8	11	4	5	5	3	7	5	6
1:00	3	1	7	2	1	3	2	3	2	3
2:00	1	7	4	3	1	0	3	3	2	3
3:00	4	5	8	7	4	5	4	5	6	5
4:00	15	9	18	6	7	11	11	13	7	11
5:00	26	24	27	15	8	25	24	25	12	21
6:00	36	43	42	23	20	45	33	40	22	35
7:00	79	73	69	49	21	64	72	71	35	61
8:00	88	86	90	44	41	94	79	87	43	75
9:00	88	84	87	64	37	74	79	82	51	73
10:00	71	85	72	102	59	69	84	76	81	77
11:00	82	57	74	97	62	84	74	74	80	76
12:00	69	77	75	83	68	91	79	78	76	77
13:00	97	104	93	90	55	83	87	93	73	87
14:00	86	101	128	92	56	100	107	104	74	96
15:00	115	106	124	105	74	104	122	114	90	107
16:00	137	122	159	110	72	121	139	136	91	123
17:00	122	141	142	65	62	149	138	138	64	117
18:00	69	95	110	34	36	75	78	85	35	71
19:00	41	60	48	29	34	39	37	45	32	41
20:00	26	35	27	18	12	22	16	25	15	22
21:00	32	35	25	19	20	23	28	29	20	26
22:00	7	19	21	26	10	14	10	14	18	15
23:00	7	9	19	18	5	6	5	9	12	10
Total	1310	1386	1480	1105	770	1306	1314	1359	938	1239

Average Week Day

Summary

	from	to	
AM Peak	8:00 AM	9:00 AM	94
PM Peak	4:00 PM	5:00 PM	159
Week Day Average			1359
Weekend Day Average			937
7 Day Average			1239

Site 1 4133 Manilla Rd [80]
Southbound

Day Time	Wed 11/12/19	Thu 12/12/2019	Fri 13/12/2019	Sat 14/12/2019	Sun 15/12/2019	Mon 16/12/2019	Tue 17/12/2019	W/Day Ave.	W/End Ave.	7 Day Ave
0:00	2	3	3	10	2	1	4	3	6	4
1:00	5	5	6	9	4	3	6	5	7	5
2:00	6	2	2	5	2	6	5	4	4	4
3:00	6	12	7	3	1	6	3	7	2	5
4:00	11	16	20	8	4	18	20	17	6	14
5:00	34	34	30	16	7	26	34	32	12	26
6:00	58	65	70	33	18	64	61	64	26	53
7:00	137	138	131	71	32	131	137	135	52	111
8:00	151	138	139	129	46	147	168	149	88	131
9:00	107	145	124	116	77	119	122	123	97	116
10:00	89	101	128	93	90	101	101	104	92	100
11:00	81	101	89	104	92	80	71	84	98	88
12:00	66	69	105	88	71	63	67	74	80	76
13:00	98	77	85	41	76	71	82	83	59	76
14:00	100	97	87	60	69	78	84	89	65	82
15:00	108	97	108	60	50	76	91	96	55	84
16:00	74	89	77	49	57	73	59	74	53	68
17:00	83	77	84	53	58	72	60	75	56	70
18:00	34	49	41	40	41	52	50	45	41	44
19:00	21	20	33	37	23	30	24	26	30	27
20:00	20	18	23	20	17	26	23	22	19	21
21:00	13	17	18	20	13	17	7	14	17	15
22:00	11	22	10	8	6	10	10	13	7	11
23:00	4	7	8	7	5	3	3	5	6	5
Total	1319	1399	1428	1080	861	1273	1292	1342	971	1236

Average Week Day

Summary

	from	to	
AM Peak	8:00 AM	9:00 AM	168
PM Peak	3:00 PM	4:00 PM	108
Week Day Average			1342
Weekend Day Average			970
7 Day Average			1236

ATTACHMENT C

TRAFFIC GENERATION INFORMATION

Preliminary Manilla SF Vehicle Movement Guidance

Jake May, 05/02/2020

1 Traffic Generated by Construction Works

During the construction of the solar farm, it is estimated that approximately 50 x 40 ft containers will be transported to site. Added to these containers are waste traffic, equipment, temporary installations and workforce transport to and from site. A logistics agent will be engaged to manage the freight from the delivery port [TBC] to the solar farm site.

An estimation of the traffic created by the worksite is provided in Figure 1, below.

The vehicular traffic for the transport vehicles is based on a 3-axle rigid truck. The General Mass Limit (GML) for a 3-axle load is assumed to be 20 tonnes based on The Australian Trucking Association's 'Technical Advisory Procedure for Truck Configurations' [24]. Depending on the availability of vehicles it may be possible that a conventional B-doubles will transport equipment to site. The GML for this vehicle is 40 tonnes. In this case the vehicular traffic for the container loads will reduce by a factor of 2 for each B-double transporting equipment to site.

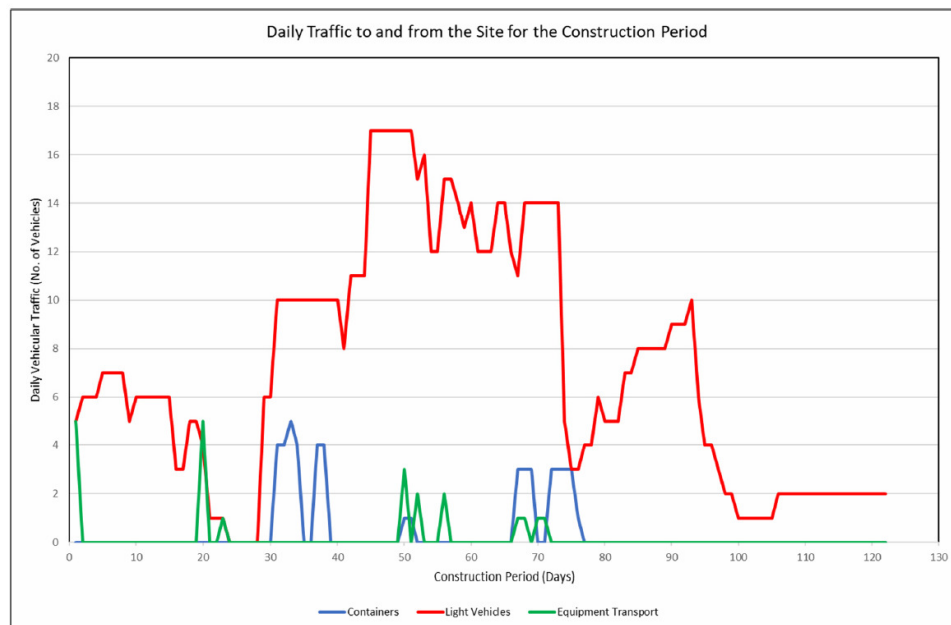


Figure 1 - Daily Traffic to and from Site for the Construction Period

At the peak of the equipment supply, the number of transport vehicles entering and leaving the solar farm site will be 4 to 5 daily for a period of just over a month into the construction period. There will be another busy week midway through the construction period where there will be approximately 3 transport vehicles entering and leaving the site daily.



All heavy transport to and from the site will predominantly be on standard working days between 8am and 4pm.

It is anticipated that there will be up to 30 personnel working on the site during the construction period that will generate the anticipated light vehicle traffic.

The light traffic will be concentrated at the beginning and the end of the day around 6-7am and 4-5pm. The container transport will be concentrated between 10am and 3pm.

2 Impact on Existing Traffic

With a maximum of eight to ten light vehicles and six to eight heavy vehicles travelling to and from the site daily, it is not anticipated that the increased traffic due to construction works will have any significant impact on the existing traffic.

3 Additional Road Signage of Existing Road

It is suggested that road signage is provided for the proposed site entrance on Manilla Road. The recommended locations of the warning signs be placed at distances of 200 metres approaching the intersection to the north and south. The warning signs will indicate that it is a construction site entrance. The entrance to the site on Mannum Road will be designed for the anticipated heavy transport loads volumes during the construction period that are detailed in Section 1. A Traffic Control Plan will be submitted to the DPTI Traffic Management Centre for approval, with all signage to be placed and maintained to the satisfaction of the Commissioner of Highways.

4 Parking

All parking for site personnel will be on site. This will be sign posted at the site entrance. Balance will not permit parking on Mannum Road and will incorporate this in the site induction.

5 O&M Traffic

Once the solar farm has been constructed and has entered the “operations and maintenance” stage the traffic onto site will consist of light vehicles, with few exceptions, at a frequency of 1 to 5 visits per fortnight.

5MW Solar Farm - Typical Vehicle Movements			
Construction - Major Equipment	Load	Quantity	Comments
Piling & Tracker Components	40' Container / Trailer	24	Doubles if permitted / practical
PV Modules	40' Container / Trailer	26	Doubles if permitted / practical
Switchgear	20' Container / Trailer	1	
Inverters	20' Container / Trailer	2	
Cranes	~50T	3	
Cables	40' Container / Trailer	2	Doubles if permitted / practical
Balance of Plant (BOP)	40' Container / Trailer	3	
Civil Plant	Float or Drop Deck	8	4ea at mob / demob
Piling Plant	Float or Drop Deck	4	2ea at mob / demob
Site Facilities	Float/Drop Deck/40' Trailer	8	4ea at mob / demob
Light trucks - 6 wheelers	local deliveries - sand, gen fteight etc	10	
Light trucks - 4 wheelers	local deliveries - sand, gen fteight etc	10	
		101	
Construction - Light Vehicles / Other	Load	Quantity	Comments
Light Vehicle - 4WD ute or similar	Personell / tools	384	Average 4 per day
Light Vehicle - ?	Workforce private vehicles	576	Average 6 per day - depends on engagement of workforce
		960	
O&M	Load	Quantity	Comments
Light Vehicle - 4WD ute or similar	fortnightly inspection	30	1 per fortnight, plus additional
Light Vehicle - 4WD ute or similar	3 monthly Inspections	8	2 visits, 4 times per year
Light Vehicle - 4WD ute or similar	Faults	4	
Light trucks - 4 wheelers	PV Module cleaning	2	Once per Year
		44	

Noise Assessment

Manilla Solar Farm
Manilla, NSW



Document Information

Noise Assessment

Manilla Solar Farm, Manilla NSW.

Prepared for: KDC Pty Ltd
Suite 2B, 125 Bull Street
Newcastle NSW 2300

Prepared by: Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com

Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC190968-01RP1	Final	24 March 2020	Rod Linnett		Oliver Muller	

DISCLAIMER

All documents produced by Muller Acoustic Consulting Pty Ltd (MAC) are prepared for a particular client's requirements and are based on a specific scope, circumstances and limitations derived between MAC and the client. Information and/or report(s) prepared by MAC may not be suitable for uses other than the original intended objective. No parties other than the client should use or reproduce any information and/or report(s) without obtaining permission from MAC. Any information and/or documents prepared by MAC is not to be reproduced, presented or reviewed except in full.

CONTENTS

1	INTRODUCTION	5
1.1	PURPOSE AND OBJECTIVES	5
1.2	SCOPE OF THE ASSESSMENT	5
2	PROJECT DESCRIPTION	7
2.1	BACKGROUND	7
2.2	DESCRIPTION OF PROPOSED CONSTRUCTION WORKS	7
2.3	DESCRIPTION OF PROPOSED OPERATION	8
2.4	POTENTIALLY SENSITIVE RECEIVERS	9
3	NOISE POLICY AND GUIDELINES	11
3.1	INTERIM CONSTRUCTION NOISE GUIDELINE	11
3.1.1	CONSTRUCTION NOISE MANAGEMENT LEVELS	13
3.1.2	CONSTRUCTION SLEEP DISTURBANCE	14
3.2	NOISE POLICY FOR INDUSTRY	14
3.2.1	PROJECT NOISE TRIGGER LEVELS	15
3.2.2	PROJECT INTRUSIVENESS NOISE LEVEL	15
3.2.3	PROJECT AMENITY NOISE LEVEL	15
3.2.4	MAXIMUM NOISE LEVEL ASSESSMENT	17
3.3	ROAD NOISE POLICY	17
4	ASSESSMENT CRITERIA	19
4.1	CONSTRUCTION NOISE MANAGEMENT LEVELS	19
4.2	OPERATIONAL NOISE CRITERIA	19
4.2.1	PROJECT INTRUSIVENESS NOISE LEVELS	19
4.2.2	PROJECT AMENITY NOISE LEVELS	20
4.2.3	PROJECT NOISE TRIGGER LEVELS	20
4.2.4	MAXIMUM NOISE LEVEL SCREENING CRITERION	21
4.3	ROAD TRAFFIC NOISE CRITERIA	21
5	MODELLING METHODOLOGY	23

5.1	CONSTRUCTION ASSESSMENT METHODOLOGY	23
5.2	OPERATIONAL ASSESSMENT METHODOLOGY	24
5.2.1	OPERATIONAL NOISE MODELLING SCENARIOS	24
5.2.2	METEOROLOGICAL ANALYSIS	25
6	RESULTS	27
6.1	CONSTRUCTION NOISE RESULTS.....	27
6.2	OPERATIONAL NOISE RESULTS	27
6.3	MAXIMUM NOISE LEVEL ASSESSMENT - OPERATIONS	28
6.4	ROAD TRAFFIC NOISE ASSESSMENT.....	28
7	RECOMMENDATIONS	29
7.1	CONSTRUCTION NOISE RECOMMENDATIONS.....	29
7.2	OPERATIONAL NOISE RECOMMENDATIONS	30
8	CONCLUSION	31
APPENDIX A – GLOSSARY OF TERMS		

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been engaged by KDC Pty Ltd (KDC) to complete a Noise Assessment (NA) on behalf of Providence Asset Group (PAG) for the proposed Manilla Solar Farm near Manilla, NSW (the 'project'). This report presents the methodology and findings of the NA for the construction and operation of the project.

1.1 Purpose and Objectives

A NA is required as part of the Statement of Environmental Effects (SEE) to be submitted to Tamworth Regional Council as part of the Development Application (DA). The purpose of the NA is to quantify potential environmental noise emissions associated with the construction and operation of the project. Where impacts are identified, the assessment includes recommendations for potential noise mitigation and management measures.

1.2 Scope of the Assessment

The NA includes the following key tasks:

- review construction and operating activities to identify key noise generating plant, equipment, machinery or activities proposed to be undertaken as part of the project;
- identify the closest and/or potentially most affected receivers situated within the area of influence to the project;
- establish existing noise levels to determine project-specific construction Noise Management Levels (NMLs), and operational noise criteria;
- undertake 3D noise modelling to predict levels that may occur as a result of the construction and operation of the project at the closest and/or potentially most affected receivers;
- provide a comparison of predicted noise levels against relevant construction and operational criteria;
- assess the potential noise impacts associated with construction and operational aspects of the project; and
- provide feasible and reasonable noise mitigation and management measures, and monitoring options, where NMLs or operational criteria may be exceeded.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

This page has been intentionally left blank

2 Project Description

2.1 Background

PAG propose to construct and operate a 5 Megawatt (MW) solar farm using photovoltaic (PV) technology at Manilla Road, approximately 3km south of Manilla, NSW.

2.2 Description of Proposed Construction Works

The project includes installation of groups of north facing PV modules (approximately 2m x 1m) on mounting structures of approximately 1.5m in height. An estimated 15,000 PV panels will be installed using a single axis tracking system, tilting along the north-south axis. The PV mounting structure would comprise steel posts driven to approximately 1.5m below ground using a small pile driver. Additional support structures would be attached to the piles, which would then support the PV panels.

Where cabling of each PV array/module to inverters is required to be underground, earthworks will primarily involve trenching. Other minor earthworks would be completed for the preparation of the site and in most cases a concrete slab would be required to support the ancillary infrastructure. Most of the infrastructure would be pre-fabricated off-site, delivered and assembled on-site.

It is anticipated that the solar farm would be constructed in stages, with two to three stages in construction at any one time over a six month period during standard construction hours.

All vehicles would access the project via the Manilla Road during construction and operational phases.

During construction, traffic generated by the project would include employee and delivery vehicles. During the peak construction period, the daily traffic volume is expected to be up to four heavy vehicles (semi-trailers or b-doubles) per hour and 20 light commercial vehicles or equivalent mini buses for worker transport during the morning and afternoon peaks.

2.3 Description of Proposed Operation

PV infrastructure on site will comprise of groups of PV panels installed in rows running north to south. Each row of PV modules will rotate to track the sun across the sky from east to west each day. There is approximately 6m spacing between each row. The hub height of each tracker is 1.5m with the peak of the modules reaching a height of 2.3m when the array is fully tilted.

Electrical cabling would be attached beneath the modules and would connect the individual PV modules to each other. Inverters will be located centrally to groups of PV panels and connected to each other by underground cables. The PV modules will be on a single axis tracker system which will follow the sun and move in an east to west direction.

The project will be contained solely within the site as shown in **Figure 1**.

The project would operate 24 hours a day, 7 days a week, with no permanent staff on site. During operation, the PV panels would generate electricity which would be fed into the power grid via a 2km powerline to the Essential Energy Manilla Zone Substation. Key noise emissions from the operation of the project are associated with the inverter and transformer(s). It is noted that emissions from these sources are anticipated to be acoustically insignificant compared to ambient background noise levels at assessed receivers.

When required, maintenance activities will occur during standard working hours (except for emergencies) and are expected to include:

- panel cleaning;
- repairs or replacement of infrastructure, as required; and
- land management including mowing to control vegetation as required.

Typical noise sources associated with maintenance activities would include light vehicle movements on site and maintenance of equipment.

2.4 Potentially Sensitive Receivers

Using aerial photography, geospatial information and other project design information, MAC has identified the following potentially sensitive receivers that may be affected by noise from operation or construction activities and project related road traffic. **Table 1** presents a summary of receiver identification, address and coordinates. These are reproduced graphically in **Figure 1**.

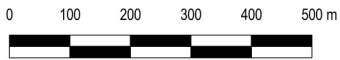
Table 1 Noise Sensitive Receivers				
ID	Description/Address	Receiver Type	Coordinates (MGA 56)	
			Easting	Northing
R01	4133 Manilla Road	Residential	283792	6592424
R02	4124 Manilla Road	Residential	283893	6592345
R03	4077 Manilla Road	Residential	283921	6591928
R04	83 Melrose Lane	Residential	284668	6592232
R05	4182 Manilla Road	Residential	283804	6592945
R06	118 Doring Lane	Residential	282731	6593733
R07	Doring Lane	Residential	282664	6593903
R08	4279 Manilla Road	Residential	282897	6594003
R09	4279 Manilla Road	Residential	283401	6593864



FIGURE 1
PROJECT LAYOUT
MAC190968-01
Manilla Solar Farm

KEY

- Receivers
- Panel Array
- Access Road
- Project Boundary
- Construction Compound



3 Noise Policy and Guidelines

This Noise Assessment has been conducted in accordance with the following key policy and guidelines:

- NSW Department of Environment and Climate Change, NSW Interim Construction Noise Guideline (ICNG), 2009;
- Environment Protection Authority's (EPA's), Noise Policy for Industry (NPI), 2017; and
- NSW Department of Environment, Climate Change and Water (DECCW), NSW Road Noise Policy (RNP), 2011.

The assessment has also considered and applied the following additional policy, guidelines and standards where relevant:

- Australian Standard AS 2436-2010 (R2016) (AS 2436) – Guide to Noise and Vibration Control on Construction, Demolition and Maintenance sites;
- Australian Standard AS 1055:2018 – Description and Measurement of Environmental Noise;
- Australian Standard AS /NZS IEC 61672.1-2019 (AS 61672) – Electro Acoustics - Sound Level Meters Specifications Monitoring; and
- Australian Standard AS IEC 60942-2004 (AS 60942) – Electroacoustics – Sound Calibrators.

3.1 Interim Construction Noise Guideline

The assessment and management of noise from construction work is completed with reference to the Interim Construction Noise Guideline (ICNG). The ICNG is specifically aimed at managing noise from construction work regulated by the EPA and is used to assist in setting statutory conditions in licences or other regulatory instruments. The types of construction regulated by the EPA under the POEO Act (1997), include construction, maintenance and renewal activities carried out by a public authority, such as road upgrades as described in Schedule 1 of the POEO Act.

The ICNG sets out procedures to identify and address the impact of construction noise on residences and other sensitive land uses. This section provides a summary of noise objectives that are applicable to the assessment.

The ICNG provides two methodologies for the assessment of construction noise emissions:

- Quantitative, which is suited to major construction projects with typical durations of more than three weeks; or
- Qualitative, which is suited to short term infrastructure maintenance (for projects with a typical duration of less than three weeks).

The methodology for a quantitative assessment requires a more complex approach, involving noise emission predictions from construction activities to the nearest relevant receivers. The qualitative assessment methodology is a more simplified approach that relies more on noise management strategies. This study has adopted a quantitative assessment approach.

The quantitative approach includes identification of potentially affected receivers, description of activities involved in the project, derivation of the construction noise management levels, quantification of potential noise impact at receivers and, provides management and mitigation recommendations. **Table 2** summarises the ICNG recommended standard hours for construction.

Table 2 Recommended Standard Hours for Construction	
Period	Preferred Construction Hours
Day (Standard construction hours)	Monday to Friday - 7am to 6pm
	Saturdays - 8am to 1pm
	Sundays or Public Holidays - No construction

The recommended hours do not apply in the event of direction from police, or other relevant authorities, for safety reasons or where required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. Work conducted outside of standard hours are considered out of hours work (OOH). OOH periods are divided into two categories representing evening and night periods and cover the hours listed below:

Period 1 (evening/low risk period): Monday to Friday – 6pm to 10pm, Saturdays – 1pm to 6pm, Sundays – 8am to 6pm.

Period 2 (night/medium to high risk period): Monday to Friday – 10pm to 7am, Saturdays/Sundays – 6pm to 7am (8am on Sunday mornings).

There are no out of hours work proposed for this project.

3.1.1 Construction Noise Management Levels

Section 4 of the ICNG details the quantitative assessment method involving predicting noise levels and comparing them with the Noise Management Level (NML) and are important indicators of the potential level of construction noise impact. **Table 3** provides the ICNG recommended LAeq(15min) NMLs and how they are to be applied.

Table 3 Noise Management Levels		
Time of Day	Management Level LAeq(15min) ¹	How to Apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays.	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq,15min is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of work to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account times identified by the community when they are less sensitive to noise (such as before and after school for work near schools, or mid-morning or mid-afternoon for work near residences; and if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours.	Noise affected RBL + 5dB	A strong justification would typically be required for work outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

Note 1: The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the construction noise management levels for noise assessment purposes and is the median of the ABL's.

3.1.2 Construction Sleep Disturbance

Section 4.3 of the ICNG (DECC, 2009) states that a sleep disturbance assessment is required where construction activities are planned to occur for more than two consecutive nights. Given that construction activities are anticipated to occur during standard construction hours, sleep disturbance has not been considered in this assessment.

3.2 Noise Policy for Industry

The EPA released the Noise Policy for Industry (NPI) in October 2017 which provides a process for establishing noise criteria for consents and licenses enabling the EPA to regulate noise emissions from scheduled premises under the Protection of the Environment Operations Act 1997.

The objectives of the NPI are to:

- provide noise criteria that is used to assess the change in both short term and long-term noise levels;
- provide a clear and consistent framework for assessing environmental noise impacts from industrial premises and industrial development proposals;
- promote the use of best-practice noise mitigation measures that are feasible and reasonable where potential impacts have been identified; and
- support a process to guide the determination of achievable noise limits for planning approvals and/or licences, considering the matters that must be considered under the relevant legislation (such as the economic and social benefits and impacts of industrial development).

The policy sets out a process for industrial noise management involving the following key steps:

1. Determine the Project Noise Trigger Levels (PNTLs) (ie criteria) for a development. These are the levels (criteria), above which noise management measures are required to be considered. They are derived by considering two factors: shorter-term intrusiveness due to changes in the noise environment; and maintaining the noise amenity of an area.
2. Predict or measure the noise levels produced by the development with regard to the presence of annoying noise characteristics and meteorological effects such as temperature inversions and wind.
3. Compare the predicted or measured noise level with the PNTL, assessing impacts and the need for noise mitigation and management measures.

4. Consider residual noise impacts - that is, where noise levels exceed the PNTLs after the application of feasible and reasonable noise mitigation measures. This may involve balancing economic, social and environmental costs and benefits from the proposed development against the noise impacts, including consultation with the affected community where impacts are expected to be significant.
5. Set statutory compliance levels that reflect the best achievable and agreed noise limits for the development.
6. Monitor and report environmental noise levels from the development.

3.2.1 Project Noise Trigger Levels

The policy sets out the procedure to determine the PNTLs relevant to an industrial development. The PNTL is the lower (ie, the more stringent) of the **Project Intrusiveness Noise Level (PINL)** and **Project Amenity Noise Level (PANL)** determined in accordance with Section 2.3 and Section 2.4 of the NPI.

3.2.2 Project Intrusiveness Noise Level

The PINL (LAeq(15min)) is the RBL + 5dB and seeks to limit the degree of change a new noise source introduces to an existing environment. Hence, when assessing intrusiveness, background noise levels need to be measured.

3.2.3 Project Amenity Noise Level

PANL is relevant to a specific land use or locality. To limit continuing increases in intrusiveness levels, the ambient noise level within an area from all combined industrial sources should remain below the recommended amenity noise levels specified in Table 2.2 (of the NPI) and are reproduced in **Table 4**. The NPI defines two categories of amenity noise levels:

- **Amenity Noise Levels (ANL)** – are determined considering all current and future industrial noise within a receiver area.
- **Project Amenity Noise Levels (PANL)** – is the recommended levels for a receiver area, specifically focusing the project being assessed.

Notwithstanding, where the PANL is applicable and can be satisfied, the assessment of cumulative industrial noise is not required.

Table 4 Amenity Criteria

Receiver Type	Noise Amenity Area	Time of day	Recommended amenity noise level dB LAeq
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See column 4	5dBA above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School classroom – internal	All	Noisiest 1-hour period when in use	35
Hospital ward			
- internal	All	Noisiest 1 hour	35
- external		Noisiest 1 hour	50
Place of worship – internal	All	When in use	40
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50
Active recreation area (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5dBA to recommended noise amenity area

Notes: The recommended amenity noise levels refer only to noise from industrial noise sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Types of receivers are defined as rural residential; suburban residential; urban residential; industrial interface; commercial; industrial – see Table 2.3 and Section 2.7.

Time of day is defined as follows: (These periods may be varied where appropriate, for example, see A3 in Fact Sheet A.)

- day – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays;
- evening – the period from 6pm to 10pm;
- night – the remaining periods.

In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable LAeq noise level may be increased to 40dB LAeq(1hr).

3.2.4 Maximum Noise Level Assessment

The potential for sleep disturbance from maximum noise level events from a project during the night-time period needs to be considered. The NPI considers sleep disturbance to be both awakenings and disturbance to sleep stages.

Where night-time noise levels from a development/premises at a residential location exceed the following criteria, a detailed maximum noise level event assessment should be undertaken:

- LAeq(15min) 40dB or the prevailing RBL plus 5dBA, whichever is the greater, and/or
- LAmax 52dB or the prevailing RBL plus 15dBA, whichever is the greater,

a detailed maximum noise level event assessment should be undertaken.

A detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Other factors that may be important in assessing the impacts on sleep disturbance include:

- how often the events would occur;
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the development;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current understanding of effects of maximum noise level events at night.

3.3 Road Noise Policy

The road traffic noise criteria are provided in the Department of Environment, Climate Change and Water NSW (DECCW), Road Noise Policy (RNP), 2011. The policy sets out noise criteria applicable to different road classifications for the purpose of quantifying traffic noise impacts. Road noise criteria relevant to this assessment are presented in detail in **Section 4**.

This page has been intentionally left blank

4 Assessment Criteria

Background noise monitoring has not been conducted for this project and hence, the minimum applicable Rating Background Levels (RBL) of 35dBA for the daytime period and 30dBA for the evening and night time periods have been adopted in accordance with NPI methodology.

4.1 Construction Noise Management Levels

Noise Management Levels (NMLs) for construction activities at all residential receivers are 45dB LAeq(15min) (RBL +10dB). Construction activities are planned for standard hours, however the relevant NML standard construction hours and out of hours periods are summarised in **Table 5**.

Table 5 Construction Noise Management Levels			
Location	Assessment Period ¹	RBL, dBA	NML dB LAeq(15min)
All Residential Receivers	Day (Standard Hours)	35	45 (RBL+10dBA)
	Evening (OOH Period 1)	30	35 (RBL+5dBA)
	Night (OOH Period 2)	30	35 (RBL+5dBA)

Note 1: See Table 2 of this report for Recommended Standard Hours for Construction.

4.2 Operational Noise Criteria

4.2.1 Project Intrusiveness Noise Levels

The PINLs for the project are presented in **Table 6** and have been determined based on the RBLs +5dBA.

Table 6 Project Intrusiveness Noise Levels			
Receiver	Period ¹	Adopted RBL dB LA90	PINL dB LAeq(15min)
All Residential Receivers	Day	35	40
	Evening	30	35
	Night	30	35

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.2.2 Project Amenity Noise Levels

The PANLs for receivers potentially affected by the project are presented in **Table 7**.

Table 7 Project Amenity Noise Levels					
Receiver Type	Noise Amenity Area	Assessment Period ¹	Recommended ANL dB LAeq(period) ²	PANL dB LAeq(period) ³	PANL dB LAeq(15min) ⁴
Residential	Rural	Day	50	50	53
		Evening	45	45	48
		Night	40	40	43

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: Recommended amenity noise levels as per Table 2.2 of the NPI.

Note 3: Project Amenity Noise Level equals the amenity noise level as there is no other industry in the area.

Note 4: Includes a +3dB adjustment to the amenity period level to convert to a fifteen-minute assessment period as per Section 2.2 of the NPI.

4.2.3 Project Noise Trigger Levels

The PNTLs are the lower of either the PINLs or the PANLs. **Table 8** presents the derivation of the PNTLs in accordance with the methodologies outlined in the NPI. For this assessment the night time PNTL of 35dB LAeq(15min) is the limiting criteria for residential receivers.

Table 8 Project Noise Trigger Levels				
Catchment	Assessment Period ¹	PINL dB LAeq(15min)	PANL dB LAeq(15min)	PNTL dB LAeq(15min)
Residential	Day	40	53	40
Receivers (Rural)	Evening	35	48	35
	Night	35	43	35

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.2.4 Maximum Noise Level Screening Criterion

The maximum noise level screening criterion shown in **Table 9** are based on night time RBLs and trigger values as per Section 2.5 of the NPI.

Table 9 Maximum Noise Assessment Trigger Levels			
Residential Receivers			
LAeq(15min)		LAmax	
40dB LAeq(15min) or RBL + 5dB		52dB LAmax or RBL + 15dB	
Trigger	40	Trigger	52
RBL +5dB	35	RBL +15dB	45
Highest	40	Highest	52

Note: As per Section 2.5 of the NPI, the highest of the two criteria are adopted as the screening criteria.

4.3 Road Traffic Noise Criteria

The relevant road traffic noise criteria are provided in the RNP and are presented in **Table 10** for residential receivers.

Table 10 Road Traffic Noise Assessment Criteria for Residential Land Uses				
Road category	Road Name	Type of Project/Development	Assessment Criteria - dBA	
			Day (7am to 10pm)	Night (10pm to 7am)
Arterial Roads	Manilla Road	Existing residences affected by		
		additional traffic on existing	60dBA LAeq(15hr)	55dBA LAeq(9hr)
		arterial roads generated by land use developments	external	external

Note: For road noise assessments, the day period is from 7am to 10pm (ie there is no evening assessment period as there is with operational noise). Night is from 10pm to 7am.

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2dB, which is generally accepted as the threshold of perceptibility to a change in noise level.

This page has been intentionally left blank

5 Modelling Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers for typical construction activities and operations. DGMR (iNoise, Version 2019.1) noise modelling software was used to quantify noise emissions from typical construction activities and operations. iNoise is a new intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation'. The ISO 9613 standard from 1996 is the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

5.1 Construction Assessment Methodology

Construction activities are proposed to be progressive (trenching, piling and assembly) and will occur at several locations simultaneously. Noise emissions were modelled for the following four scenarios:

- earthworks for internal road and compound construction including the stripping of topsoil and unsuitable soil and the placement and compaction of road base;
- earthworks involving trenching for cabling;
- piling of panel supports; and
- assembly of the panels.

It is envisaged that all four construction scenarios have the potential to occur simultaneously at up to two key locations across the site. Noise emission data and assumptions used in this assessment are summarised in **Table 11**. All significant noise generating construction activities will be limited to standard construction hours. Where low intensity construction activities are required to be undertaken outside standard construction hours, such as cabling, minor assembly, use of hand tools etc, they will be managed such that they are not audible at any residential receivers.

Table 11 Construction Equipment Teams Sound Power Levels, Lw dBA re 10⁻¹² W				
Noise Source/Item	Utilisation %	Quantity	Lw/Item	Total Lw
Trenching & Earthworks				
Backhoe	80	1	104	103
Light vehicle	25	2	76	73
Total – Trenching & Earthworks				103
Piling				
Piling Rig (hydraulic)	80	1	113	112
Tele-handler	75	1	106	105
Light vehicle	25	2	76	73
Total – Piling				113
Assembly				
Mobile Crane/HIAB	75	1	104	103
Tele-handler	75	1	106	105
Light vehicle	25	2	76	73
Hand tools/Power tools	50	1	102	99
Welder	50	1	105	102
Total – Assembly				109
Transport (on site)				
Heavy vehicle	40	1	104	101
Tele-handler	50	1	106	103
Total – Transport				105

5.2 Operational Assessment Methodology

5.2.1 Operational Noise Modelling Scenarios

For this assessment, noise predictions were modelled for a typical worst-case operational scenario over a 15-minute assessment period based on the assumptions and sound power levels in **Table 12**. Plant noise emission data used in modelling for this assessment were obtained from manufacturers data or the MAC database. Where relevant, modifying factors in accordance with Section 3.3 and Fact Sheet D of the NPI have been applied to calculations.

Table 12 Operational Equipment Sound Power Levels, Lw dBA re 10⁻¹² W

Noise Source/Item	Activity	Quantity	Lw/Item	Total Lw
PV Panel Tracking Motor ^{1,2}	All tracking motors in operation 1 minute per 15-minute period	8	78	87
2.5MW Inverter ²	Constant	2	81	84
5MVA Transformer ²	Constant	1	77	77

Note 1: Tracking motor is situated underneath the PV panel, -5dB attenuation applied to account for shielding provided by the panel.

Note 2: Modifying factor penalty of +5dB added for low frequency and +5dB added for tonality.

5.2.2 Meteorological Analysis

Noise emissions from industry can be significantly influenced by prevailing weather conditions. Light stable winds (<3m/s) and temperature inversions have the potential to increase noise at a receiver.

Fact Sheet D of the NPI provides two options when considering meteorological effects:

- adopt the noise enhancing conditions for all assessment periods without an assessment of how often the conditions occur – a conservative approach that considers a source to receiver winds for all receivers and F class temperature inversions with wind speeds up to 2m/s at night; or
- determine the significance of noise enhancing conditions. This requires assessing the significance of temperature inversions (F and G Class stability categories) for the night time period and the significance of light winds up to 3m/s for all assessment periods during stability categories other than E, F or G.

Given that a detailed analysis of the significance of noise enhancing conditions has not been undertaken, Noise Enhancing Meteorological Conditions as per Table D1 of the NPI have been adopted in the noise modelling assessment and are summarised in **Table 13**.

Table 13 Modelled Site Specific Meteorological Parameters – Noise Enhancing Meteorological Condition

Assessment Condition ¹	Temperature	Wind Speed / Direction	Relative Humidity	Stability Class
Day - Calm	20°C	3m/s all directions	50%	D
Evening - Calm	10°C	3m/s all directions	50%	D
Night - Calm	10°C	2m/s all directions	50%	F

Note 1: Day 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening 6pm to 10pm; Night - the remaining periods.

This page has been intentionally left blank

6 Results

6.1 Construction Noise Results

Noise levels were predicted to each assessed receptor assuming receiver heights of 1.5m above ground level for typical construction activities during noise enhancing meteorological conditions. **Table 14** summarises the maximum predicted noise level from each of the construction scenarios (trenching, piling and assembly) at identified residential receivers.

Table 14 Predicted Construction Noise Levels

Receiver ID	Description/Address	Predicted Noise Level Range dB LAeq(15min) ¹	Highest Predicted Noise Level dB LAeq(15min)	NML Standard Hours dB LAeq(15min)	Compliance Achieved
R01	4133 Manilla Road	28-49	49	45	No
R02	4124 Manilla Road	26-47	47	45	No
R03	4077 Manilla Road	22-42	42	45	Yes
R04	83 Melrose Lane	17-36	36	45	Yes
R05	4182 Manilla Road	29-49	49	45	No
R06	118 Doring Lane	24-44	44	45	Yes
R07	Doring Lane	22-42	42	45	Yes
R08	4279 Manilla Road	22-41	41	45	Yes
R09	4279 Manilla Road	24-43	43	45	Yes

Note 1: Noise levels from construction activities vary due to their position across the project site with respect to surrounding receivers.

Noise levels at three receivers are expected to exceed the NMLs when works nearest to those locations. The exceedance would be temporary, and of short duration and is primarily due to piling activities.

6.2 Operational Noise Results

Noise levels were predicted at each assessed receiver assuming heights of 1.5m above ground level during noise enhancing meteorological conditions. **Table 15** summarises the predicted operational noise levels which are demonstrated to comply with the PNTLs at all residential receivers.

Table 15 Predicted Operational Noise Levels - Noise Enhancing Meteorological Condition

Receiver ID	Description/Address	Predicted Noise Level dB LAeq(15min)	Limiting Night PNTL dB LAeq(15min)	Compliance Achieved
R01	4133 Manilla Road	<30	35	Yes
R02	4124 Manilla Road	<30	35	Yes
R03	4077 Manilla Road	<30	35	Yes
R04	83 Melrose Lane	<30	35	Yes
R05	4182 Manilla Road	<30	35	Yes
R06	118 Doring Lane	<30	35	Yes
R07	Doring Lane	<30	35	Yes
R08	4279 Manilla Road	<30	35	Yes
R09	4279 Manilla Road	<30	35	Yes

6.3 Maximum Noise Level Assessment - Operations

A detailed maximum noise level assessment is not required as predicted noise levels for night time operations do not exceed the maximum noise level screening criterion of 40dB LAeq(15min) and there are no operational noise sources that generate significant maximum noise events.

6.4 Road Traffic Noise Assessment

Manilla Road would be the major transport route for all vehicles to access the project site. During construction, traffic generated by the project includes employee/subcontractor and delivery vehicles. The traffic volume over a typical day for standard construction hours is expected to be up to four heavy vehicles (semi-trailers or B-doubles) per hour and 20 light commercial vehicles or equivalent mini buses for worker transport during the morning and afternoon peak hour periods.

Predicted noise levels from project related construction traffic at the closest receiver on Manilla Road (20m) between the project site and the township (has been completed using the United States (US) Environment Protection Agency's road traffic calculation method and results are presented in **Table 16**.

Table 16 Predicted Construction Road Traffic Noise Levels

Road Name	Offset Distance to Receiver	Predicted Noise Level	RTN Criteria	Compliance Achieved
Manilla Road	20m	49dB LAeq(15hr)	60dBA LAeq(15hr)	Yes

Results demonstrate that project construction traffic noise levels would comply with the relevant RNP criteria.

7 Recommendations

7.1 Construction Noise Recommendations

It is noted that construction noise emissions are anticipated to exceed the relevant NMLs depending on the type of construction and proximity of activities to receivers. Recommendations for consideration during the construction phase to reduce emissions to the surrounding community for this project may include:

- a construction noise management protocol to minimise noise emissions, manage out of hours (minor) works to be inaudible, and to respond to potential concerns from the community;
- where possible use localised mobile screens or construction hoarding around plant to act as barriers between construction works and receivers, particularly where equipment is near the site boundary and/or a residential receiver including areas in constant or regular use (eg unloading and laydown areas);
- operating plant in a conservative manner (no over-revving), shutdown when not in use, and be parked/started at farthest point from relevant assessment locations;
- selection of the quietest suitable machinery available for each activity;
- minimise noisy plant/machinery working simultaneously where practicable;
- minimise impact noise wherever possible;
- utilise a broadband reverse alarm in lieu of the traditional high frequency type reverse alarm;
- provide toolbox meetings, training and education to drivers and contractors visiting the site during construction so they are aware of the location of noise sensitive receivers and to be cognisant of any noise generating activities;
- signage is to be placed at the front entrance advising truck drivers of their requirement to minimise noise both on and off-site; and
- utilise project related community consultation forums to notify residences within close proximity of the site with project progress, proposed/upcoming potentially noise generating works, its duration and nature and complaint procedure.

7.2 Operational Noise Recommendations

Operational noise predictions identify that relevant noise criteria would be satisfied at all receivers. Notwithstanding, it is recommended that the proponent actively minimise potential noise emissions from the project. To assist in noise management for the project it is recommended that a one-off noise validation monitoring assessment be completed to quantify emissions from site and to confirm emissions meet relevant criteria.

8 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has been engaged by KDC Pty Ltd (KDC) to complete a Noise Assessment (NA) for the proposed Manilla Solar Farm near Manilla, NSW. The assessment has quantified potential noise emissions associated with the construction and operation of the project.

The results of the NA demonstrate that construction noise levels have potential to exceed relevant construction NMLs at three receiver locations. Recommendations have been provided to minimise the potential noise impacts from construction, albeit of a temporary nature during the daytime over a six month construction period.

Operational noise levels satisfy the NPI PNTLs for assessed receivers. However, recommendations to ensure noise levels are verified have been provided in this report.

Additionally, the NA demonstrates that the road noise criteria as specified in the RNP will be satisfied at all receivers on the proposed transport route.

Based on the NA results, there are no noise related issues which would prevent the approval of the project. The results of the assessment shows compliance with the relevant operational and road noise criteria. Accordingly, no additional ameliorative measures will be required.

This page has been intentionally left blank

Appendix A – Glossary of Terms

A number of technical terms have been used in this report and are explained in Table A1.

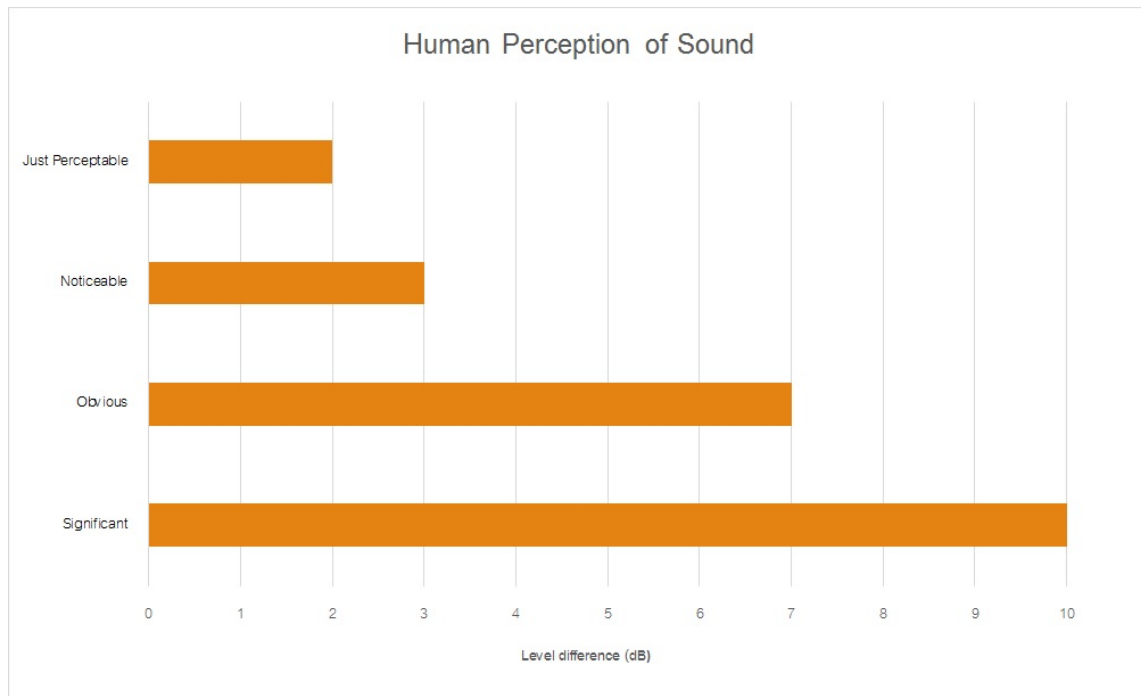
Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Ambient Noise	The noise associated with a given environment. Typically, a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmx	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : $= 10 \cdot \log_{10} (W/W_0)$ Where: W is the sound power in watts and W₀ is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com



Project Number: HN19102401



ABORIGINAL DUE DILIGENCE ASSESSMENT REPORT – 4133 MANILLA ROAD, MANILLA, NSW

19 / 3 / 2020 FINAL

ANDERSON ENVIRONMENT AND PLANNING

Ian Benson - ian@andersonep.com.au

CONTACT

tessa@heritagenow.com.au

0425 250 310

www.heritagenow.com.au



Executive Summary

Heritage Now has been engaged by Anderson Environment and Planning to undertake an Aboriginal Due Diligence Assessment of 4133 Manilla Road, Manilla, NSW for the purpose of a Providence Asset Group's Manilla Solar Farm. The Project Area is located within the boundaries of the Tamworth Local Government Area and the Tamworth Local Aboriginal Land Council.

The Project Area was inspected with representatives of the Tamworth Local Aboriginal Land Council and the Gomeroi Native Title Claimants.

Two Aboriginal sites were identified in the southern portion of the Project Area. An artefact scatter and PAD (HN-MA-A01) and an isolated find (HN-MA-A02). The Aboriginal cultural values and archaeological values of the sites were assessed. The Gomeroi and Tamworth representatives indicated that the two Aboriginal sites had Aboriginal cultural significance for demonstrating Aboriginal occupation and camping in the area. HN-MA-A01 Artefact Scatter and PAD has moderate archaeological value on a local level and HN-MA-A02 has low archaeological value on a local level.

The Project Proposal is for the construction of a solar farm with 180 sets of trackers with 15,120 solar panels, as well as an access road, a hardstand area, car park, detention basin, power conversion unit, temporary construction office and offload area, encircled by 1800 metres of security fencing.

The placement all infrastructure associated with the development has avoided both Aboriginal sites (HN-MA-A01 and HN-MA-A02). There is potential for inadvertent impact to the Aboriginal sites from light vehicle and solar panel installation. To mitigate the risk of inadvertent impact to Aboriginal sites (HN-MA-A01 and HN-MA-A02), their locations are to be marked as no-go zones on all construction maps and if necessary, are to be fenced. All on-site personnel are to be made aware of their heritage obligations under the NSW National Parks and Wildlife Act 1974. This may be implemented through a heritage induction.

The following recommendations are to be followed.

Recommendation 1

The locations of Aboriginal sites (HN-MA-A01 and HN-MA-A02) are to be marked as no-go zones on all construction plans. During construction it may be necessary to demarcate these sites using temporary fencing or other visual markers to prevent inadvertent impact.

Recommendation 2

All on-site personnel are to be made aware of their obligations under the NSW National Parks and Wildlife Act 1974, which may be implemented through a heritage induction.

Contents

1	Introduction	1
1.1	Project Area	1
1.2	Project Proposal	1
2	Legislative Context	2
2.1	National Parks and Wildlife Act 1974	2
2.2	National Parks and Wildlife Regulations 2009	2
2.3	Aboriginal Land Rights Act 1983	2
2.4	Environmental Planning and Assessment Act 1979	2
3	Environmental Context	4
3.1	Geology and Soils	4
3.2	Topography and Hydrology	4
3.3	Flora and Fauna	4
3.4	Land Use	5
3.5	Synthesis	5
4	Heritage Context	6
4.1	Aboriginal Occupation of the North West Slopes	6
4.1.1	Archaeological background	6
4.1.2	Ethnographic and Historical Records	6
4.1.3	Aboriginal Material Culture	7
4.2	Aboriginal Heritage Information Management System (AHIMS)	7
4.3	Previous Heritage Assessment	9
4.4	Synthesis	9
5	Site Visit	10
5.1	Summary	12
6	Significance Assessment	13
6.1	Methodology	13
6.1.1	Aboriginal Cultural Values	13
6.1.2	Archaeological (Scientific) Values	13
6.2	Aboriginal Cultural Values of the Project Area	14
6.3	Archaeological Values of the Project Area	14
6.3.1	HN-MA-A01 Artefact Scatter and PAD	14
6.3.2	HN-MA-A02 Isolated Find	14
6.4	Summary	14

7	Impact Assessment	15
7.1	Project Proposal	15
7.2	Impact Assessment	15
7.3	Mitigation.....	15
7.4	Summary	15
8	Conclusions and Recommendations	17
9	References	18
10	Plates.....	19
11	Acronyms and Definitions.....	24
	Attachment 1 AHIMS Search.....	25

Tables

Table 1.	Manilla soil profile.....	4
Table 2.	Aboriginal sites recorded on AHIMS	7

Figures

Figure 1.	Project Area.....	1
Figure 2	AHIMS Sites	8
Figure 3	Survey Units and Aboriginal Sites Identified.....	11
Figure 4	Impact Area and Aboriginal sites	16

Plates

Plate 1	View of western paddock from south to north (February 2020)	19
Plate 2	Exposed yellowy brown silty soils (February 2020)	19
Plate 3	Chert flake HN-MA-A01 Artefact 1 (February 2020).....	20
Plate 4	Chert Flake HN-MA-A01 Artefact 2 (February 2020).....	20
Plate 5	HN-MA-A02 Basalt flake (February 2020).....	21
Plate 6	Location of proposed access road (February 2020).....	21
Plate 7	Survey Unit 3 (February 2020)	22
Plate 8	Greenhatch Creek section (December 2019).....	22
Plate 9	Greenhatch Creek section (February 2020).....	23

1 Introduction

Heritage Now has been engaged by Anderson Environment and Planning to undertake an Aboriginal Due Diligence Assessment of 4133 Manilla Road, Manilla, NSW for the purpose of a Providence Asset Group's Manilla Solar Farm.

1.1 Project Area

The Project Area is situated at 4133 Manilla Road, Manilla, NSW. It is approximately 3.5km southeast from the junction of the Namoi and Manilla Rivers. The town of Manilla sits in the bend of the Namoi River. This location is part of the North Western Slopes region. The Project Area is located within the boundaries of the Tamworth Local Government Area and the Tamworth Local Aboriginal Land Council.



 Project Area

0 100 200 m



Figure 1. Project Area

1.2 Project Proposal

The Project Proposal is for the construction of a solar farm with 180 sets of trackers with 15,120 solar panels, as well as an access road, a hardstand area, car park, detention basin and power conversion unit. A temporary construction office will be constructed along with a hardstand and construction laydown area. The development will be encircled by 1800 metres of security fencing. The proposal also entails a 5 metre wide access road running west from Manilla Road, with access across the disused railway line, to the solar panel installation.

2 Legislative Context

This section provides an outline of the Acts, Regulations and guidelines under which this assessment has been undertaken. It is for information purposes only and should not be taken as legal advice.

2.1 National Parks and Wildlife Act 1974

This Act contains the provisions for protecting Aboriginal objects in NSW. Aboriginal objects are protected regardless of whether they are in their original context (location) or not and it is an offence to harm an Aboriginal object regardless of whether you know it is an Aboriginal object or not. Protection under Section 86 of the Act is as follows:

- s86(1) A person must not harm or desecrate an object that the person knows is an Aboriginal object.
- s86(2) A person must not harm an Aboriginal object.
- s86(3) A person must not harm or desecrate an Aboriginal place.

Penalties for harming Aboriginal objects or Places range from \$80,000-\$800,000 for individuals and \$330,000-\$1,650,000 for corporations and may also include imprisonment. Under Section 87 there are certain defences from prosecution, these include that harm was authorised under an Aboriginal Heritage Impact Permit (AHIP) and actions were in accordance with the AHIP, that due diligence was exercised in relation to Aboriginal object/s and/or the activity was classified as low impact.

Under Section 89A Aboriginal object/s must be reported to the Office of Environment and Heritage (OEH) within a reasonable timeframe, unless it has previously been recorded and submitted to the Aboriginal Heritage Information Management System (AHIMS). Penalties for failure to report an Aboriginal object range from \$16,500 for individuals and \$33,000 for corporations.

2.2 National Parks and Wildlife Regulations 2009

This Regulation provides a framework for exercising due diligence and provides codes of practice in respect to Aboriginal objects (Section 80A) as well as defences for carrying out certain low impact activities (Section 80B). The Regulation also outlines requirements for Aboriginal consultation (Section 80C), particularly in relation to an Aboriginal Heritage Impact Permit. Under the Regulation the following codes of practice are recognised, amongst others:

- *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (OEH, formerly DECCW 2010)
- *NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects* (Minerals Council)

2.3 Aboriginal Land Rights Act 1983

This Act provides land rights to Aboriginal people through the Local Aboriginal Land Councils. It outlines a process for claiming unused Crown Land in NSW and for creating land use. It also allows for agreements to permit traditional hunting, fishing and gathering.

2.4 Environmental Planning and Assessment Act 1979

The Environmental Planning and Assessment (EP&A) Act provides triggers for undertaking environmental and heritage assessments as part of the wider land use planning framework. Part 4

outlines the how consent authorities are to determine development applications, as well as identifying whether projects require an environmental impact statement. Part 9 outlines the implementation and enforcement of the EP&A Act. As part of this, there are Section 117 directions (2017 renumbering as Section 9.1-9.5). The Section 117 directions include the following in respect to Aboriginal heritage:

2.3[4] A planning proposal must contain provisions that facilitate the conservation of:

- a) items, places, buildings, works, relics, moveable objects or precincts of environmental heritage significance to an area, in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item, area, object or place, identified in a study of the environmental heritage of the area,
- b) Aboriginal objects or Aboriginal places that are protected under the National Parks and Wildlife Act 1974, and
- c) Aboriginal areas, Aboriginal objects, Aboriginal places or landscapes identified by an Aboriginal heritage survey prepared by or on behalf of an Aboriginal Land Council, Aboriginal body or public authority and provided to the relevant planning authority, which identifies the area, object, place or landscape as being of heritage significance to Aboriginal culture and people.

Tamworth Regional Local Environmental Plan (LEP) 2010

The Tamworth Regional LEP outlines triggers for heritage assessments as part of the Development Application process. It also protects heritage as listed in Schedule 5.10 of the LEP.

3 Environmental Context

This section provides the environmental context for the assessment of past Aboriginal occupation in the Project Area.

3.1 Geology and Soils

The geological formations of the local area can provide valuable information regarding the stone resources that may have been available to Aboriginal people in the area.

The Project Area is located on the sandstone rich facies of the Baldwin Formation belonging to the Devonian Period. This geological type is characterised by massive feldspathic to lithic volcanoclastic sandstone, with interceded siltstone and mudstone (Geological Survey of NSW, 2008). Mudstone is known to have been used by Aboriginal people for the manufacture of stone tools, so it is likely that where a suitable outcrop of mudstone occurs, the resource was being exploited by local Aboriginal people. Sandstone is also known to have been used extensively in Aboriginal cultures. Large sandstone outcrops were often used for rock art/engravings. Larger outcrops often provided rock-shelter which could be used as campsites with natural protection from the weather. Sandstone with a nearby water source was also used for sharpening and grinding stone tools, leaving axe-grinding groove sites.

Local soils comprise of light and medium heavy clays. (NSW Soil and Land Information System, 2016). Based on the soil samples taken just south of Manilla (Table 1).

Table 1. Manilla soil profile

Layer 1 0.00 – 0.20m A1 Horizon	Light clay, brown, with weak pedality, field pH 8.0, few coarse fragments (2-10%)
Layer 2 0.20 -1.15m B2 Horizon	Medium heavy clay, strong brown, with weak pedality, field pH 8.5, few coarse fragments (<2%)

3.2 Topography and Hydrology

The Project Area is located at 380m above sea level (Australian Height Datum). The western boundary of the property associated with this Project Area follows the topography of Greenhatch Creek, a fourth-order stream and tributary of the Namoi River. Greenhatch Creek may have been a source of fresh drinking water and food gathering for the local Aboriginal people.

3.3 Flora and Fauna

The Project Area is located in the Nandewar biogeographical region. Past Aboriginal peoples may have encountered the broad vegetation formation of Western Grassy Slopes Woodlands, a eucalyptus woodland typically up to 20 m tall with a sparse shrub stratum and continuous ground cover of tussock grasses and a variety of herbs (Keith, 2006). The characteristic trees of this vegetation type are Yellow Gum and Blakeley's Red Gum. Shrubs include blackthorn, sifton bush, winter apple, native olive, curved rice flower and leafy templetonia. Ground cover includes lomandra, variable plantain, plains grass, rough spear grass, wheatgrass and kangaroo grass. Some of these species would have been used as by Aboriginal people as raw materials for implements and weaving, as well as food and medicine.

Fauna associated with this vegetation type includes kangaroos, emus, echidna, possums, platypus and bandicoot, as well as many kinds of birds, lizards, snakes and frogs. The rivers and creeks supported many kinds of fish, crayfish, mussels and shrimp. These were all potential sources of food for Aboriginal people in the area.

3.4 Land Use

The land is predominantly cleared land used for agricultural and pastoral purposes.

3.5 Synthesis

Overview of the environmental context indicates that there is likely to have been useful resources including food, raw materials and drinking water to support Aboriginal occupation.

4 Heritage Context

This section outlines the Aboriginal heritage context of the Project Area. It includes a general outline of Aboriginal occupation in Australia and the region, an analysis of search results from the Aboriginal Heritage Information Management System (AHIMS), as well as relevant heritage studies.

4.1 Aboriginal Occupation of the North West Slopes

The lands in and around the North West Slopes/Tamworth region are the traditional lands of the Gamilaroi people (there are many recorded spellings and pronunciations including Kamilaroi, Gamilaraay, Gomeroi and various others). The Gamilaroi had a complex social system of moieties, sections and totemic clans. Responsibility for caring for the land was inherited through this system, ensuring the ongoing survival and increase of plant and animal resources. The Gamilaroi territory was vast, but they lived in small family groups, occupying defined hunting grounds with boundaries marked by watercourses, trees and other recognised landmarks. They utilised a wide variety of plant and animal foods, seasonally available in the rich riverine environment of the Barwon, Gwydir and Namoi rivers. They had trade and exchange relationships with surrounding tribal groups, and held social gatherings where marriages were arranged, ceremonies held, alliances forged and disputes settled. The region is known for its ornately carved trees, ceremonial bora grounds and art sites, indicative of the close spiritual and physical attachment of Gamilaroi people to the landscape they inhabited.¹

4.1.1. Archaeological background

Aboriginal people have occupied Australia for at least 50,000 years, with potential evidence for earlier occupation. Evidence for earlier occupation is limited by the lower preservation of archaeological deposits extending back in time but is also limited by the types of scientific dating techniques available. Aboriginal occupation in northern NSW has been dated to 20,310 BP near Coonabarabran. In the North West Slopes/Tamworth region, dates range between 3,600 BP and 4,950 BP, although it is likely that Gamilaroi people have occupied their territory for at least 20,000 years, and these dates may be extended with further excavations in the area.²

4.1.2. Ethnographic and Historical Records

The early Europeans kept written records of their observations of Aboriginal culture, including the use of tools, resources, particular places, and in some instances, even recorded indigenous language. These records have become important sources of information, although it must be remembered they also contain cultural and historical biases. These primary sources used in conjunction with archaeological sources and traditional knowledge can reveal much about Aboriginal society, history, lifestyle and use of resources. There are only a limited number of early sources on Gamilaroi culture, often from the northwest region.³

¹ J. Boileau 2007, *Thematic History of Nundle, Manilla and Barraba*, Tamworth Regional Council Community Based Heritage Study.

² J. Wilson and L. McAdam 2000, *The Tamworth Aboriginal/Archaeological Site Study*, Report prepared for Tamworth City Council, p.9.

³ R.S.Fuller, R.P.Norris, M.Trudgett no date *The Astronomy of the Kamilaroi People and their Neighbours* <https://arxiv.org/pdf/1311.0076.pdf>.

4.1.3. Aboriginal Material Culture

The material culture of Aboriginal people was made from natural materials sourced from their local environment or traded with other groups from where the resource could be found. Stone, trees, plants and grasses, clays, shells, as well as parts of animals, were all utilised in making shelter, fire, tools, weapons, implements, apparel and ceremonial equipment. Historic records and oral history demonstrate there was a vast array of material culture. Not all of the materials used by Aboriginal people survive particularly well in archaeological contexts. This is partly due to the wet-dry effect of Australian soils, as well as the nature of the organic material. An exception to this would be if the artefacts were buried in an anaerobic environment such as a peat swamp, which would enable the preservation and survival of organic material such as wood and fibre. Often only the stone component, such as stone barbs used on spears, are most likely to survive in an archaeological deposit.

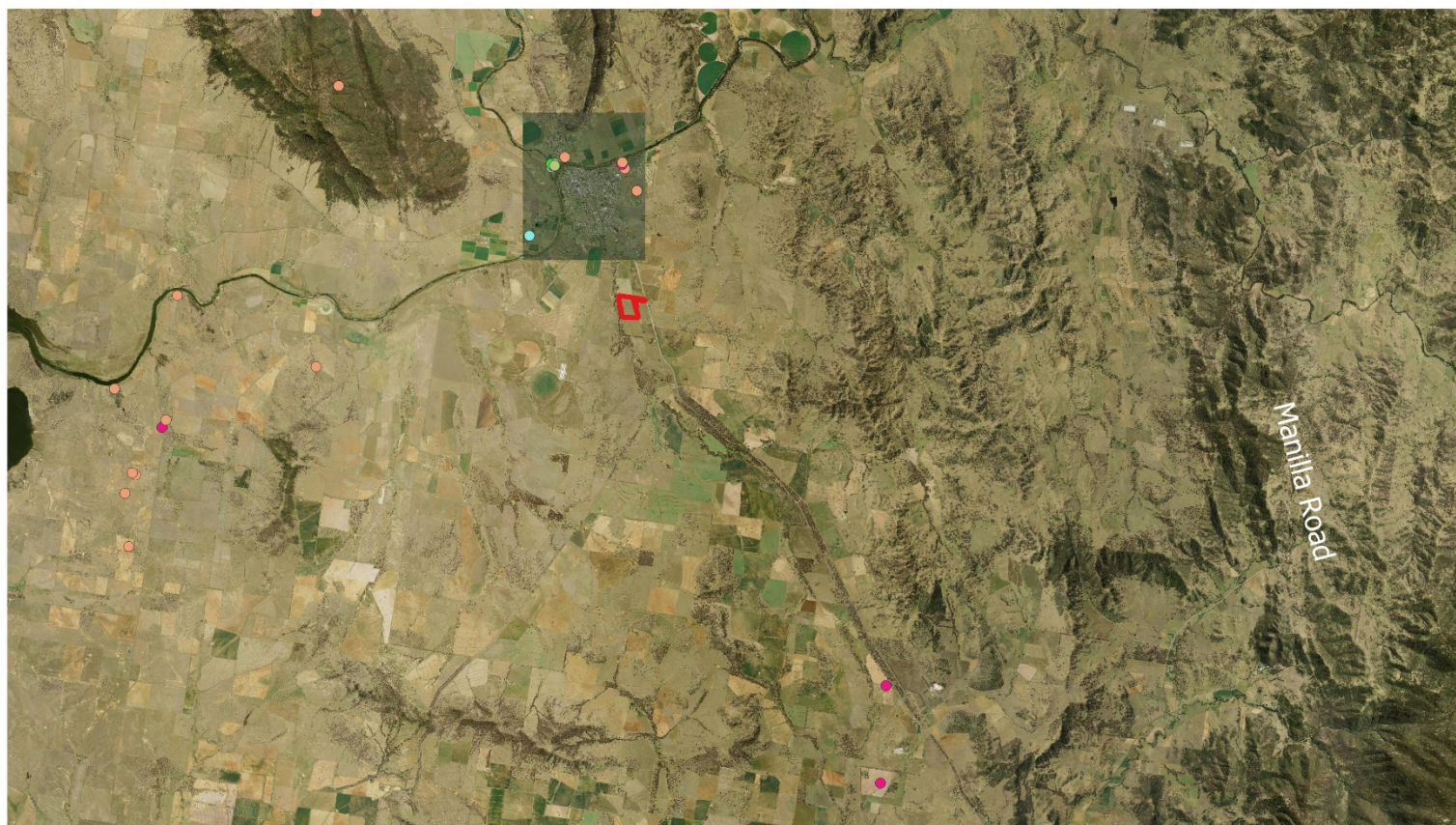
4.2 Aboriginal Heritage Information Management System (AHIMS)

A search of the AHIMS database was undertaken for the Project Area and its surrounding area (Latitude: -30.9082, Longitude: 150.5886 to Latitude: -30.6771, Longitude: 150.9076, 26/11/2019). AHIMS has 31 Aboriginal sites recorded within this search area (Appendix 1). Surface artefacts are the most common site type, equalling approximately 45% of sites recorded (Table 2). Ceremony and Dreaming sites make up a high proportion of sites with almost 23% of which 16% are Restricted sites (sites where the cultural information cannot be released without special permission). Modified Trees and Burial sites both constitute 12% each of all sites.

The distribution of surface artefacts is mostly associated with the Namoi River, or the tributaries of the Namoi River, although there are some examples up in highlands (Figure 2). The remaining site types do not have a distinct spatial distribution.

Table 2. Aboriginal sites recorded on AHIMS

Site types	Count	Percentage
Artefact	14	45.16%
Ceremony and Dreaming/Restricted	5	16.13%
Modified Tree (Carved or Scarred)	4	12.90%
Burial	4	12.90%
Ceremony and Dreaming	2	6.45%
Stone arrangement	1	3.23%
Artefact/Open Camp site	1	3.23%
Grand Total	31	100.00%



- Project Area
- Artefact/Open Camp site
- Modified Tree (Carved or Scarred)
- AHIMS
- Burial
- Stone arrangement
- Artefact
- Ceremony and Dreaming

0 2.5 5 km



Figure 2 AHIMS Sites

4.3 Previous Heritage Assessment

There are few heritage reports which have been undertaken in the region. The below is the most relevant to the Project Area.

Robins, T., Piper, A. & Towers, J. (2015) Cultural Heritage Due Diligence Assessment of the Glen Artney Industrial Development West Tamworth, NSW (Feb 2015). Everick Heritage Consultants Pty Ltd unpublished report prepared for GHD and Tamworth Regional Council.

Everick Consulting was commissioned by GHD on behalf of Tamworth Regional Council to undertake a cultural heritage assessment of the assessment area (Glen Artney Industrial Development) in order to provide advice on the suitability of rezoning the assessment area. Methodology included desktop survey of the assessment area, consultation with Tamworth LALC and a targeted archaeological survey. AHIMS search revealed 3 sites within assessment area, and six within close proximity. Six sites were located during field survey (artefacts and a modified tree) and were subsequently registered with the OEH as part the requirements of the NPW Act. The assessment area was considered having predominantly low archaeological significance due to the heavily disturbed landscape. The archaeological significance of the modified tree was rated as moderate. The report concluded that there were no cultural heritage impediments to the rezoning and that further assessment of the located sites would take place at the Development Application stage. They also recommended minimal disturbance of creek banks in the assessment area as they retain the potential for subsurface Aboriginal objects and outlined a Finds Procedure for Aboriginal Objects and Aboriginal Human Remains Procedure.

4.4 Synthesis

The AHIMS search revealed 31 sites have been previously recorded in the region. The distribution of surface artefacts is mostly associated with the Namoi River, or the tributaries of the Namoi River, although there are some examples up in highlands. The remaining site types do not have a distinct spatial distribution.

5 Site Visit

A visual inspection of the Project Area was conducted by Heritage Now Consultant Sarah Mane on 19 February 2020 along with Gomeroi Native Title representatives Peter White -Senior, Peter White – Junior, Sharon Porter and Steve Talbot, as well as Danny Fermor from the Tamworth Local Aboriginal Land Council. This site visit followed a preliminary inspection by Nicola Hirschhorn on the 6th of December 2019. The Project Area is located on a floodplain immediately east of Greenhatch Creek. The area is highly disturbed, with all vegetation cleared for wheat production and pasturing of livestock in the past. The paddocks have been heavily ploughed over a long period of time, and other disturbances include the erection of fencing, construction of dams, access by vehicles, and installation of water pipes.

Three survey units (SU) were inspected for Aboriginal objects (Figure 3). SU1 comprised the fenced paddock west of the railway line where the bulk of the proposed infrastructure will be located; SU2, the proposed access road adjacent to the northern fence of the eastern paddock and crossing the disused railway line into the western paddock; and SU3, located east of, and parallel with, the disused railway line (will possibly be used for a power line).

SU1 - The western paddock was inspected by foot using east/west transects as well as opportunistic inspections of exposures (Plate 1). Ground surface exposure was moderate due to the erosion of topsoils and visibility generally moderate-high gaps between the vegetation and combined with exposures. In parts of the paddock up to 100% of the ground surface was visible; closer to the railway line, long, dry tufted grasses reduced visibility to around 30-50%. Exposed soils were of yellowy-brown compacted silt (Plate 2). A probe could be inserted to approximately 20 centimetres. One dead tree was located within SU1 and no cultural markings were evident. Two Aboriginal sites were identified.

An artefact scatter and PAD (HN-MA-A01) was identified on a rise 140 metres from Greenhatch Creek. Two chert flakes were identified; one measured 29 millimetres in length, 24 millimetres in width and 12 millimetres in thickness (Plate 3), the other measured 26 millimetres in length, 20 millimetres in width and 5 millimetres in thickness (Plate 4). These artefacts were located on a rise with potential archaeological deposit, a flag probe indicated the subsurface soils are approximately 20 centimetres in depth.

An isolated find (HN-MA-A02) was identified on a rise 56 metres east of Greenhatch Creek. This Aboriginal object comprised a complete grey basalt flake 20 millimetres in length, 15 millimetres in width and 6 millimetres in thickness (Plate 5).

SU2 – The proposed access road follows the northern boundary fence from Manilla Road west across the eastern paddock and the disused railway line, to the western paddock (Plate 6). The length of the access road was inspected to a width of approximately 10 metres. The area is highly disturbed as a result of prior farming and vehicle access. Exposed soils were similar to those in SU1. Inspection of the proposed access road identified no Aboriginal objects or places.

SU3 – An area located east of the railway line was inspected for a proposed powerline. The railway line is built up and constructed on imported fill including crushed granite and blue metal. Ground visibility in this area was around 20% with limited ground surface exposures (Plate 7). No Aboriginal objects or potential archaeological deposits were identified in this survey unit.



Survey Units
 Survey Unit 1
 Survey Unit 2
 Survey Unit 3
 Aboriginal Sites Identified

0 100 200 m


Figure 3 Survey Units and Aboriginal Sites Identified

Although not within the Project Area, a section of Greenhatch Creek was observed. In December 2019 no water was flowing and the creekbed and it was vegetated with reeds and grasses (Plate 8). In February 2020, water was flowing in the creek due to summer rainfall (Plate 9). During both inspections it was noted the banks of the creek were highly eroded due to clearance of vegetation. No sandstone outcrops were observed. No Aboriginal objects were identified and the few existing trees showed no evidence of cultural marking.

5.1 Summary

Two Aboriginal sites were identified in the southern portion of the Project Area. An artefact scatter and PAD (HN-MA-A01) and an isolated find (HN-MA-A02).

6 Significance Assessment

Cultural heritage refers to the tangible and intangible values that we choose to pass on to future generations. In order to identify the values worth passing on, a significance assessment needs to be undertaken. The significance assessment needs to: identify the range of values present across the Project Area and assess their importance.

6.1 Methodology

Identifying the Aboriginal cultural values is part of the significance assessment process and is guided by the Burra Charter and the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*.

There are four recognised classes of values under the Burra Charter (Australia ICOMOS, 2013):

- Social,
- Historical,
- Aesthetic, and
- Scientific

Within this significance assessment, Aboriginal cultural values are captured within social, historical and aesthetic values. The archaeological values are contained within scientific values.

Social value refers to the spiritual, traditional, historical or contemporary associations that Aboriginal people have for place. Historical value refers to the associations of a place with a historically important person, event, phase or activity in the Aboriginal community. Aesthetic value refers to the sensory, scenic, architectural and creative aspects of the place.

Archaeological values refer to the importance of the landscape, area, place or object because of its rarity, representativeness and the extent to which it may inform our understanding of Aboriginal culture.

6.1.1. Aboriginal Cultural Values

Aboriginal cultural values are identified through the Aboriginal consultation process. Representatives of Gomeroi Native Title Claimants and Tamworth Local Aboriginal Land Council were consulted with regards to the Project Area during the site inspection.

6.1.2. Archaeological (Scientific) Values

Archaeological (scientific) values relate to whether the Project Area can contribute to our understanding of Aboriginal culture. Under the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*, archaeological values are to be considered within the below sub-categories:

- Representativeness,
- Rarity,
- Research potential, and
- Educational potential.

6.2 Aboriginal Cultural Values of the Project Area

The Gomeroi and Tamworth representatives indicated that the two Aboriginal sites had Aboriginal cultural significance for demonstrating Aboriginal occupation and camping in the area.

6.3 Archaeological Values of the Project Area

6.3.1. HN-MA-A01 Artefact Scatter and PAD

This site is highly representative of Aboriginal occupation in the locality. The artefact type and raw materials were not rare on a local level. The site has moderate research potential which may be further demonstrated by the potential archaeological deposit. The site has moderate educational value for understanding Aboriginal campsites and occupation in the local region. Overall, this site has moderate archaeological value on a local level and low archaeological value on a regional level.

6.3.2 HN-MA-A02 Isolated Find

This site is highly representative of Aboriginal occupation in the locality. The artefact type and raw material is not rare on a local level. The site has low research potential with no further information contained in the site through archaeological deposit or other artefact associations. The site has low education value. Overall, this site has low archaeological value on a local level and low archaeological value on a regional level.

6.4 Summary

HN-MA-A01 Artefact Scatter and PAD has moderate archaeological value on a local level and HN-MA-A02 has low archaeological value on a local level. Neither site is of regional significance.

7 Impact Assessment

This section assesses the potential impact of the proposed works in relation to Aboriginal heritage values in the Project Area and provides options for mitigating loss of Aboriginal cultural values.

7.1 Project Proposal

The Project Proposal is for the construction of a solar farm with 180 sets of trackers with 15,120 solar panels, as well as an access road, a hardstand area, car park, detention basin and power conversion unit. A temporary construction office will be constructed along with a hardstand and construction laydown area. The development will be encircled by 1800 metres of security fencing. The proposal also entails a 5 metre wide access road running west from Manilla Road, with access across the disused railway line, to the solar panel installation.

7.2 Impact Assessment

The placement all infrastructure associated with the development has avoided both Aboriginal sites (HN-MA-A01 and HN-MA-A02). The solar panel are located north of HN-MA-A01 and a minimum 10 metre buffer has been applied around the site (Figure 4).

There is potential for inadvertent impact to the Aboriginal sites from light vehicle and solar panel installation.

7.3 Mitigation

To mitigate the risk of inadvertent impact to Aboriginal sites (HN-MA-A01 and HN-MA-A02), their locations are to be marked as no-go zones on all construction maps and if necessary, are to be fenced.

All on-site personnel are to be made aware of their heritage obligations under the NSW National Parks and Wildlife Act 1974. This may be implemented through a heritage induction.

7.4 Summary

The placement of all infrastructure associated with the development has avoided the Aboriginal sites. There is potential for inadvertent impact to the Aboriginal sites from light vehicle and solar panel installation. This risk is to be mitigated by ensuring all onsite personnel are aware that these sites are to be avoided through clear construction drawings, fencing, if necessary and direct communication with all on-site personnel.

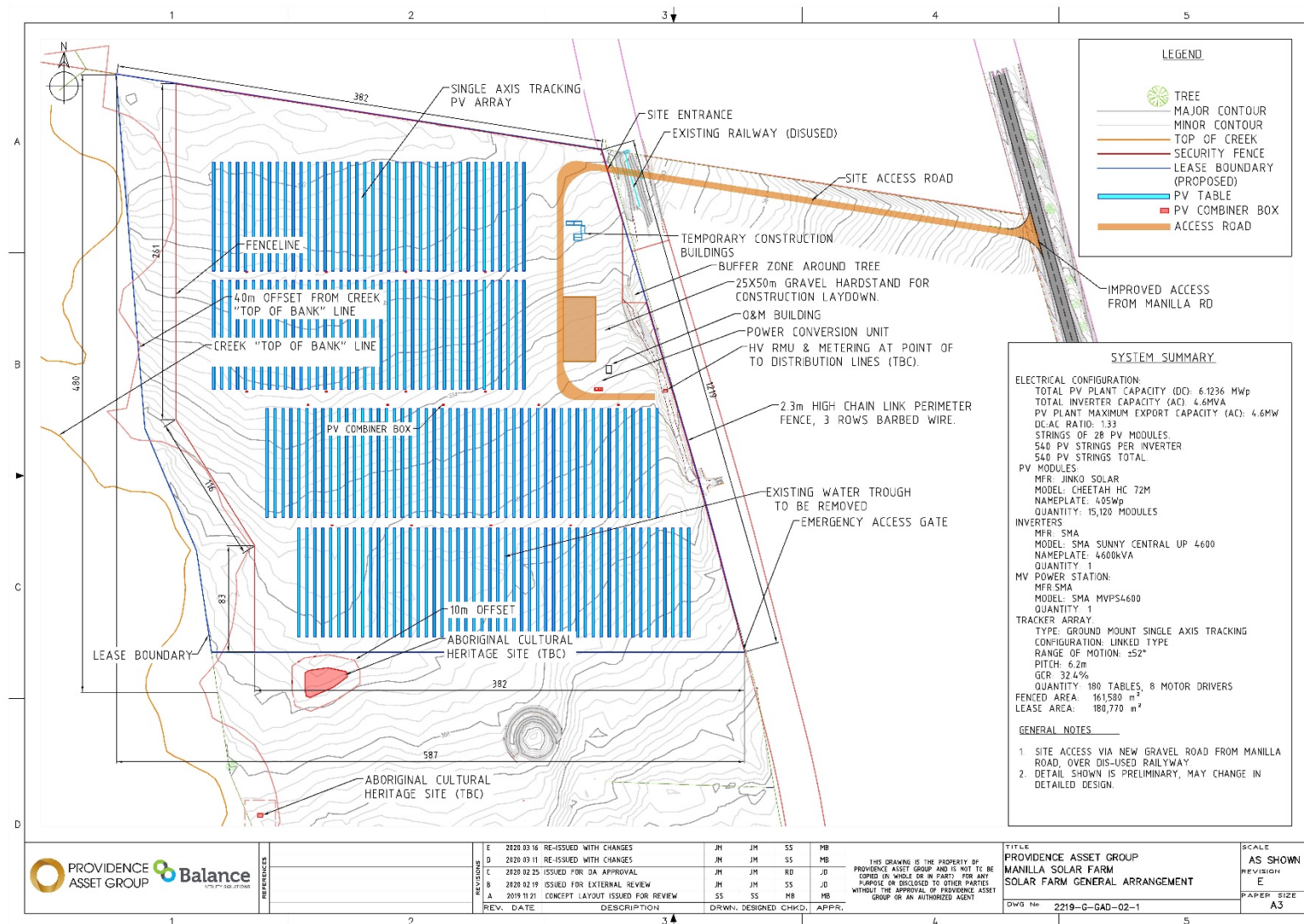


Figure 4 Impact Area and Aboriginal sites

8 Conclusions and Recommendations

Two Aboriginal sites were identified in the southern portion of the Project Area. An artefact scatter and PAD (HN-MA-A01) and an isolated find (HN-MA-A02). The Gomeroi and Tamworth representatives indicated that the two Aboriginal sites had Aboriginal cultural significance for demonstrating Aboriginal occupation and camping in the area. HN-MA-A01 Artefact Scatter and PAD has moderate archaeological value on a local level and HN-MA-A02 has low archaeological value on a local level.

The placement of all infrastructure associated with the development has avoided both Aboriginal sites (HN-MA-A01 and HN-MA-A02). There is potential for inadvertent impact to the Aboriginal sites from light vehicle and solar panel installation. To mitigate the risk of inadvertent impact to Aboriginal sites (HN-MA-A01 and HN-MA-A02), their locations are to be marked as no-go zones on all construction maps and if necessary, are to be fenced. All on-site personnel are to be made aware of their heritage obligations under the NSW National Parks and Wildlife Act 1974. This may be implemented through a heritage induction.

The following recommendations are to be followed.

Recommendation 1

The locations of Aboriginal sites (HN-MA-A01 and HN-MA-A02) are to be marked as no-go zones on all construction plans. During construction it may be necessary to demarcate these sites using temporary fencing or other visual markers to prevent inadvertent impact.

Recommendation 2

All on-site personnel are to be made aware of their obligations under the NSW National Parks and Wildlife Act 1974, which may be implemented through a heritage induction.

9 References

Australia ICOMOS. (2013). *The Burra Charter*. Australia International Council on Monuments and Sites.

Geological Survey of NSW. (1975). *Newcastle 1:100,000 mapsheet*. Department of Mines .

NSW Spatial Data Catalog. (2011). Retrieved from Six Maps: NSW Spatial Services:
<https://maps.six.nsw.gov.au/>

Robins, T. (2015).

Cultural Heritage Due Diligence Assessment of the Glen Artney Industrial Development West Tamworth, NSW (February 2015). Everick Heritage Consultants Pty Ltd unpublished report prepared for GHD and the Tamworth Regional Council. .

10Plates



Plate 1 View of western paddock from south to north (February 2020)



Plate 2 Exposed yellowy brown silty soils (February 2020)



Plate 3 Chert flake HN-MA-A01 Artefact 1 (February 2020)



Plate 4 Chert Flake HN-MA-A01 Artefact 2 (February 2020)



Plate 5 HN-MA-A02 Basalt flake (February 2020)



Plate 6 Location of proposed access road (February 2020)



Plate 7 Survey Unit 3 (February 2020)



Plate 8 Greenhatch Creek section (December 2019)



Plate 9 Greenhatch Creek section (February 2020)

11 Acronyms and Definitions

Acronym	Definition
AHIMS	Aboriginal Heritage Information Management System managed by OEH
AHIP	Aboriginal Heritage Impact Permit
DECCW	Department of Climate Change and Water, NSW, became the Office of Environment and Heritage in 2011
GDA	Geocentric Datum Australia
km/s	Kilometre/Kilometres
LALC	Local Aboriginal Land Council – Land Council under the Aboriginal Land Rights Act 1983
LEP	Local Environmental Plan
LGA	Local Government Area
OEH	Office of Environment and Heritage, NSW
m	Metric metres

Attachment 1 AHIMS Search

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : Manilla19102401 20km

Client Service ID : 467504

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
20-5-0045	MANILLA SEWERAGE TREATMENT WORKS 1	AGD	56	280540	6594760	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
20-5-0011	Attunga;Kaytoun;	AGD	56	290000	6580000	Open site	Valid	Modified Tree (Carved or Scarred) : -	Carved Tree	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
20-5-0015	Manilla;	AGD	56	290150	6582630	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
20-5-0051	NRA 10: Baldwins Range	AGD	56	275400	6598800	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
20-5-0052	NRA 11: Dinawirindi	AGD	56	274800	6600800	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
20-5-0055	NRA14: Spring Creek	AGD	56	271050	6593150	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
20-5-0087	Manilla Burial	GDA	56	281136	6596606	Open site	Valid	Burial : -		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
20-5-0089	Burial Manilla	GDA	56	281135	6596604	Open site	Valid	Burial : -		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
20-5-0090	Manilla Old Cemetery Burial 6	GDA	56	281148	6596696	Open site	Valid	Aboriginal Ceremony and Dreaming : -, Stone Arrangement : -		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
20-5-0091	Ski Gardens Road Manila	GDA	56	270637	6589591	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
20-5-0092	Manilla Cemetery S/e Directional	GDA	56	281180	6596636	Open site	Valid	Stone Arrangement : -		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
20-5-0093	Manilla Cemetery Burial No 7	GDA	56	281202	6596711	Open site	Valid	Burial : -		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							

Report generated by AHIMS Web Service on 26/11/2019 for Tessa Boer-Mah for the following area at Lat, Long From : -30.9082, 150.5886 - Lat, Long To : -30.6771, 150.9076 with a Buffer of 0 meters. Additional Info : report. Number of Aboriginal sites and Aboriginal objects found is 31

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : Manilla19102401 20km

Client Service ID : 467504

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
20-5-0094	Old Cemetery Manilla	GDA	56	281122	6596697	Open site	Valid	Aboriginal Ceremony and Dreaming : -, Burial : -, Non-Human Bone and Organic Material : -, Stone Arrangement : -, Modified Tree (Carved or Scarred) : -		
	Contact									
20-5-0081	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact Ms.Veronica Talbott									
		Recorders		Ms.Jane Delaney-John					Permits	
20-5-0082	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact Ms.Veronica Talbott									
		Recorders		Ms.Jane Delaney-John					Permits	
20-5-0083	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact Ms.Veronica Talbott									
		Recorders		Ms.Jane Delaney-John					Permits	
20-5-0084	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact Ms.Veronica Talbott									
		Recorders		Ms.Jane Delaney-John					Permits	
20-5-0085	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact Ms.Veronica Talbott									
		Recorders		Ms.Jane Delaney-John					Permits	
20-5-0086	Old Cemetery Manilla Burial 4	GDA	56	281222	6596649	Open site	Valid	Burial : -		
	Contact Ms.Veronica Talbott									
		Recorders		Ms.Jane Delaney-John					Permits	
20-5-0117	Bondah-OS1	GDA	56	269358	6590634	Open site	Valid	Artefact : -		
	Contact									
		Recorders		OzArk Environmental and Heritage Management, Miss.Philippa Sokol					Permits	
20-5-0126	Bondah-IF1	GDA	56	269923	6588309	Open site	Valid	Artefact : -		
	Contact									
		Recorders		OzArk Environmental and Heritage Management, Miss.Philippa Sokol					Permits	
20-5-0127	Bondah-IF2	GDA	56	269837	6588361	Open site	Valid	Artefact : -		
	Contact									
		Recorders		OzArk Environmental and Heritage Management, Miss.Philippa Sokol					Permits	
20-5-0128	Bondah-IF3	GDA	56	269641	6587816	Open site	Valid	Artefact : -		
	Contact									
		Recorders		OzArk Environmental and Heritage Management, Miss.Philippa Sokol					Permits	
20-5-0133	Happy Hills-IF1	GDA	56	269741	6586383	Open site	Valid	Artefact : -		
	Contact									
		Recorders		OzArk Environmental and Heritage Management, Miss.Philippa Sokol					Permits	

Report generated by AHIMS Web Service on 26/11/2019 for Tessa Boer-Mah for the following area at Lat, Long From : -30.9082, 150.5886 - Lat, Long To : -30.6771, 150.9076 with a Buffer of 0 meters. Additional Info : report. Number of Aboriginal sites and Aboriginal objects found is 31

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : Manilla19102401 20km

Client Service ID : 467504

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
20-5-0095	Manilla WTP AS3	GDA	56	281497	6596879	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>	Mr.Matthew Barber,NGH Heritage - Fyshwick					<u>Permits</u>	4131	
20-5-0096	Manilla WTP AS2	GDA	56	283111	6596568	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>	Mr.Matthew Barber,NGH Heritage - Fyshwick					<u>Permits</u>	4131	
20-5-0097	Manilla WTP ST1	GDA	56	283036	6596677	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	<u>Contact</u>	<u>Recorders</u>	Mr.Matthew Barber,NGH Heritage - Fyshwick					<u>Permits</u>		
20-5-0098	Manilla WTP IF1	GDA	56	283437	6595971	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>	Mr.Matthew Barber,NGH Heritage - Fyshwick					<u>Permits</u>	4131	
20-5-0099	Manilla WTP AS1	GDA	56	283044	6596738	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>	Mr.Matthew Barber,NGH Heritage - Fyshwick					<u>Permits</u>	4131	
20-5-0135	Rushes Creek OS-1	GDA	56	270745	6589790	Open site	Valid	Artefact : -		103941
	<u>Contact</u>	<u>Recorders</u>	OzArk Environmental and Heritage Management, Miss.Stephania Rusden					<u>Permits</u>		
20-5-0136	Thorn Hill IF-1	GDA	56	274791	6591228	Open site	Valid	Artefact : -		103941
	<u>Contact</u>	<u>Recorders</u>	OzArk Environmental and Heritage Management, Miss.Stephania Rusden					<u>Permits</u>		

Report generated by AHIMS Web Service on 26/11/2019 for Tessa Boer-Mah for the following area at Lat, Long From : -30.9082, 150.5886 - Lat, Long To : -30.6771, 150.9076 with a Buffer of 0 meters. Additional Info : report. Number of Aboriginal sites and Aboriginal objects found is 31

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

A wide-angle photograph of a rural landscape. The foreground is filled with tall, dry, yellowish-brown grass. In the middle ground, there are scattered trees and shrubs, some with green foliage and others with brown, dry leaves. A fence line is visible in the distance. The background shows a hazy horizon under a pale sky.

Visual Impact Assessment

Manilla Solar Farm

Providence Asset Group

25 March 2020



Mara Consulting

Consultation + Urban Design

Creating vibrant communities through
powerful conversations

Copyright © Mara Consulting

Confidentiality

All information, concepts, strategies and ideas and all other information contained in this document is provided on a commercial in confidence basis, remaining the intellectual property and copyright of Mara Consulting. This document may contain information of a commercially sensitive nature and should not be made available to any individual or organisation outside of Mara Consulting without the written authority of the Managing Director or Communication and Stakeholder Engagement Manager.

Project Name	
Location	Manilla, NSW
Project Number	1968
Client	Providence Asset Group
Mara Consulting Document	20200325_1968_Mara_Providence-Manilla VIA-RevD

Mara Consulting Pty Ltd		
ACN:	168 093 918	Level 1, 161 King Street
ABN:	13 168 093 918	Newcastle NSW 2300
E: mara@maraconsulting.com.au		
W: maraconsulting.com.au		
P: 02 4965 4317		

Revision	Date of issue	Details	Author	Approved
A	20/03/2020	Draft	TA	TA
B	25/03/2020	For submittal	TA	KL

Contents

1. Introduction	4
1.1. Background	4
1.2. The site and context	4
2. Methodology	6
2.1. Background	6
2.2. Existing visual environment	6
2.3. Assessment criteria	7
2.4. Viewing zones	9
3. Proposal	12
3.1. Project Description	12
4. Visual impact assessment	14
4.1. Viewpoint Analysis	14
4.2. Visual impact assessment summary	22
5. Photo-montages	23
5.1. Photo-montage development	23
6. Glare Analysis	27
6.1. Angle of reflection	27
6.2. Reflectivity	28
6.3. Analysis	28
7. Visual mitigation measures	29
7.1. Recommendations	29
References	30

1. Introduction

1.1. Background

This report is meant to aid in the approval process for the proposed solar farm near the township of Manilla, NSW. The site is located at 4133 Manilla Road, Manilla. The proposed development will consist of solar panels with supporting inverters and switchboards with an access road to Manilla Road. The development will be fully contained within Lot A DP442930.

This visual impact assessment has been prepared to identify and evaluate the visual impacts on the landscape and to recommend measures to minimise the visual impact of the proposed development.

This report describes the existing visual environment and provides a methodology to assess the visual sensitivity of the site and to assess the visual impact of the planned development. Viewing zones and significant viewing locations within each zone are identified and assessed.

1.2. The site and context

The site is situated along the western side of Manilla Road as it approaches the township of Manilla from the south. The township of Manilla generally sits in a valley that runs north-south. The town is located at the northern end of the valley with hills rising up to the north and west.

South of the town the valley floor is fairly flat, with Manilla Road running down the length of it. The solar farm site is located several km south of the town with the outlying residential community about 1.5km from the site.

Most of the land surrounding the town is used for agricultural purposes. The site and the land immediately surrounding it is primarily used for grazing.



Image: Existing site



Figure 1.1. Site location (shown in red)
The site is located in Manilla, 40 km north of Tamworth along Manilla Road.
Aerial from SIXmaps.

2. Methodology

2.1. Background

This section provides a methodology for the visual impact assessment. The methodology used in this assessment has been adapted from the Roads and Maritime Services *Environmental Impact Assessment Guidance Note (2013): Guidelines for landscape character and visual impact assessment*. This methodology has been used as a guide to align with the features and requirements of this Proposal.

The methodology for assessing the visual impact includes the following key processes:

- Section 2.2 identifies the existing visual environment, the significant landscape features of the site and the visibility of the site from the significant vantage points
- Section 2.3 provides an assessment criteria that describes site visibility and visual absorption capacity
- Section 2.4 identifies viewing zones from which the site could be visible from various distances within the immediate vicinity, local area and regional context
- Section 3 provides an overview of the proposed development
- Section 4 assesses the potential visual impact from a variety of viewing locations
- Section 5 provides photo-montages
- Section 6 provides a reflection and glare analysis
- Section 7 recommended mitigation measures.

2.2. Existing visual environment

This section describes the character and visibility of the site from the surrounding area.

2.2.1. Landscape character

The site and surrounding area is normally characterised by grassy paddocks. The site sits on terrain that gently rises to the east and slopes down with varying degrees toward the west.

The vegetation in the surrounding area is mostly used for grazing purposes. However, the land is currently experiencing prolonged drought conditions and therefore little grass and scrub available for grazing. There are sparsely planted trees along Manilla Road, and along the edges of paddocks. There are occasional residential structures with tree planting surrounding them.

There is a watercourse that runs north-south along the western edge of the site. This is lined with large trees, which provide a visual screen from the west of the site.

2.2.2. Site visibility

The procedure for assessing site visibility involved:

- Determination of various viewing zones (regional, local and immediate vicinity)
- Detailed field investigations to plot those portions of the site that are visible from the various viewing zones.

2.3. Assessment criteria

The potential visual impact of planned development would result from the combination of two factors:

- Visibility of development
- Visual absorption capacity of the landscape in which the development occurs.

The visibility and the visual absorption capacity for each representative view location have been assessed to determine the overall visual impact of the project. These are defined below.

2.3.1. Visibility

“Visibility” is a measure of the extent to which particular activities/components of a proposal may be visible from surrounding areas, the relative number of viewers, the period of view, viewing distance and context of view. The rationale for the assessment is that if a proposal is not visible the impact is nil and if the number of people who would potentially see the proposal is low, then the visual impact would be lower than if a potential large number of people had the same view.

For the purpose of this study, the general categories of visibility have been defined broadly as:

- High (H) – where a large number of people would see new development at short distance over a short, moderate or long period of time
- Moderate (M) – where a small number of people would see new development at a short or medium distance over a moderate or

long period of time, or a moderate number of people would see the new development at a medium distance over a short, moderate or long period of time, or a large number of people would see it at a medium or long distance over a short period of time

- Low (L) – where a small number of people would see new development at long distance over a short (< 1 minute), moderate (< 1-10 minutes) or long (> 10 minutes) period of time.

The procedure for assessing site visibility involved:

- Determination of viewing locations from which parts of the planned development could potentially be visible (eg. by a motorist, visitor, resident)
- A field inspection to determine the extent of site visibility from the various viewing locations.



Figure 2.1: Aerial view of the proposed development site from Manilla Road.

2.3.2. Visual absorption criteria

“Visual Absorption Capacity” is an estimation of the capacity of the landscape to absorb development without creating significant visual change. The capacity to absorb development is primarily dependent on land form, vegetation cover and the presence of other development.

The extent to which portions of the site can potentially absorb development without reducing the scenic quality of the area has been assessed under this criteria. Given the visual landscape character of the site this capacity is primarily dependent on repetition of built form and vegetation cover. The surrounding building and tree canopies provide capacity to visually absorb development without significantly changing its scenic quality provided vegetation is retained in public and private land.

The potential for development to significantly change the visual character or to reduce the scenic quality of the area will result from removal of portions of the tree cover and creation of visual contrast between development (buildings, roads and new landscape) and the existing landscape of surrounding areas.

The level of contrast is also strongly influenced by the nature of the backdrop against which development is viewed. In particular, structures that are viewed above the skyline will potentially create a higher degree of contrast than the same elements viewed against a backdrop of similar structures or a landscape of similar colour/textures as the building or structure.

The degree of contrast between proposed development and the existing landscape (buildings and vegetation) can be reduced by careful attention to the colour, scale, texture, and reflectivity of building materials and by avoiding development that breaks the height of the existing tree canopy. Where possible these considerations are to be incorporated into the design and siting of buildings, roads and other structures.

Table 2.1: Visual absorption criteria.

Criteria	Definition
High	Existing landscape and built environment able to absorb development. Low degree of visual contrast
Medium	Existing landscape able to absorb some development. Some visual contrast will result.
Low	Existing landscape unable to absorb development (unless the denser future character of an area is to deliberately make a development prominent such as a public building or special focus). High degree of visual contrast will result.

2.3.3. Visual Impact Rating

Table 2.2 provides a matrix that compares the visibility rating with the visual absorption capacity rating to determine the visual impact rating.

Table 2.2: Visual impact rating matrix

		Visibility		
		Low	Moderate	High
Visual Absorption Capacity	High	Low	Low	Moderate
	Medium	Low	Moderate	High
	Low	Moderate	High	High

2.4. Viewing zones

Viewing zones are areas outside the site that have potential views to the site from various distances within the immediate vicinity, local area and regional context.

The site of the proposed solar farm is adjacent to Manilla Road along the floor of a valley. It is adjacent to a watercourse that has mature trees and other vegetation along its banks. The watercourse vegetation screens views from the west, and further west is a ridge-line that eliminates any views from beyond.

To the east, south and north, there is very little planting to screen the site. The terrain is hilly, so views of the entire development are not readily available. There are hills to the south and east of the site, which effectively shield the site from Manilla Road. To the north, a hill exists at the edge of

the Manilla township, so there are no views of the site from the town. The viewing zones and viewshed is illustrated in Figures 2.2 and 2.3.

In order to assess the potential visual impacts of the solar farm, viewing zones based on the distance from the proposed development were defined as follows:

- Immediate vicinity (< 1.5km)
- Local area (1.5km – 3km)
- Regional area (3km – 6km).

Representative view locations were selected from each zone and the visual impact of the planned development has been assessed from each location.

Immediate vicinity (< 1.5km).

- View 1: 4182 Manilla Road, Manilla
- View 2: 4077 Manilla Road, Klori
- View 3: 83 Melrose Lane, Manilla
- View 4: 4279 Manilla Road, Manilla

Local area (1.5km – 3km).

- View 5: 3472 Tamworth Road, Manilla.

Regional area (3km – 6km).

- View 6: 28 Rangari Road, Manilla
- View 7: VJ Byrnes Memorial, Manilla Lookout Road

Each view is addressed separately in Section 4 of this report.

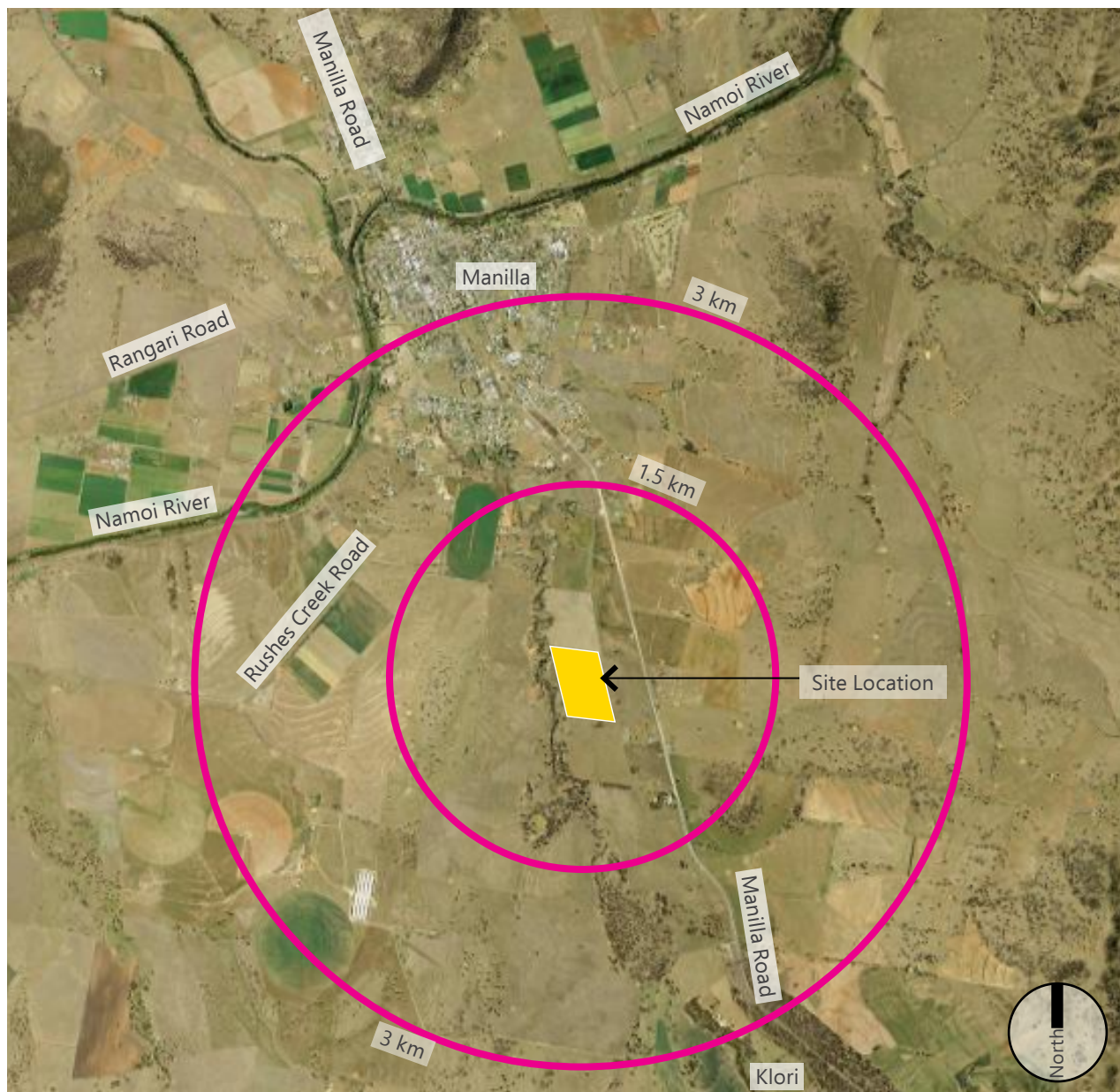
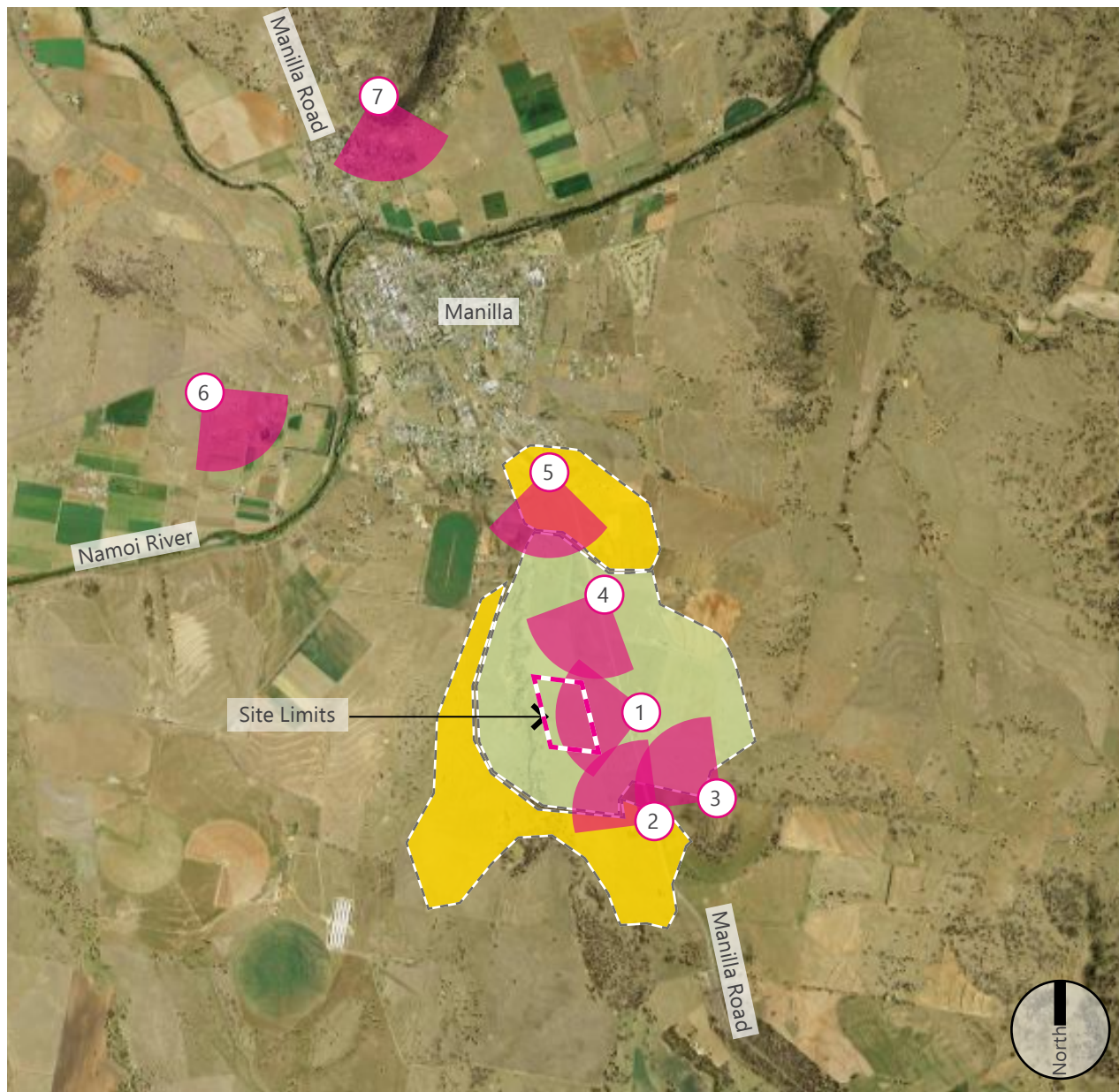


Figure 2.2: Viewing Zones

The viewing zones indicated as distance from the subject site. Figure 2.3 shows specific locations of each viewpoint that will be discussed in Section 4.



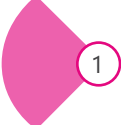
-  Extent of the viewing area from which the site is visible
-  Extent of the viewing area from which a portion of the site is visible, screened by topography or vegetation
-  1 View point and direction of view.

Figure 2.3: Viewing Locations

The view locations are shown with arrows. The number on the arrows are associated with the visual assessment in Section 4 of this report

3. Proposal

3.1. Project Description

The proposed Manilla Solar Farm is located approximately two kilometres south of Manilla, within the Tamworth Regional Council local government area.

The site is located approximately 300m from Manilla road and covers an area of 18.8 hectares. An indicative layout for the proposal has been provided (refer to Figure 3.1). This layout may be refined following the findings of various studies, of which this VIA is one.

3.1.1. Indicative project layout

The solar electricity generating facility will consist of the following elements:

- Solar array cell area up to 15Ha
- Solar array panels mounted on trackers (180 sets)
 - Rectangular photovoltaic module
 - Trackers are horizontal single-axis type, 1.5m high with +/-60° rotation angle
 - Trackers oriented north-south
- Associated infrastructure
 - Power Conversion Unit (PCU)
 - Site access from north east corner of site to Manilla Road via a 5m wide road
 - Security fencing
 - Car park area
 - Off-load area.

During construction, temporary facilities located within the site may include:

- Construction office.

3.1.2. Solar panel dimensions and arrangement

The proposed solar array module dimensions are approximately 1m wide x 2m high. They are mounted on a tracking system that will maximise electricity production. The tracking system rotates about a north-south axis to follow the sun with the aim of orienting each panel perpendicular to the incoming sun.

The tracking systems will be arranged in rows running in a north-south direction as indicated in Figure 3.1. The solar arrays will cover about 16 Ha.

The diagram in Figure 3.2 illustrates the dimensions and rotation of the panels. The panels only rotate from east to west and are not tilted toward the north.



Image: Solar panels similar to the proposed development.

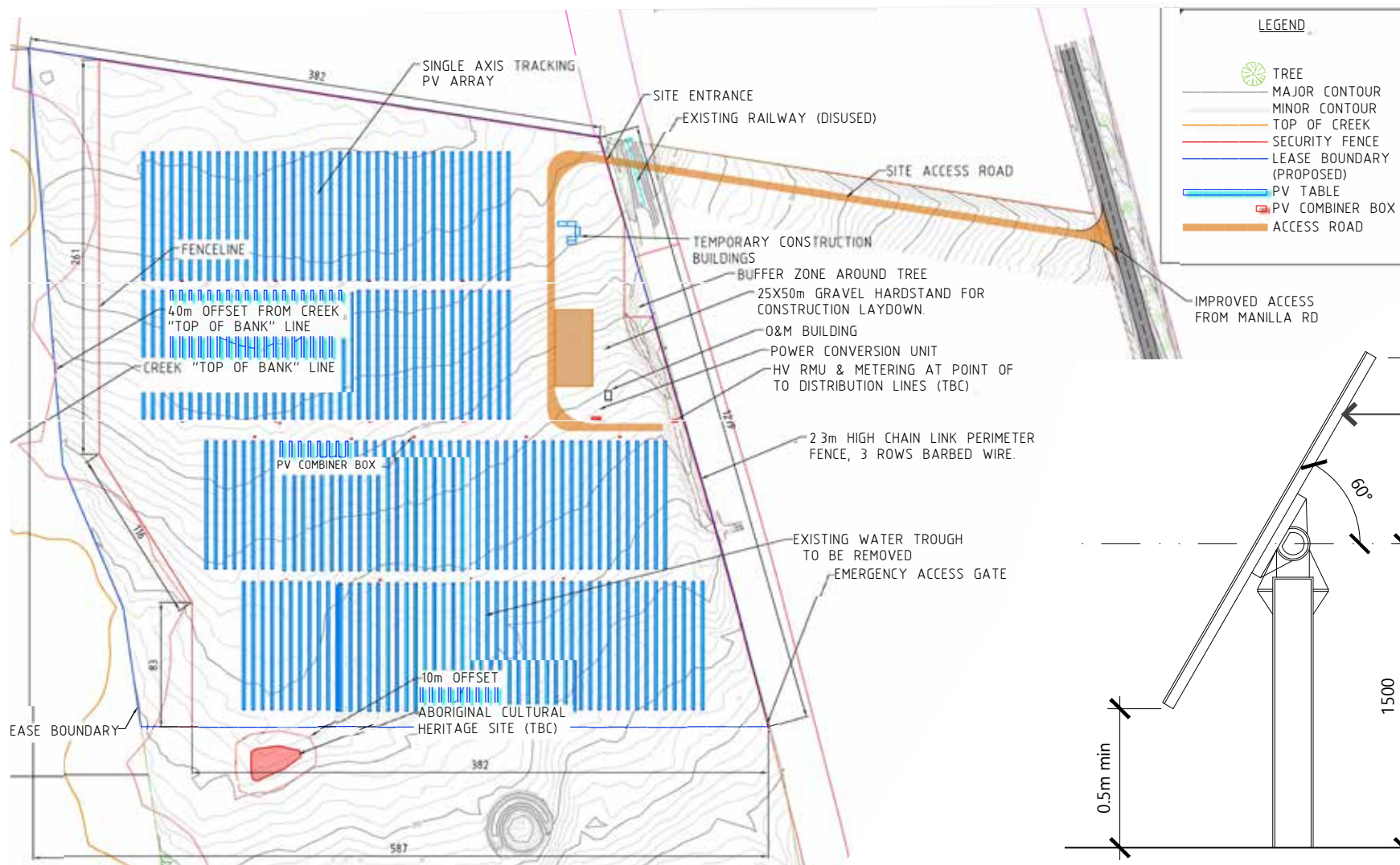


Figure 3.1: Concept layout of the project

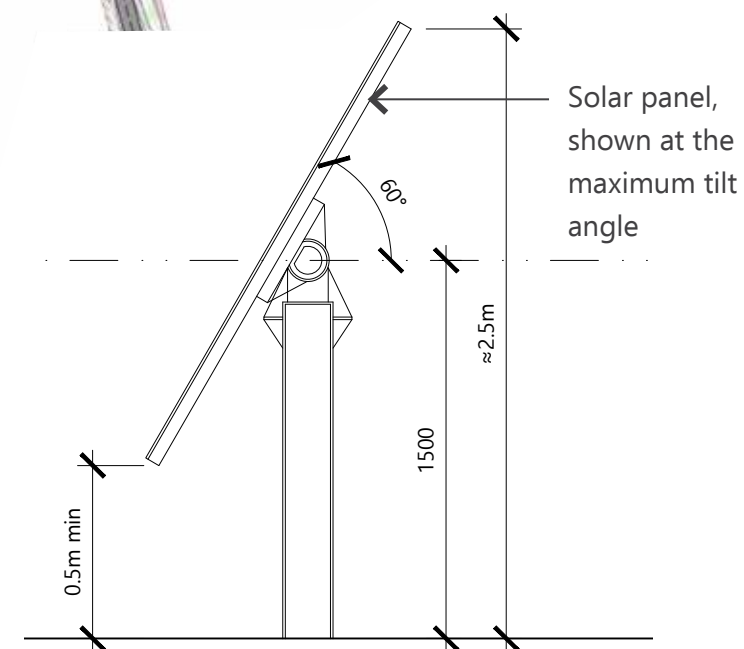


Figure 3.2: Solar array panel on the tracking system

4. Visual impact assessment

4.1. Viewpoint Analysis

This section of the visual assessment considers the likely impact that the proposed development may have on the views toward the site. This is done by identifying and selecting particular sites, referred to as viewpoints, conducting inspections and determining what part of the development will be visible from those viewpoints and the visual impact of that development proposal.

The viewpoints, as shown on Figure 2.4, were selected on the basis of where the development would appear to be most prominent either based on degree of exposure or the number of people likely to be affected. Sites were further selected on the basis of significant features, significant viewpoints and significant ridge lines.

The following viewpoint worksheets provide photographs and analysis data from each of the viewpoints. The images were taken using a digital camera with a focal length equal to a standard 50mm for a conventional 35mm camera. This focal length is widely accepted as closely approximating the vision of the human eye.

4.1.1. Site Visit

A two-day site visit was undertaken on 28 and 29 November 2019 by a registered landscape architect and environmental planner who has substantial experience analysing and mitigating visual impacts on the landscape.

During the site visit, viewpoints were confirmed and an assessment was made of each potential representative public viewpoint against the extent of the solar farm project.

There were significant bushfires throughout the region so visibility was somewhat diminished.

Viewpoint 1



Viewpoint 1	4182 Manilla Road, Manilla
Viewing situation	Same level and typically viewed from a moving vehicle
Category of view	Immediate vicinity
Context of view	From nearest roadway (300m from site)
Relative number of viewers	High
Distance of view	300m
Likely period of view	Low (traffic) Long (2-3 residents along the road)
Visibility	High
Visual absorption capacity	Low
Visual impact rating	High

Description:

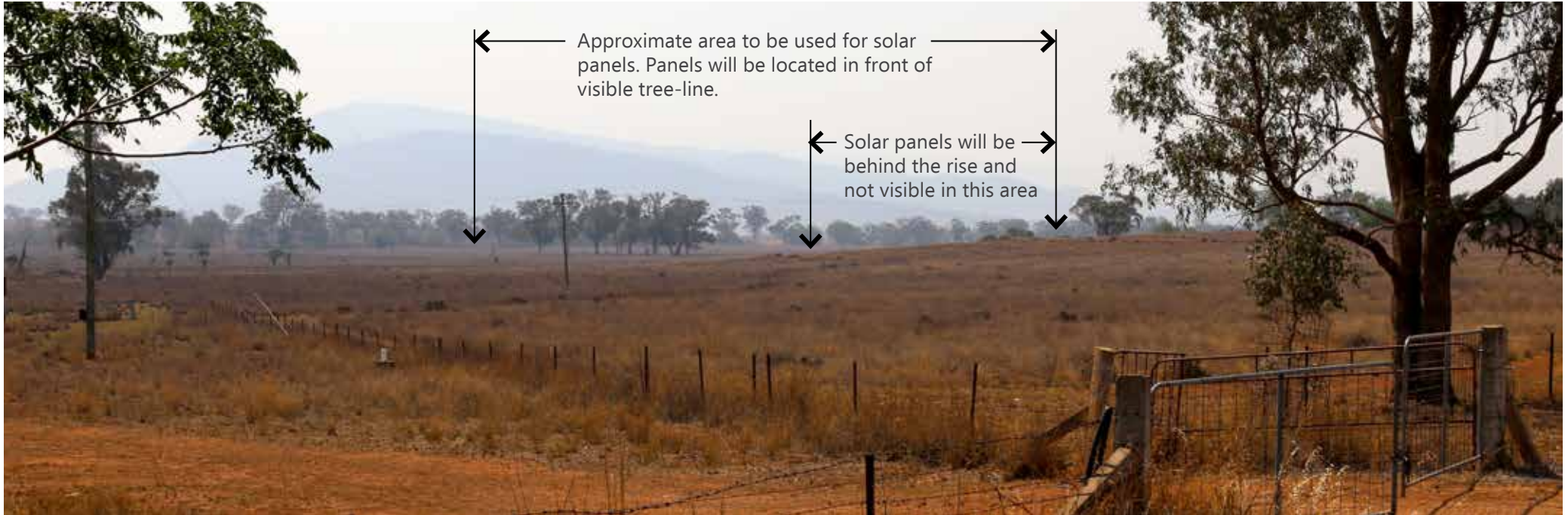
View from the Manilla Road adjacent to the site looking toward the proposed development. This is the closest viewing location for the general public.

Comments:

This is the closest viewing location for the general public. The views will be from a moving vehicle with very few opportunities to see the entire solar site. Most views from this location will be intermittent, lasting for a few seconds.

This is also the view from the closest residential property, and will affect three properties.

Viewpoint 2



Viewpoint 2	4077 Manilla Road, Klori
Viewing situation	Slightly above the site and typically viewed from a moving vehicle
Category of view	Immediate vicinity
Context of view	From roadway over grass paddock
Relative number of viewers	High
Distance of view	750m
Likely period of view	Low (traffic); Long (1 resident along the road)
Visibility	Moderate
Visual absorption capacity	Medium
Visual impact rating	Moderate

Description:

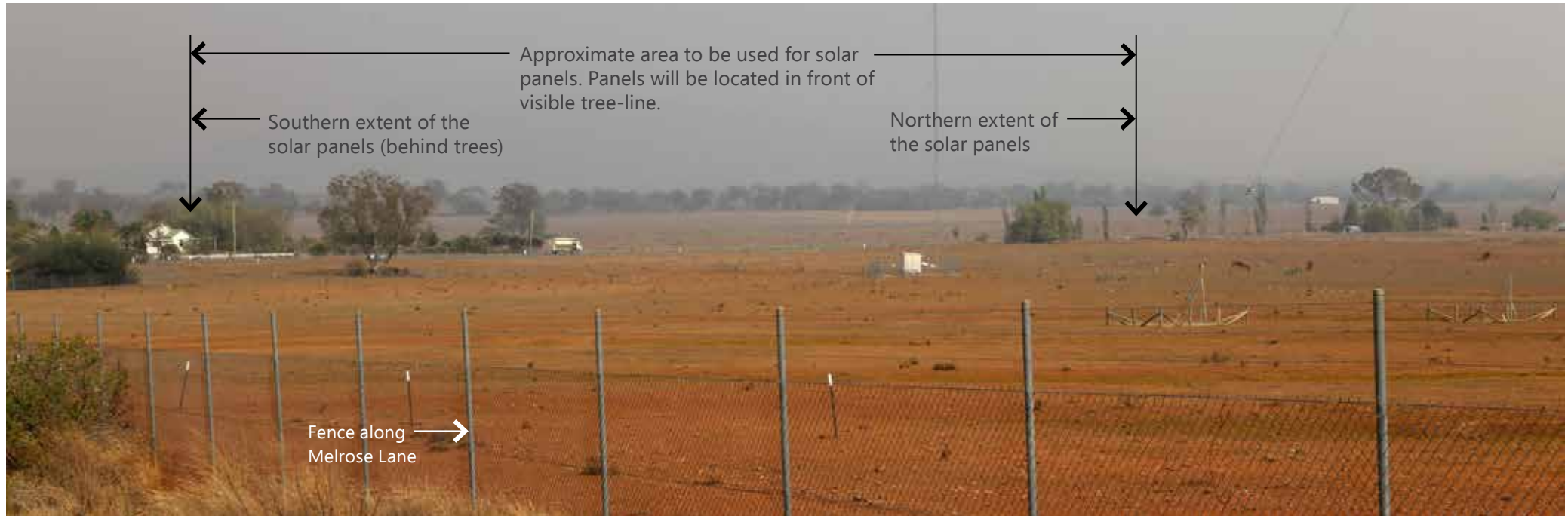
View from the Manilla Road, south of the site looking toward the proposed development. This view is available for approximately 170m of road.

Comments:

This is the first location from which the solar panels will be visible from Manilla Road while traveling from the south. This location only allows views to a portion of the solar farm. The view will be from a moving vehicle.

This is the view from one residential property.

Viewpoint 3



Viewpoint 3	83 Melrose Lane, Manilla
Viewing situation	Slightly elevated above the site
Category of view	Immediate vicinity
Context of view	From roadway near residence
Relative number of viewers	Low
Distance of view	980m
Likely period of view	Low (traffic) Long (1 resident nearby)
Visibility	Moderate
Visual absorption capacity	Low
Visual impact rating	High

Description:

View from Melrose Lane on the slopes of a nearby hillside. This is a gravel road that is used primarily by local residents. There is a radio station antenna and building in the foreground that partially screens the site. A residential building with trees around it also screen the left half of the site from view.

Comments:

The solar panels will be placed in front of the trees that appear in the background. Only a portion of the proposed solar farm will be visible from this location.

This is the view from one residential property.

Viewpoint 4



Viewpoint 4	4279 Manilla Road, Manilla
Viewing situation	Same level and typically viewed from a moving vehicle
Category of view	Immediate vicinity
Context of view	From roadway and residence over grass paddock
Relative number of viewers	High
Distance of view	1.2km
Likely period of view	Low (traffic) Long (5 residents along the road)
Visibility	Moderate
Visual absorption capacity	Medium
Visual impact rating	Moderate

Description:

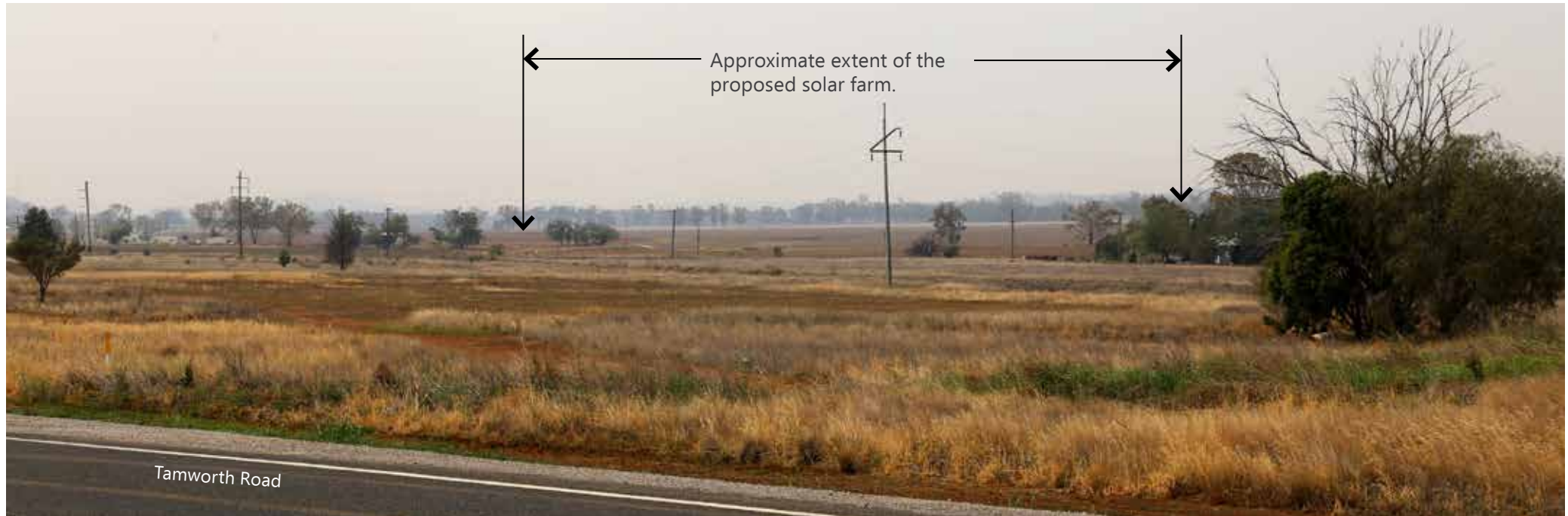
View from the Manilla Road, north of the site looking toward the proposed development.

Comments:

This is the initial location from which the entire solar farm will be visible from Manilla Road while traveling from the north.

This is the view from five residential property.

Viewpoint 5



Viewpoint 5	3472 Tamworth Road, Manilla
Viewing situation	Slightly elevated looking south to site
Category of view	Local area
Context of view	From roadway near residential driveways
Relative number of viewers	High
Distance of view	1.7km
Likely period of view	Low (traffic) Long (residents along the road)
Visibility	Low
Visual absorption capacity	Medium
Visual impact rating	Moderate

Description:

View from the Manilla Road, north of the site looking toward the proposed development.

Comments:

This is the first location from which the solar panels will be visible from Manilla Road while traveling from the north. Only a glimpse of the solar farm will be visible.

This view is from the edge of the township. Residences that form the edge of town will share this view.

The ridge line from which this location also shields most of the township from viewing the solar farm.

Viewpoint 6



Viewpoint 6	28 Rangari Road, Manilla
Viewing situation	Slightly elevated looking over multiple tree-lines
Category of view	Regional area
Context of view	Across the valley on a regional road
Relative number of viewers	Medium
Distance of view	3.5km
Likely period of view	Low (traffic) Long (residents along the road)
Visibility	Low
Visual absorption capacity	High
Visual impact rating	Low

Description:

View from across the valley. Representing one of the rare opportunities to see the site from beyond the local site area.

Comments:

There are very few vantage points from which to view the valley. This view illustrates the difficulty in seeing the site from any distance as there are multiple tree-lines and structures and topographic visual barriers.

Viewpoint 7



Viewpoint 7	VJ Byrnes Memorial, Manilla Lookout Road
Viewing situation	Elevated looking over the valley
Category of view	Regional area
Context of view	Across the valley from a hilltop lookout point
Relative number of viewers	Low
Distance of view	4.8km
Likely period of view	Low (traffic) Long (residents along the road)
Visibility	Low
Visual absorption capacity	High
Visual impact rating	Low

Description:

View from the only lookout area with views to the site.

Comments:

This represents the furthest location from which the site may be visible with correct atmospheric conditions.

From this view, only glimpses of the solar farm will be available. The trees on the solar farm site will offer screening, and the urban development will cause the solar development to visually blend in with the existing landscape.

This location is a prominent lookout and thus the view is included in this analysis.

4.2. Visual impact assessment summary

This section of the report summarises the findings of the visual impact assessment of views in the immediate vicinity, local views and regional views of the site.

4.2.1. Views from the immediate vicinity (< 1.5km)

The proposed development is likely to have a high visual impact from the adjacent roads. This is especially true of Manilla Road as it runs beside the proposed development. It is also the only publicly accessible place with full views of the development.

The visual impact is primarily due to the close proximity and lack of visual buffer. Additionally, the rectilinear forms and rigid linear arrangement of the solar panels contrasts with the surrounding natural forms.

Beyond the roads adjacent the development, views of the site reduce significantly. Where views exist, they are limited to small portions of the proposed solar farm.

The visual impact can be mitigated by introducing new trees and screen planting along northern, eastern and southern boundaries. Trees will help break up the visual mass of the solar farm and reduce the visual dominance.

4.2.2. Local views (1.5 – 3km)

There are few locations where the site is visible from this distance. The only publicly accessible locations are located north of the site due to the topography and existing development. As illustrated in the photographs, the viewpoints north of the site are screened by buildings and trees.

The visual impact is minimal due to the small number of locations where views are available.

Regional Views (3 – 6km)

The only regional views occur north of the site. As with the local views, only roofs and tree-lines are visible from this distance.

Where views are available, only glimpses of solar panels will be discernible.

5. Photo-montages

5.1. Photo-montage development

A photo-montage is a visualisation based on superimposing an image (of proposed development) onto a photograph. Its purpose is to simulate a realistic representation of proposed or potential changes to a view (Horner and MacLennan et al, 2006). The photo-montages used in this VIA are to assist in the assessment of the impacts from the proposed development.

5.1.1. Photo-montage development process

Since a photo-montage is a representation of the development superimposed on a photograph, an image of the proposal must be developed. This is done as a digital model of the solar panels and structures. The digital model is then captured from the perspective of the photograph, and then superimposed on it.

In these photo-montages, the solar panel are shown at their maximum height to simulate a worst-case scenario.

5.1.2. Selection process

The photo-montages selected represent key views to demonstrate the visibility of the proposed solar farm within the existing context. Photo-montages have been prepared for Viewpoint 1, Viewpoint 2 and Viewpoint 4. These viewpoints illustrate the general visibility of the site from locations of the highest visibility and the highest number of viewers.

Photo-montage 1 - Viewpoint 1



Existing view



Existing view with proposed solar farm development. This photo-montage shows the affect of the solar panels on the landscape from this vantage point without any plant screening. The proposed planting will be installed in front of the panels and will effectively hide them with 3-5 years of growth.

Photo-montage 2 - Viewpoint 2



Existing view



Existing view with proposed solar farm development. This photo-montage shows the affect of the solar panels on the landscape from this vantage point without any plant screening. The proposed planting will be installed in front of the panels and will effectively hide them with 3-5 years of growth.

Photo-montage 3 - Viewpoint 4



Existing view



Existing view with proposed solar farm development. This photo-montage shows the affect of the solar panels on the landscape from this vantage point without any plant screening. The proposed planting will be installed in front of the panels and will effectively hide them with 3-5 years of growth.

6. Glare Analysis

When sunlight is reflected off a smooth surface, it can result in glint or glare. Glint is a quick reflection or flash of light, while glare is experience for a longer period of time. Both of these can be annoying and dangerous in certain situations.

6.1. Angle of reflection

The angle of reflection of light off a reflective surface is directly related to the angle of incidence of the light from the source (see Figure 6.1 and 6.2). In the case of a solar array, the sunlight will reflect off the panel at the same angle as it arrives from the sun. If the panel is stationary, the sun's angle relative to the solar panel will vary by time of day and therefore reflect toward the west in the morning and eastward in the evening.

The proposed solar arrays will track the sun's movement across the sky. As a result, reflections will be directed upward and away from any ground-based viewers. Geometrically, the lowest angle of reflection will be 30° above the horizon line.

The seasonal change of the sun's movements will vary the reflection angles as well. As the sun move southward in the summer months, the reflection will move northward, and vice versa in the winter months (when the sun is north of the equator). While this movement changes the reflection angle in a north-south direction, the reflection angle will not fall below 30° above the horizon line.

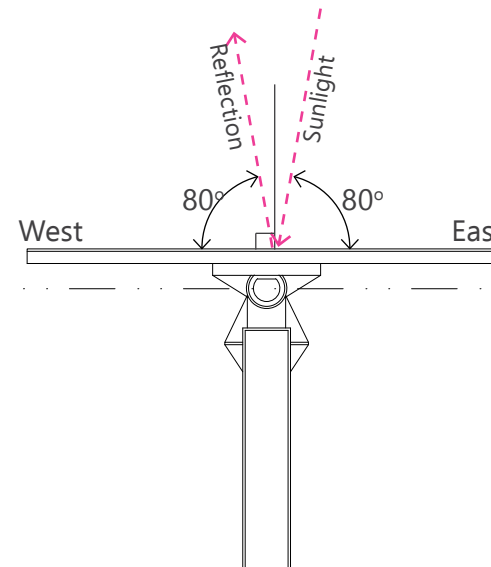


Figure 6.1: Typical reflection and glare angles during the day.

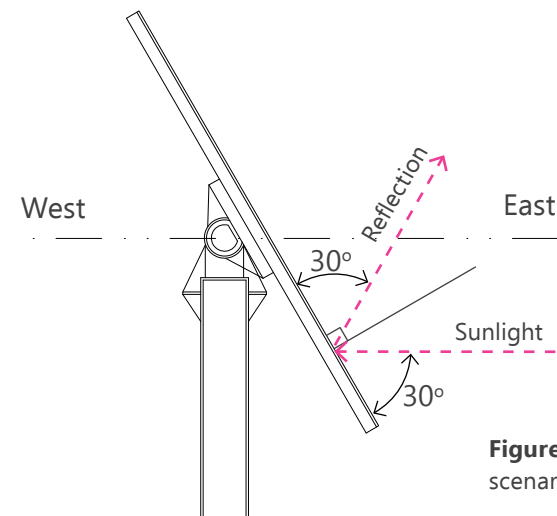


Figure 6.2: Typical sunrise/sunset reflection scenario with direction of reflection and glare.

6.2. Reflectivity

Solar panels are designed to absorb light energy to create electrical currents. As such, they will only reflect a portion of the sunlight that falls on them.

Generally, the light reflected is diminished by first hitting the substrate that reflected it. Typically, solar panels are constructed from a treated glass that is designed to minimise reflection and maximise the amount of light transmitted through the glass to the receptor. Typical treated glass that is used for solar panels reflects about 4% of the light that hits the cell.

6.3. Analysis

By knowing the characteristics of reflected light, we can determine where glare is likely to be an issue. In the case of the Manilla solar farm, trackers will be used to maximise the sunlight absorbed by the cells. The trackers are designed to keep the panel perpendicular to the sun. We can therefore assume that the sunlight reflected will reflect perpendicular to the cell and directly back toward the sun. At times when the tracking system has reached the limit of its tracking range, the angle of incidence moves from perpendicular and the light that is reflected is expected to reflect up and away from the ground. Given that the tracking stops when the panel is 60° from horizontal, the reflection will be at a minimum of 30° above the horizon.

Given the parameters of reflection and the movement of the solar panels, there are no locations surrounding the site where glint or glare are geometrically possible.



Image: Example of similar solar panels from adjacent roadway



Image: Example of similar solar panels

7. Visual mitigation measures

7.1. Recommendations

The visual impact assessment in Section 4 of this report assigns either a high, medium or low visual impact rating when viewed from the immediate vicinity, local views and regional views. The following mitigation measures should be considered in the design and assessment of the proposed development.

Visual character

To maintain this character, the following recommendations are suggested.

- The site and immediate surrounds contain a number of existing mature trees and shrubs that should be retained
- Trees planted within the site (along the boundaries) should be selected for their canopy size and ability to blend in with the existing trees
- Placement of the trees should maximise visual screening while allowing unobstructed sunlight to reach the solar panels
- Since the solar panels will reach approximately 2m in height, large shrubs may be more appropriate for screening.

Built form, materials and colours

- Materials, textures and colour selection should relate to the palette of the surrounding environment in areas of high visibility and potential for visual impact
- Bright and contrasting colours should be avoided
- Solar arrays should use anti-reflective coatings
- Consideration should be given to controlling the type and height of PCU's and storage sheds to ensure the development does not contrast significantly with the surrounding landscape.

References

EDAW (Australia) Pty Ltd (2000) '*Section 12 – Visual Assessment*', *The Mount Arthur North Coal Project: Environmental Impact Statement*, URS Australia Pty Ltd, Prepared for Coal Operations Limited.

Google Maps (2020), <http://google.com/maps/>

Horner + MacLennan & Envision (2006) *Visual Representation of Windfarms - Good Practice Guidelines*. Scottish Natural Heritage, Inverness, Scotland.

New South Wales Department of Planning, (2010) <http://www.planning.nsw.gov.au/>

Pager Power (2018) *Solar Photovoltaic Glint and Glare Study*, Prepared for Bookaar Solar Farm Pty Ltd.

Roads and Maritime Services *Environmental Impact Assessment Guidance Note (2013): Guidelines for landscape character and visual impact assessment*.

Six Maps (2020), <https://maps.six.nsw.gov.au/>

The Landscape Institute with the Institute of Environmental Management and Assessment (2013) *Guidelines for Landscape and Visual Assessment* Third Edition, Newport, Lincoln.

“Creating vibrant communities through powerful conversations

Consultation and urban design working together

Level 1, 161 King Street
Newcastle, NSW, 2300

Level 6, 307 Queen Street
Brisbane, QLD, 4000

Phone 02 4965 4317
mara@maraconsulting.com.au
maraconsulting.com.au
ABN 13 168 093 918

MANILLA SOLAR FARM

Reflective Glare Assessment

Prepared for:

KDC
Suite 2B, 125 Bull Street
NEWCASTLE WEST NSW 2302

SLR Ref: 620.13566-R01
Version No: -v1.3
March 2020



PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
Tenancy 202 Submarine School, Sub Base Platypus, 120 High Street
North Sydney NSW 2060 Australia

T: +61 2 9427 8100
E: sydney@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with KDC (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
620.13566-R01-v1.3	27 March 2020	Dr Peter Georgiou	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy
620.13566-R01-v1.2	19 March 2020	Dr Peter Georgiou	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy
620.13566-R01-v1.1	13 March 2020	Dr Peter Georgiou	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy
620.13566-R01-v1.0	3 December 2019	Dr Peter Georgiou	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy

EXECUTIVE SUMMARY

SLR Consulting Australia Pty Ltd (SLR) has been engaged by KDC to carry out a Reflective Glare assessment of the proposed Manilla Solar Farm (the “Project”) under development by Providence Asset Group. The Project is located approximately 3.5 km south-southeast of Manilla, NSW. The Project is located approximately 40 km north-northwest of Tamworth and 50 km northeast of Gunnedah.

The proposed (up to) 5 MWac facility will comprise 15,120 solar PV panels within a 16 ha project site area. The 405 W panels, measuring approximately 2.0 m by 1.0 m, will be positioned as currently understood on single-axis trackers oriented north-south with a spacing of 6.2 m.

Section 2 describes the footprint and envelope of the proposed Manilla Solar Farm.

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels within the facility
- Night-time Illumination glare from 24/7 operational security lighting within the facility

In terms of potential glare scenarios, the following has been considered:

- Aviation Sector Reflective Glare;
- Motorist “Disability” Reflective Glare and Pedestrian “Discomfort” Reflective Glare;
- Rail Operator Reflective Glare;
- Industrial critical machinery operators (heavy vehicles, etc) Reflective Glare; and
- Residential “Nuisance” Glare from daytime reflections or night-time illumination.

In all cases, the present study has found that the potential for adverse glare from the proposed facility will be negligible, due to a combination of factors, including:

- The choice of a single axis tracking mounting system and the distances to nearest receivers of interest in relation to aviation, road traffic, rail traffic and residential.

24/7 lighting is currently not proposed for the facility for operational purposes. Should 24/7 lighting be incorporated into the facility in the future, there will negligible impact assuming the lighting design is in accordance with AS 4282-1997 *Control of the Obtrusive Effect of Outdoor Lighting*. This will also address any potential adverse eco-lighting issues in relation to nocturnal fauna within and surrounding the site.

When key Project decisions are finalised during detailed design (eg final panel selection, mounting details, etc), the present analysis should be re-visited to confirm the conclusions set out above if key assumptions made in the analysis change significantly.

CONTENTS

1	INTRODUCTION	7
1.1	Structure of Report	7
2	PROPOSED MANILLA SOLAR FARM PROJECT	8
2.1	Site Location.....	8
2.2	Site Description and Key Project Components	9
3	RECEIVERS AND ASSOCIATED IMPACTS	11
3.1	Receiver Impacts.....	11
3.2	Nearest Receiver Locations	11
4	GLARE ACCEPTABILITY CRITERIA	14
4.1	Aviation Sector Reflective Glare	14
4.2	Motorist “Disability” Glare and Pedestrian “Discomfort” Glare.....	15
4.3	Rail Operators Reflective Glare.....	16
4.4	Residential “Nuisance” Glare.....	16
4.5	Industrial Critical Machinery Operations.....	16
4.6	Night-Time Illumination Glare	17
5	GLARE IMPACT ASSESSMENT - ASSUMPTIONS.....	19
5.1	Assumptions – Solar Panel Geometry.....	19
5.2	Project Site Solar Angles – Annual Variations.....	19
5.3	Project Solar Reflections	20
5.4	Solar Panel Reflectivity	21
6	GLARE IMPACT ASSESSMENT - RESULTS	23
6.1	Aviation Sector Reflective Glare	23
6.2	Motorist “Disability” Glare and Pedestrian ‘Discomfort’ Glare	24
6.3	Rail Operator Reflective Glare	26
6.4	Industrial Critical Machinery Operators	26
6.5	Residential “Nuisance” Glare.....	26
6.6	Night-Time Illumination Glare	27
7	CONCLUSION.....	29

CONTENTS

DOCUMENT REFERENCES

TABLES

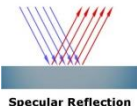
Table 1	Typical Illuminance Levels for Various Scenarios.....	17
Table 2	Recommended Maximum Values of Light Technical Parameters (AS4282-1997).....	18
Table 3	Key Annual Solar Angle Characteristics for Project Site.....	19
Table 4	TI Value Results – Combined Results from ALL PROJECT SOLAR PANELS	24
Table 5	TI Value Results	27

FIGURES

Figure 1	Manilla Solar Farm - Location Map	8
Figure 2	Manilla Solar Farm Site Layout.....	9
Figure 3	Nearest Airfields to Project Site	12
Figure 4	Surrounding Road Network.....	12
Figure 5	Surrounding Rail Network and NSW Rail Map	13
Figure 6	Nearest Representative Residential (RR) and Other (OR) Receivers	13
Figure 7	Example Solar Glare Ocular Plot (SGHAT Software Output)	15
Figure 8	Project Site Incoming Solar Angle Variations	20
Figure 9	Potential Solar PV Panel Reflection Angles from the Project (typical mid-summer)	21
Figure 10	Typical Reflectivity Curves as a Function of Incidence Angle.....	22
Figure 11	View of the Project from Surrounding Roads	25
Figure 12	Luminaire Design Features that Minimise Light Spill	28

Abbreviations and Definitions

Terms relevant to Daytime Reflective Glare

PV Panel	Photovoltaic (PV) panels are designed to absorb solar energy and retain as much of the solar spectrum as possible in order to produce electricity	
Glare	Glare refers to the reflections of the sun off any reflective surface, experienced as a source of excessive brightness relative to the surrounding diffused lighting. Glare covers reflections experienced by both stationary and moving observers (the latter sometimes referred to as “glint”) and reflections which are either specular or diffuse.	
Specular	A reflection which is essentially mirror-like – there is virtually no loss of intensity or angle dispersion between the incoming solar ray and outgoing reflection	
Diffuse	A reflection in which the outgoing reflected rays are dispersed over a wide (“diffuse”) range of angle compared to the incoming (parallel) solar rays, typical of “rougher” surfaces	
KVP	Key View Points (KVPs) are offsite locations where receivers of interest have the potential to experience adverse reflective glare	

Terms relevant to Night-Time Illumination

Spill light	Light emitted by a lighting installation, which subsequently falls outside the boundaries of the property on which the installation is sited.	
Obtrusive light	Spill light which, because of quantitative, directional or spectral attributes in a given context, gives rise to annoyance, discomfort, distraction or a reduction in the ability to see essential information, eg traffic lights.	
Luminaire	Apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except for the lamps themselves, all the parts necessary for fixing and protecting the lamps and, where necessary circuit auxiliaries together with the means for connecting them to the electrical supply.	
Luminous intensity	The concentration of luminous flux emitted in a specific direction. Unit: candela (Cd).	
Luminance AS 1158.2:2005	This is the physical quantity corresponding to the brightness of a surface (e.g. a lamp, luminaire or reflecting material such as façade glazing) when viewed from a specified direction. Unit: Cd/m ²	
Illuminance AS 1158.2:2005	This is the physical measure of illumination. It is the luminous flux arriving at a surface divided by the area of the illuminated surface – the unit is lux (lx) ... 1 lx = 1 lm/m ² The term covers both “Horizontal Illuminance” (the value of illuminance on a designated horizontal plane at ground level) and “Vertical Illuminance” (the value of illuminance on a designated vertical plane at a height of 1.5m above ground level).	
Glare AS 1158.2:2005	Condition of vision in which there is a discomfort or a reduction in the ability to see, or both, caused by an unsuitable distribution or range of luminance, or to extreme contrast in the field of vision. Glare can include: (a) Disability Glare – glare that impairs the visibility of objects without necessarily causing discomfort. (b) Discomfort Glare – glare that causes discomfort without necessarily impairing the visibility of objects.	
Threshold Increment (TI) AS 4282-1997	TI is the measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Higher TI values correspond to greater disability glare.	

1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been engaged by KDC to carry out a Reflective Glare assessment of the proposed Manilla Solar Farm (the “Project”) under development by Providence Asset Group. The Project is located approximately 3.5 km south-southeast of Manilla, NSW. The Project is located approximately 40 km north-northwest of Tamworth and 50 km northeast of Gunnedah.

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels within the facility
- Night-time Illumination glare from 24/7 operational security lighting within the facility

1.1 Structure of Report

The remainder of this report is structured as follows:

- **Section 2** describes the Project and surrounding environment;
- **Section 3** describes the range of receptors surrounding the site with the potential to experience adverse reflective glare (or glint);
- **Section 4** presents the acceptability criteria used for the study;
- **Section 5** addresses the assumptions made in the glare impact analysis;
- **Section 6** presents the results of the glare impact analysis of the Project;
- **Section 7** presents the conclusions of the study.

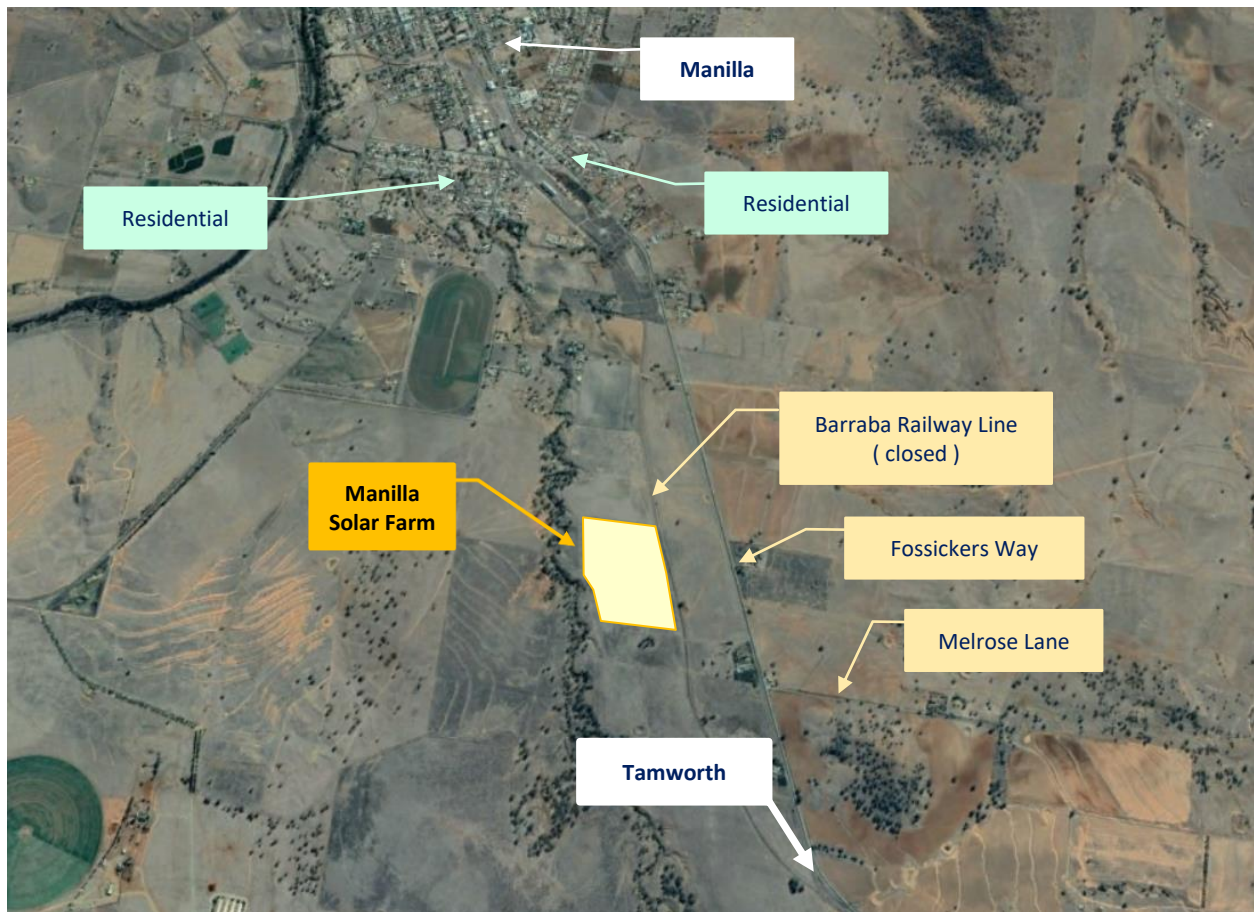
2 PROPOSED MANILLA SOLAR FARM PROJECT

2.1 Site Location

The Project is seeking approval for a proposed (up to) 5 MWac photovoltaic (PV) solar plant occupying a 16 ha area as shown in **Figure 1**. The Project site is located approximately 3.5 km south-southeast of Manilla, NSW, approximately 40 km north-northwest of Tamworth and 50 km northeast of Gunnedah.

The land required for the Project has been subject to constraints identified by site investigation, i.e. native vegetation, and areas of cultural or heritage significance. The plan of the Project has been developed following completion of these site investigations and the assessment of any constraints and their impact.

Figure 1 Manilla Solar Farm - Location Map



2.2 Site Description and Key Project Components

From a Reflective Glare point of view, the key components of the Project are:

- the photovoltaic (PV) modules in relation to their daytime reflective glare potential; and
- the facility's security/emergency lighting design in relation to potential night-time illumination glare issues.

Solar Panel Mounted Array – refer Figure 2

The proposed ground-mounted array (refer **Figure 2(a)**) would consist of 180 trackers oriented in a north-south direction, each supporting 84 x 405 W solar panels (15,120 panels in total):

- The trackers are “single-axis” capable of rotating solar panels to a maximum of $\pm 52^\circ$ - refer **Figure 2(b)**;
- The trackers are oriented north-south and spaced 6.2 m apart; and
- Individual panels (approximately 1.0m x 2.0m) reach a maximum height above ground of approximately 2.5 m at their full 52° tilt angle;
- The eastern-most tracker is located approximately 317 m from the nearest major thoroughfare, Fossickers Way.

Figure 2 Manilla Solar Farm Site Layout

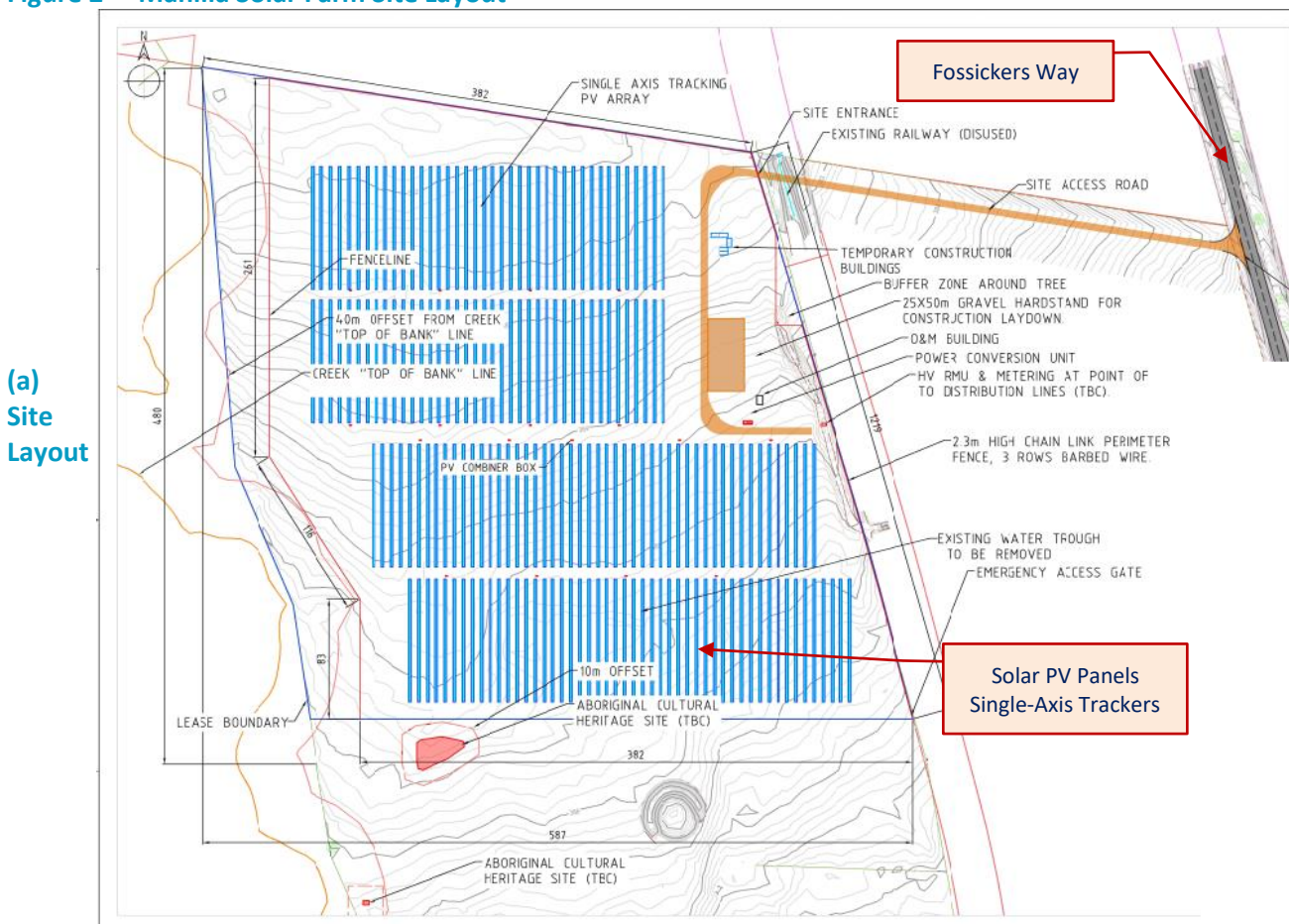
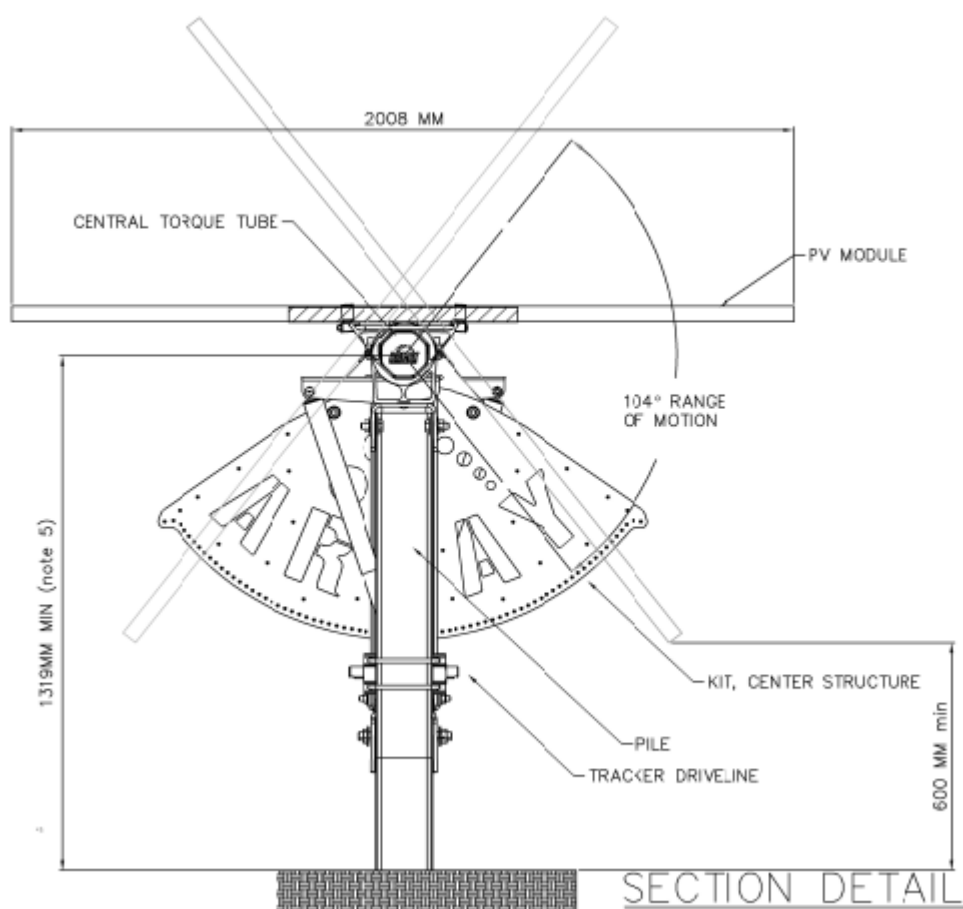


Fig.2 (cont'd)

(b)
Single-Axis
Tracker
Profile ($\pm 52^\circ$ Tilt)



3 RECEIVERS AND ASSOCIATED IMPACTS

3.1 Receiver Impacts

The issues of concern in relation to daytime reflective glare and night-time illumination glare and the associated receivers of interest are detailed below.

Aviation-Related Glint & Glare (Aircraft, Helicopters, Airport Control Towers)

There have been several documented cases globally, none in Australia, of solar panel installations at airports interfering with Airport Control Tower operations. There is the added potential for reflective glare to impact pilots especially during the latter approach stages of landing, when the line of sight of the pilot is directed downwards.

Motorist Traffic Disability Glare on the surrounding road network

The issue of concern here is the potential occurrence of Traffic Disability Glare, which most often arises from incoming solar rays striking a reflective surface at a moderately high (“glancing”) incident angle (typically greater than 70°) and altitude angle less than 25° (altitude angles greater than this would be intersected and obstructed by a typical windscreen roof-line).

Train Driver Disability Glare on the surrounding rail network

The issue of concern here is the potential impact of reflective glare interfering with or distracting a train operator’s activities or the potential for reflections to obscure railway signals.

Industrial Critical Machinery Operators (draglines, heavy trucks, etc)

The issue of concern here is the potential impact of reflective glare interfering with or distracting the operators of critical industrial machinery.

Residential Nuisance Glare on surrounding receivers

The issue of concern here is the potential “nuisance” caused by extended periods of reflective glare.

Nearest neighbours may also be impacted by light spill from night-time illumination.

3.2 Nearest Receiver Locations

Receivers of interest relevant to the Project are shown in:

- Figure 3** Nearest Airfields;
- Figure 4** Surrounding road network;
- Figure 5** Surrounding rail network; and
- Figure 6** Nearest representative residential and sensitive receivers.

Figure 3 Nearest Airfields to Project Site

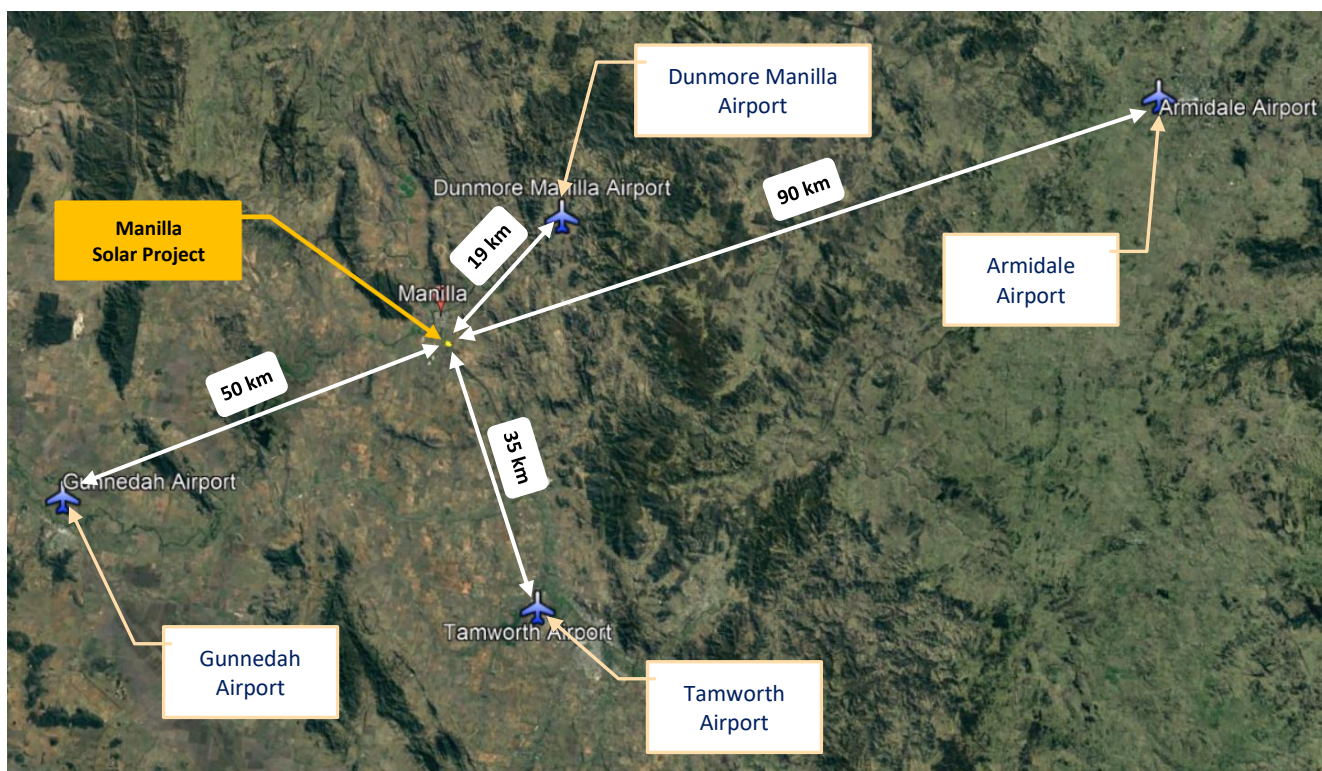


Figure 4 Surrounding Road Network

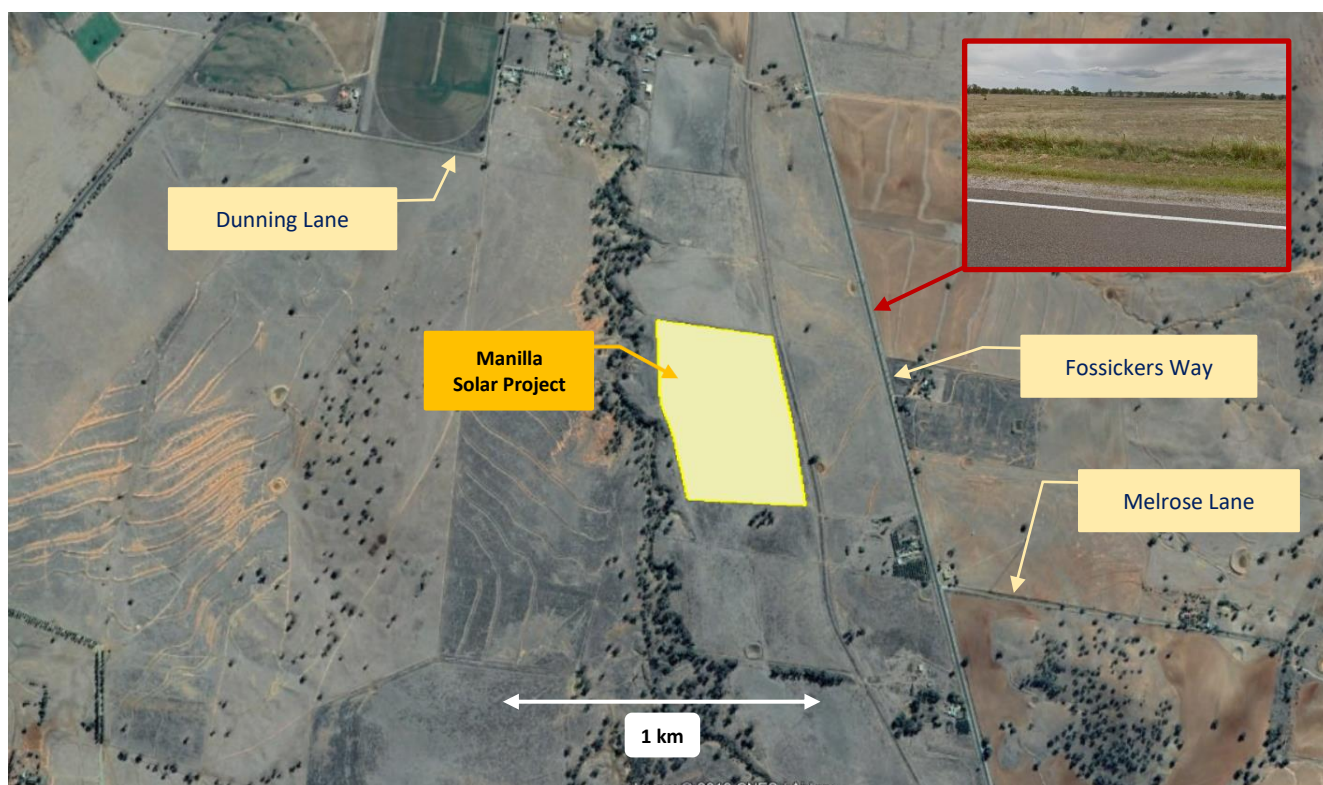


Figure 5 Surrounding Rail Network and NSW Rail Map

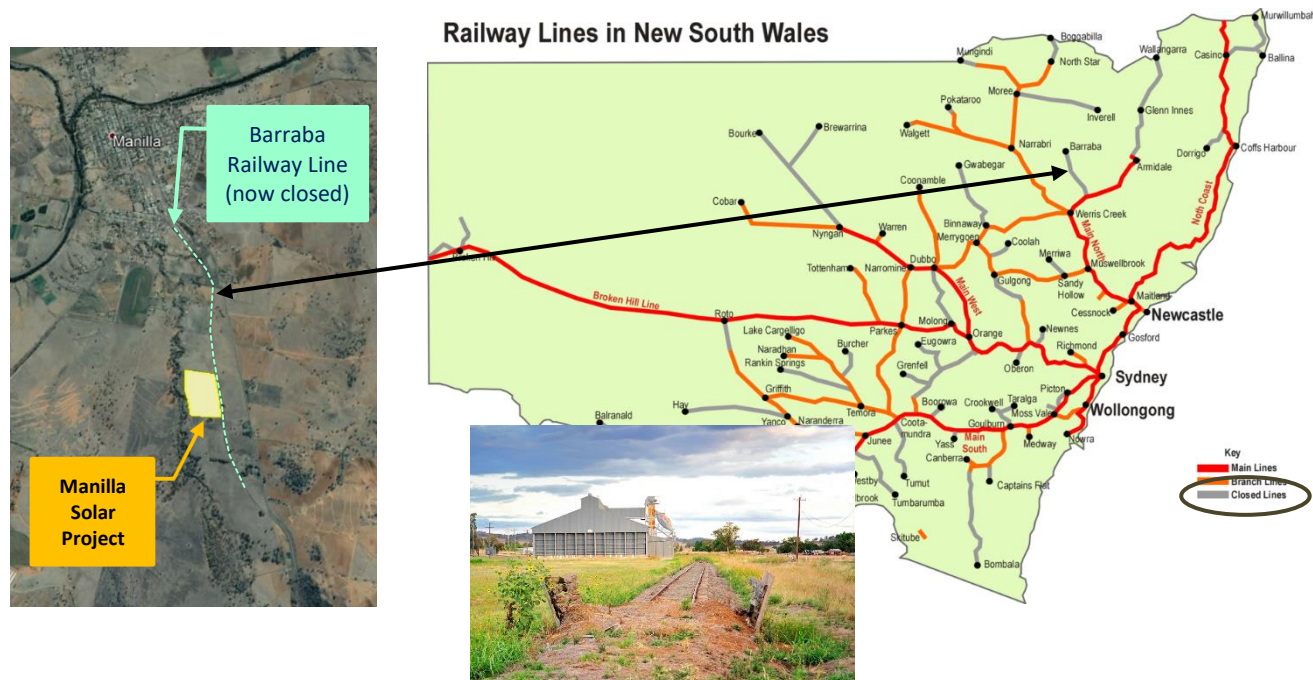


Figure 6 Nearest Representative Residential (RR) and Other (OR) Receivers



4 GLARE ACCEPTABILITY CRITERIA

In relation to **daytime** reflective glare impact, the Project contains the following elements of interest:

- PV modules using solar panels on the proposed ground array (refer **Figure 2(a)**);

In relation to **night-time** illumination glare impact, future interest would lie with:

- Any 24/7 lighting for access roads to enable site maintenance, fire and other emergency events, and 24/7 lighting for the on-site office/maintenance building and substation which provide connection to the local distribution network.

At the present time, 24/7 lighting is not proposed for the facility.

4.1 Aviation Sector Reflective Glare

The impact of solar PV systems on aviation activity is something that solar developers today are addressing more and more often, given the (global) proliferation of solar projects, in particular those located either within or around airport precincts.

Guidance in this area is available from two sources – UK CAA and US FAA.

US FAA

The reader is referred to the following technical references:

- Brumleve (various, 1976-1984), Ho, Ghanbari & Diver (2009, 2010) and Ho & Khalsa (2010)

The FAA regulates and oversees all aspects of American civil aviation. On the basis of the above and other technical R&D references, the FAA issued a Technical Guidance Policy in 2010 and a subsequent (and over-riding) Interim Policy in 2013. The Technical Guidance Policy was updated in 2018.

- FAA, *“Technical Guidance for Evaluating Selected Solar Technologies on Airports”*, Federal Aviation Administration, Washington, D.C., November 2010.
- FAA, *“Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports”* Federal Register, Oct. 23, 2013,
- FAA, *“Technical Guidance for Evaluating Selected Solar Technologies on Airports”*, Federal Aviation Administration, Washington, D.C., Version 1.1, April 2018.

In support of the above, the FAA contracted Sandia Labs to develop their **Solar Glare Hazard Analysis Tool** (SGHAT) software as the standard tool for measuring the potential ocular impact of any proposed solar facility on a federally obligated airport. SGHAT utilises the Solar Glare Ocular Hazard Plot to determine and assess the potential for glare. SGHAT is described in the following references:

- Ho, C.K., Ghanbari, C.M. and Diver, R.B.,, *“Methodology to Assess Potential Glint and Glare Hazards from Concentrating Solar Power Plants: Analytical Models and Experimental Validation”*, J. Solar Engineering, August 2011, Vol.133, 031021-1 to 031021-9.
- Ho, C.K. & Sims, C., *“Solar Glare Hazard Analysis Tool (SGHAT) User’s Manual v2.0”*, Sandia National Laboratories, Albuquerque, NM. August 2013.

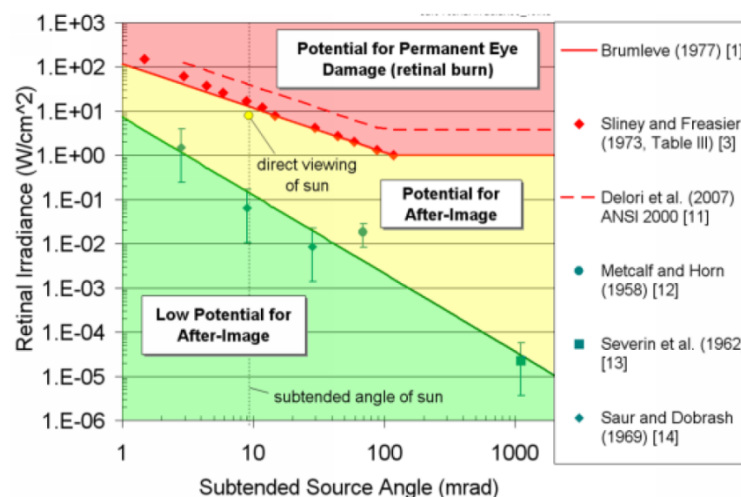
A sample Solar Glare Ocular Hazard Plot is shown in **Figure 7** along with reference sources which contributed to the delineation of various hazard “zones”. The SGHAT criteria state that a proposed solar facility should satisfy the following:

- Airport Traffic Control Tower (ATCT) cab NO Glare
- Final approach paths for landing aircraft Glare to NOT exceed “Low Potential for After-Image”

The criteria also state:

- Ocular impact must be examined over the entire calendar year in 1-minute intervals, sunrise to sunset;
- Both existing and planned ATCT cabs should be examined for potential glint and glare; and
- Both existing and planned landing thresholds should be examined for potential glint and glare.

Figure 7 Example Solar Glare Ocular Plot (SGHAT Software Output)



4.2 Motorist “Disability” Glare and Pedestrian “Discomfort” Glare

The criteria commonly used by Local Government Authorities to assess the acceptability or otherwise of road traffic glare events utilise the so-called **Threshold Increment (TI)** Value of the reflection condition (refer **Abbreviations and Definitions**). These acceptability criteria were originally developed to address adverse reflections from the glass curtain wall façade systems of medium and high-rise buildings located close to road carriageways.

- For (Motorist) Traffic Disability Glare, the TI Value should remain:
 - Below 10 for major roads
 - Below 20 for minor roads
- For Pedestrian Discomfort Glare, the TI Value should remain:
 - Below 2 at critical locations such as pedestrian crossings
 - Below 3 for other locations

The TI Value is calculated as the ratio of “veiling” luminance to the overall average carriageway luminance, with the necessary constant and exponent parameters provided in AS 1158.2:2005.

4.3 Rail Operators Reflective Glare

Almost all Australian Rail Authorities have guidelines covering glare in general (ie not specific to solar PV panel glare) aimed at avoiding discomfort/distraction to train operators and obscuring train signals. Most guidelines refer either to Table 2.10 of AS 1158.3.1 for the TI Value criterion and/or Table 3.2 of AS 1158.4 for the Cd (Candela) criterion associated with the control of glare.

- For Rail Traffic Disability Glare, the relevant AS1158 criteria are:
 - The TI Value should remain below 20%
 - The Cd Value at 70° incidence should remain below 6,000.

4.4 Residential “Nuisance” Glare

Instances of documented nuisance glare associated with solar PV panels (grid-scale, industrial or residential) and nearby residential receivers have been relatively infrequent globally, especially given the widespread and rapid increase in the take-up of residential solar panels in Australia and elsewhere.

There are currently no national or state guidelines in Australia governing the acceptability or otherwise of nuisance glare specific to solar PV, although the concepts used for glare acceptability criteria in the preceding sections can assist when dealing with this issue.

Existing guidance that exists in relation to solar panels from state governments typically covers installation audits and compliance checks. Additional guidance in relation to compliance with Australia Standards is provided by:

Clean Energy Council

website: www.cleanenergycouncil.org.au

4.5 Industrial Critical Machinery Operations

There are currently no (Australian) national or state guidelines governing the acceptability or otherwise of reflective glare for industrial site critical operations. Instead, the concepts used for acceptability criteria in the preceding sections, in particular Traffic Disability Glare, can assist when dealing with this issue.

The issue most commonly arises in relation to mining operations where machinery operators can be located in elevated locations, eg dragline operations, where a line of sight may be possible to a solar facility located in very close proximity. Ports with their observation towers are another potential source of elevated receivers of interest if located adjacent to a solar facility.

No such industrial operations exist in the present case.

4.6 Night-Time Illumination Glare

The effect of light spill from outdoor lighting impacting on residents, transport users, transport signalling systems and astronomical observations is governed by AS 4282-1997.

The adverse effects of light spill from outdoor lighting are influenced by a number of factors:

- The topology of the area. Light spill is more likely to be perceived as obtrusive if the lighting installation is located higher up than the observer. Lighting installations are usually directed towards the ground and an observer could hence have a direct view of the luminaire.
- The surrounding area. Hills, trees, buildings, fences and general vegetation have a positive effect by shielding the observer from the light installation.
- Pre-existing lighting in the area. Light from a particular light source is seen as less obtrusive if it is located in an area where the lighting levels are already high, eg in cities. The same lighting installation would be seen as far more bothersome in a less well-lit residential area.
- The zoning of the area. A residential area is seen as more sensitive compared to commercial areas where high lighting levels are seen as more acceptable.

Typical illuminance levels for a variety of circumstances are given in **Table 1** for comparison.

Table 1 Typical Illuminance Levels for Various Scenarios

Lighting Scenario	Horizontal Illuminance (lux)
Moonless overcast night	0.0001
Quarter Moon	0.01
Full Moon	0.1
Twilight	10
Indoor office	300
Overcast day	1,000
Indirect sunlight clear day	10,000-20,000
Direct sunlight	100,000-130,000

Recommended criteria of light technical parameters for the control of obtrusive lighting are given in **Table 2**. The vertical illuminance limits for *curfew hours* apply in the plane of the windows of habitable rooms or dwellings on nearby residential properties. The vertical illuminance criteria for *pre-curfew hours* apply at the boundary of nearby residential properties in a vertical plane parallel to the boundary.

Values given are for the direct component of illuminance, i.e. no reflected light is taken into account.

- Limits for luminous intensity for *curfew hours* apply in directions where views of bright surfaces of luminaires are likely to be troublesome to residents, from positions where such views are likely to be maintained.
- Limits for luminous intensity for *pre-curfew hours* apply to each luminaire in the principal plane, for all angles at and above the control direction.

Table 2 Recommended Maximum Values of Light Technical Parameters (AS4282-1997)

Light Technical Parameter	Time of Operation	Commercial Areas	Residential Areas	
			Light Surrounds	Dark Surrounds
Illuminance in vertical plane (E_v)	Pre-curfew hours	25 lx	10 lx	10 lx
	Curfew hours	4 lx	2 lx	1 lx
Luminous Intensity emitted by luminaires (I)	Pre-curfew hours	7,500 Cd (for a medium to large area with Level 1 control)	100,000 Cd (for a large area with Level 1 control)	100,000 Cd (for a large area with Level 1 control)
	Curfew hours	2,500 Cd	1,000 Cd	500 Cd

The Project is located 3.5 km south-southeast of the township of Manilla and has the potential to impact on surrounding residential properties – refer **Figure 6**. These properties are not located within township environs and would therefore be classed as being in a residential area with “Dark Surrounds” - refer **Table 2**.

The applicable limits for adverse spill light will depend on the time of operation for the lighting installation.

For the Project, it is likely that internal access roads and any equipment buildings in particular, will be operational 24/7, suggesting the application of the more restrictive limit relevant to *curfew hours*.

Accordingly:

- If 24/7 lighting were to be incorporated into the Project, any associated night-time light spill onto the facades of the surrounding residential dwellings should be kept below 1 lux during curfew hours

Finally, it has been known for some time that night-time artificial lighting has the potential to disrupt the natural behaviour of nocturnal fauna species such as arboreal mammals, large forest owls and microbats. The standards mentioned above do not contain limiting lux levels in relation to the mitigation of such eco-lighting impacts.

Mitigation recommendations in relation to adverse eco-lighting therefore centre on feasible night-time lighting minimisation, bearing in mind the provision of appropriate health and safety and security conditions given the nature of the site. Biodiversity associated with the Project is discussed in the Ecological Assessment Report prepared for the Project. As far as is known, no adverse eco-lighting issues are apparent.

5 GLARE IMPACT ASSESSMENT - ASSUMPTIONS

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the Project's solar PV panels
- Night-time Illumination glare from 24/7 operational security lighting within the ground array (noting that, at this stage, 24/7 lighting is not proposed for the Project)

5.1 Assumptions – Solar Panel Geometry

The glare assessment discussed in detail in following sections is based on the following assumptions:

- The solar panel array trackers are “single-axis” capable of rotating solar panels to a maximum of $\pm 60^\circ$.
- The trackers are oriented north-south and spaced 6.2 m apart;
- Individual panels (approximately 1.0m x 2.0m) reach a maximum height above ground of approximately 2.5 m at their full $\pm 52^\circ$ tilt angle; and
- The eastern-most tracker is located approximately 317 m from the nearest major thoroughfare, Fossickers Way.

5.2 Project Site Solar Angles – Annual Variations

One of the challenging issues encountered with daytime solar panel glare is the varying nature of the reflections, whose duration will vary with time of day and day of the year as the sun's rays follow variable incoming angles between the two extremes of ...

- summer solstice - sunrise incoming rays from just south of east, maximum angle altitude rays at midday, sunset incoming rays from just south of west
- winter solstice - sunrise incoming rays from the northeast, minimum angle altitude rays at midday, sunset incoming rays from the northwest

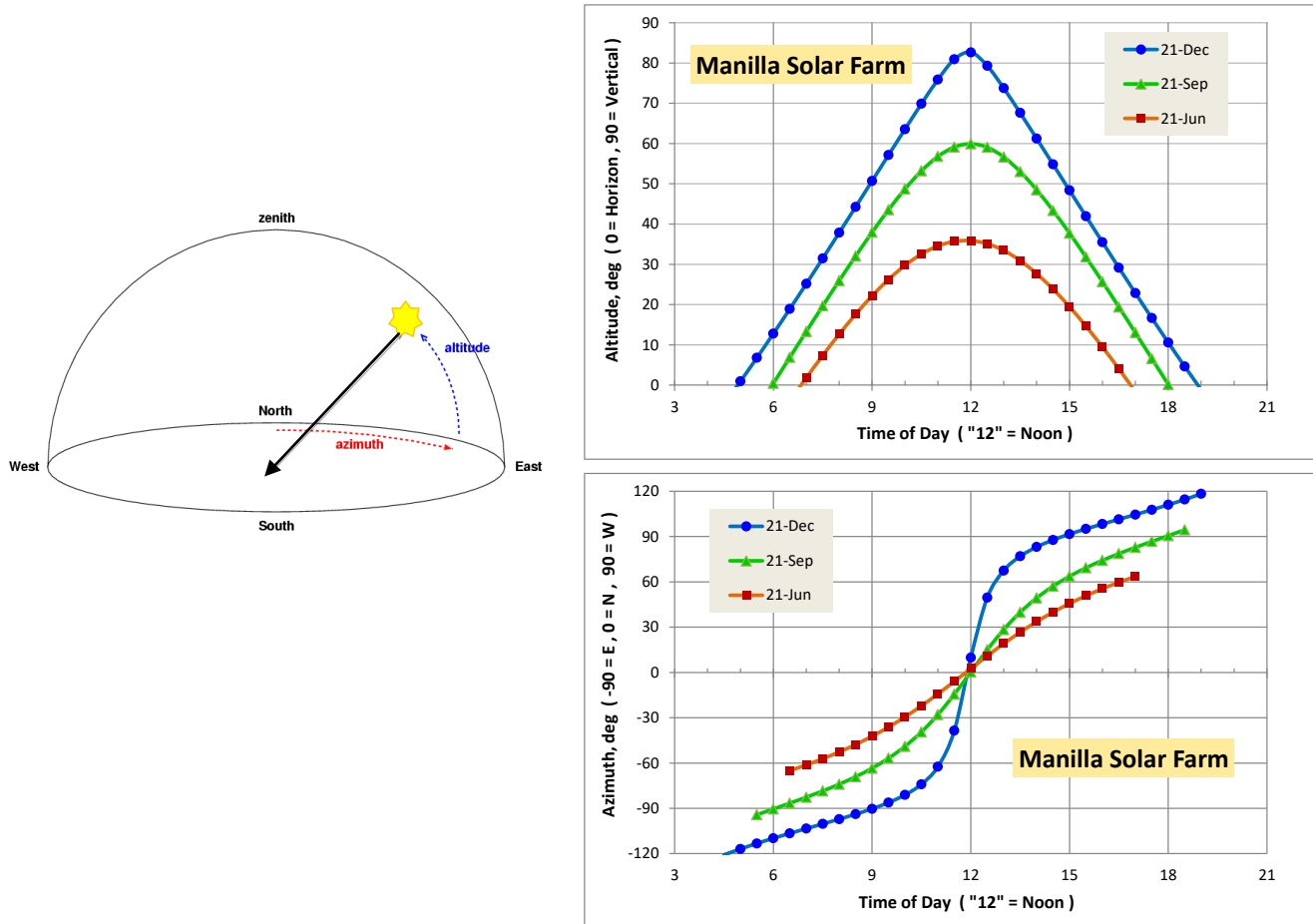
Any solar glare analysis must take into account the complete cycle of annual reflection variations noted above.

The potential range of incoming solar angles at the Project site relevant to daytime glare is shown in **Figure 8** with relevant critical angles summarised in **Table 3**.

Table 3 Key Annual Solar Angle Characteristics for Project Site

Day of Year	Sunrise	Sunset	Azimuth Range (sunrise-sunset)	Max Altitude
Summer Solstice	4:55 am	6:54 pm	117° E of North to 117° W of North	82.6°
Equinox	5:58 am	6:01 pm	91° E of North to 91° W of North	59.9°
Winter Solstice	6:55 am	4.51 pm	62° E of North to 62° W of North	35.9°

Figure 8 Project Site Incoming Solar Angle Variations

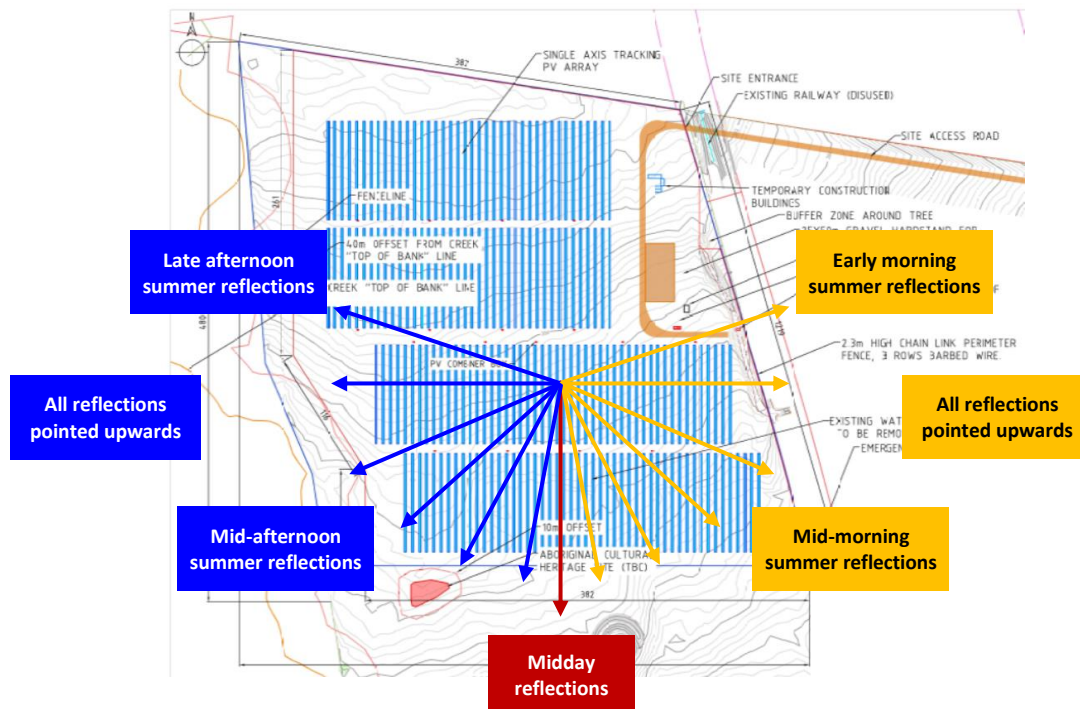


5.3 Project Solar Reflections

The project will use single-axis tracking panels (with the axis of rotation oriented north-south) as described in **Section 2.2**. In “plan” view, reflections from the project’s panels will be directed as shown in **Figure 9** for a representative area of panels, with the direction of reflected rays shown for typical mid-summer days.

As a result of the tracking motion of the solar panels throughout the day, reflections will generally be directed upwards and hence not visible by ground-based receivers. Where such reflections can be observed by surrounding elevated receivers they would be seen as “low incidence” reflections with corresponding low reflectivity. This is the inevitable outcome of the objective of maximising the solar gain of each panel (where the reflectivity would ideally be minimal) and justifying the additional cost of using a tracking system for the panels which follows the sun, rather than a fixed panel system.

Figure 9 Potential Solar PV Panel Reflection Angles from the Project (typical mid-summer)



5.4 Solar Panel Reflectivity

Solar PV panels are designed to capture (absorb) the maximum possible amount of light within the layers below the front (external) surface. Consequently, solar PV panels are designed to minimise reflections off the surface of each panel. Reflections are a function of:

- the angle at which the light is incident onto the panel (which will vary depending on the specific location, time of day and day of the year), and
- the index of refraction of the front surface of the panel and associated degree of diffuse (non-directional) versus specular (directional or mirror-like) reflection which is a function of surface texture of the front module (reflecting) surface.

Some typical reflectivity values (given in terms of the “n” refractive index value) are:

- | | |
|-------------------------------|----------|
| • Snow (fresh, flaky) | n = 1.98 |
| • Standard Window Glass | n = 1.52 |
| • Plexiglass, Perspex | n = 1.50 |
| • Solar Glass | n = 1.33 |
| • Solar Glass with AR Coating | n = 1.25 |

Standard PV Solar Panels

Representative reflectivity curves are shown in **Figure 10**.

Figure 10 Typical Reflectivity Curves as a Function of Incidence Angle

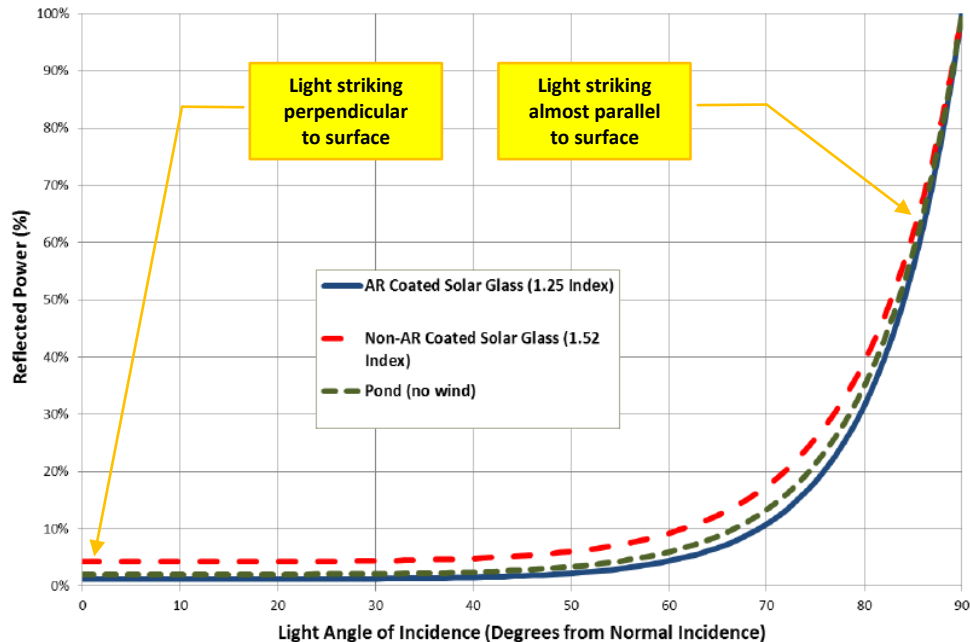


Figure 10 shows that:

- When an oncoming solar ray strikes the surface of a solar PV panel close to perpendicular to the panel surface (i.e. low “incident” angle), the reflectivity percentage is minimal (less than 5% for all solar panel surface types).
- It is only when an incoming solar ray strikes the panel at a large “incidence” angle, i.e. almost parallel to the panel, that reflectivity values increase. When this happens, reflections become noticeable and potentially at “glare” level for all solar panel surface types.
- However, for very high incidence angle, it would almost always be the case that the observer (motorist, train driver, pedestrian, etc) would perceive reflections coming from virtually the same direction as the incoming solar rays themselves. Such a condition would not constitute a glare situation as the intensity of the incoming solar ray itself would dominate the field of vision perceived by the observer.

6 GLARE IMPACT ASSESSMENT - RESULTS

6.1 Aviation Sector Reflective Glare

As can be seen in **Figure 3**, the nearest airfields to the Project site are: Dunmore Manilla Airfield (19 km to the northeast), Tamworth Airport (35 km to the south-southeast), Gunnedah Airport (50 km to the southwest) and Armidale Airport (90 km to the east-northeast).

Due to the distances involved (refer **Figure 3**) and the possible angles of reflections from the Project's solar PV panels (refer **Figure 9**) in relation to the pilot line of sight on landing approach, potential glare conditions for aircraft on any possible approach paths for all the nearest airports, including Dunmore Manilla, are deemed non-existent.

Helicopter flight paths can be highly variable and landing approach paths often vary in relation to an airfield's standard runway glide paths. However, again, and including the nearest airfield (Dunmore Manilla), due to the distances involved, potential glare conditions for any possible helicopter landing approach paths are deemed non-existent.

Accordingly, a quantitative analysis (eg using Sandia Labs SGHAT) is not deemed necessary to assess the potential for adverse and unacceptable glare (and glint) conditions.

Aerial Spraying / Crop Dusting

Given the surrounding agricultural land usage in the vicinity of the Project site, it is possible that aerial spraying might take place within several kilometres of the Project. There are no "standard" aircraft flight paths associated with such aviation activity.

SLR has previously undertaken quantitative analyses using the SGHAT software tool of such activities, under the following assumptions:

- Assume potential flight paths whereby an aircraft is flying horizontally towards a Project site from any direction and at an elevation of 200 ft (60 m) above local ground level;
- Assume that the aircraft can get as close as 1 km to the nearest part of the Project's solar array;
- Assume that solar panels track the sun during the day, tilted from 60 east to 60 west, about a horizontal axis oriented north-south.

When run for a full year of potential incoming solar angles at latitudes similar to the Project Site (hence similar incoming solar angles), the resulting SGHAT Ocular Plots showed that the potential for aviation glare was negligible. This was primarily due to the low incidence angle of reflected rays (regardless of the time of the year) arising from the tilting action of the tracking systems.

6.2 Motorist “Disability” Glare and Pedestrian ‘Discomfort’ Glare

The “major” and “minor” thoroughfares in the immediate vicinity of the Project are shown in **Table 4**, including:

- Fossickers Way – northbound and southbound “major”
- Melrose Lane – westbound only “minor”
- Dunning Lane – eastbound only “minor”

The relevant TI criteria for the above roads would be:

- For (Motorist) Traffic Disability Glare, the TI Value should remain below 20 for “minor” roads and below 10 for “major” roads; and
- For Pedestrian Discomfort Glare, the TI Value should remain below 2 at pedestrian crossings and below 3 for other locations.

Important factors influencing the potential for traffic disability glare include:

- Any difference in elevation between the motorist and the solar panel array;
- The potential for solar reflections of concern to be obstructed by intervening terrain and topography;
- The difference between the line of sight of a driver (i.e. in the direction of the road) and the line of sight relative to incoming reflections. Significant TI values can only occur when this difference is small. In some cases, eg when traffic is moving away from the line of incoming reflections, such reflections become essentially invisible to the motorist – this would apply for example to traffic on Melrose Lane moving eastwards, or Dunning Lane moving westwards.

Figure 11 shows that some of the potential road glare scenarios for the Project site. In most cases, the difference in line of sight of a driver and the Project (and hence potential reflections) is reasonable, ie not small.

SLR has undertaken TI Value calculations for the roadways discussed above. Calculation locations were varied along the relevant carriageways at positions where the line of sight of drivers was close to the angle of potential incoming solar reflected rays. The results are shown in **Table 4**.

Table 4 TI Value Results – Combined Results from ALL PROJECT SOLAR PANELS

Location	Classification	TI Value	Occurrence	
			Time of Year / Day	Duration
Fossickers Way - northbound	major	nil	all-year-round	na
Fossickers Way - southbound	major	nil	all-year-round	na
Melrose Lane - westbound	minor	nil	all-year-round	na
Dunning Lane - eastbound	minor	nil	all-year-round	na

Figure 11 View of the Project from Surrounding Roads

Driving southwards
along Fossickers Way



Driving northwards
along Fossickers Way



At the intersection of
Fossickers Way and
Melrose Lane



The TI calculation results shown in **Table 4** indicate the following:

- TI Values registered for all carriageways were zero at all times of the year.

In all cases above, the relevant Motorist Traffic Disability Glare criteria and Pedestrian Discomfort Glare criteria are satisfied. The reasons for this result are:

- The same elevation for motorists and the solar array panels; and
- The single axis trackers which support the panels cause outgoing reflections for all incoming solar angles to be redirected upwards away from the ground.

6.3 Rail Operator Reflective Glare

Figure 5 shows the Barraba Railway Line which runs along the eastern perimeter of the Project site. **Figure 5** also shows the current NSW rail network and a photo taken along the Barraba Railway Line just north of the site. The following is noted:

- The Barraba Railway Line was opened in 1908 and ran for 99 km from West Tamworth, past Manilla and through to the township of Barraba.
- The line is no longer in use, except for a 6 km section near Tamworth, for use as grain wagon storage.
- A search of TransportNSW and NSW Department of Planning websites has revealed that there are no plans for the line to be re-opened.

Given the absence of an operational rail line close to the site, TI Value calculations would yield nil glare.

There are no disability glare issues relevant to rail operations relevant to the Project.

6.4 Industrial Critical Machinery Operators

There are no industrial operations in the vicinity of the Project (e.g. mining operations) and none planned (mining or otherwise), with the kind of machinery where the relevant operators have the potential to experience reflective glare from the Project, eg elevated cabins in draglines, etc.

6.5 Residential “Nuisance” Glare

The nearest residential and other sensitive receivers to the Project are identified in **Figure 6**. They lie to the north clockwise around to the south relative to the site. Regional ABC Broadcasting Station, 2NU, lies over 550 m to the southeast of the nearest solar panels at the southeast corner of the Project site.

There are no formal TI Value (or alternative) criteria governing reflective glare from solar facilities.

Accordingly, SLR has carried out TI Value calculations for the receivers discussed above, to gain an understanding of the potential for nuisance glare conditions from the project. The results are shown in **Table 5**.

Table 5 TI Value Results

Receiver (refer Figure 6)	TI Value	Occurrence	
		Time of Year / Day	Duration
RR1, RR2, RR3, RR4, RR5	nil	all-year-round	na
OR1 (2NU)	nil	all-year-round	na

The results indicate that there is no glare potential from the Project to any surrounding residential or sensitive receivers, primarily due to:

- The same elevation for all receivers and the solar array panels; and
- The single axis trackers which support the panels cause outgoing reflections for all incoming solar angles to be redirected upwards away from the ground.

6.6 Night-Time Illumination Glare

Although presently not fully defined, it is assumed that an area within the Manilla Solar Farm Project site will be set aside for an Operation and Maintenance Building, fire access routes and egress, etc, and that some of these may need to be operational 24/7.

Although night-time illumination is not presently planned for the Project, it may be required in the future for some of the above relevant areas and, as such, is addressed in principle in this assessment.

The only potential for any future night-time illumination glare would be associated with the nearest thoroughfares and residential and other sensitive receivers to the Project.

Consideration has also been given to the potential for adverse eco-lighting impacts on nocturnal fauna habitats in close proximity to the Project site, especially within any close-by native vegetation areas. On the basis of the Ecological Assessment Report carried out for the Project, there are no such habitats close to the Project site.

The recommendations set out below are therefore made in the event that future 24/7 lighting is incorporated into the Project, to achieve the best lighting performance (taking into account safety considerations) while having a minimal impact on the surrounding properties, carriageways and nocturnal fauna.

In terms of any future potential night-time lighting, the adopted goal of limiting night-time light spill to no more than 1 lux falling on the nearby residential facades during curfew hours will be easily achieved given the distances to the nearest residential and other receivers.

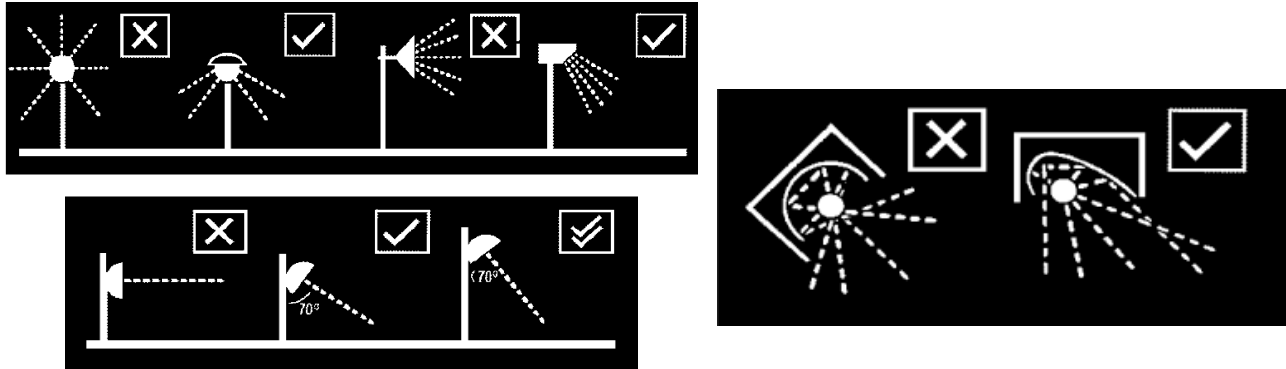
Accordingly, the potential for any future nuisance glare will be non-existent.

AS4282-1997 Control of the Obtrusive Effect of Outdoor Lighting sets out general principles that should be applied when designing outdoor light to minimise any adverse effect of the light installation.

- Direct lights downward as much as possible and use luminaires that are designed to minimise light spill, e.g. full cut-off luminaires where no light is emitted above the horizontal plane, ideally keeping the main beam angle less than 70°. Less spill-light means that more of the light output can be used to illuminate the area and a lower power output can be used, with corresponding energy consumption benefits, but without reducing the illuminance of the area - refer **Figure 12**.

- Do not waste energy and increase light pollution by over-lighting.
- Wherever possible use floodlights with asymmetric beams that permit the front glazing to be kept at or near parallel to the surface being lit.

Figure 12 Luminaire Design Features that Minimise Light Spill



7 CONCLUSION

SLR Consulting Australia Pty Ltd (SLR) has been engaged by KDC to carry out a Reflective Glare assessment of the proposed Manilla Solar Farm (the “Project”) under development by Providence Asset Group. The Project is located approximately 3.5 km south-southeast of Manilla, NSW. The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels within the facility:
 - . Aviation Sector Reflective Glare;
 - . Motorist “Disability” Reflective Glare and Pedestrian “Discomfort” Reflective Glare;
 - . Rail Operator Reflective Glare;
 - . Industrial critical machinery operators (heavy vehicles, etc) Reflective Glare; and
 - . Residential “Nuisance” Glare
- Night-time Illumination glare from 24/7 operational security lighting within the facility

The Project is located approximately 40 km north-northwest of Tamworth and 50 km northeast of Gunnedah. The proposed (up to) 5 MWac facility will comprise 15,120 solar PV panels within a 16 ha project site area. The 405 W panels, measuring approximately 2.0 m by 1.0 m, will be positioned as currently understood on single-axis trackers oriented north-south with a spacing of 6.2 m.

In all cases, the present study has found that the potential for adverse glare from the proposed facility will be negligible.

Aviation-Related Potential Glare

There will be nil glare from the Project in relation to aviation-related glare.

Motorist “Traffic Disability” Glare

Primarily due to the selection of the single-axis tracking system for the mounting of the ground-based array panels, there will be nil glare from the Project in relation to traffic disability glare.

Rail Traffic “Disability” Glare

Given the absence of any operational rail lines close to the Project site, the potential for related glare is nil.

Residential Nuisance Glare

The potential for nuisance glare from the Project to surrounding residential or other receivers is nil.

Night-Time Illumination Glare

Although presently not incorporated into the Project, consideration has been given to the future potential for night-time lighting related to equipment and/or buildings, fire access routes and egress, etc.

Recommendations have been made to ensure that the potential for any future possible night-time illumination glare will be non-existent.

ASIA PACIFIC OFFICES

BRISBANE

Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

MACKAY

21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

ROCKHAMPTON

rockhampton@slrconsulting.com
M: +61 407 810 417

AUCKLAND

68 Beach Road
Auckland 1010
New Zealand
T: +64 27 441 7849

CANBERRA

GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

MELBOURNE

Suite 2, 2 Domville Avenue
Hawthorn VIC 3122
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

SYDNEY

2 Lincoln Street
Lane Cove NSW 2066
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

NELSON

5 Duncan Street
Port Nelson 7010
New Zealand
T: +64 274 898 628

DARWIN

5 Foelsche Street
Darwin NT 0800
Australia
T: +61 8 8998 0100
F: +61 2 9427 8200

NEWCASTLE

10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

TAMWORTH

PO Box 11034
Toowoomba NSW 2340
Australia
M: +61 408 474 248
F: +61 2 9427 8200

NEW PLYMOUTH

Level 2, 10 Devon Street East
New Plymouth 4310
New Zealand
T: +64 0800 757 695

GOLD COAST

Ground Floor, 194 Varsity
Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

PERTH

Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

TOWNSVILLE

Level 1, 514 Sturt Street
Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001



WASTE MANAGEMENT PLAN

Establishment of Solar PV Power
Generation Plant
4133 Manilla Road, MANILLA NSW 2346

KDC

This page has been left blank intentionally

Address: 4133 Manilla Road, Manilla NSW 2346

Proposal: Establishment of Solar PV Power Generation Plant.

OBJECTIVES FOR THE WASTE MANAGEMENT ON THIS SITE

- + To minimise resource requirements and construction waste through reuse and recycling; and the efficient selection and ordering of resources.
- + To ensure the waste management systems are compatible with the relevant waste collection services.

The management of waste is addressed in this WMP in the following sections, according to the stages of the development: site preparation and construction and ongoing operation.

1 CONSTRUCTION STAGE

Construction waste will be separated on site by builder's contractors and builder's laborer's during the construction stage. The site manager will erect a sign on site for waste areas and will inform the builder's staff where material is to be collected for recycling, and will set aside on site an area to store the recyclable materials for transportation to local recycling plants. The site manager and/or builder will impose the execution of the waste separation policy on a regular basis and to have on-going checks.

Stockpiles shall be located and managed appropriately to prevent sediment runoff and ensure minimal environmental impact from the building site.

A suitable all-weather vehicular access point shall be provided for the construction phase, and all sediment and erosion control devices implemented on site prior to commencement of construction works.

Type of waste generated	Estimates Volume in m ³ or area m ² or weight in tonne (t)	Reuse and Recycling		Disposal
		On-Site	Off-Site	
Excavated Material	<10m ³	Possible reuse of soil for backfilling purposes.	Un-recyclable excavated material to be disposed at local waste facility.	
Metal (Ferrous) E.g. Steel	3.15t		Sent to local metal recycler by contractor.	
Metal (Non-ferrous) E.g. Aluminium	<1t		Sent to local metal recycler by contractor.	
Packaging (Wood) E.g. Pallets, dunnage	42.1t		Reuse by logistics contractor. Broken directed to recycler.	
Packaging (Other) (Plastic, cardboard etc.)	5.15t		Cardboard/paper sent to recycler by contractor.	Disposed of at local waste facility by contractor
Other waste e.g. pvc plastics, paint, paper / cardboard	<2t	-		Disposed of at local waste facility by contractor

2 OPERATION STAGE

Staff will separate general waste and recyclables within the waste storage / management area. A minimum of two separate bins (general and recycle bins) will be located within the waste area. Waste and recycling bins will be clearly labelled and identifiable. The bins and waste storages areas will be cleaned by staff with protective gloves as required.

Type of waste generated	Estimated Volume per week	Reuse and Recycling		Disposal
		On-Site	Off-Site	
Food and General Waste	20L			Disposed of at local landfill by waste contractor
Recyclable Waste	20L			Disposed of at local recycle plant by waste contractor
Green Waste	20L			Disposed of at local recycle plant by waste contractor

Manilla Solar Farm Flood Impact Assessment

R.T2003.001.03



March 2020
Final Report

Torrent Consulting Pty Ltd
86 Blanch Street
Shortland NSW 2307

ABN 11 636 418 089

www.torrentconsulting.com.au

Document: R.T2003.001.03.docx
Title: Manilla Solar Farm Flood Impact Assessment
Project Manager: Dan Williams
Author: Dan Williams
Client: Providence Asset Group c/o KDC
Client Contact: Rosie Turner (KDC)
Prepared: Verified:

Daniel Williams

Synopsis

Flood Impact Assessment report documenting the existing flood risk profile at the proposed Manilla Solar Farm development site and the assessment of flood impacts both to and resulting from the proposed development. Appropriate measures for the management of the identified flood risks are also discussed.

Revision History

Revision	Description	Date
01	Preliminary Draft	11/12/2019
02	Draft	9/03/2020
03	Final	24/03/2020

Disclaimer

This report has been prepared on behalf of and for the exclusive use of Providence Asset Group, and is subject to and issued in accordance with the agreement between Providence Asset Group and Torrent Consulting Pty Ltd. Torrent Consulting Pty Ltd accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by and third party.

Executive Summary

Torrent Consulting was engaged by Providence Asset Group to undertake a Flood Impact Assessment to assist in the DA process for the proposed solar farm at 4133 Manilla Road (Lot A DP442930), Manilla, NSW (the Site).

For this assessment a TUFLOW model was developed covering the Greenhatch Creek catchment to the confluence with the Namoi River some 4 km downstream of the Site, at which the contributing catchment area is around 60 km². A more detailed TUFLOW model was developed covering the Greenhatch Creek floodplain from around 3 km upstream of the Site, downstream to the Namoi River confluence.

The TUFLOW hydrologic model (refer Section 2.1) was simulated (using the HPC solver) in accordance with the Australian Rainfall and Runoff (ARR) 2019 guidelines to derive design flood hydrology for the full range of design rainfall events between the 20% AEP and 0.2% AEP, with storm durations ranging from 30 minutes to nine hours.

The detailed TUFLOW hydraulic model (refer Section 2.2) was simulated (using the HPC solver) for the adopted design flood hydrology detailed in Section 3. Mapping of the modelled peak flood depths and levels for each of the simulated design events is presented in Appendix A. Mapping of the modelled peak flood hazard for each of the simulated design events is presented in Appendix B.

The provisions of the Tamworth Regional DCP require the on-site electrical infrastructure and the floor level of any buildings to be above the 1% AEP flood level. The modelled 1% AEP post-development flood levels are presented in Figure 5-1. However, due to the nature of flooding on the Site, the flood depths provide a more meaningful indicator as to the required height various infrastructure is required to be situated above existing ground surface levels, as summarised:

- temporary construction buildings 0.3 m
- O & M building 0.1 m
- power conversion unit 0.1 m
- HV RMU & metering 0.4 m
- PV combiner boxes 0.1 – 0.3 m (location dependent)

The assessment indicates that the flood impacts of the proposed solar farm development are effectively contained within the Site boundary. There are localised increases in the modelled flood levels along the upstream sides of the access road and central road alignments. There is also a localised change in the flood velocity distribution around the access road crossing of the railway embankment, due to the redistribution of flood flows across the proposed access road. Scour protection measures should be considered for the access road embankment to prevent erosion by overtopping floodwaters.

The proposed Site access road does not provide reliable flood-free access for evacuation. The raising of the road level to provide flood-free access may also result in adverse impact to the neighbouring property due to the redistribution of downstream flood flows. However, it is expected that the Site would be unattended most of the time. Therefore, it is unlikely that people would be present on-site in the event of a flood. Preventing access to the Site following the issuing of a severe weather or flood warning by the BoM should provide a reasonable mitigation of potential risk to life. This measure should be formalised within the site management plan.

Contents

1	Introduction.....	1
1.1	Project Background	1
1.2	Study Catchment	1
1.3	Previous Studies	1
2	Model Development	4
2.1	Hydrologic Model	4
2.2	Hydraulic Model.....	4
3	Design Flood Hydrology	7
3.1	Methodology.....	7
3.2	Model Results	9
3.3	Local Catchment Runoff.....	12
4	Baseline Design Flood Conditions	14
4.1	Model Results	14
4.2	Flood Hazard	14
5	Flood Impact Assessment	17
5.1	Management of Flood Risk	17
5.2	Management of Flood Impacts.....	18
6	Conclusion.....	21
7	References	22
Appendix A	Baseline Design Flood Depth Mapping	23
Appendix B	Baseline Design Flood Hazard Mapping	32
Appendix C	Flood Level Impact Mapping	41
Appendix D	Flood Velocity Impact Mapping.....	49

List of Figures

Figure 1-1	Study Locality	2
Figure 1-2	Greenhatch Creek Catchment Topography.....	3

Figure 2-1	TUFLOW Model Components.....	5
Figure 3-1	BoM Design Point Rainfall.....	7
Figure 3-2	Greenhatch Creek Ensemble Method Results for the 1% AEP Event	10
Figure 3-3	Greenhatch Creek Ensemble Method Results for the 20% AEP Event	10
Figure 3-4	Adopted Design Flood Flow Hydrographs for Greenhatch Creek	11
Figure 3-5	Simulated PMF Flow Hydrographs for Greenhatch Creek.....	12
Figure 4-1	Modelled Flood Extents and Site Layout.....	15
Figure 4-2	General Flood Hazard Vulnerability Curves (AIDR, 2017).....	16
Figure 5-1	Modelled 1% AEP Flood Depths and Levels - Post-development Conditions	19
Figure 5-2	Modelled 1% AEP Flood Hazard Classification - Post-development Conditions	20

List of Tables

Table 3-1	Design Rainfall Areal Reduction Factors	8
Table 3-2	Design Rainfall Depths for Greenhatch Creek	8
Table 3-3	PMP Depths for Greenhatch Creek	9
Table 3-4	Adopted Design Event Durations and Temporal Patterns for Greenhatch Creek.....	11
Table 3-5	Adopted Design Event Durations and Temporal Patterns for the Local Catchment .	13

1 Introduction

1.1 Project Background

Torrent Consulting was engaged by Providence Asset Group to undertake a Flood Impact Assessment to assist in the DA process for the proposed solar farm at 4133 Manilla Road (Lot A DP442930), Manilla, NSW (the Site). It is understood that Tamworth Regional Council has identified the site as being potentially at risk of flooding, although no current information exists for the Site, which is upstream of the extent covered by the Manilla Flood Study (GHD, 2017).

The Site is located between Manilla Road and Greenhatch Creek, some 4 km south of Manilla, as presented in Figure 1-1.

Documents detailing the proposed development were provided to Torrent Consulting, including:

- 19197 Version 2004.dwg, containing existing site survey
- 2219-G-GAD-02-1.dwg and associated detailed plans, containing solar farm details
- 190284.CIV01-03.pdf, containing stormwater management infrastructure

1.2 Study Catchment

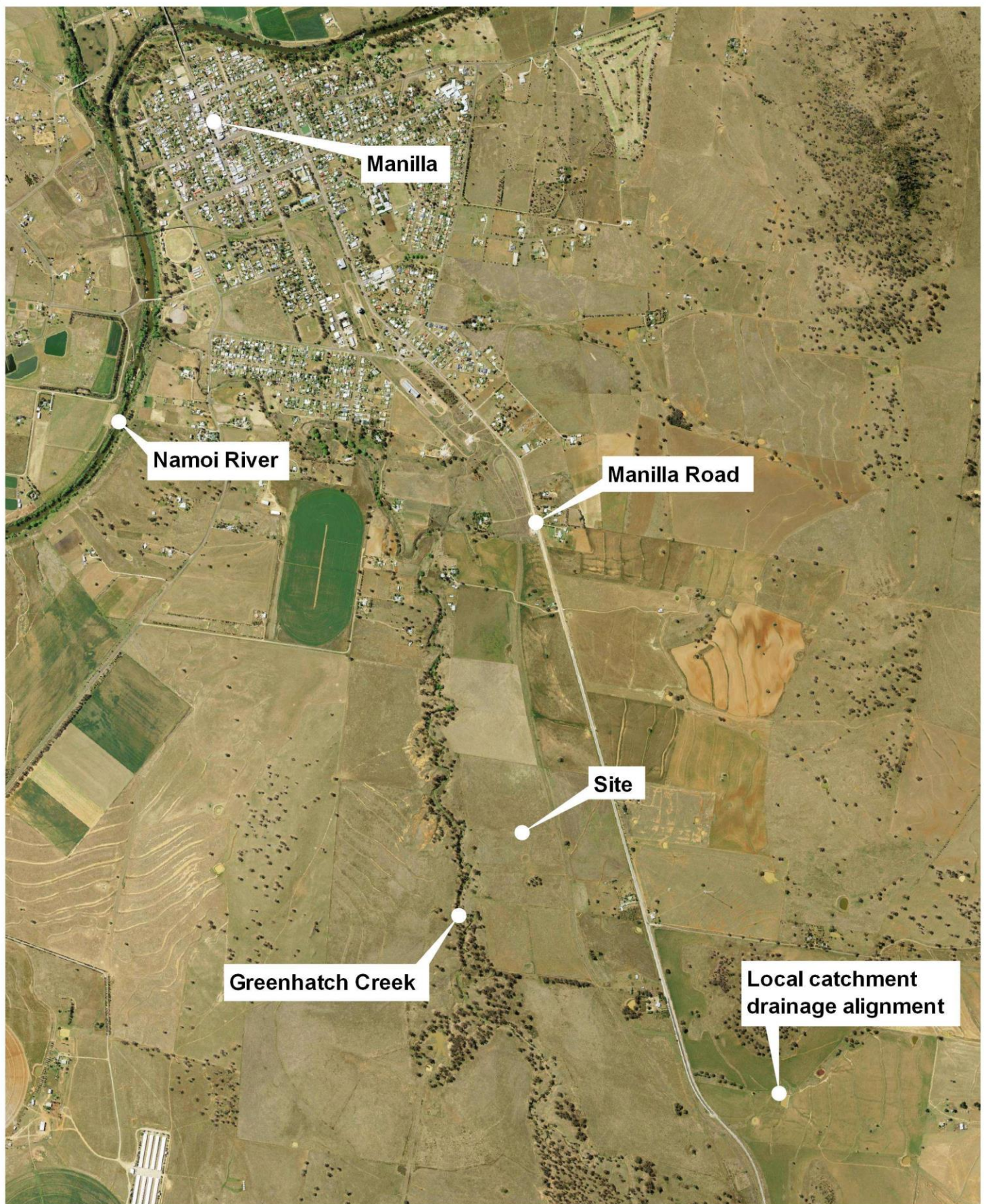
This Site is located within the Greenhatch Creek catchment, which totals some 72 km² at the confluence with the Namoi River 4 km downstream of the Site. The contributing catchment upstream of the Site is around 60 km², as presented in Figure 1-2.

The proposed solar farm is potentially at risk of flooding from Greenhatch Creek and local catchment runoff from the hill slopes to the east of the Site. Flood modelling is required to establish the existing flood risk at the Site and to assess any potential flood impacts relating to the proposed development.

1.3 Previous Studies

The Manilla Flood Study was completed by GHD for Tamworth Regional Council in April 2012. The focus of the study was the township of Manilla, including design flood flows for the Manilla River and the Namoi River. As such, the model details are insufficient for a detailed assessment of Greenhatch Creek.

The Greenhatch Creek catchment was included as a single sub-catchment node in the RORB hydrological model, with the inflows input to the TUFLOW model (and therefore, flood mapping outputs) around 2 km upstream of the confluence with the Namoi River (some 2 km downstream of the Site). However, the Manilla Flood Study provides useful design flood information for the Namoi River that can be incorporated as suitable downstream boundary conditions for the modelling undertaken for this assessment.



Title:
Study Locality

0 0.6 1.2 km
approx. scale

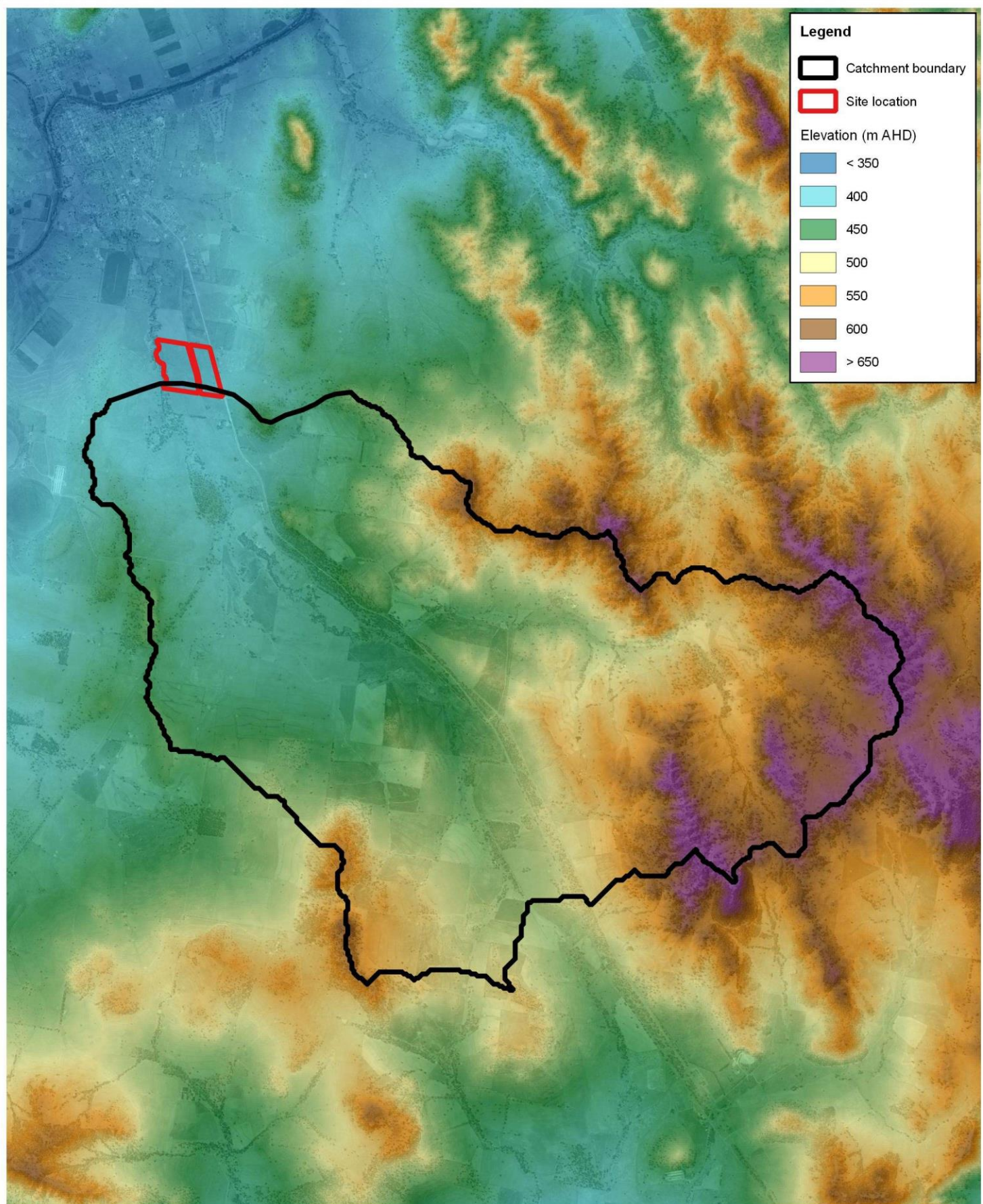
Figure: **1-1** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision: **A**

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_001_191205_Locality.qgz



Torrent
CONSULTING
www.torrentconsulting.com.au



Title:

Greehatch Creek Catchment Topography

0 2 4 km



approx. scale

Figure:

1-2

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision:

A



Filepath: I:\Projects\T2003_Manilla_Rd_FIA\GIS\T2003_002_191205_Topography.qgz

2 Model Development

2.1 Hydrologic Model

For this assessment a TUFLOW model was developed covering the Greenhatch Creek catchment to the confluence with the Namoi River some 4 km downstream of the Site, at which the contributing catchment area is around 60 km². The model utilised the Geoscience Australia 1-second SRTM (Satellite Radar Topography Mission) derived DEM-S (Digital Elevation Model, with smoothing) product to define the catchment topography.

The Digital Elevation Model (DEM) was pre-processed using GIS-based terrain analysis techniques to remove sinks within the grid and create a hydrologically corrected DEM. This prevents the initial loss of catchment rainfall to artificial trapped storages. A 30 m model grid cell resolution was adopted, which maximises the detail contained within the SRTM DEM-S product.

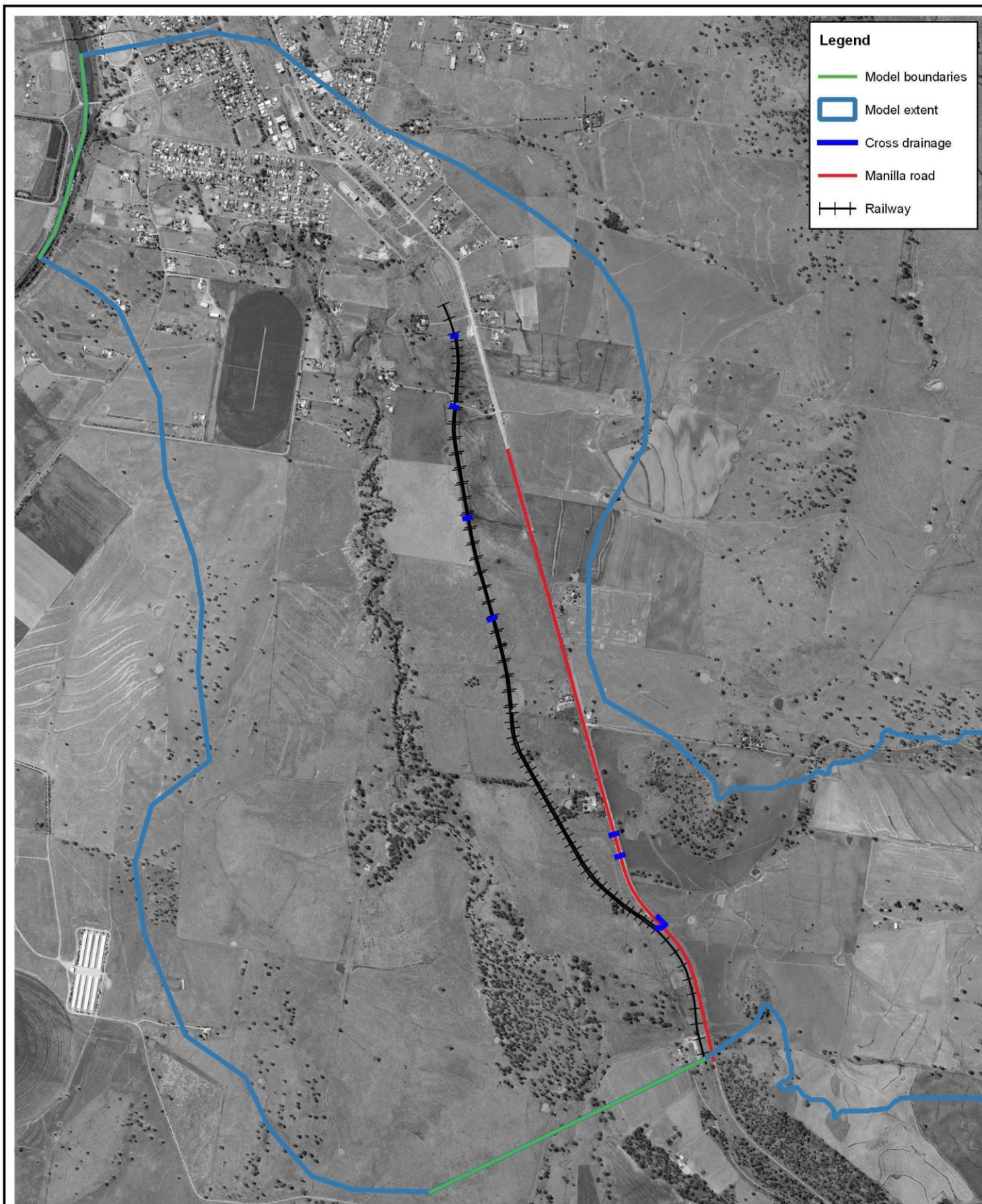
Land use coverage in the catchment was digitised using aerial imagery, to distinguish between cleared land and areas of remnant vegetation. The cleared floodplain was assigned a Manning's 'n' roughness coefficient of 0.05, with areas of remnant vegetation being assigned an 'n' value of 0.1. The downstream boundary of the model was configured as an automatically generated stage-discharge curve with a slope of 0.8%.

2.2 Hydraulic Model

A more detailed TUFLOW model was developed covering the Greenhatch Creek floodplain from around 3 km upstream of the Site, downstream to the Namoi River confluence, as presented in Figure 2-1. A local catchment area of around 5 km² covering the hill slopes to the south-east of the Site was also included in the model extent to simulate local catchment runoff draining to the Site. The model utilised the NSW Spatial Services photogrammetry data product, downloaded via the ELVIS Foundation Spatial Data portal to define the floodplain topography.

Torrent Consulting has found the photogrammetric data (which is a 5 m grid cell resolution DEM product) to provide a similar representation of overall floodplain topography to that captured in more detailed LiDAR (Light Detection and Ranging) surveys, when coincidentally available. However, the absolute elevation values can often differ to those within the LiDAR data. This is to be expected, given the relative vertical accuracy requirements of the photogrammetry compared to the LiDAR, which are +/- 0.3 m and +/- 1.0 m within a 95% confidence respectively.

The practical application of these elevation data products in previous flood studies has found that LiDAR data typically compares well to traditional ground survey techniques in terms of absolute elevation values. However, the photogrammetry data can present up to around a +/- 0.5 m difference in floodplain elevations when compared to available ground survey data. It is therefore important to make a corrective adjustment when using the photogrammetry data for flood modelling applications. Comparison of the photogrammetry data to the available site survey identified a median error of +0.235 m. Therefore, the photogrammetry elevations had a -0.235 m corrective adjustment applied within the TUFLOW model. A 5 m model grid cell resolution was adopted, which maximises the detail contained within the photogrammetry product.



Title:
TUFLOW Model Components

0 0.6 1.2 km
approx. scale

Figure: **2-1** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision: **A**

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_003_191205_TUFLOW.qgz



The crest elevations for Manilla Road and the parallel railway alignment were re-enforced within the TUFLOW model, with an assumed embankment height of 0.5 m and 0.75 m above the floodplain respectively. A single cell cross-drainage connection was provided at the appropriate locations.

Land use coverage in the catchment was digitised using aerial imagery, to distinguish between cleared land and areas of remnant vegetation. The cleared floodplain was assigned a Manning's 'n' roughness coefficient of 0.05, with areas of remnant vegetation being assigned an 'n' value of 0.1. The Greenhatch Creek channel was assigned a Manning's 'n' roughness of 0.05, based on site inspection and the modified Cowan method for determining channel roughness.

The downstream boundary of the model was configured as a fixed water level on the Namoi River. The Greenhatch Creek inflows were extracted from the whole-of-catchment TUFLOW hydrologic model at the upstream hydraulic model boundary. Direct rainfall input was also included for the local catchment and floodplain areas upstream of the Site.

3 Design Flood Hydrology

3.1 Methodology

The TUFLOW hydrologic model (refer Section 2.1) was simulated (using the HPC solver) in accordance with the Australian Rainfall and Runoff (ARR) 2019 guidelines to derive design flood hydrology for the full range of design rainfall events between the 20% AEP and 0.2% AEP, with storm durations ranging from 30 minutes to nine hours. The design rainfall depths were sourced from the BoM IFD (Intensity Frequency Duration) portal and are presented in Figure 3-1.

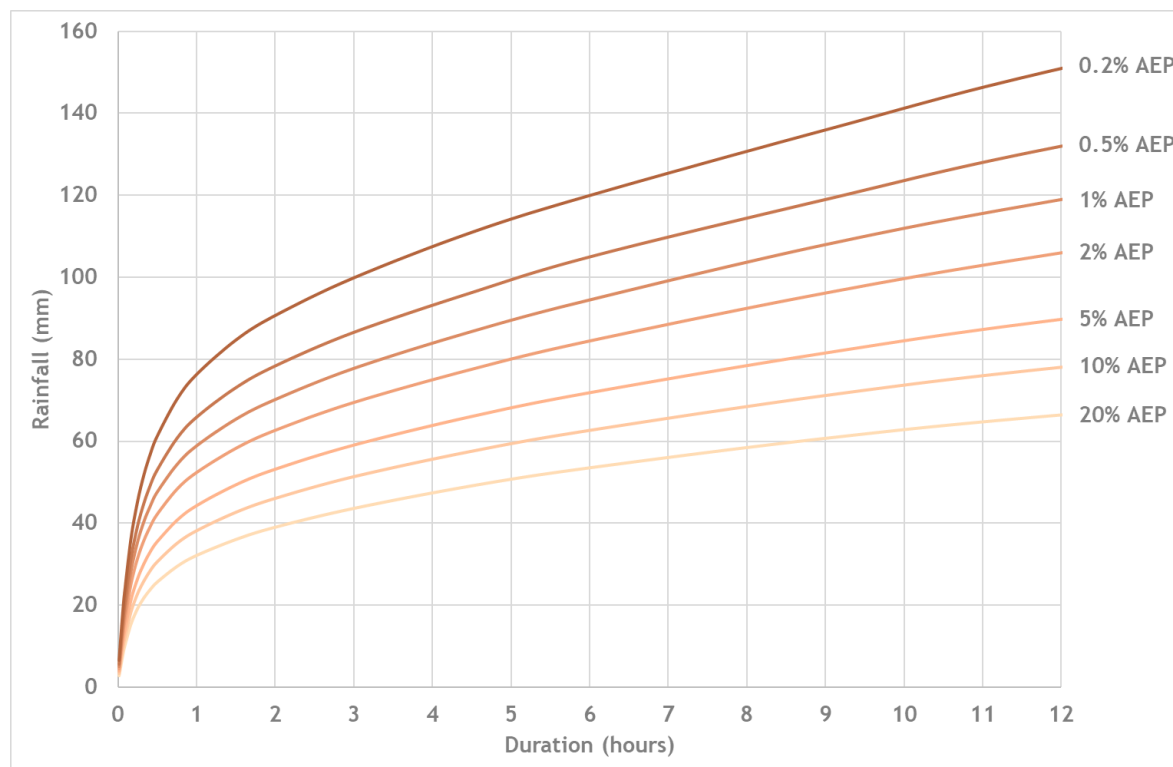


Figure 3-1 BoM Design Point Rainfall

An Areal Reduction Factor (ARF) was applied to the design point rainfall using the contributing catchment area of 60 km² upstream of the Site. ARFs calculated in accordance with ARR 2019 for the Semi-Arid Inland QLD ARF region range from around 0.77 at the 30-minute duration to around 0.93 at the nine-hour duration, as presented in Table 3-1. The resultant design rainfall depths for Greenhatch Creek at the Site, from the point rainfall data and ARFs are presented in Table 3-2.

Design rainfall losses considered the recent NSW-specific guidance and in the absence of suitable rainfall loss calibration data an initial loss of 5 mm and continuing loss of 0.2 mm/h were adopted accordingly. The 5 mm initial loss was selected as being best representative of the calculated Probability Neutral Burst Initial Loss for the range of design event magnitudes and durations considered. The 0.2 mm/h continuing loss is 40% that of the Storm Initial Loss rate provided through the ARR Data Hub (i.e. 0.5 mm/h).

The ARR 2019 guidelines ensemble method to design flood hydrology involves the simulation of ten rainfall temporal patterns for each design event magnitude and duration, with the average condition

of the ten being adopted for design purposes. The point rainfall temporal patterns provided for the Central Slopes temporal rainfall region were adopted for the ensemble method accordingly.

Table 3-1 Design Rainfall Areal Reduction Factors

Dn. (h)	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	0.2% AEP
0.50	0.795	0.788	0.78	0.771	0.763	0.756	0.746
0.75	0.826	0.818	0.81	0.799	0.79	0.782	0.771
1.00	0.845	0.836	0.826	0.814	0.805	0.796	0.784
1.50	0.866	0.856	0.845	0.831	0.82	0.809	0.795
2.00	0.879	0.867	0.855	0.839	0.827	0.815	0.799
3.00	0.895	0.882	0.868	0.85	0.837	0.824	0.806
4.50	0.913	0.902	0.89	0.876	0.864	0.853	0.838
6.00	0.927	0.92	0.913	0.904	0.897	0.89	0.881
9.00	0.942	0.938	0.935	0.929	0.926	0.922	0.916

Table 3-2 Design Rainfall Depths for Greehatch Creek

Dn. (h)	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	0.2% AEP
0.50	20.4	24.0	27.6	32.5	36.3	40.1	45.7
0.75	24.3	28.6	32.9	38.6	42.9	47.5	54.1
1.00	27.1	31.8	36.5	42.7	47.4	52.5	59.8
1.50	31.2	36.5	41.7	48.4	53.6	59.2	67.3
2.00	34.3	39.9	45.4	52.6	58.0	63.9	72.4
3.00	39.0	45.2	51.2	59.1	65.1	71.3	80.5
4.50	44.8	51.8	58.8	67.9	75.0	82.2	93.1
6.00	49.6	57.6	65.6	76.4	84.8	93.5	106
9.00	57.2	66.7	76.2	89.4	100	110	125

The ensemble method will often produce a few event durations with similar peak flows. If only considering the absolute peak flow values when selecting the duration, a suite of temporal patterns exhibiting significant variance in simulated hydrograph shape may be adopted. This can result in the adoption of a hydrograph shape that is not best suited for design purposes, e.g. with a dual peak and/or too slow a response time. Typically, the shortest duration of those close to the overall critical peak flow condition provides the least variance in flows and most preferable simulated design flood hydrograph shape. It is also prudent to assess the critical duration across the full range of simulated design event magnitudes to maintain consistency where possible.

Once a suitable event duration has been selected for each design flood magnitude, a representative hydrograph must be selected from those simulated. Typically, the hydrograph that produced the peak flow closest to the calculated mean is selected. If multiple hydrographs provide suitable peak flows, then that with the most typical design hydrograph shape is preferable. However, if design flows at multiple locations are critical for the assessment then the hydrograph that provides a peak flow condition closest to the mean consistently at each location may be the most appropriate. The adoption of a suitable and consistent hydrograph shape is ultimately the key outcome of this process, as adopted hydrographs can always be scaled in magnitude to better match the calculated mean peak flow condition from the ensemble method if required.

For the simulation of the PMF (Probable Maximum Flood) condition the Generalised Short Duration Method (GSDM) published by the BoM was adopted. The critical duration of the PMF is typically shorter than that of the standard design flood events. The calculation of the Probable Maximum Precipitation (PMP) determined the rainfall depths for the 15-minute to three-hour duration events to be as presented in Table 3-3.

Table 3-3 PMP Depths for Greehatch Creek

Dn. (h)	Initial	Adjusted	Adopted
0.25	225	169	170
0.50	330	248	250
0.75	415	311	310
1.00	485	364	360
1.50	625	469	470
2.00	730	548	550
2.50	805	604	600
3.00	880	660	660

3.2 Model Results

The TUFLOW model simulations were analysed for Greenhatch Creek at the Site to identify the critical duration, i.e. that which produces the peak flood flows for each design event magnitude. This is undertaken by calculating the average peak flood flow and the peak flood flow variance of the ten simulated hydrographs for each design event duration and magnitude. This process can be better visualised by summarising the results for each design event magnitude as a box whisker plot containing the ensemble results for each of the simulated design event durations.

Figure 3-2 presents the ensemble method analysis for the 1% AEP event for Greenhatch Creek. In this case the critical duration is readily identified as a three-hour event. However, for the 20% AEP event (refer Figure 3-3) the events between three and nine hours all produce similar peak flows. The six-hour duration produces the absolute critical mean peak flow value but the variation in simulated peak flows across all ten temporal patterns is too large and provides an unsuitable design hydrograph shape. The three-hour duration produces a mean peak flow close to that of the nine-hour event but has much less variance in the simulated hydrograph peaks and hence hydrograph shape also.

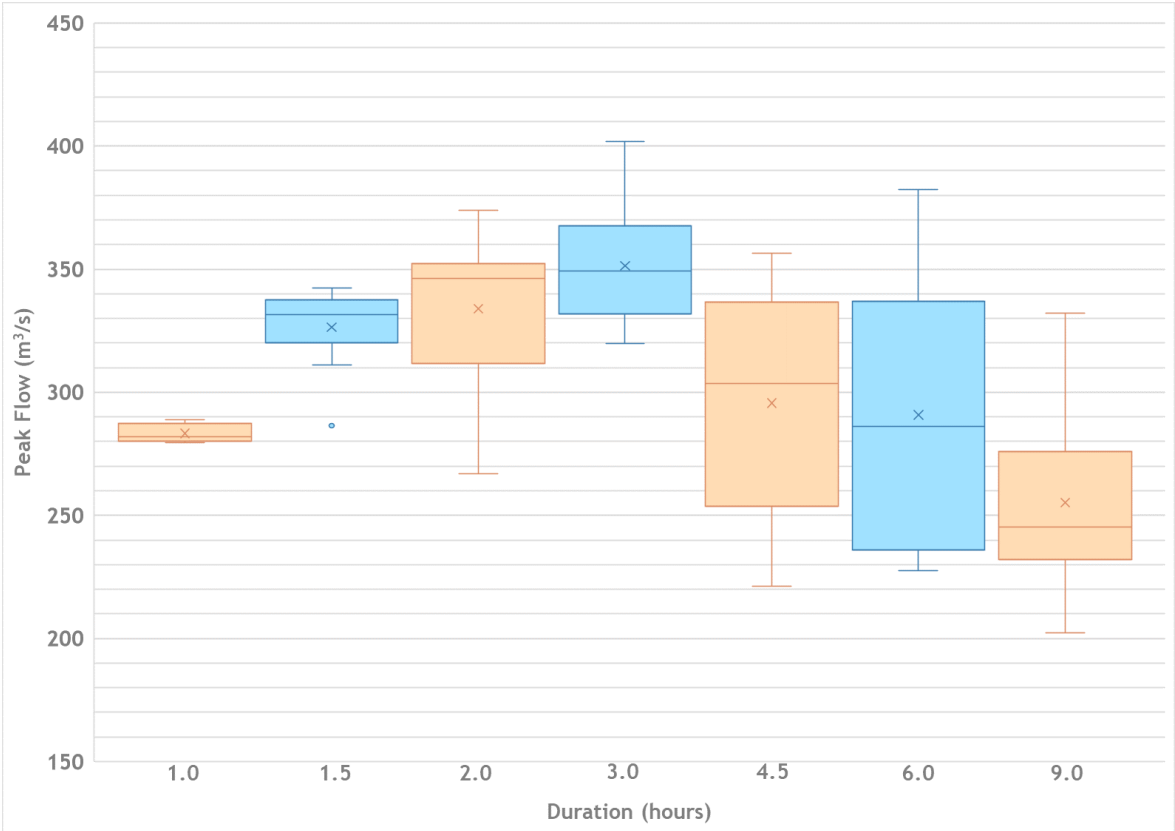


Figure 3-2 Greenhatch Creek Ensemble Method Results for the 1% AEP Event

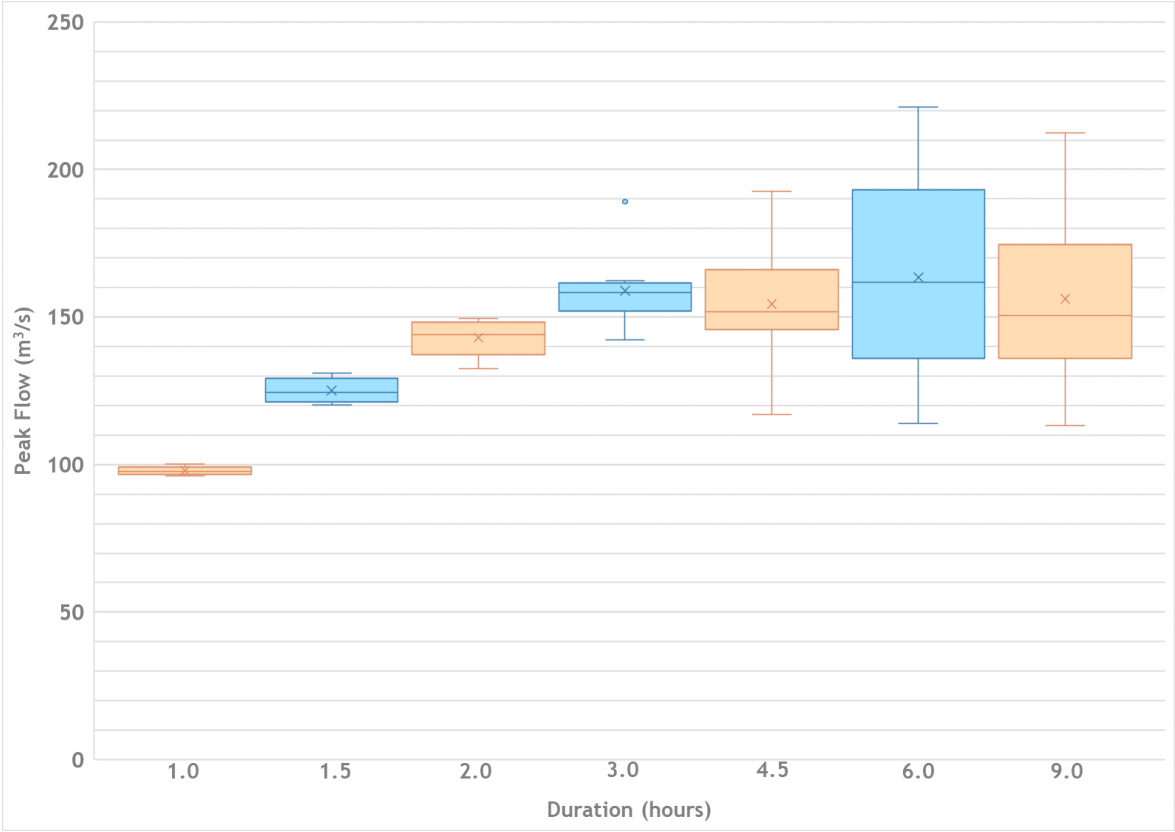


Figure 3-3 Greenhatch Creek Ensemble Method Results for the 20% AEP Event

The three-hour duration was selected as being best representative of the critical condition across the range of simulated design flood events. The calculated critical mean peak flow and duration for each event is presented in Table 3-4, together with the adopted duration, rainfall temporal pattern and peak flow. The adopted design conditions utilise only three temporal patterns and have peak flows within 2% of the calculated mean. The adopted design hydrographs are presented in Figure 3-4.

Table 3-4 Adopted Design Event Durations and Temporal Patterns for Greenhatch Creek

Design Event	Calculated Mean Peak Flow (m ³ /s) [duration]	Adopted Duration [Temporal Pattern ID]	Adopted Peak Flow (m ³ /s)
20% AEP	163 [6-hour]	3-hour [2319]	162
10% AEP	208 [6-hour]	3-hour [2302]	205
5% AEP	247 [6-hour]	3-hour [2302]	246
2% AEP	307 [3-hour]	3-hour [2279]	307
1% AEP	351 [3-hour]	3-hour [2279]	351
0.5% AEP	398 [3-hour]	3-hour [2279]	398
0.2% AEP	467 [3-hour]	3-hour [2279]	466

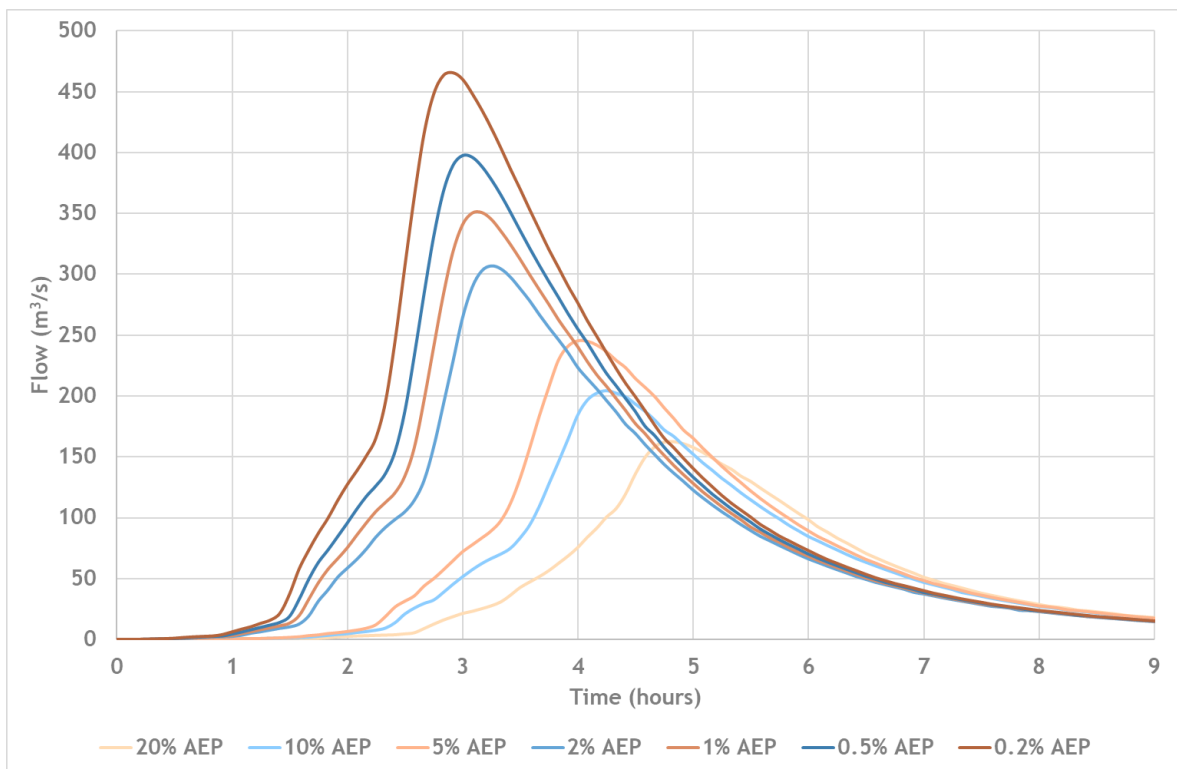


Figure 3-4 Adopted Design Flood Flow Hydrographs for Greenhatch Creek

The simulation of the PMP durations found the 1.5-hour event to be the critical for the PMF condition, with a peak flow of around 4700 m³/s for Greenhatch Creek at the Site, as presented in Figure 3-5.

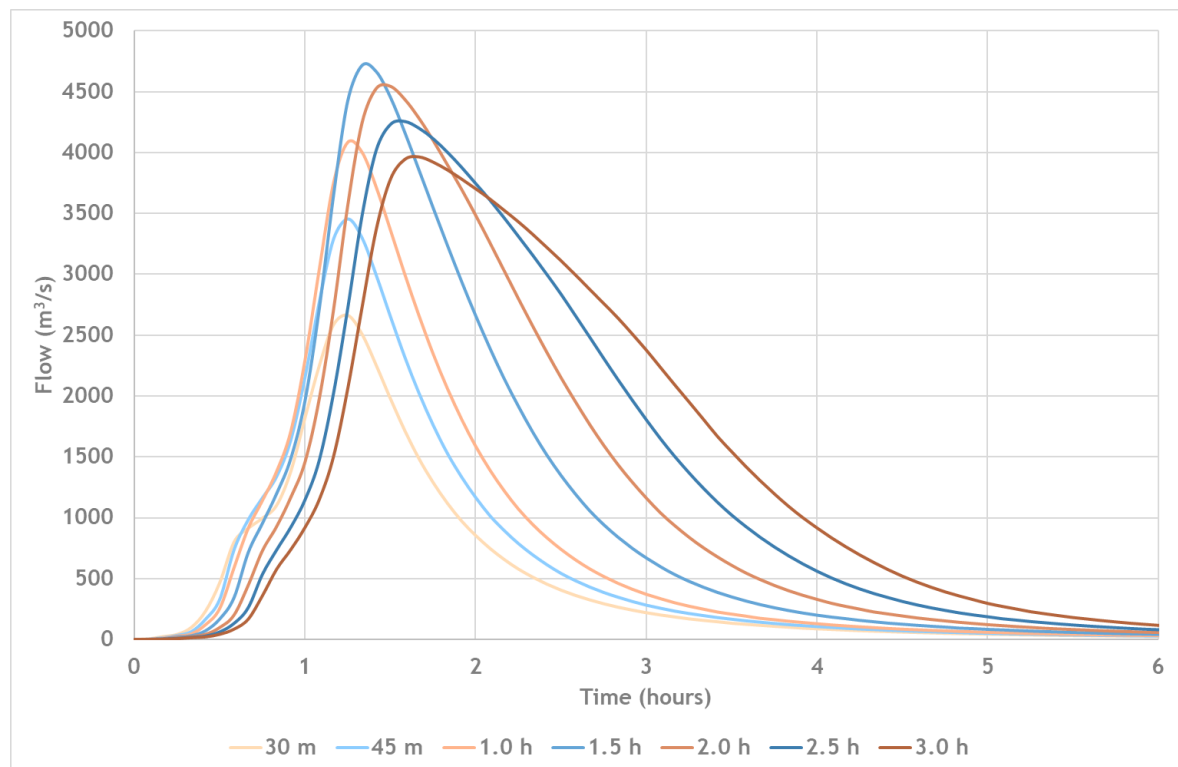


Figure 3-5 Simulated PMF Flow Hydrographs for Greenhatch Creek

3.3 Local Catchment Runoff

A similar method was adopted for the selection of appropriate design flood hydrology in the local catchment and floodplain area to the south-east of the Site as was undertaken for Greenhatch Creek. However, for this local runoff assessment the TUFLOW hydrologic model was simulated with an adopted ARF of 1.0, due to the relatively small size of the catchment areas being considered (largest catchment being around 4 km²). The TUFLOW model simulations were analysed for the outlet location of the 4 km² local catchment, upstream of Manilla Road.

The 60-minute duration was selected as being best representative of the critical condition for the frequent and intermediate events (20% AEP to 5% AEP), with the 45-minute duration being best representative of the rarer design flood events. The calculated critical mean peak flow and duration for each event is presented in Table 3-5, together with the adopted duration, rainfall temporal pattern and peak flow. The adopted design conditions utilise only three temporal patterns and have peak flows within 1% of the calculated mean.

The simulation of the PMP durations found the 30-minute event to be the critical for the PMF condition, with a peak flow of around 580 m³/s for the 4 km² local catchment outlet.

The flood flows from the 4 km² local catchment are not well-contained within a defined floodplain and diverge when traversing Manilla Road. Therefore, the local catchment runoff has been simulated within the detailed hydraulic model through the application of direct rainfall rather than through defined but uncertain approach flow boundary conditions. This ensures that local controls influencing the spread and divergence of flood waters will be better represented.

Table 3-5 Adopted Design Event Durations and Temporal Patterns for the Local Catchment

Design Event	Calculated Mean Peak Flow (m ³ /s) [duration]	Adopted Duration [Temporal Pattern ID]	Adopted Peak Flow (m ³ /s)
20% AEP	24.2 [90-min]	60-min [2209]	24.0
10% AEP	32.1 [60-min]	60-min [2196]	32.1
5% AEP	40.0 [60-min]	60-min [2196]	39.9
2% AEP	51.7 [45-min]	45-min [2130]	52.1
1% AEP	61.8 [45-min]	45-min [2130]	62.2
0.5% AEP	73.1 [45-min]	45-min [2130]	73.7
0.2% AEP	90.0 [45-min]	45-min [2130]	90.7

4 Baseline Design Flood Conditions

4.1 Model Results

The detailed TUFLOW hydraulic model (refer Section 2.2) was simulated (using the HPC solver) for the adopted design flood hydrology detailed in Section 3. Figure 4-1 presents the modelled peak flood extents at the Site for the 5% AEP, 1% AEP and PMF events. The results have a 0.1 m minimum depth filter applied to remove the simulated sheet flow from the local catchment rainfall-runoff process and only present the accumulated flood flow paths.

Mapping of the modelled peak flood depths and levels for each of the simulated design events is presented in Appendix A. Again, the results have a 0.1 m minimum depth filter applied.

The modelled flood conditions show that the Site is not affected by flooding from Greenhatch Creek for the range of modelled design flood events. Flooding of the Site is principally derived from local catchment runoff from the hill slopes to the south-east of the Site. Only at the PMF event does the modelled flood condition at the Site become dominated by flood flows from Greenhatch Creek. The floodplain of Greenhatch Creek at the 1% AEP event is confined locally to the channel alignment. This is consistent with the mapping presented within the Manilla Flood Study.

4.2 Flood Hazard

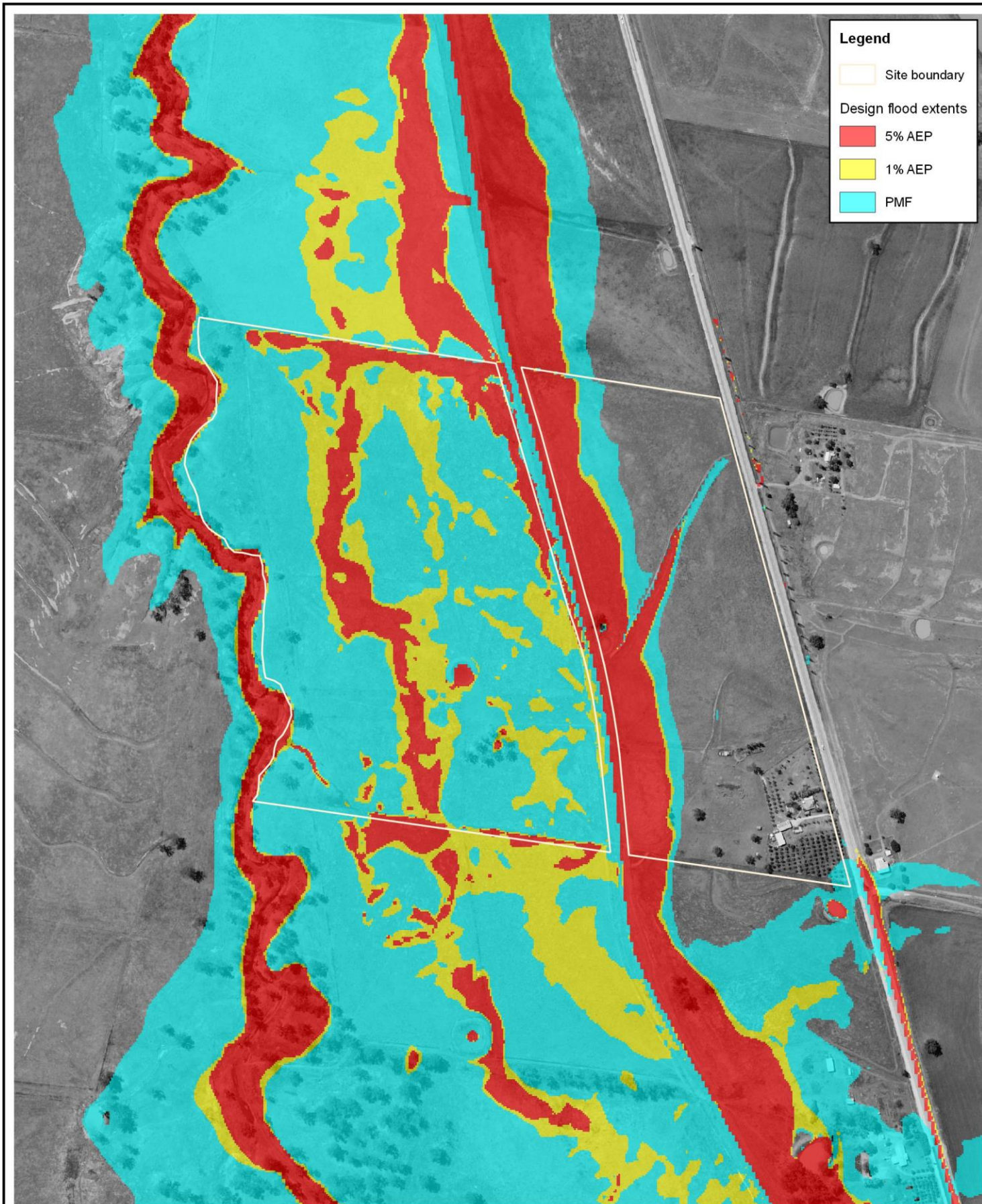
The flood hazards have been determined in accordance with Guideline 7-3 of the Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR, 2017). This produces a six-tier hazard classification, based on modelled flood depths, velocities and velocity-depth product. The hazard classes relate directly to the potential risk posed to people, vehicles and buildings, as presented in Figure 4-2.

The flood hazard mapping is useful for providing context to the nature of the modelled flood risk and to identify potential constraints for the future development of the Site with regards to floodplain risk management. The principal consideration of good practice floodplain risk management is to ensure compatibility of the proposed development with the flood hazard of the land, including the risk to life and risk to property.

Mapping of the modelled peak flood hazard for each of the simulated design events is presented in Appendix B. The results have a 0.1 m minimum depth filter applied to remove the simulated sheet flow from the local catchment rainfall-runoff process and only present the accumulated flood flow paths.

At the 1% AEP event the Site is largely a low hazard (H1 and H2) flood environment. Peak flood depths are below 0.5 m and peak velocities below 2.0 m/s. As such, the Site is suitable for the proposed solar farm infrastructure, with minimal risk with regards to potential flood damages. This is the case even at the 0.2% AEP event. It is only for an extreme event such as the PMF where the modelled flood hazards would be expected to damage infrastructure.

The Site access road traverses an area of higher hazard associated with the deeper flood water being conveyed along the eastern side of the railway embankment.



Legend

Site boundary

Design flood extents

5% AEP

1% AEP

PMF

Title: Modelled Flood Extents and Site Layout		0 200 400 m approx. scale	
Figure:	4-1	Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.	
Revision:	A		
Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_004_191205_Flood_Extents.qgz		N	Torrent CONSULTING www.torrentconsulting.com.au

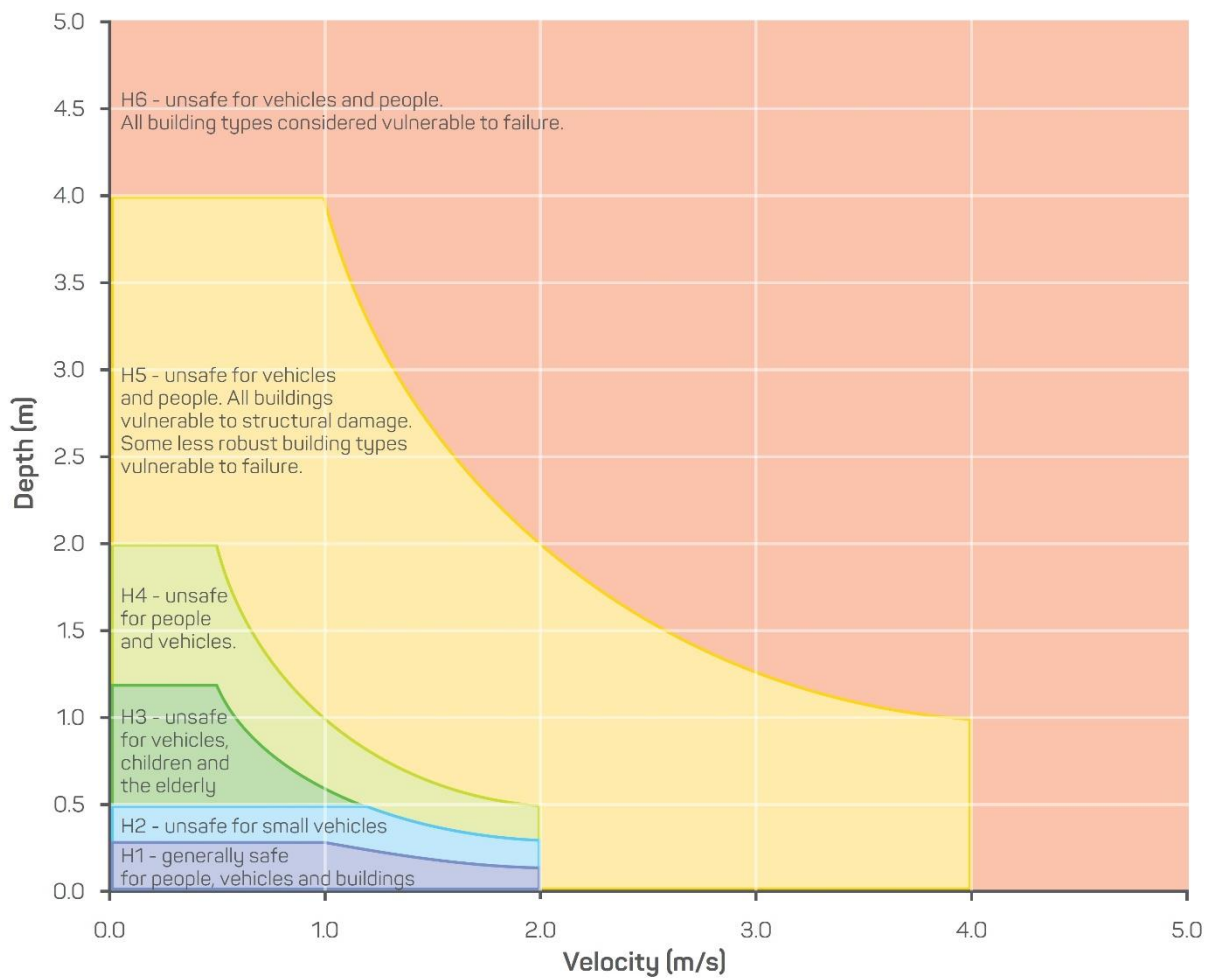


Figure 4-2 General Flood Hazard Vulnerability Curves (AIDR, 2017)

5 Flood Impact Assessment

5.1 Management of Flood Risk

The principal consideration of good practice floodplain risk management is to ensure compatibility of the proposed development with the flood hazard of the land, including the risk to life and risk to property. Requirements within a Council's LEP (Local Environment Plan) and DCP (Development Control Plan) typically consider the management of flood risk, with the application of an FPL (Flood Planning Level) being the principal control measure. The standard FPL for residential development in NSW is the 1% AEP flood level plus a 0.5 m freeboard. However, requirements for non-residential development can vary significantly.

The objective of the management of risk to property is to minimise the damages that would be incurred in the event of a flood. This includes potential damage to future building structures and their contents, and critical infrastructure and services. Risk to property is typically managed to the 1% AEP design flood event. The Tamworth Regional Development Control Plan 2010 includes the following measures to manage risk to property from flooding:

- a minimum floor level for residential buildings of the 1% AEP flood level plus a 0.5 m freeboard (i.e. above the FPL)
- a minimum floor level for non-residential buildings of the 1% AEP flood level
- adherence to the Flood Proofing Code, which provides guidelines on flood compatible construction materials and methods and electrical systems

The Flood Proofing Code refers to electrical components being situated above the DFL (Defined Flood Level). The DFL is not specified but is typically the 1% AEP flood level.

The provisions of the Tamworth Regional DCP require the on-site electrical infrastructure and the floor level of any buildings to be above the 1% AEP flood level. The modelled 1% AEP post-development flood levels are presented in Figure 5-1. However, due to the nature of flooding on the Site, the flood depths provide a more meaningful indicator as to the required height various infrastructure is required to be situated above existing ground surface levels, as summarised:

- temporary construction buildings 0.3 m
- O & M building 0.1 m
- power conversion unit 0.1 m
- HV RMU & metering 0.4 m
- PV combiner boxes 0.1 – 0.3 m (location dependent)

These are the minimum heights for the infrastructure to be situated above the existing ground surface. However, it may be beneficial to elevate some of the Site infrastructure above the minimum required levels to further reduce the residual flood risk, if such measures are viable and can be readily accommodated.

The objective of the management of risk to life is to minimise the likelihood of deaths in the event of a flood and is typically considered for rarer flood events than the 1% AEP, up to the PMF. Manilla Road is flood-free at the PMF event near the Site and as such provides suitable flood evacuation potential. However, the Site access road traverses an area of higher hazard associated with the deeper flood water being conveyed along the eastern side of the railway embankment and as such

does not provide reliable flood-free access for evacuation. The raising of the road level to provide flood-free access may also result in adverse impact to the neighbouring property due to the redistribution of downstream flood flows.

It is expected that the Site would be unattended most of the time. Therefore, it is unlikely that people would be present on-site in the event of a flood. Preventing access to the Site following the issuing of a severe weather or flood warning by the BoM should provide a reasonable mitigation of potential risk to life. This measure should be formalised within the site management plan.

5.2 Management of Flood Impacts

In addition to the management of flood risk exposure of the proposed development, the potential for off-site flood impacts to the existing baseline flood conditions also need to be considered to avoid adverse impacts to neighbouring property and infrastructure. The details contained in the site plans were incorporated into the TUFLOW model to assess the potential flood impacts. Assumptions include:

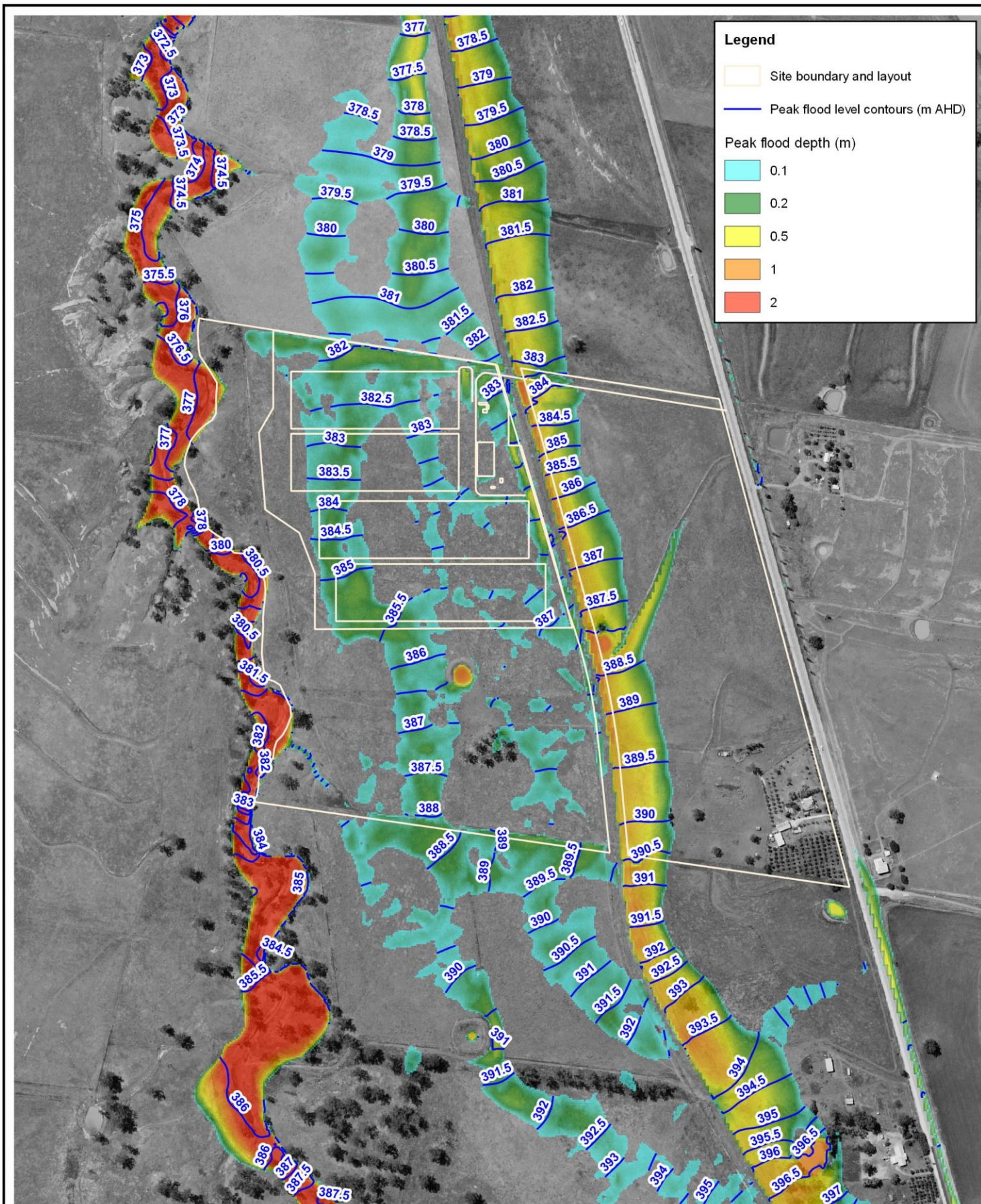
- application of a 50% blockage to flow around the perimeter fencing
- application of a 2% blockage to flow through the PV tracker arrays to account for the piles (PV modules raised above the flood surface).
- raising of the site access road and central road alignment by 0.22 m and 0.16 m above ground surface respectively
- raising of the site access road to cross the railway embankment, as per 2219-C-DET-05-1
- provision of cross-drainage pipe infrastructure, as per 2219-C-DET-05-1
- raising of the gravel hardstand construction laydown by 0.15 m above ground surface
- raising above the floodplain of all internal site infrastructure other than the PV trackers
- incorporation of proposed stormwater management infrastructure including pipes and basin.

The design flood events were then re-simulated, and the results compared to the baseline results to identify potential flood impacts.

The modelled post-development flood conditions are presented for peak flood depths and levels in Figure 5-1 and flood hazard classification in Figure 5-2. The results of the flood impact assessment are presented in Appendix C and Appendix D for the modelled peak flood level and flood velocity impacts respectively.

The assessment indicates that the flood impacts of the proposed solar farm development are largely contained within the Site boundary. There are localised increases in the modelled flood levels along the upstream sides of the road and perimeter fence alignments. There is also a localised change in the flood velocity distribution around the access road crossing of the railway embankment, due to the redistribution of flood flows across the proposed access road.

The modelled velocities along the drainage alignment east of the railway are reduced from around 2.0 m/s to 1.6 m/s at the 1% AEP event through the introduction of the access road crossing. The point of velocity concentration is shifted some 10 m to the east, across the lowest overtopping point of the proposed access road at around 383.2 m AHD. Here, baseline velocities are increased from around 1.8 m/s to 2.2 m/s. The impacted area of velocities is restricted to the immediate area and is not expected to adversely impact the neighbouring property. However, scour protection measures should be considered for the access road embankment to prevent erosion by overtopping floodwaters.



Title:

Modelled 1% AEP Flood Depths and Levels Post-development Conditions

0 200 400 m

approx. scale

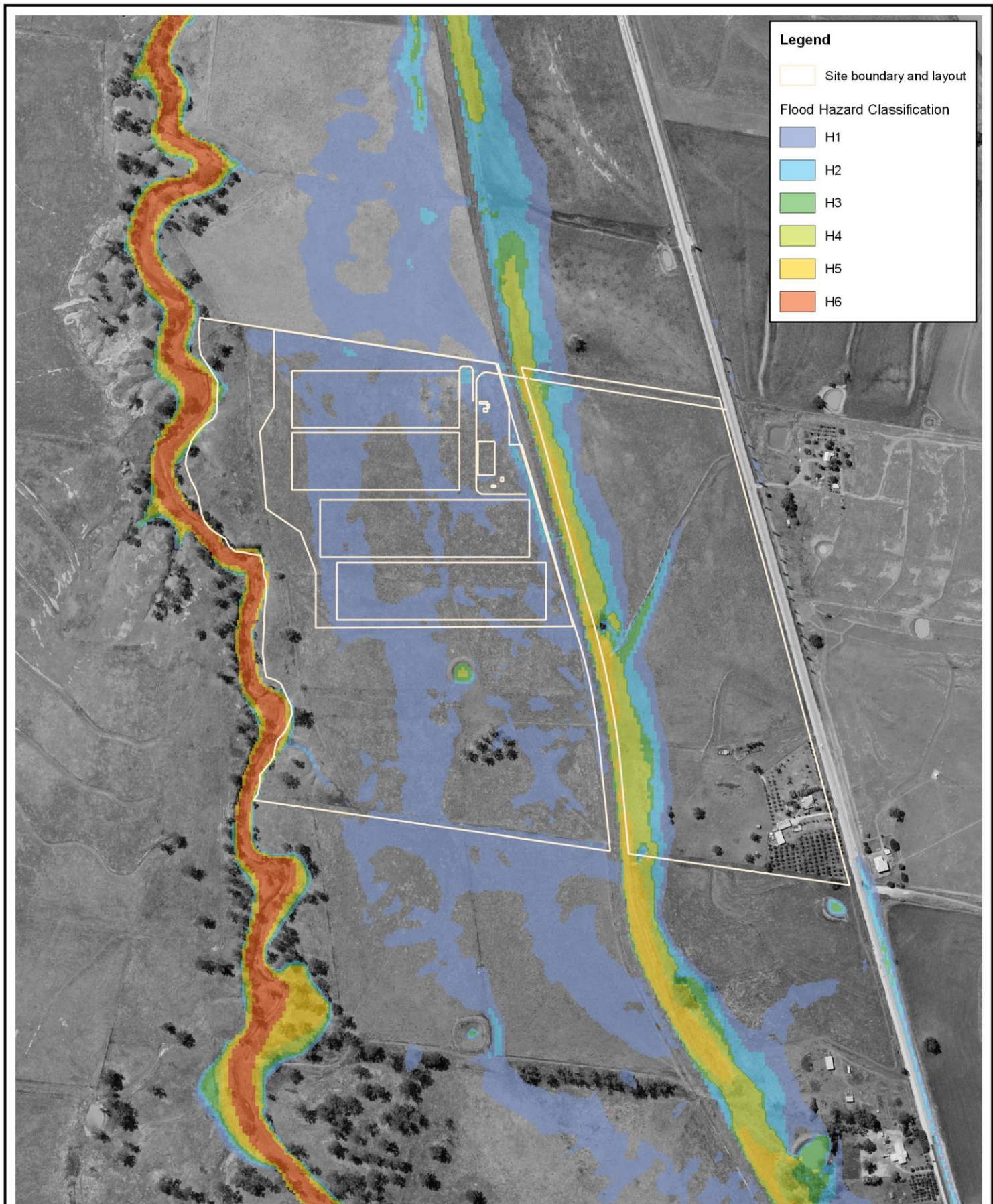
Figure: **5-1**

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision: **A**

Filepath: \Projects\T2003_Manilla_Rd_FIA\GIS\T2003_035_191205_100y_Levels_post_dev.ggz





Title:

Modelled 1% AEP Flood Hazard Classification Post-development Conditions

0 200 400 m



approx. scale

Figure:

5-2

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision:

A



6 Conclusion

Torrent Consulting was engaged by Providence Asset Group to undertake a Flood Impact Assessment to assist in the DA process for the proposed solar farm at 4133 Manilla Road (Lot A DP442930), Manilla, NSW.

This assessment has included development of a TUFLOW model for Greenhatch Creek and local catchment runoff and has simulated design flood conditions in accordance with the ARR 2019 guidelines, specifically the ensemble method for design flood hydrology.

Flood hazard mapping has been produced showing that the Site is of a relatively low flood risk and is suitable for the proposed solar farm. The Site is not affected by flooding from Greenhatch Creek for the range of modelled design flood events. Flooding of the Site is principally derived from local catchment runoff from the hill slopes to the south-east of the Site. Only at the PMF event does the modelled flood condition at the Site become dominated by flood flows from Greenhatch Creek.

The provisions of the Tamworth Regional DCP require the on-site electrical infrastructure and the floor level of any buildings to be above the 1% AEP flood level. The modelled 1% AEP post-development flood levels are presented in Figure 5-1. However, due to the nature of flooding on the Site, the flood depths provide a more meaningful indicator as to the required height various infrastructure is required to be situated above existing ground surface levels, as summarised:

- temporary construction buildings 0.3 m
- O & M building 0.1 m
- power conversion unit 0.1 m
- HV RMU & metering 0.4 m
- PV combiner boxes 0.1 – 0.3 m (location dependent)

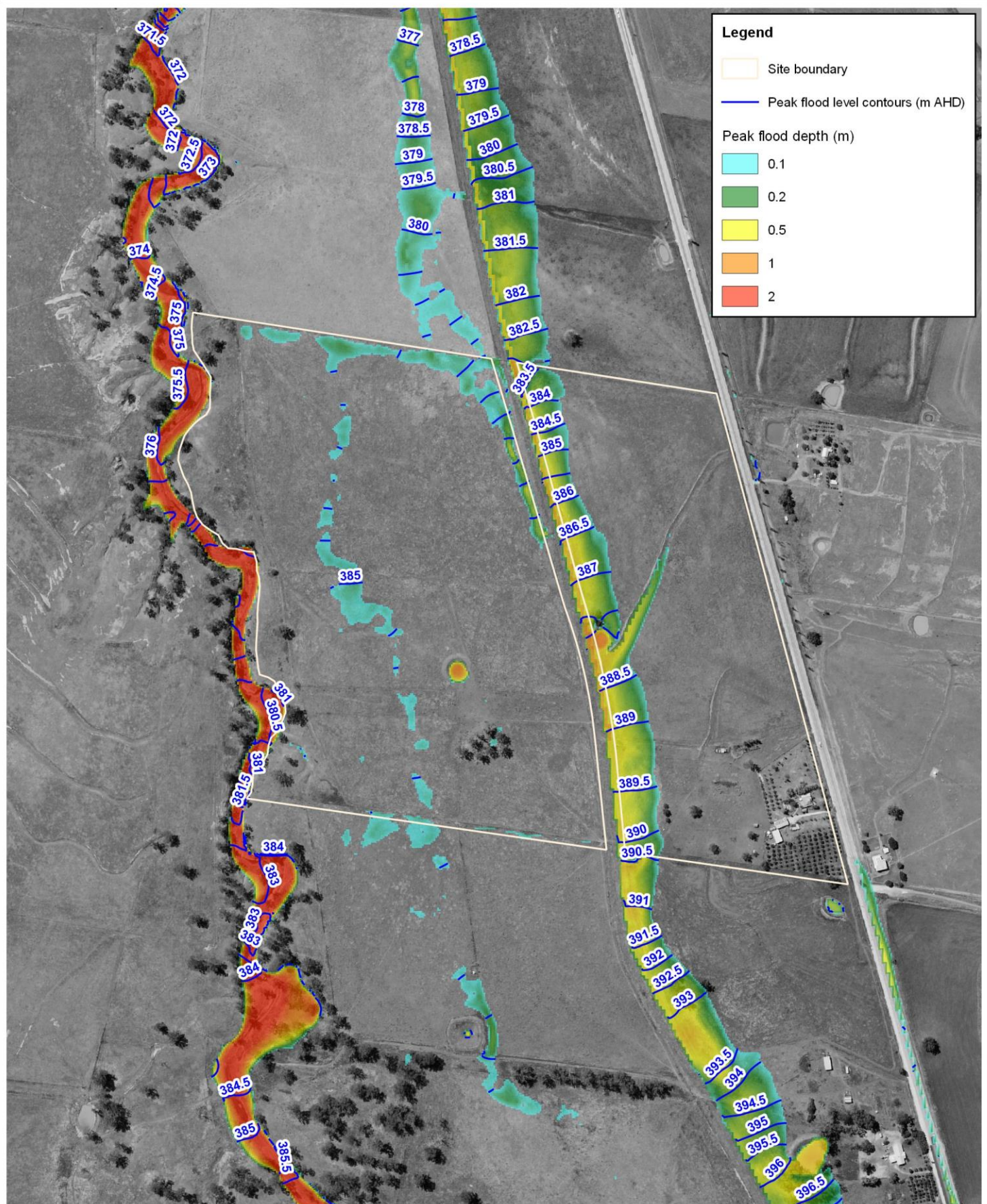
The assessment indicates that the flood impacts of the proposed solar farm development are largely contained within the Site boundary. There are localised increases in the modelled flood levels along the upstream sides of the road and perimeter fence alignments. There is also a localised change in the flood velocity distribution around the access road crossing of the railway embankment, due to the redistribution of flood flows across the proposed access road. Scour protection measures should be considered for the access road embankment to prevent erosion by overtopping floodwaters.

The proposed Site access road does not provide reliable flood-free access for evacuation. The raising of the road level to provide flood-free access may also result in adverse impact to the neighbouring property due to the redistribution of downstream flood flows. However, it is expected that the Site would be unattended most of the time. Therefore, it is unlikely that people would be present on-site in the event of a flood. Preventing access to the Site following the issuing of a severe weather or flood warning by the BoM may represent a reasonable mitigation of potential risk to life. This measure should be formalised within the site management plan.

7 References

- AIDR (2017) *Guideline 7-3, Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*
- Bureau of Meteorology (2003) *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method*
- Bureau of Meteorology (2016) *Intensity-Frequency-Duration (IFD) design rainfalls*
- Geoscience Australia (2011) *Geoscience Australia 1 second SRTM Digital Elevation Model (DEM)*
- Geoscience Australia (2019) *Australian Rainfall and Runoff: A Guide to Flood Estimation*
- GHD (2012) *Report for Manilla Flood Study*
- NSW Spatial Services (2012) *Manilla201210-PHO3-AHD*
- Tamworth Regional Council (2010) *Tamworth Regional Development Control Plan 2010*

Appendix A Baseline Design Flood Depth Mapping



Title:

Modelled 20% AEP Flood Depths and Levels

0 200 400 m



approx. scale

Figure:

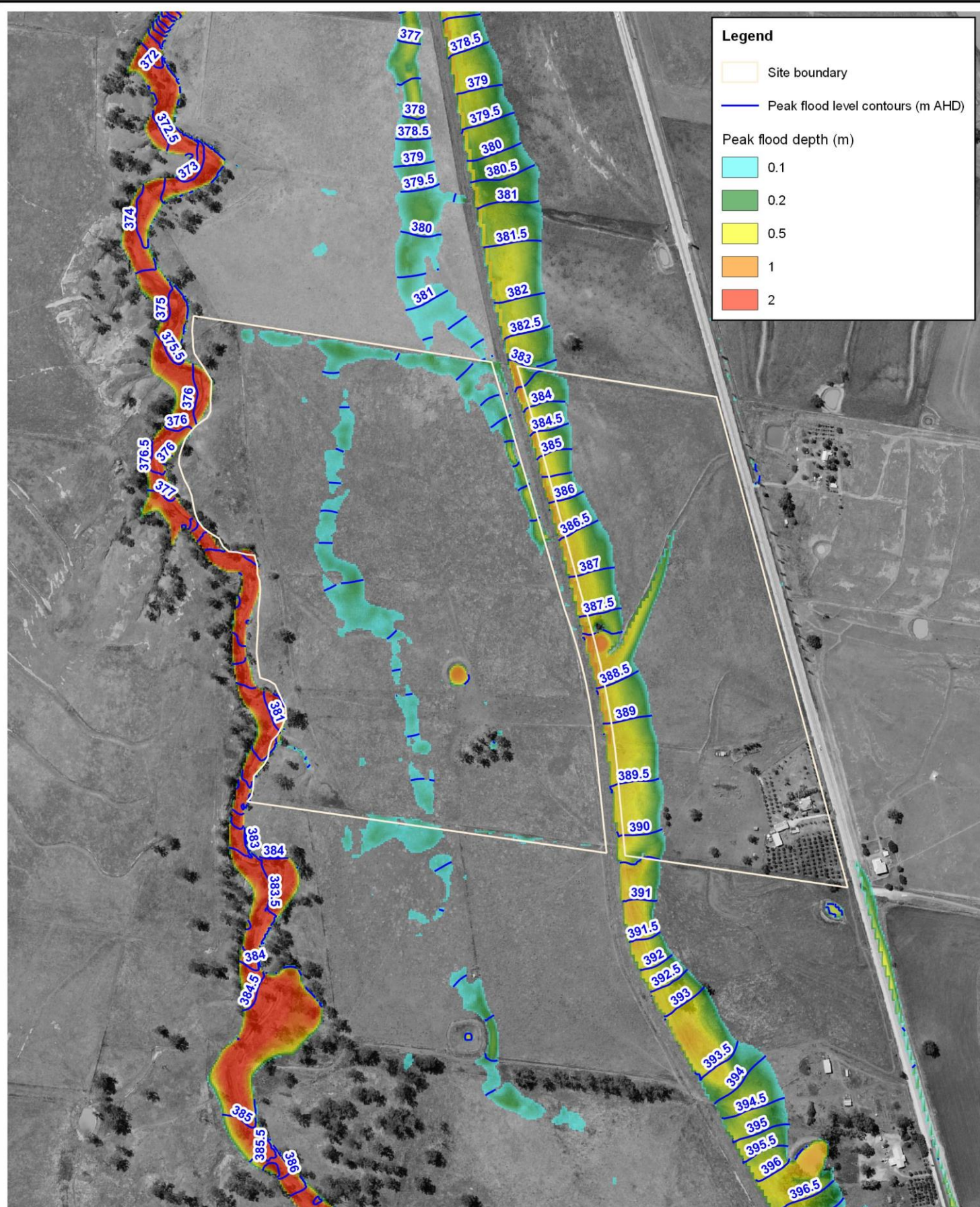
A-1

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision:

A





Title:

Modelled 10% AEP Flood Depths and Levels

0 200 400 m

approx. scale

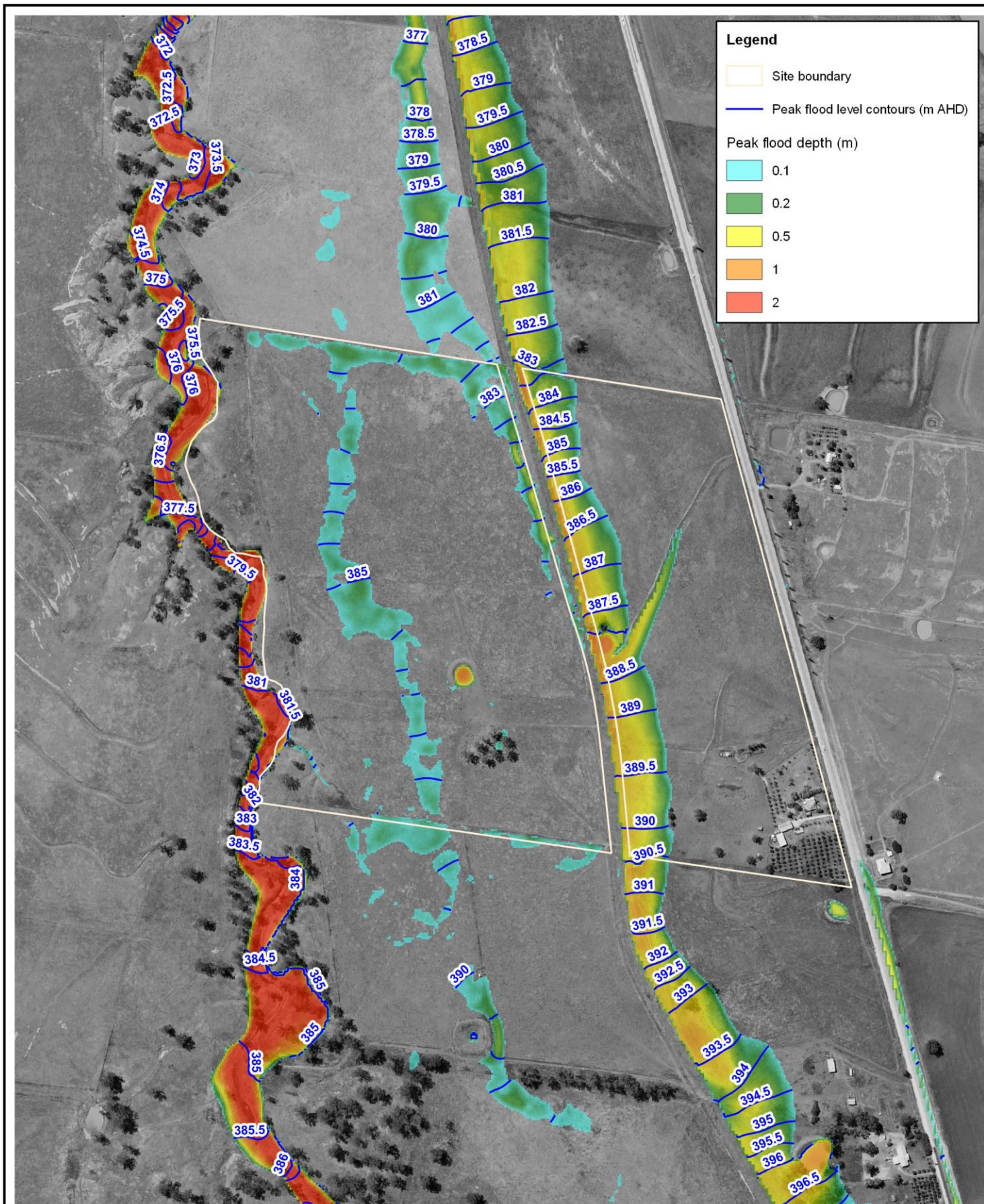
Figure: **A-2**

Revision: **A**

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_006_191205_10y_Levels.qgz





Title:

Modelled 5% AEP Flood Depths and Levels

0 200 400 m

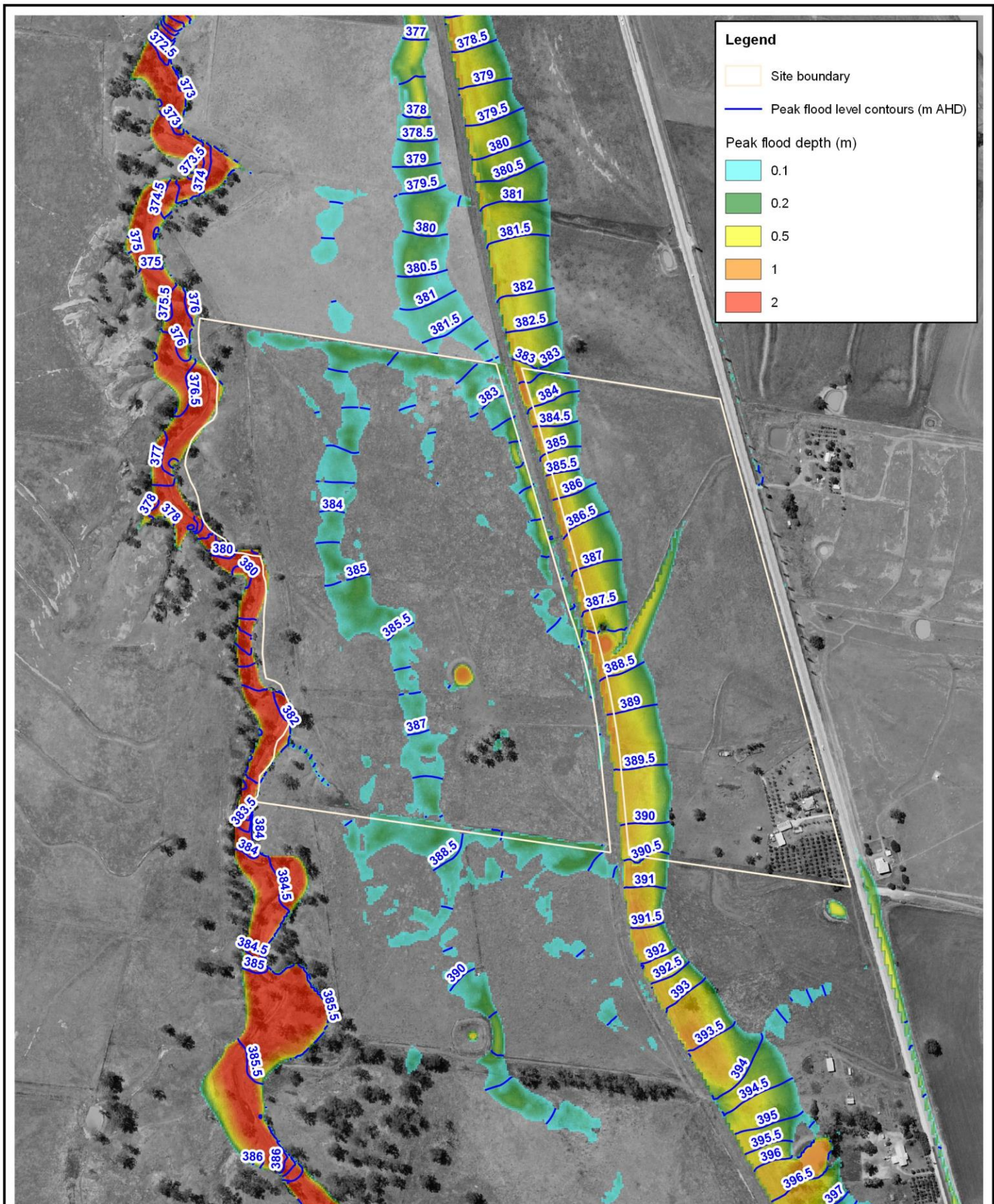
approx. scale

Figure: **A-3** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision: **A**

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_007_191205_20y_Levels.qgz





Title:
Modelled 2% AEP Flood Depths and Levels

0 200 400 m
approx. scale

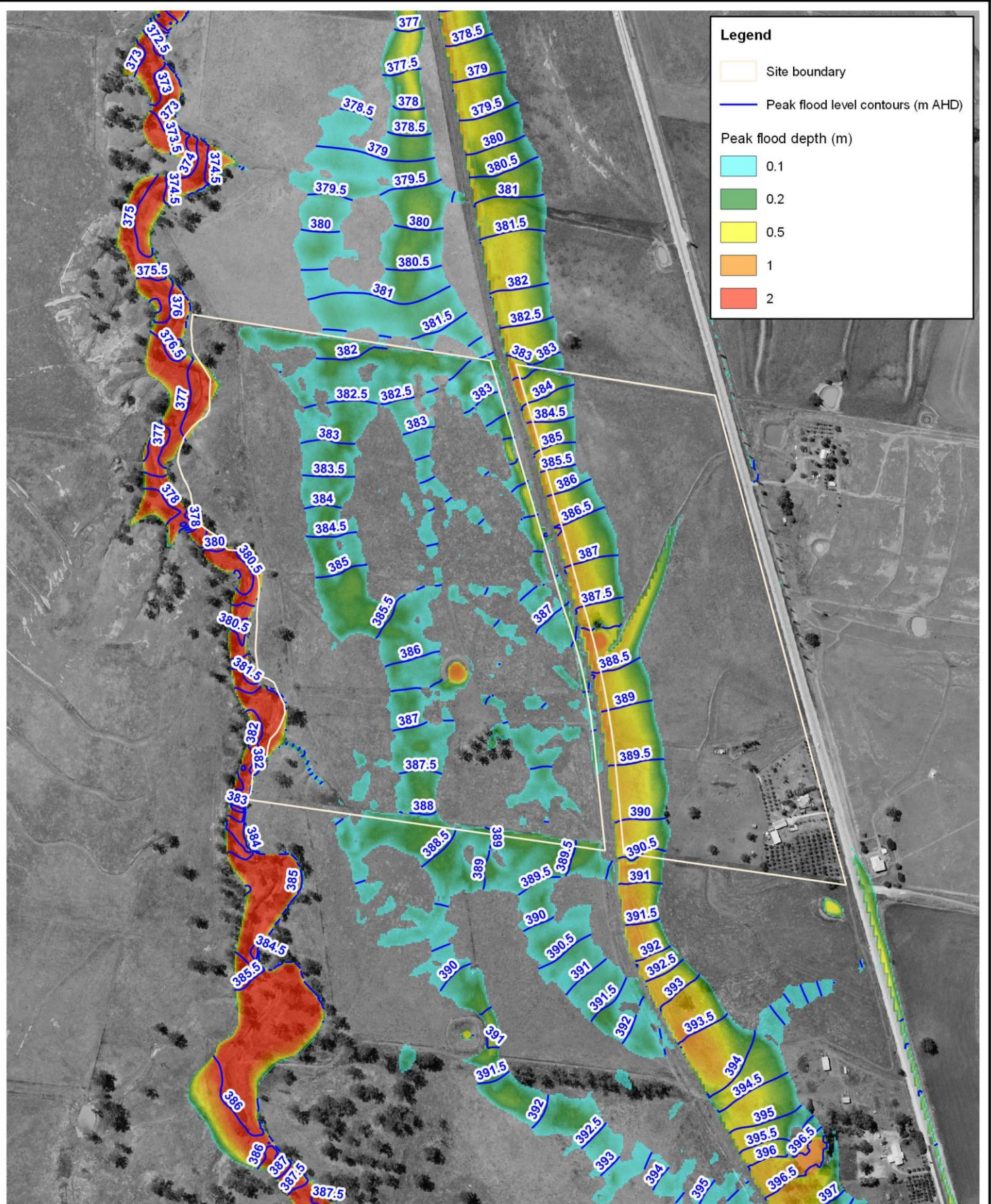
Figure: **A-4** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision: **A**

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_008_191205_50y_Levels.qgz



Torrent
CONSULTING
www.torrentconsulting.com.au



Title:

Modelled 1% AEP Flood Depths and Levels

0 200 400 m



approx. scale

Figure:

A-5

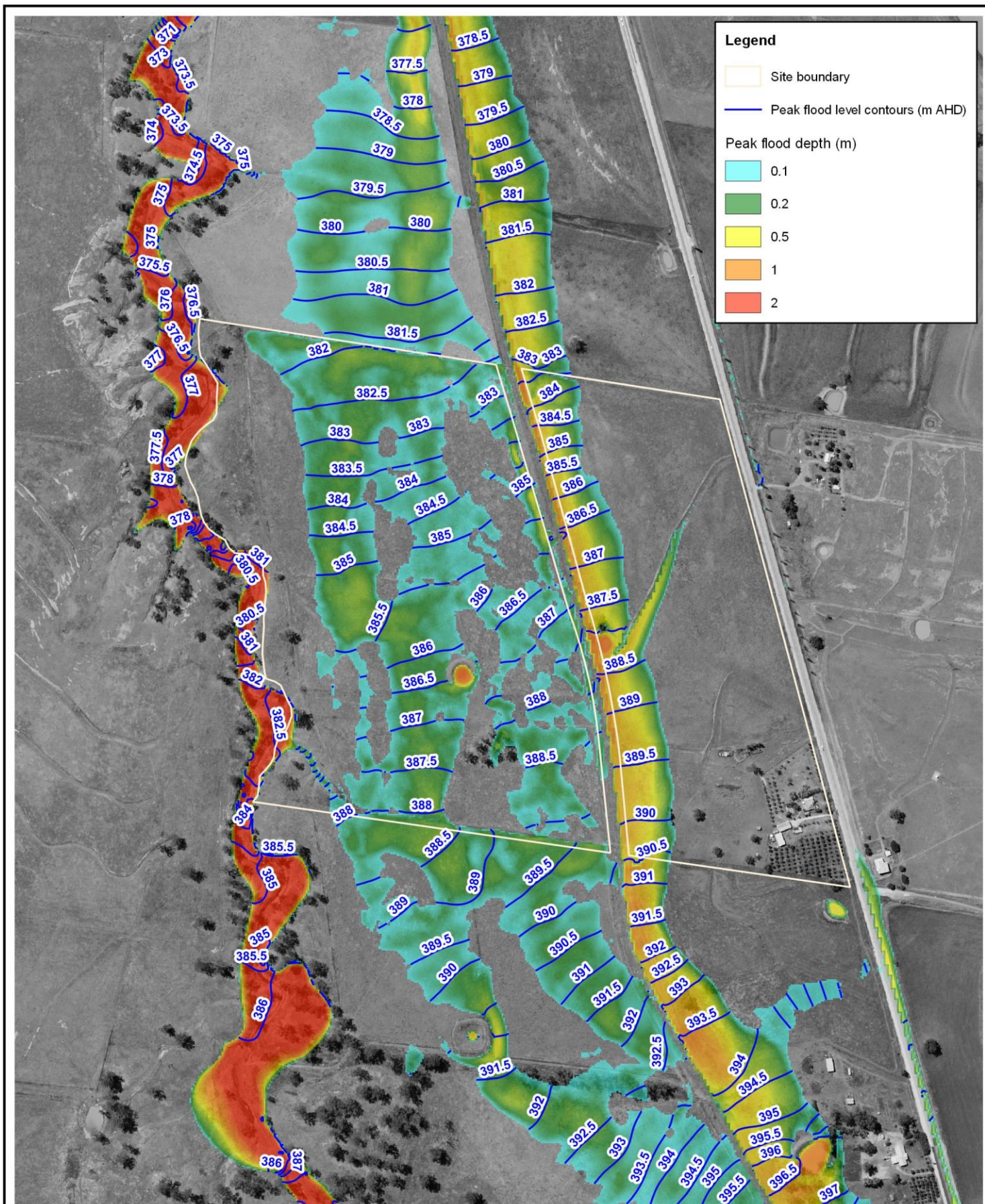
Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \Projects\T2003_Manilla_Rd_FIA\GIS\T2003_009_191205_100y_Levels.qgz





Title:

Modelled 0.5% AEP Flood Depths and Levels

0 200 400 m



approx. scale

Figure:

A-6

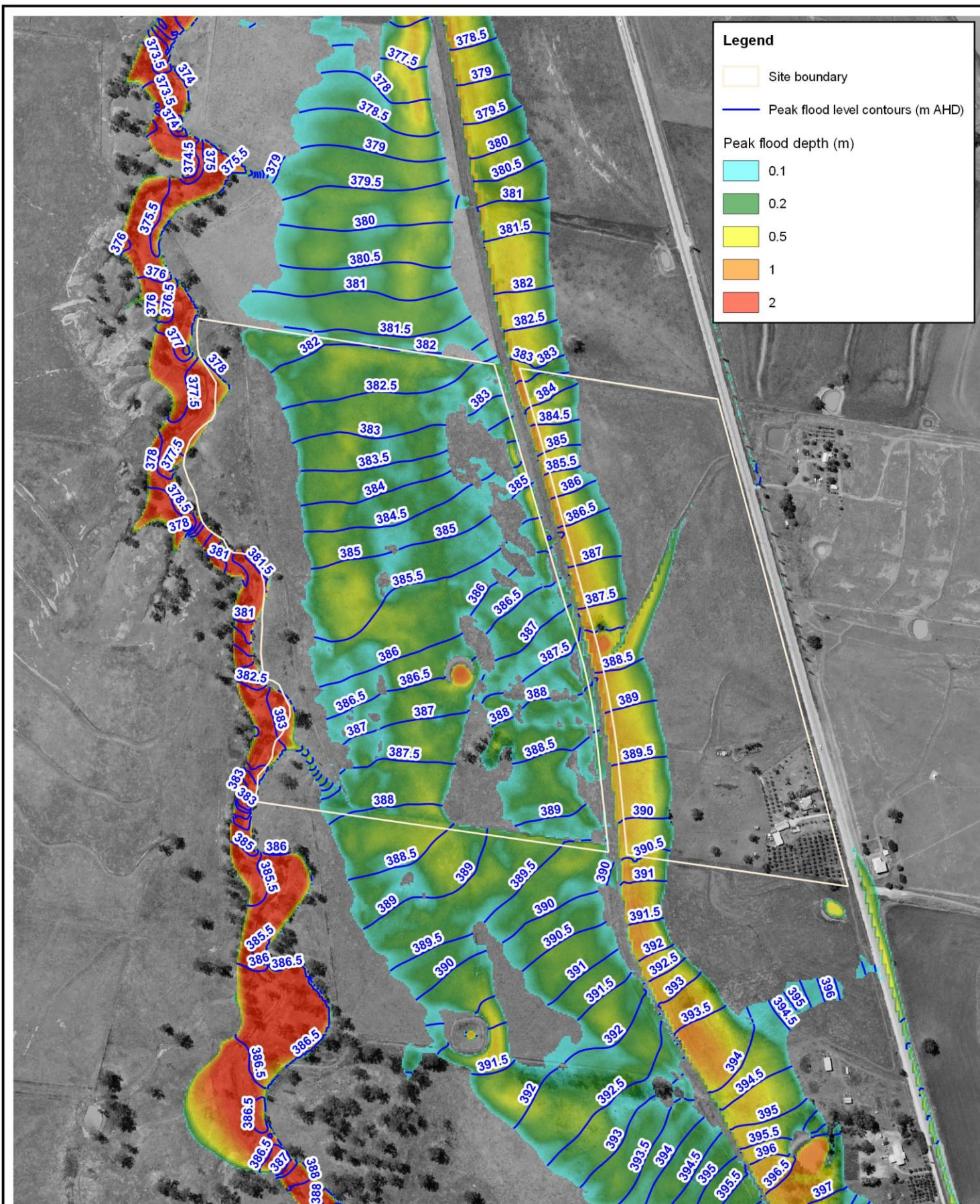
Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision:

A

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_010_191205_200y_Levels.qgz





Legend

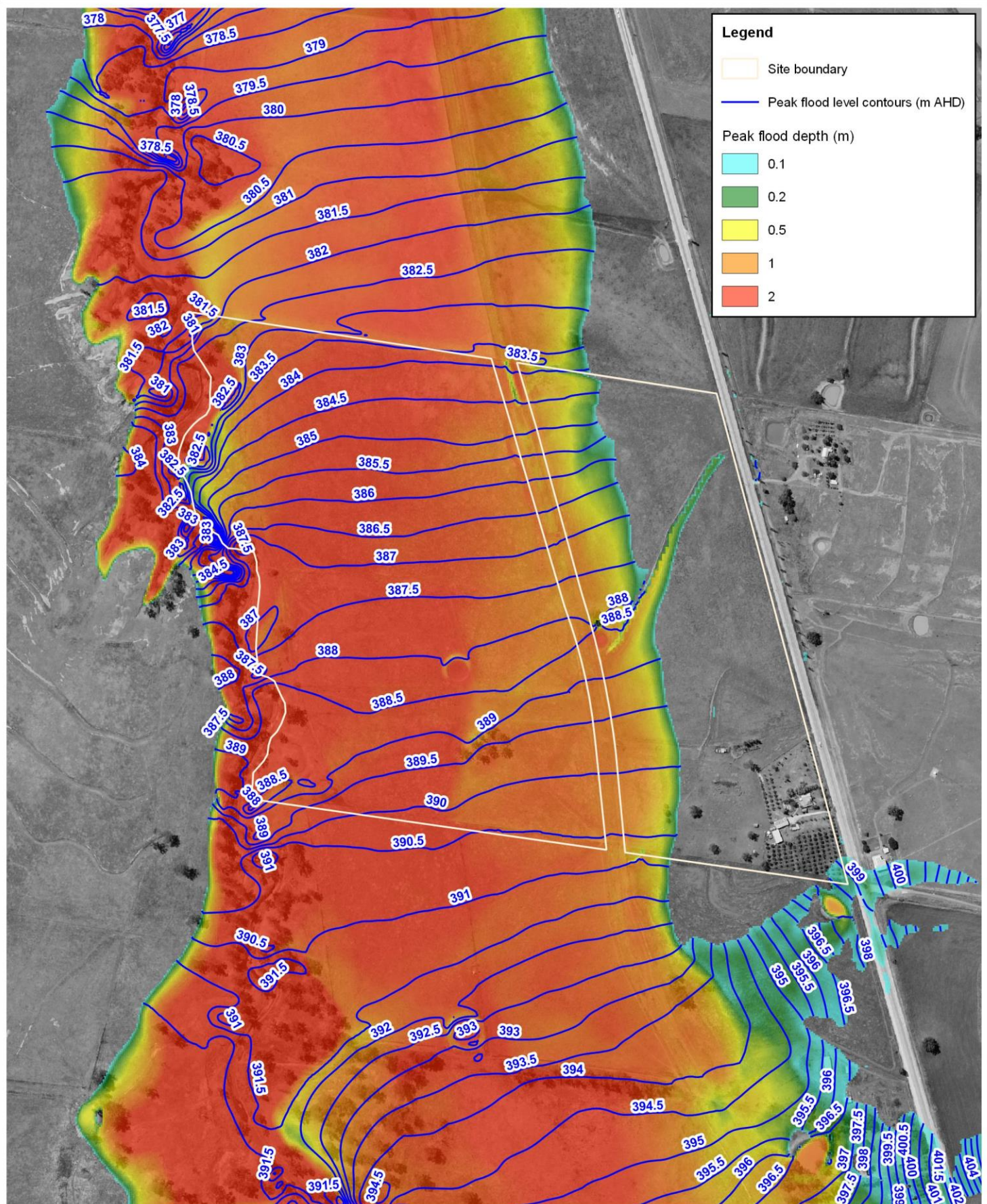
Site boundary

Peak flood level contours (m AHD)

Peak flood depth (m)

- 0.1
- 0.2
- 0.5
- 1
- 2

Title: Modelled 0.2% AEP Flood Depths and Levels		0 200 400 m approx. scale	
Figure:	A-7	Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.	
Revision:	A		
Filepath: \Projects\T2003_Manilla_Rd_FIA\GIS\T2003_011_191205_500y_Levels.qgz		N	



Title:

Modelled PMF Flood Depths and Levels

0 200 400 m



approx. scale

Figure:

A-8

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision:

A

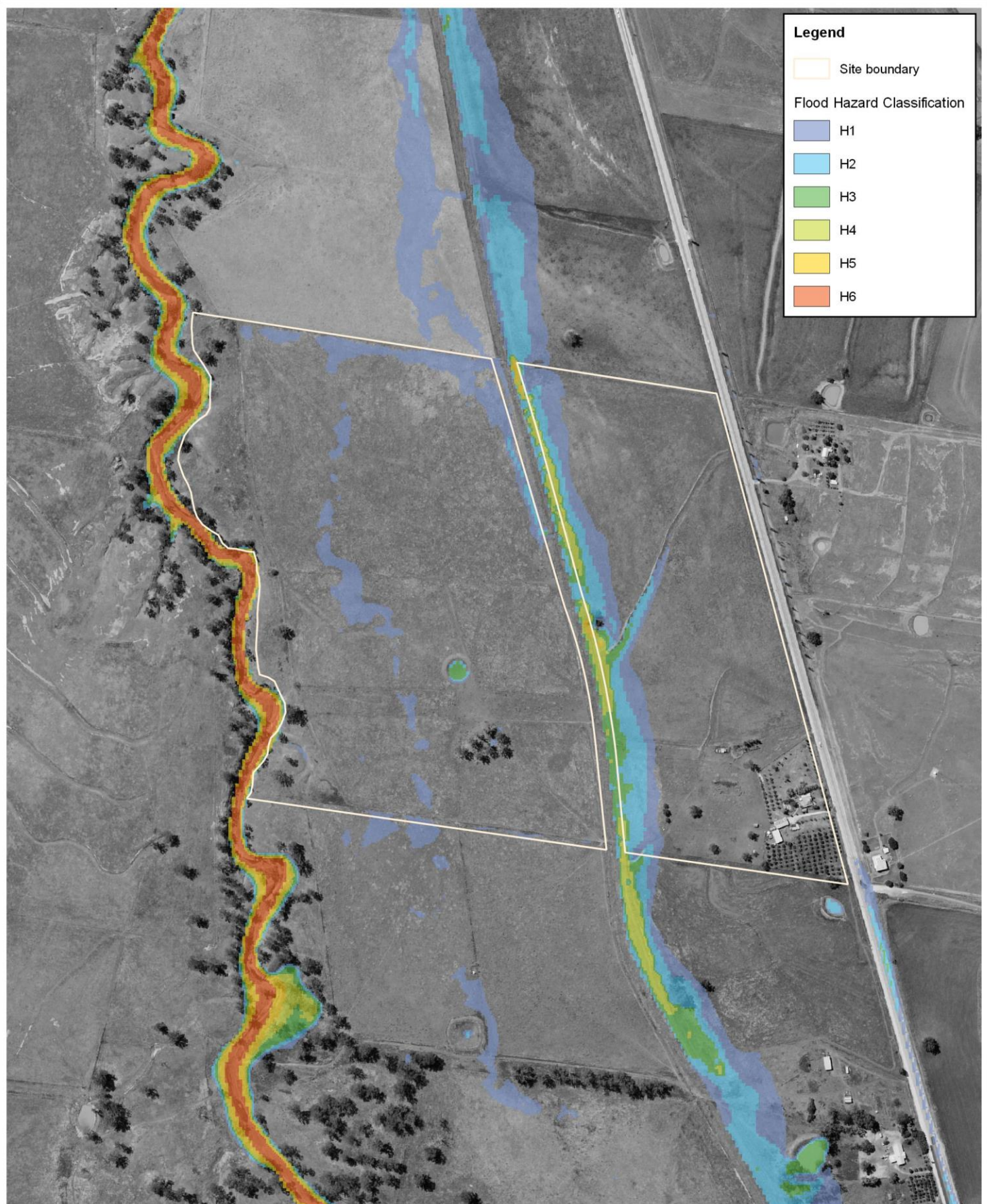
Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_012_191205_PMF_Levels.qgz



Torrent
CONSULTING

www.torrentconsulting.com.au

Appendix B Baseline Design Flood Hazard Mapping



Title:

Modelled 20% AEP Flood Hazard Classification

0 200 400 m



approx. scale

Figure:

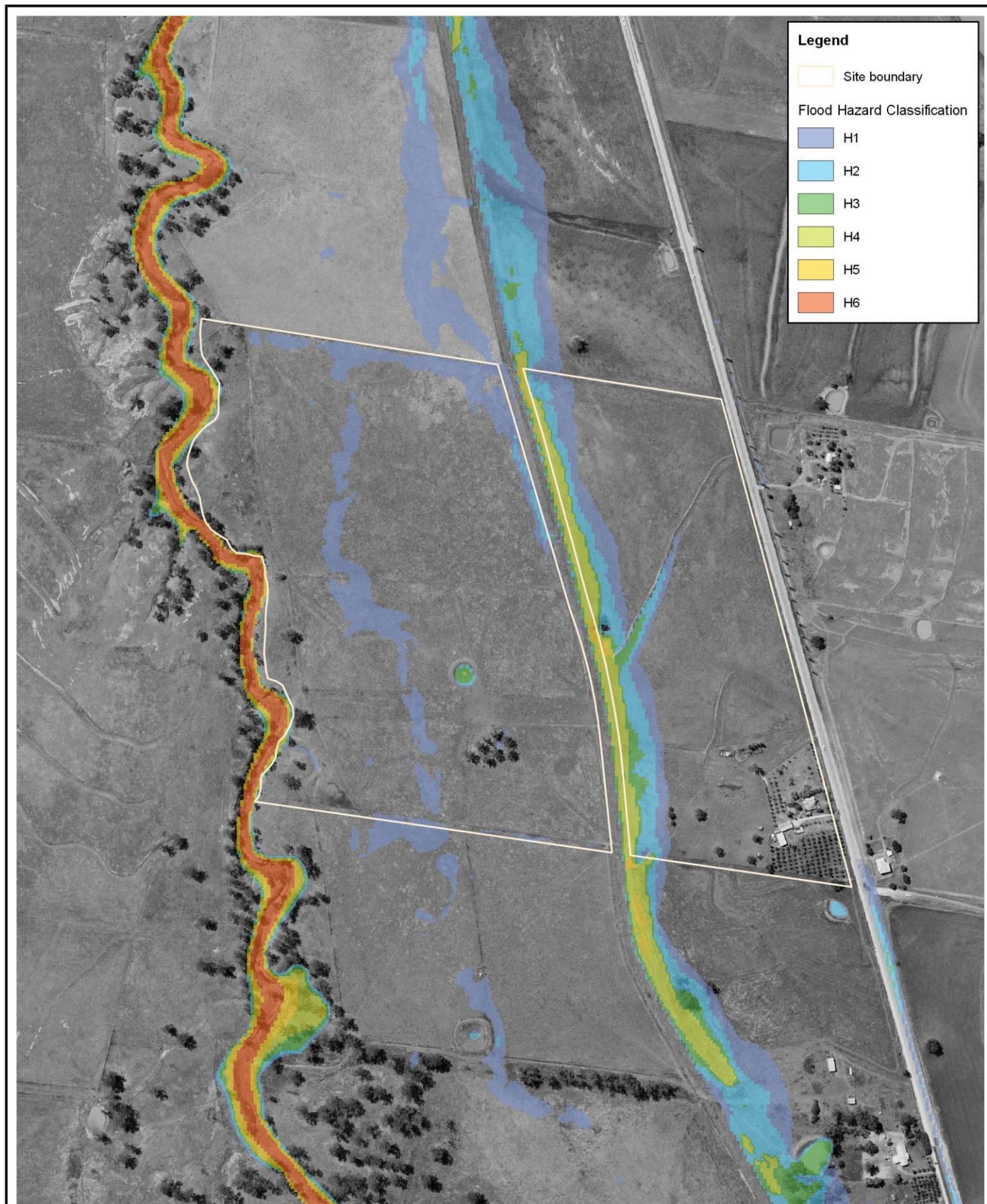
B-1

Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.





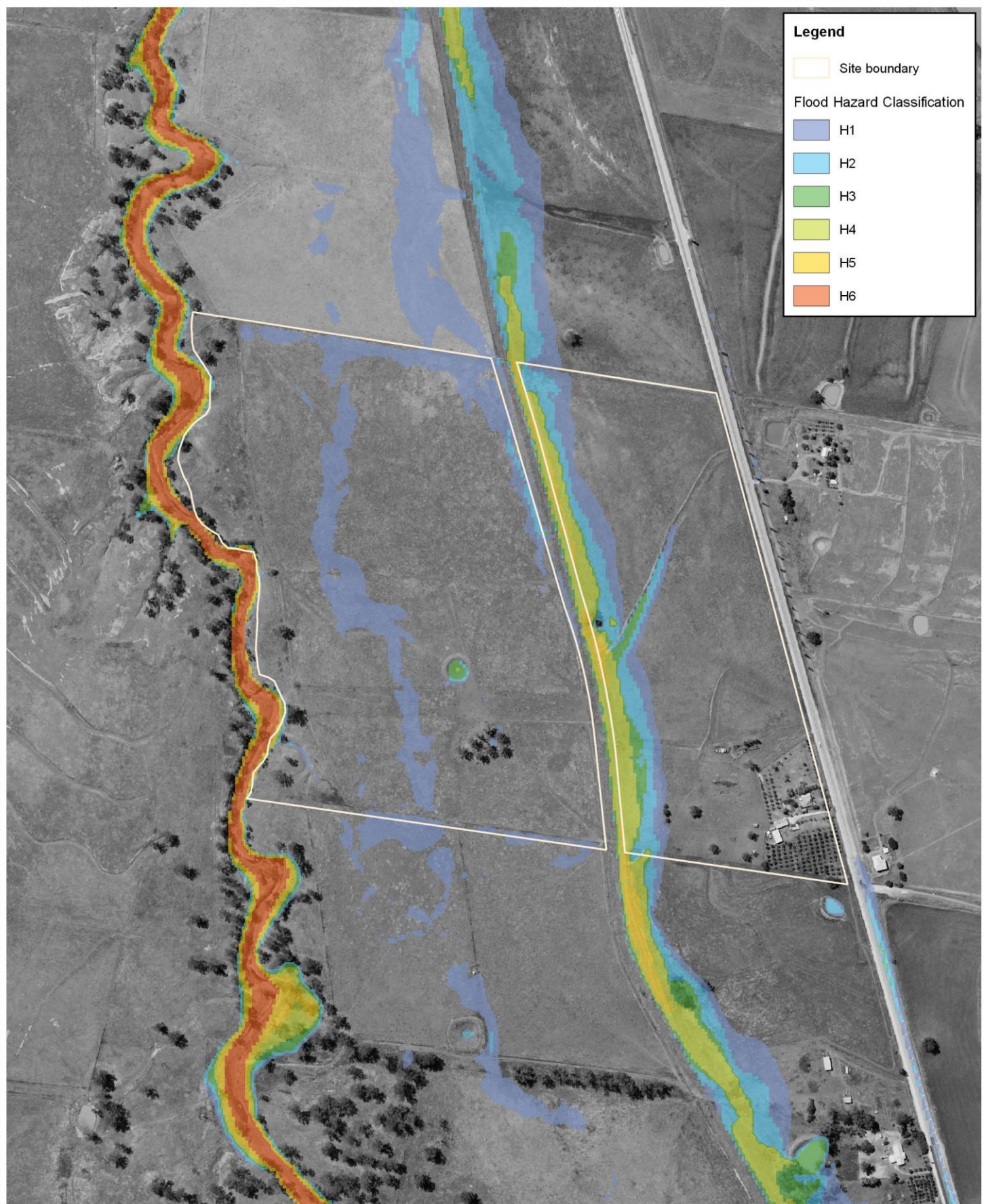
Title:
Modelled 10% AEP Flood Hazard Classification

Figure: **B-2** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision: **A**

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_014_191205_10y_Hazards.qgz





Title:

Modelled 5% AEP Flood Hazard Classification

Figure:

B-3

Revision:

A

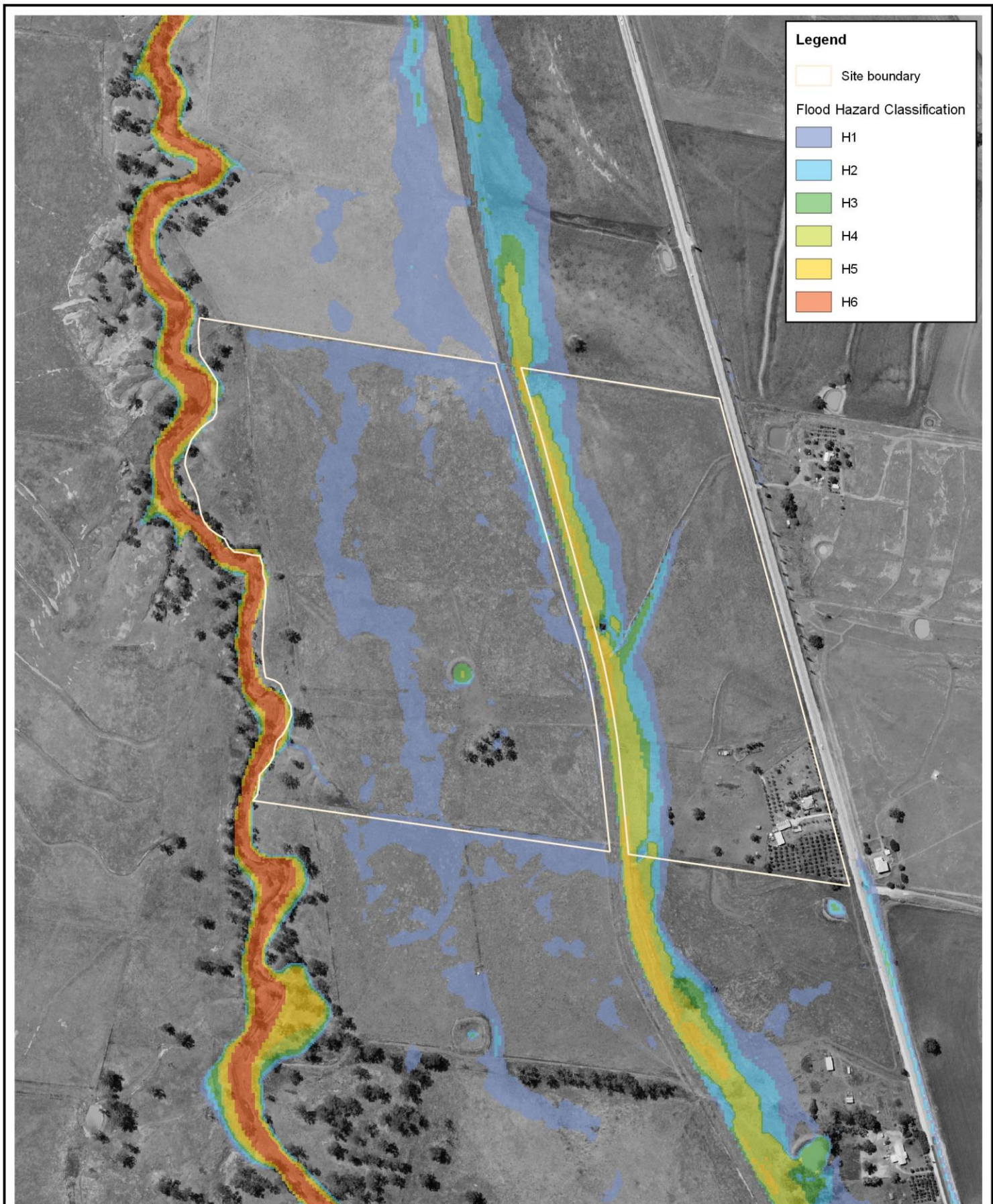
Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_015_191205_20y_Hazards.qgz



Torrent
CONSULTING

www.torrentconsulting.com.au



Title:
Modelled 2% AEP Flood Hazard Classification

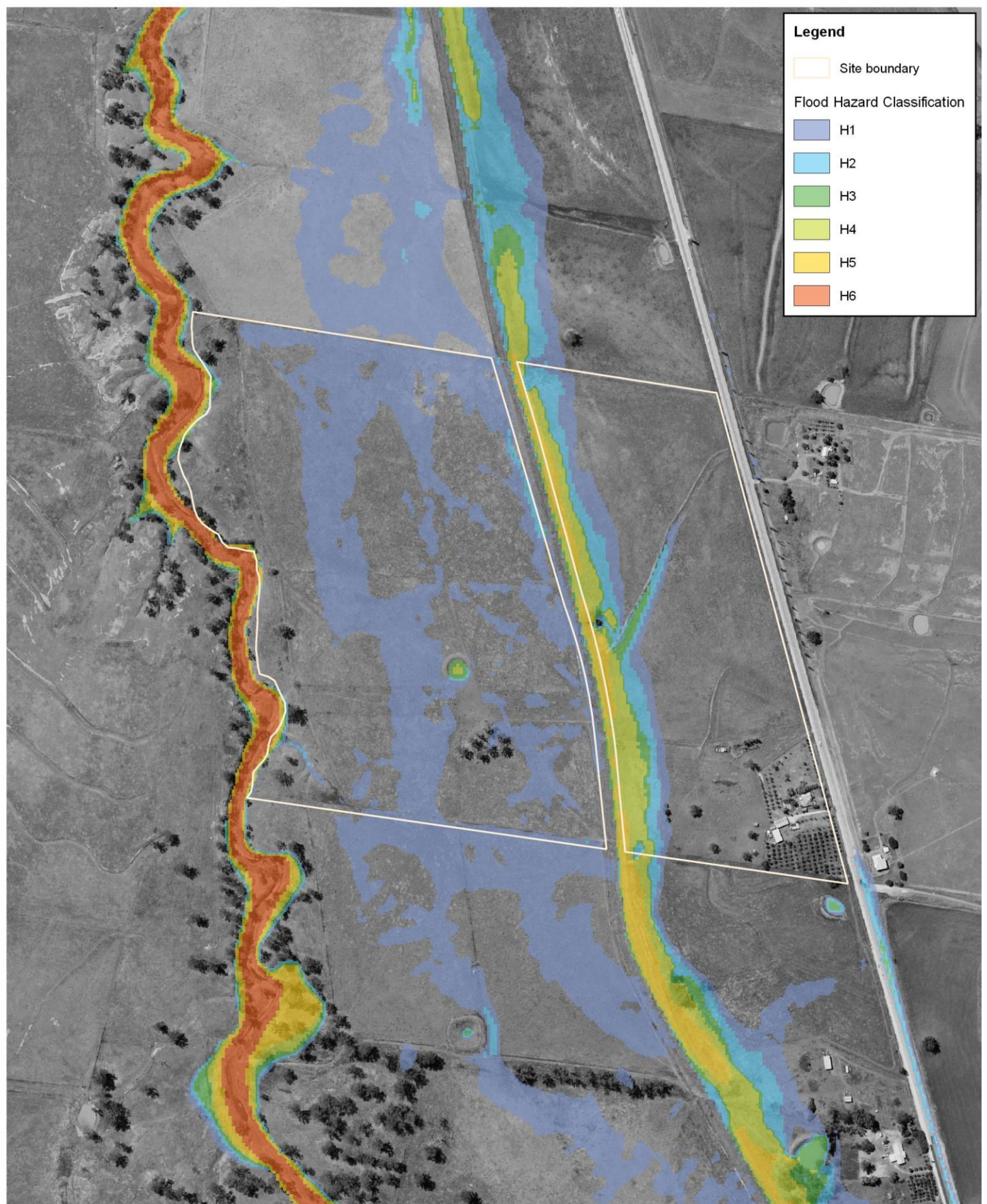
Figure:
B-4

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision:
A

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_016_191205_50y_Hazards.qgz





Title:

Modelled 1% AEP Flood Hazard Classification

Figure:

B-5

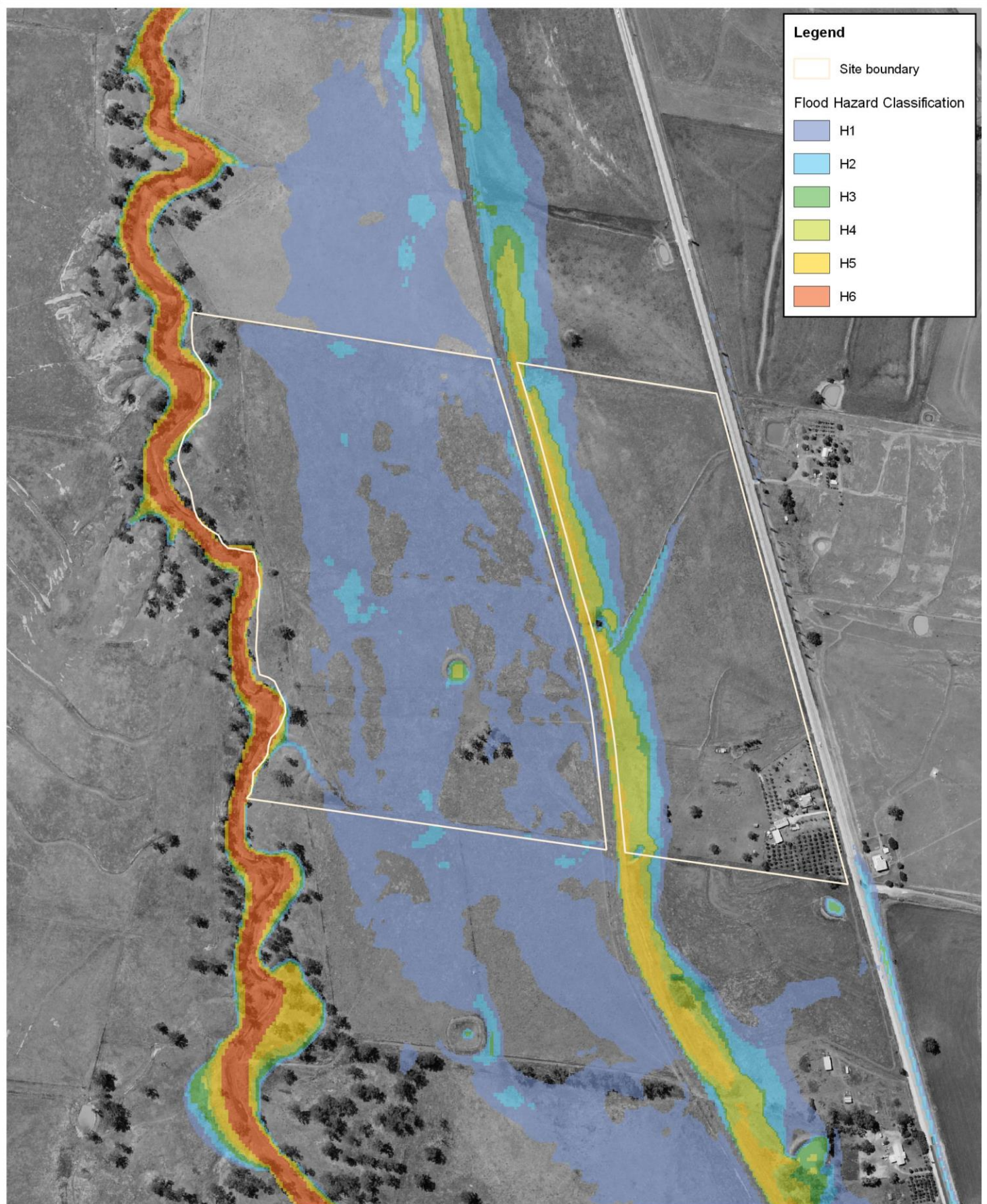
Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_017_191205_100y_Hazards.qgz





Title:

Modelled 0.5% AEP Flood Hazard Classification

0 200 400 m



approx. scale

Figure:

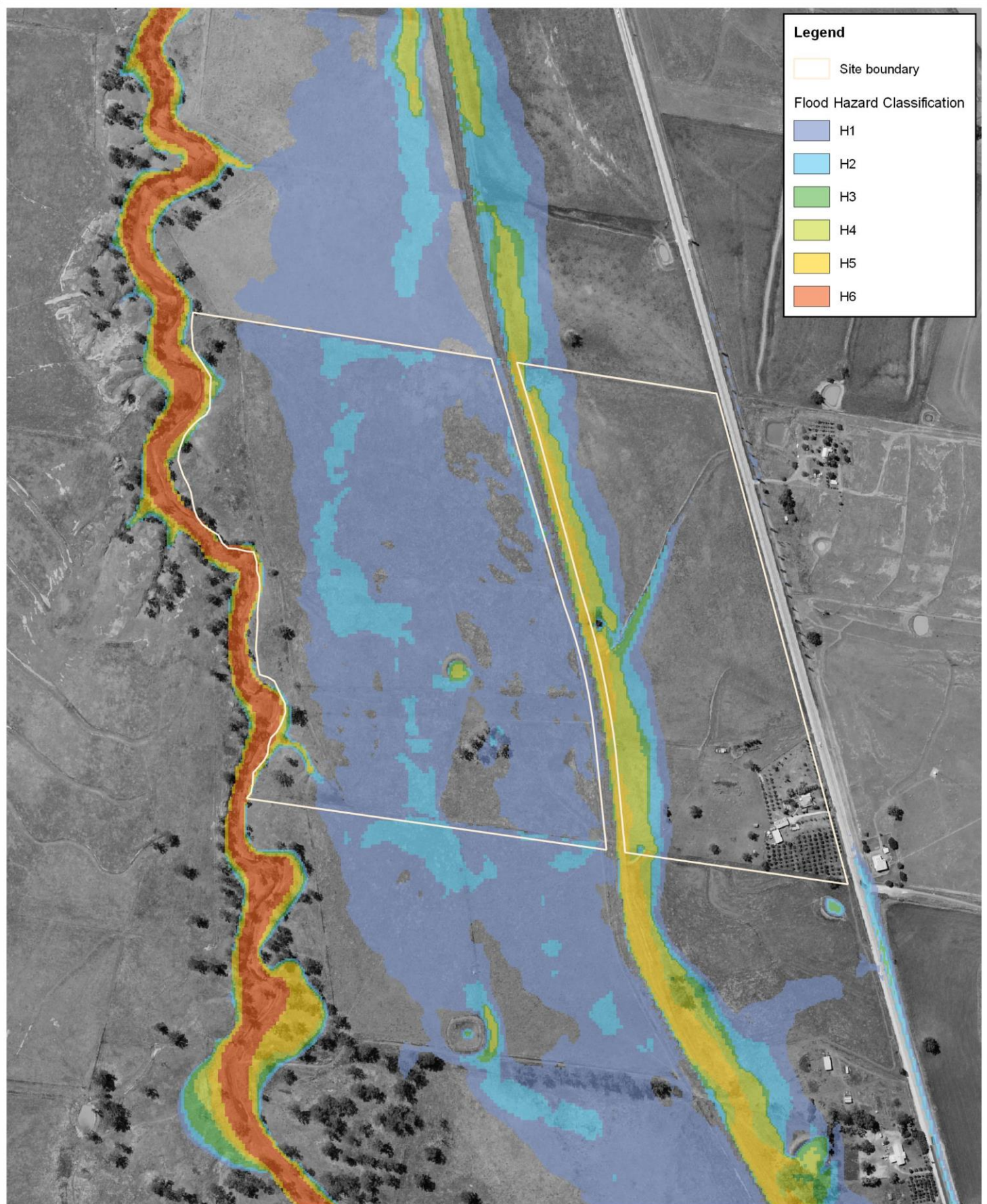
B-6

Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.





Title:

Modelled 0.2% AEP Flood Hazard Classification

Figure:

B-7

Revision:

A

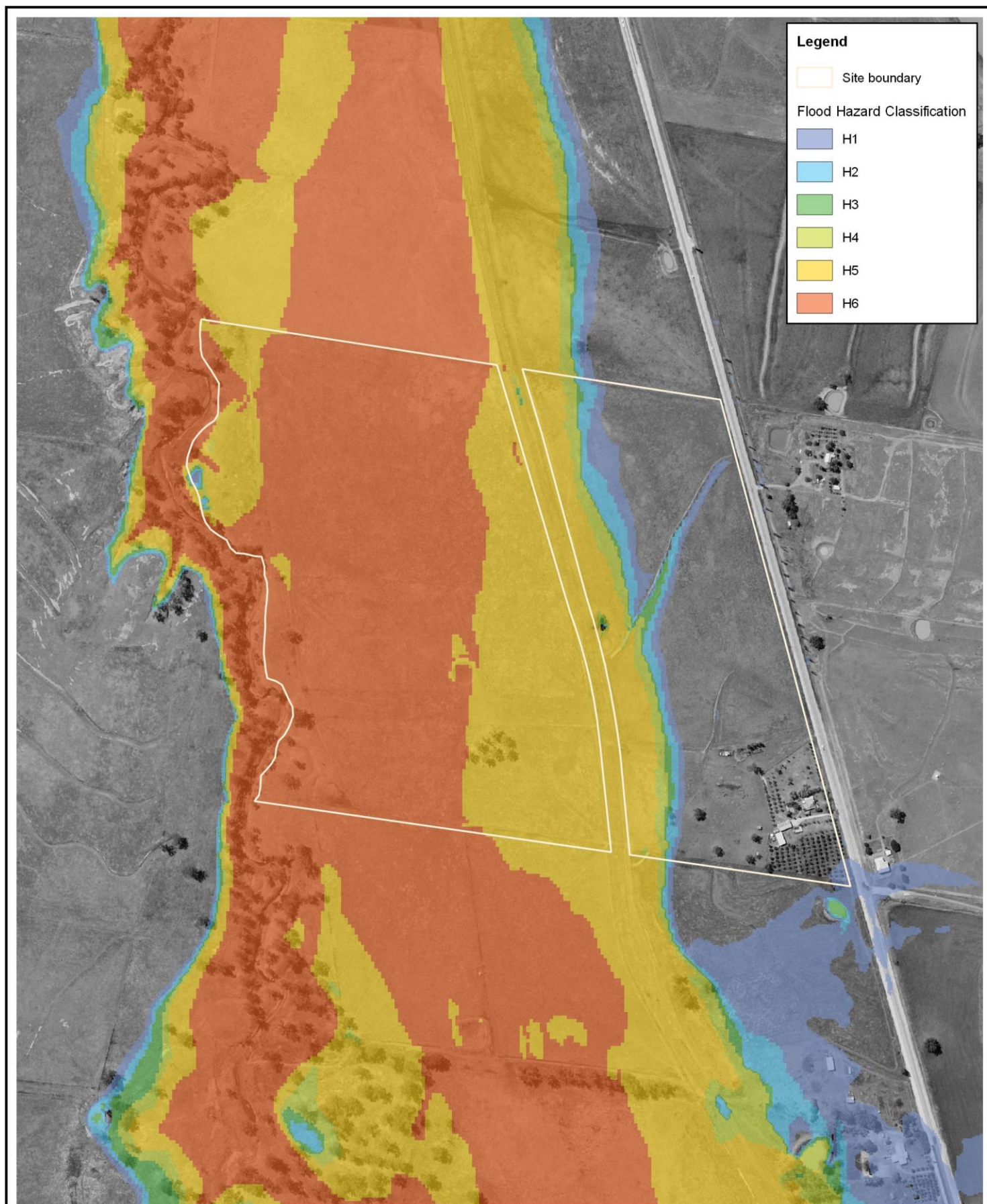
Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_019_191205_500y_Hazards.qgz



Torrent
CONSULTING

www.torrentconsulting.com.au



Title:
Modelled PMF Flood Hazard Classification

0 200 400 m
approx. scale

Figure: **B-8** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

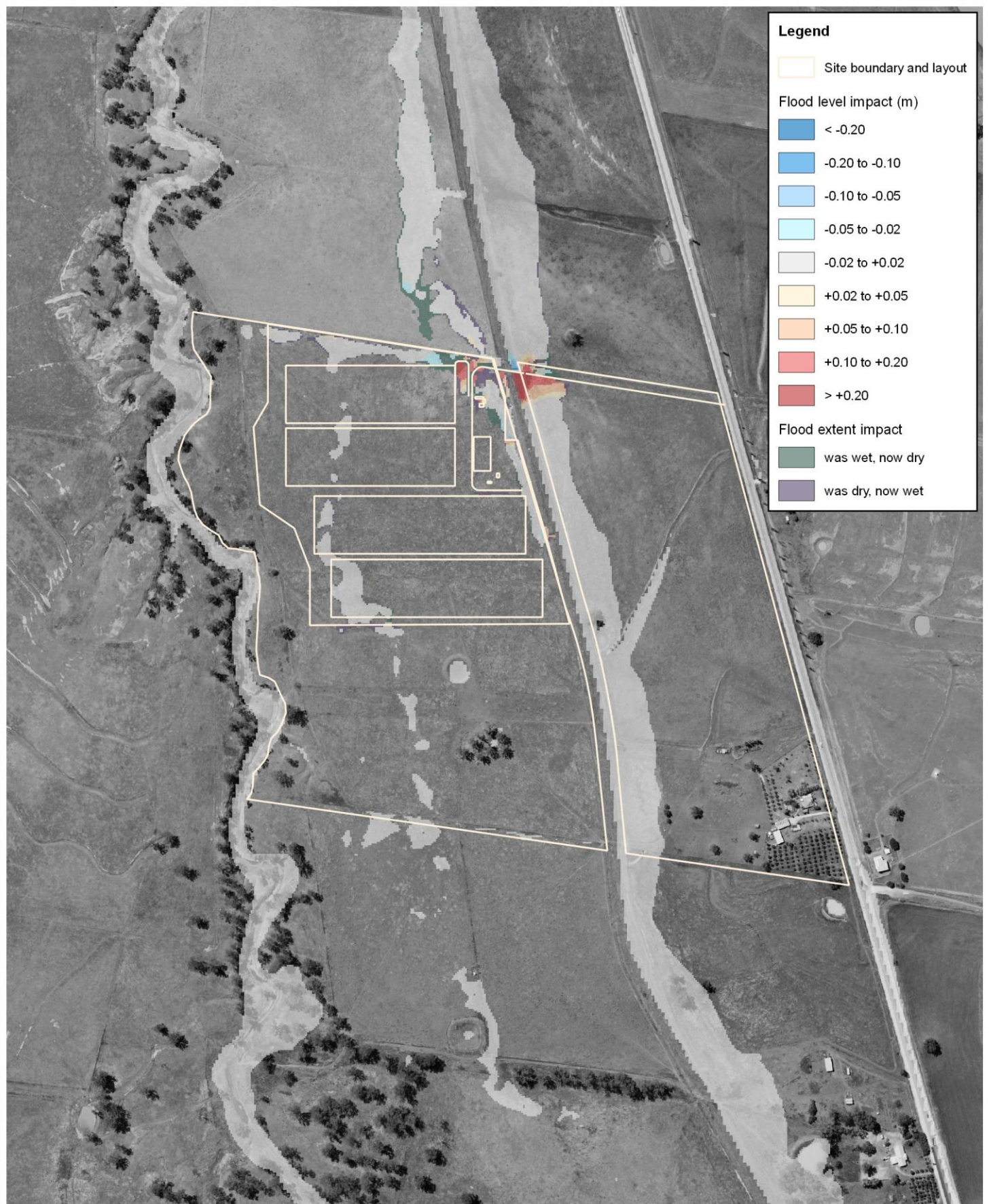
Revision: **A**

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_020_191205_PMF_Hazards.qgz



Torrent
CONSULTING
www.torrentconsulting.com.au

Appendix C Flood Level Impact Mapping



Title:

Modelled 20% AEP Peak Flood Level Impact

0 200 400 m



approx. scale

Figure:

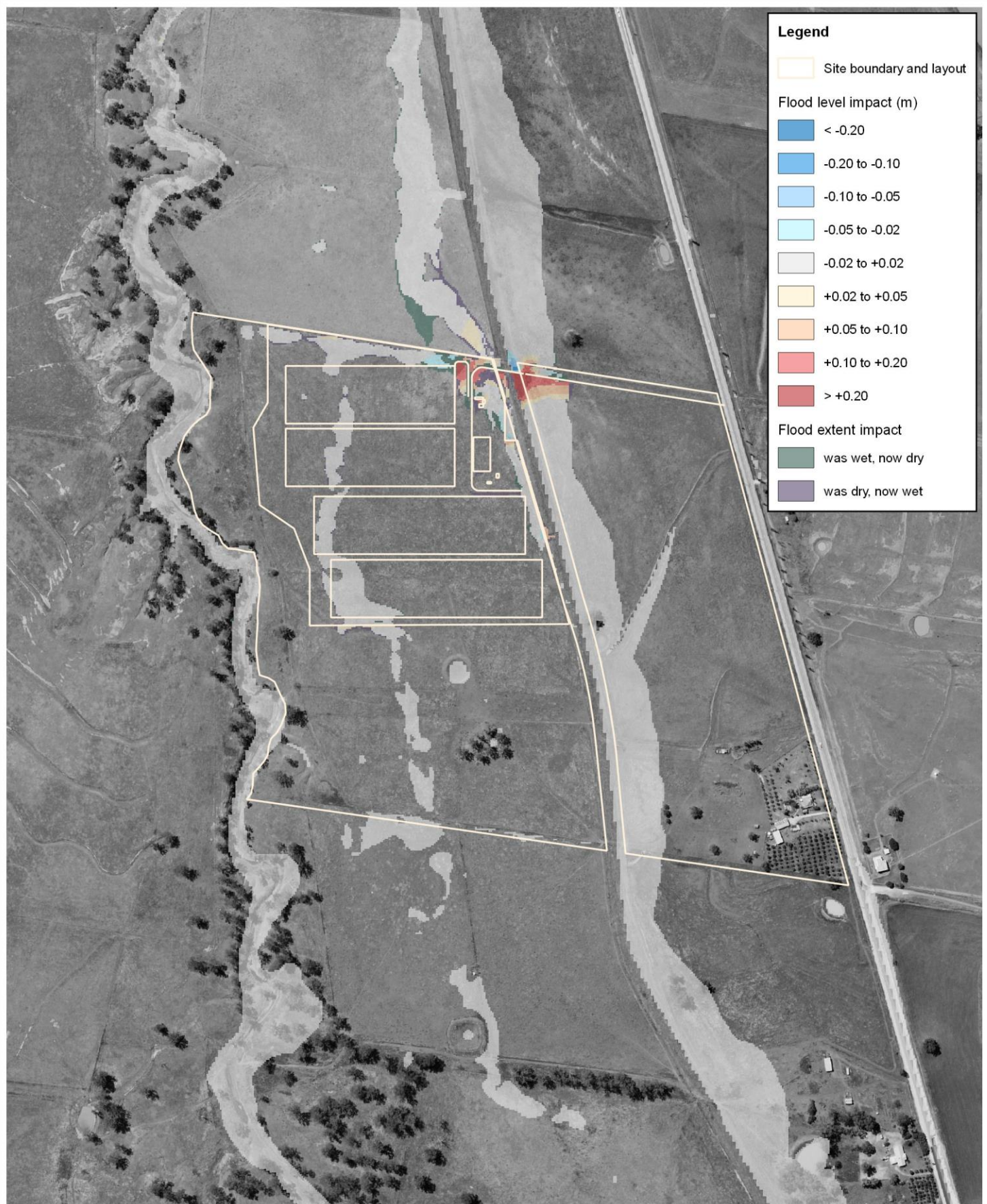
C-1

Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.





Title:

Modelled 10% AEP Peak Flood Level Impact

0 200 400 m



approx. scale

Figure:

C-2

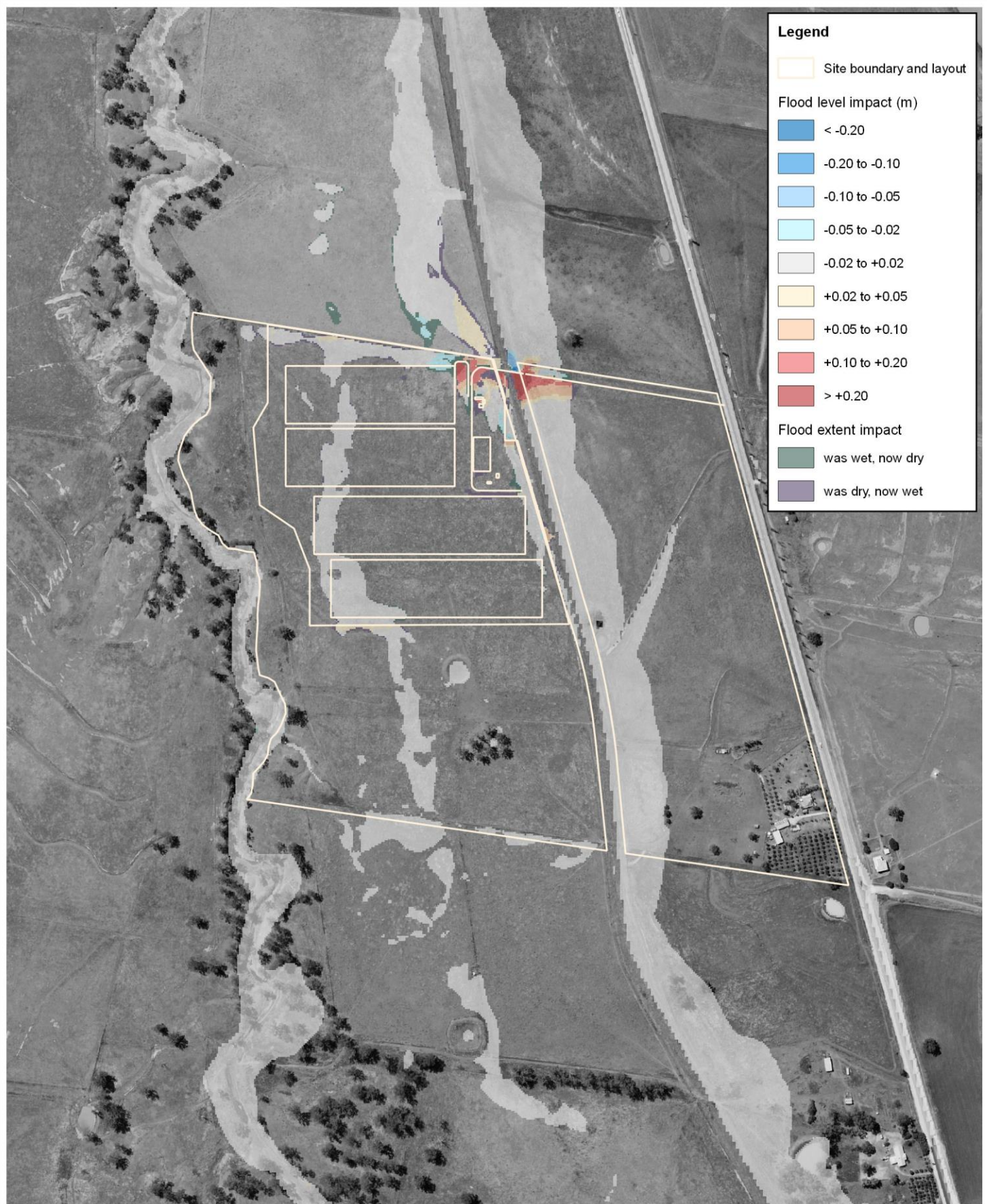
Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \Projects\T2003_Manilla_Rd_FIA\GIS\T2003_022_191205_10y_h_Impact.qgz





Title:

Modelled 5% AEP Peak Flood Level Impact

0 200 400 m



approx. scale

Figure:

C-3

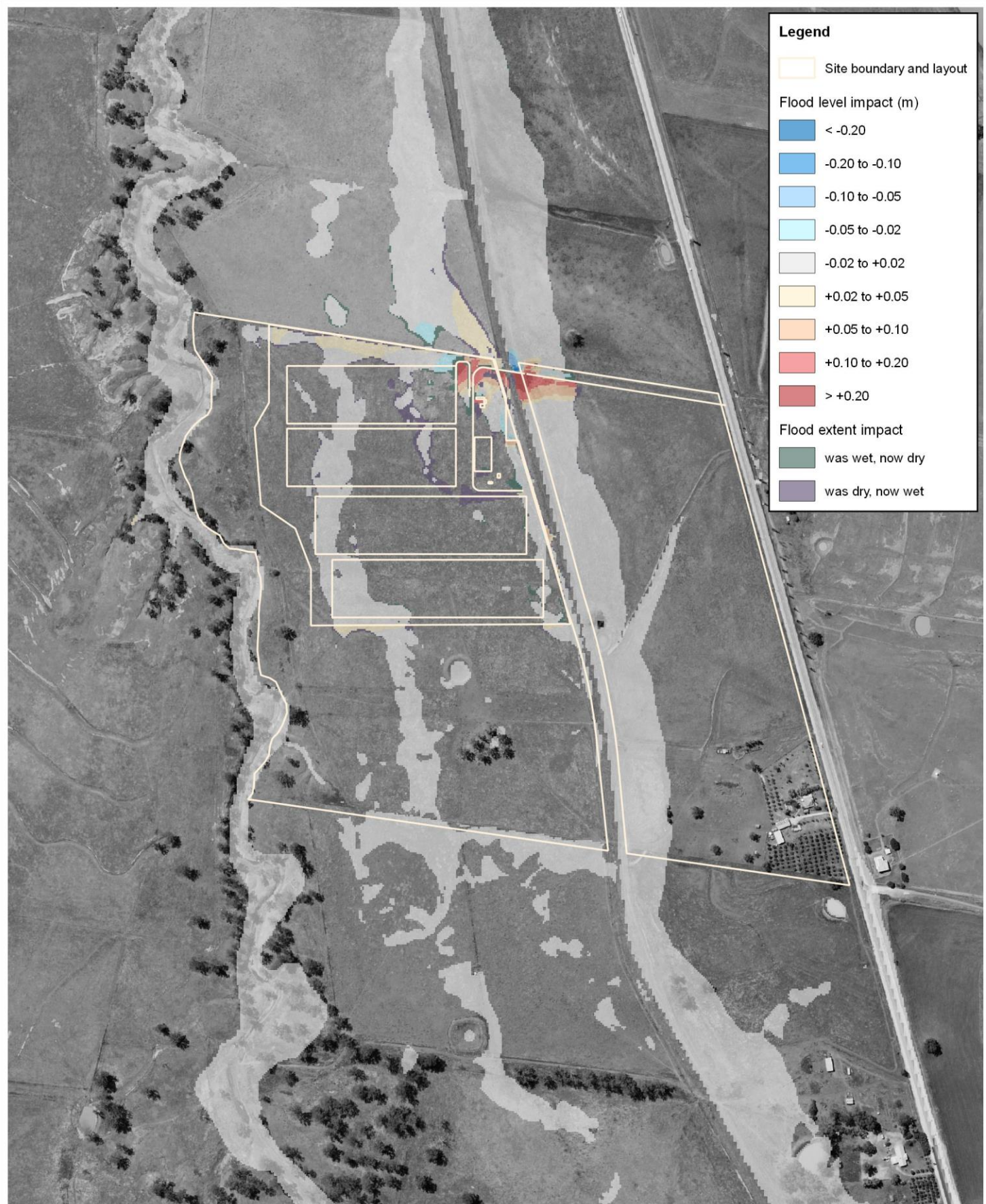
Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \Projects\T2003_Manilla_Rd_FIA\GIS\T2003_023_191205_20y_h_Impact.qgz





Title:

Modelled 2% AEP Peak Flood Level Impact

0 200 400 m



approx. scale

Figure:

C-4

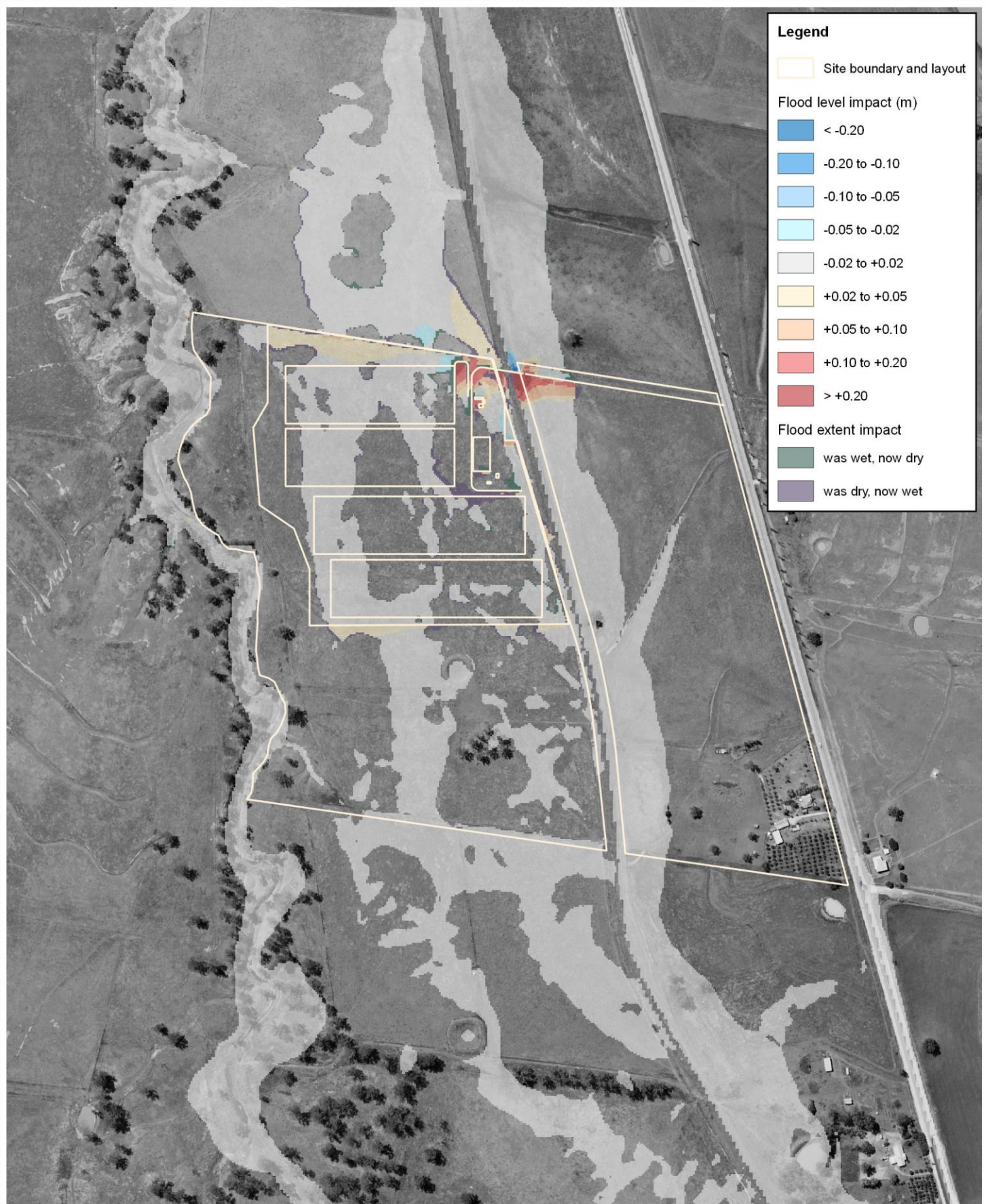
Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \Projects\T2003_Manilla_Rd_FIA\GIS\T2003_024_191205_50y_h_Impact.qgz





Title:

Modelled 1% AEP Peak Flood Level Impact

0 200 400 m



approx. scale

Figure:

C-5

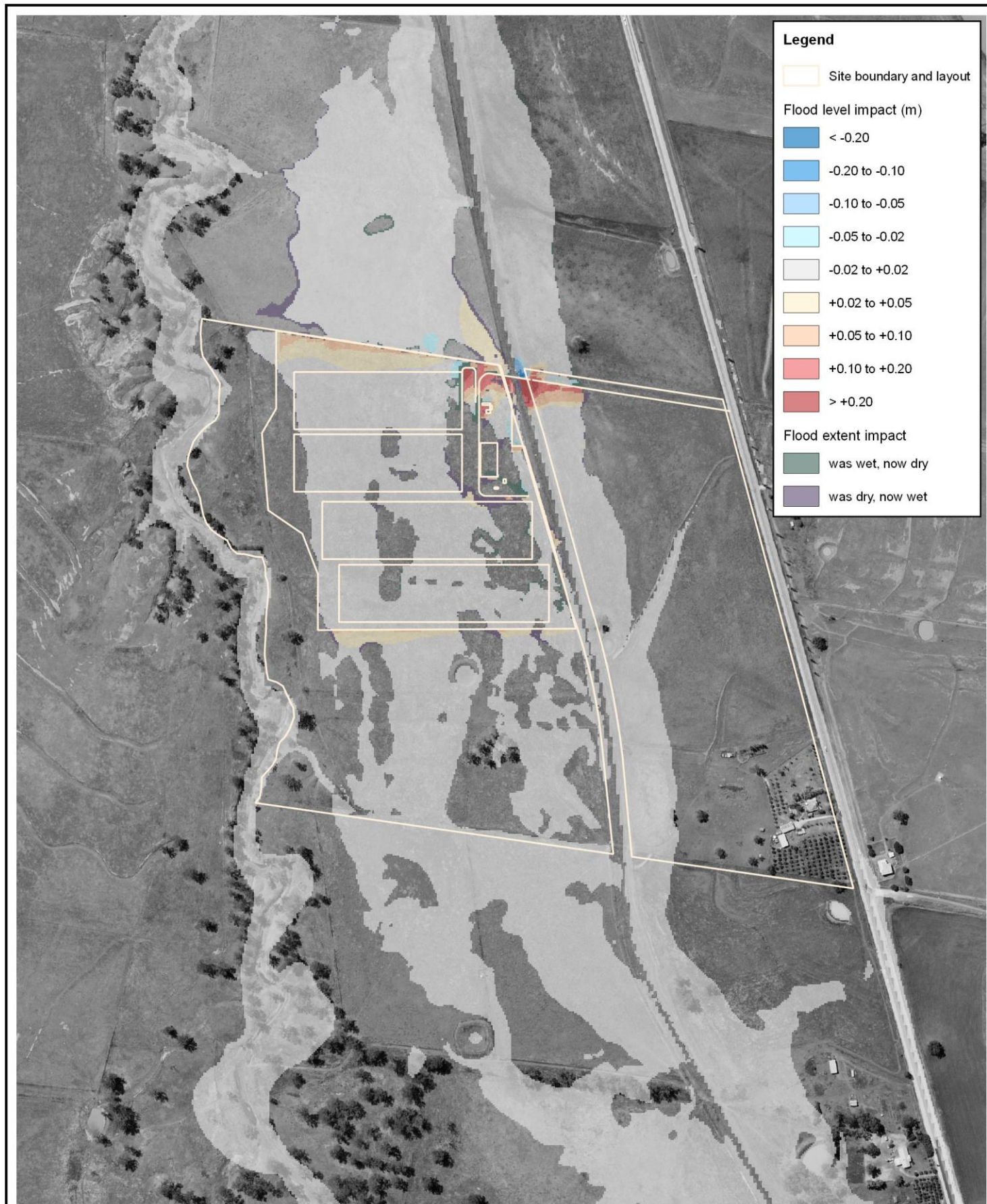
Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_025_191205_100y_h_Impact.qgz





Title:

Modelled 0.5% AEP Peak Flood Level Impact

0 200 400 m



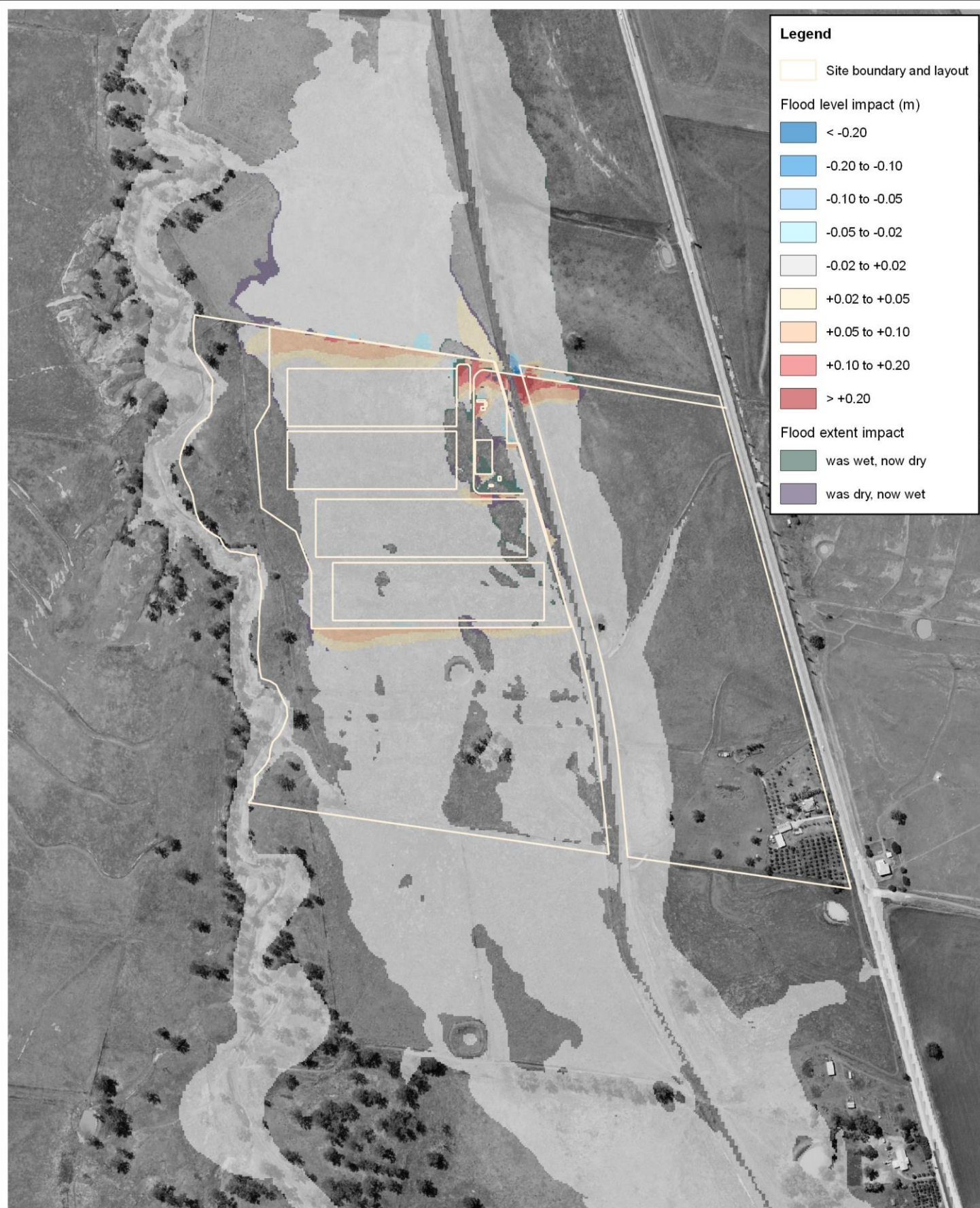
approx. scale

Figure: **C-6**

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision: **A**





Title:

Modelled 0.2% AEP Peak Flood Level Impact

0 200 400 m



approx. scale

Figure:

C-7

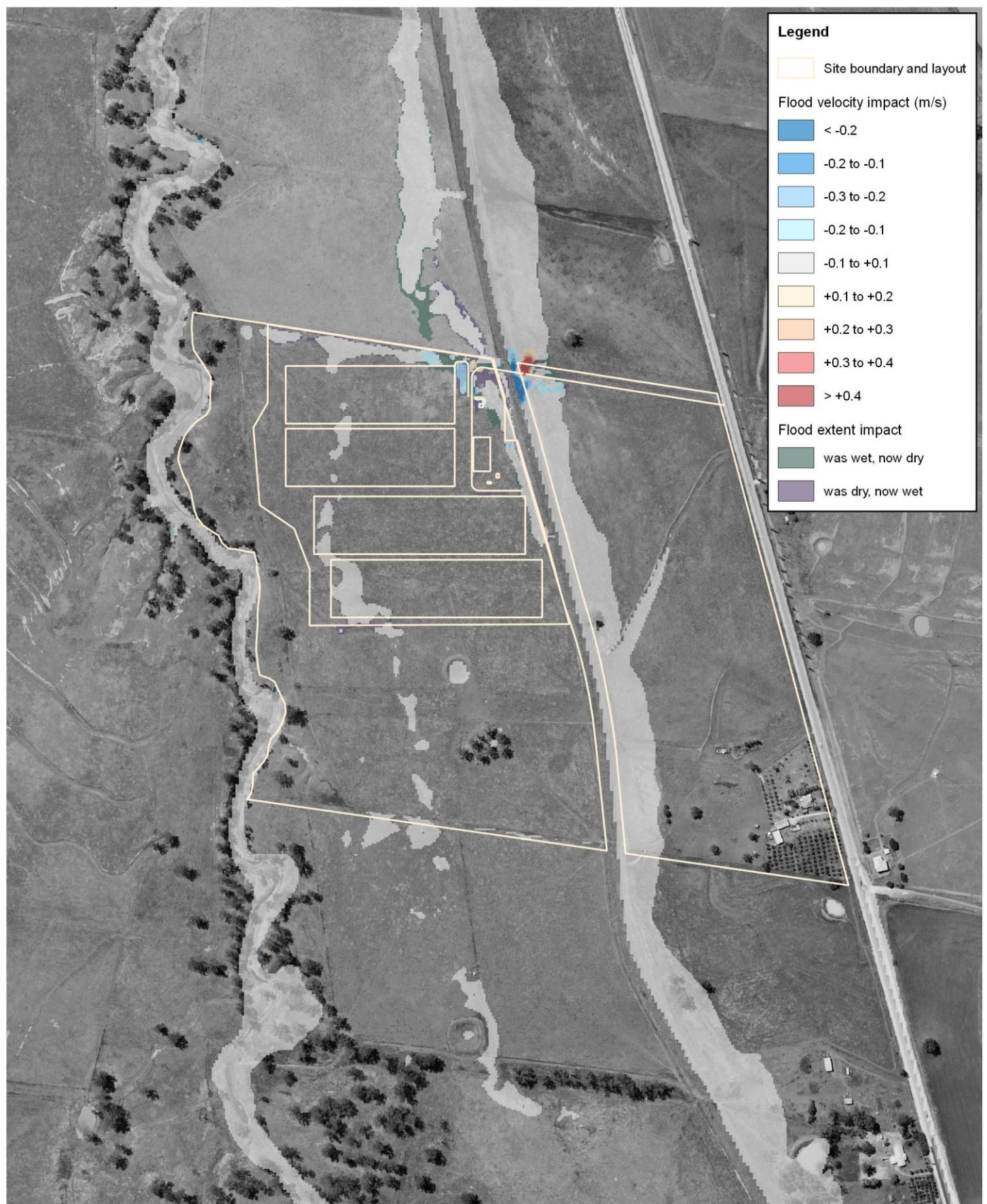
Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.



Appendix D Flood Velocity Impact Mapping



Title:

Modelled 20% AEP Peak Flood Velocity Impact

0 200 400 m



approx. scale

Figure:

D-1

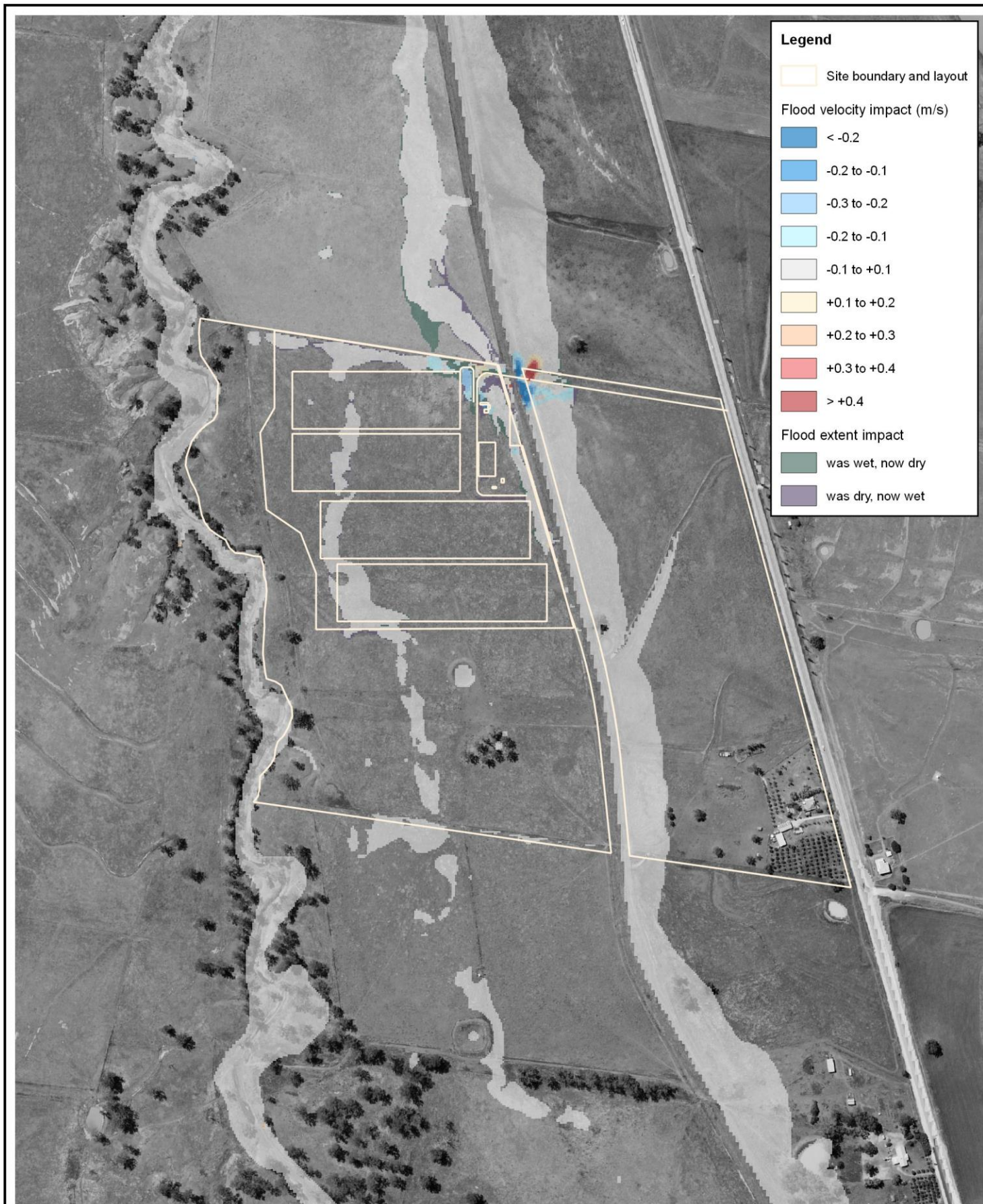
Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \Projects\T2003_Manilla_Rd_FIA\GIS\T2003_028_191205_5y_v_Impact.qgz





Title:

Modelled 10% AEP Peak Flood Velocity Impact

0 200 400 m



approx. scale

Figure:

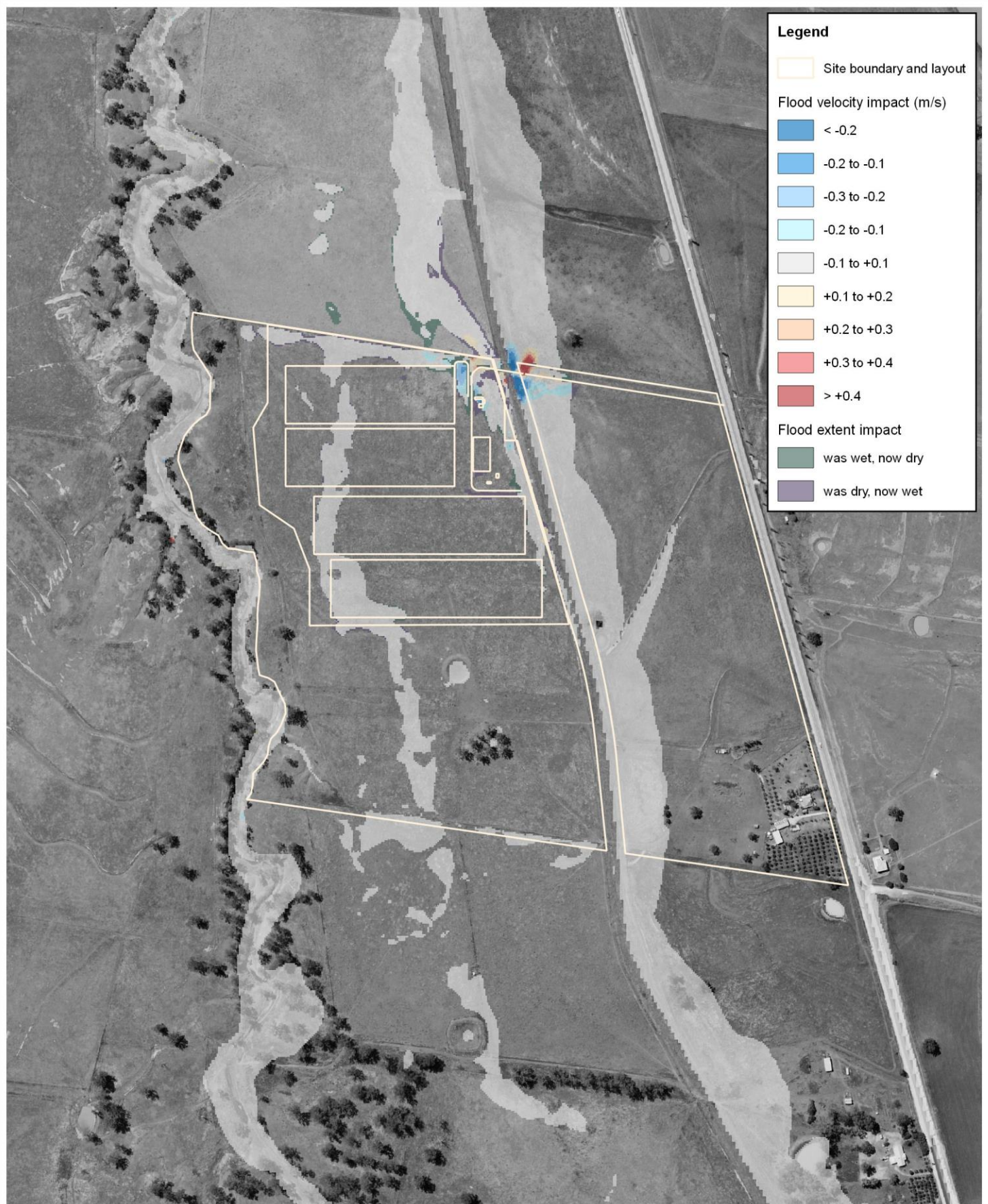
D-2

Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.





Title:

Modelled 5% AEP Peak Flood Velocity Impact

0 200 400 m



approx. scale

Figure:

D-3

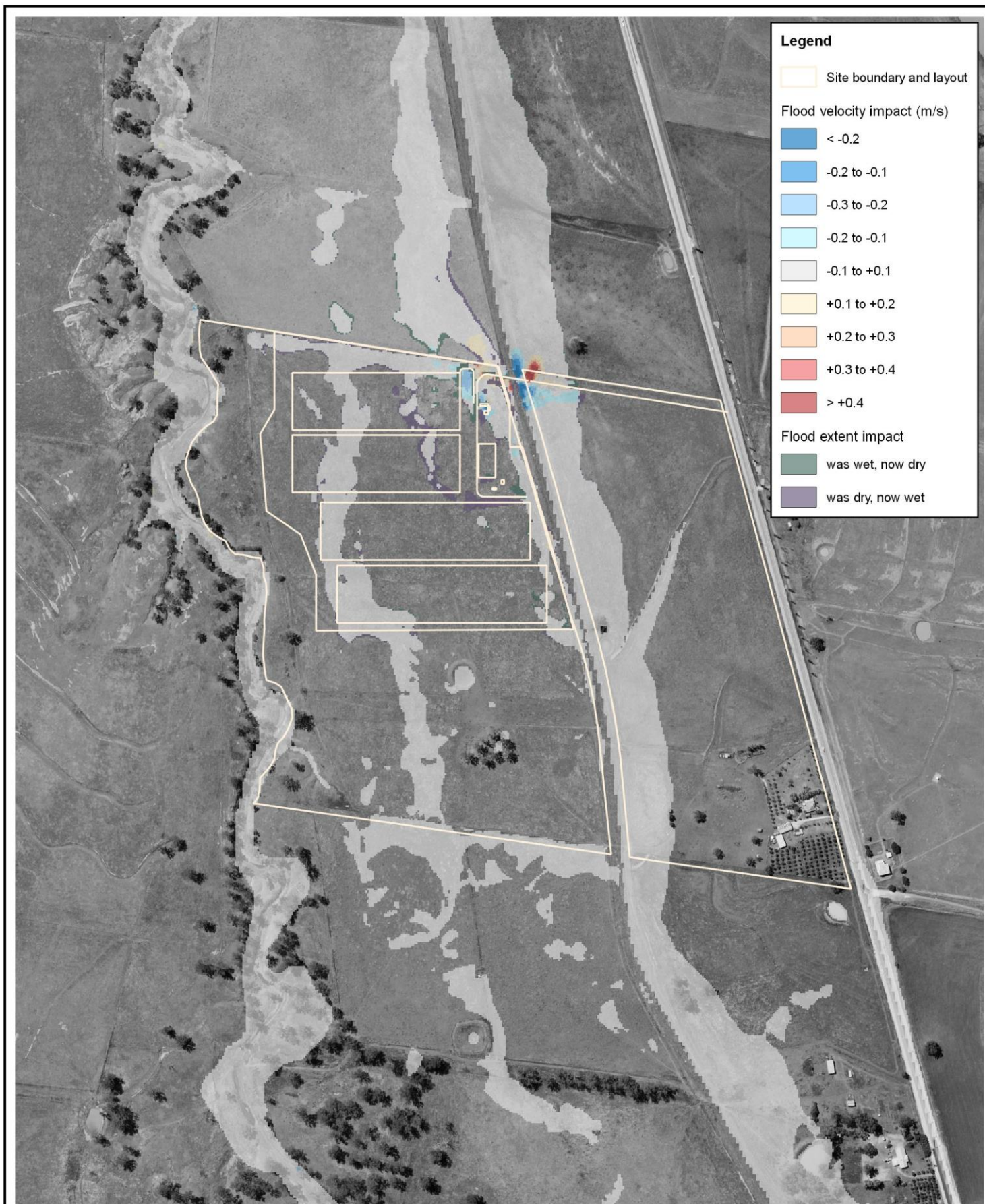
Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \Projects\T2003_Manilla_Rd_FIA\GIS\T2003_030_191205_20y_v_Impact.qgz





Title:

Modelled 2% AEP Peak Flood Velocity Impact

0 200 400 m



approx. scale

Figure:

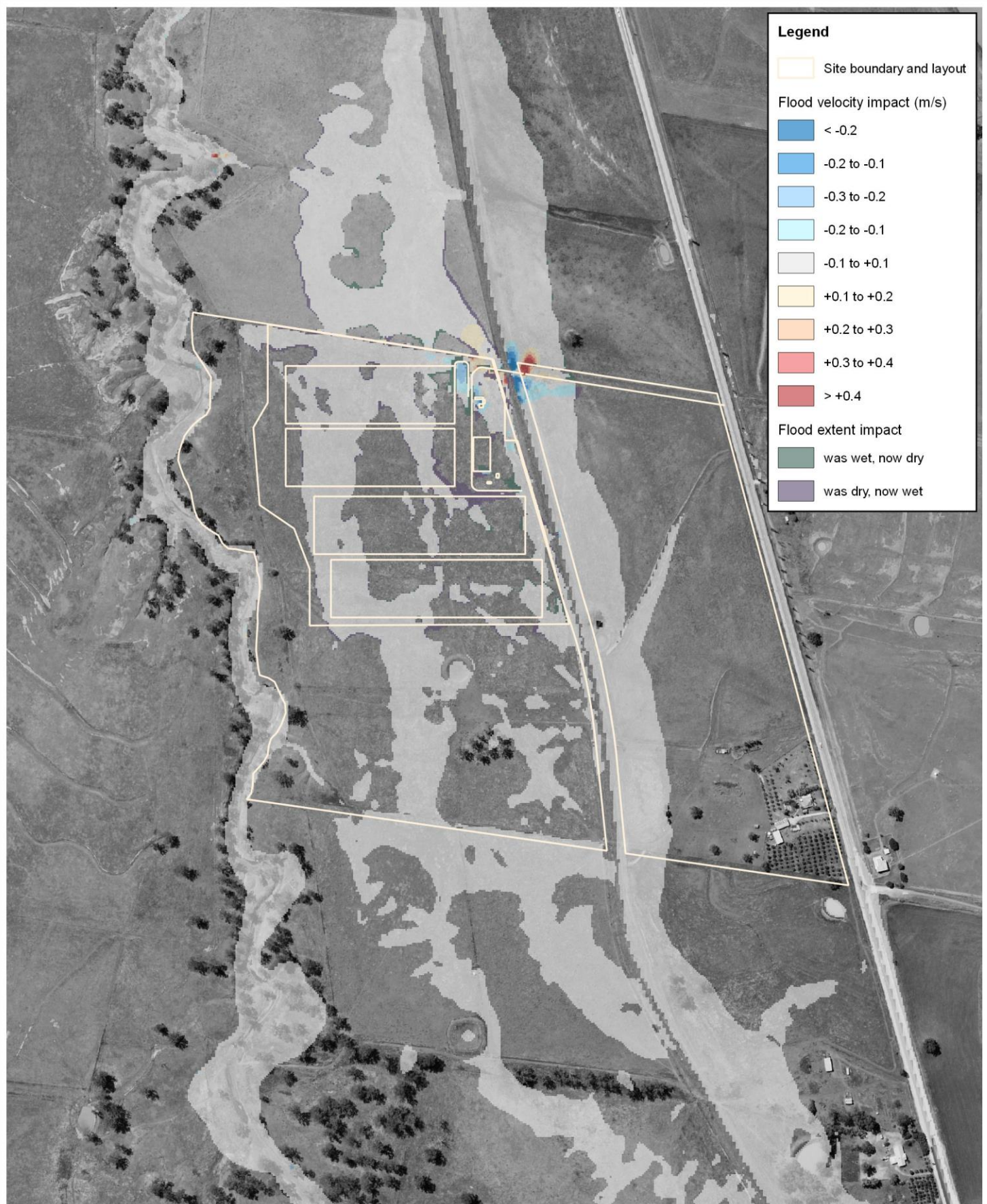
D-4

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision:

A





Title:

Modelled 1% AEP Peak Flood Velocity Impact

0 200 400 m



approx. scale

Figure:

D-5

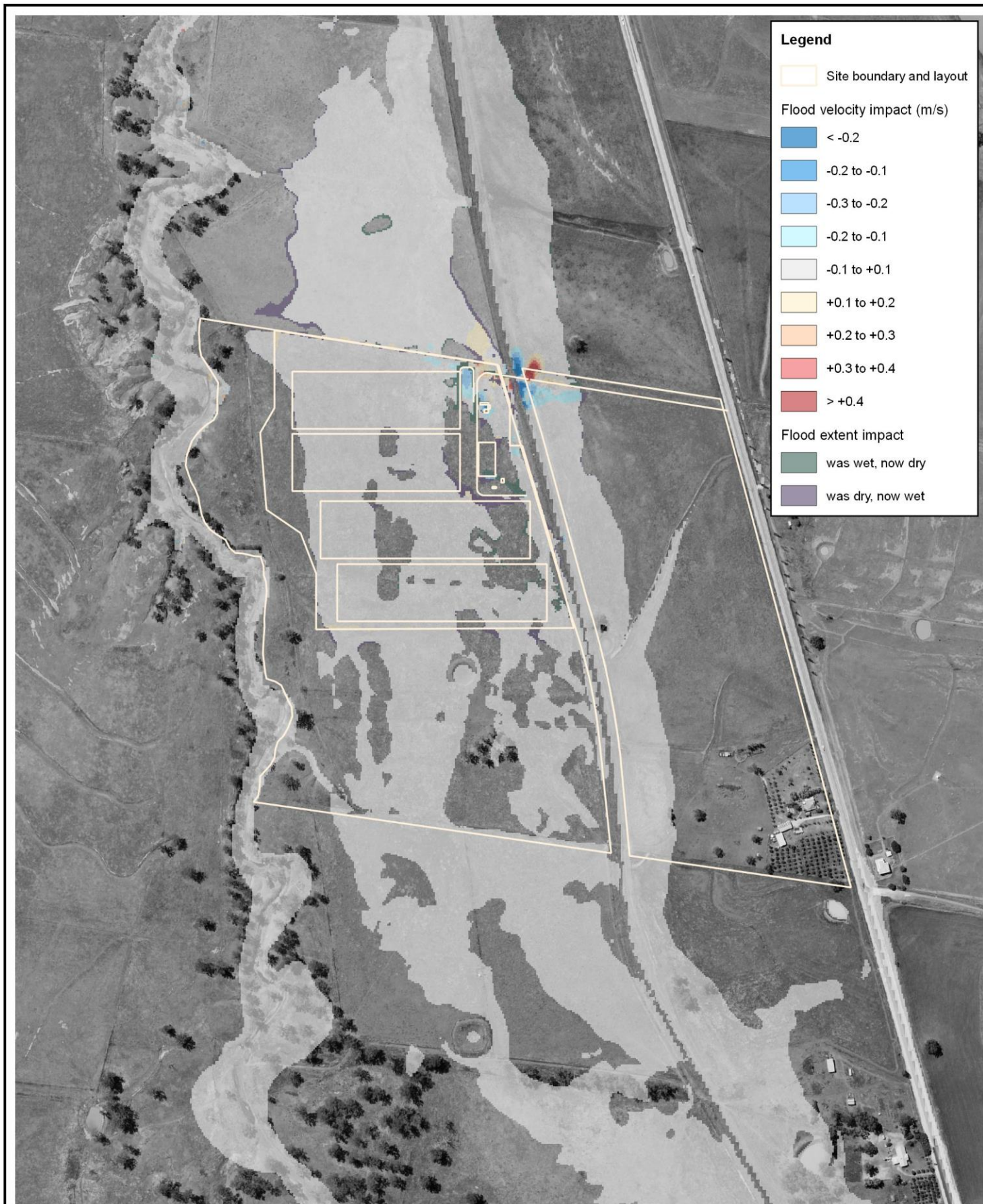
Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \Projects\T2003_Manilla_Rd_FIA\GIS\T2003_032_191205_100y_v_Impact.qgz





Title:
Modelled 0.5% AEP Peak Flood Velocity Impact

0 200 400 m

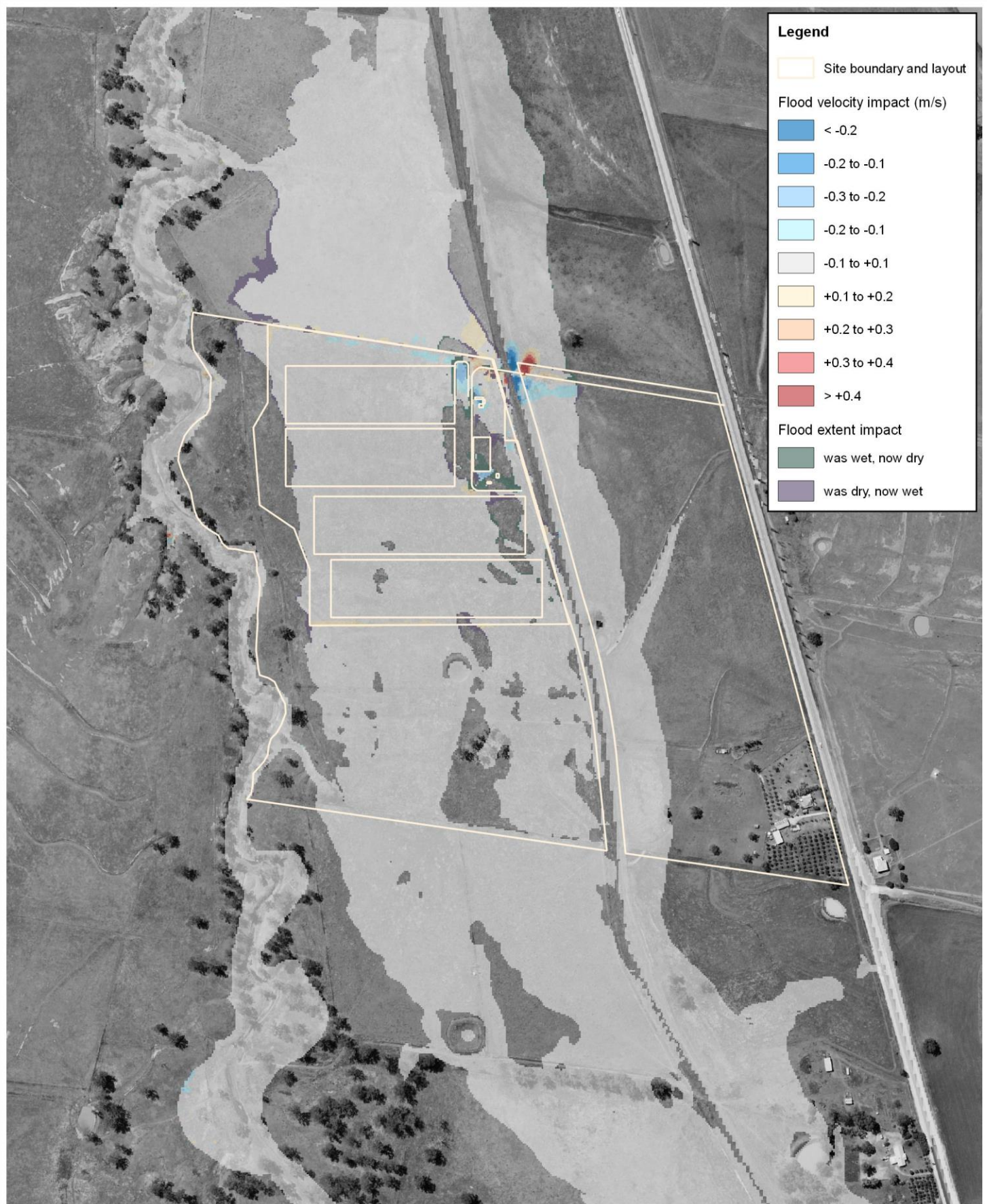
approx. scale

Figure: **D-6** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Revision: **A**

Filepath: \\Projects\\T2003_Manilla_Rd_FIA\\GIS\\T2003_033_191205_200y_v_Impact.qgz





Title:

Modelled 0.2% AEP Peak Flood Velocity Impact

0 200 400 m



approx. scale

Figure:

D-7

Revision:

A

Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

Filepath: \Projects\T2003_Manilla_Rd_FIA\GIS\T2003_034_191205_500y_v_Impact.qgz



A photograph of a rural landscape with dry, yellowish-brown grass in the foreground, scattered trees, and a line of trees in the distance under a hazy sky. A utility pole and wires are visible on the left side.

Social Impact Statement

Manilla Solar Farm

Providence Asset Group

30 March 2020

Project Name	
Location	Manilla, NSW
Project Number	1967
Client	Providence Asset Group
Mara Consulting Document	20200330_1967_Mara_Providence-Manilla SIS_005

Mara Consulting Pty Ltd	
ACN: 168 093 918	Level 1, 161 King Street
ABN: 13 168 093 91	Newcastle NSW 2300
	E: mara@maraconsulting.com.au
	W: maraconsulting.com.au
	P: 02 4965 4317

Revisions	Date of issue	Details	Author	Approved
001	23/03/2020	Draft	AP	
002	24/03/2020	Review	CH	KL
003	26/03/2020	Issued	CH	KL
004	27/03/2020	Review	CH	KL
005	30/03/2020	Final	CH	KL



Mara Consulting
Consultation + Urban Design
Creating vibrant communities through
powerful conversations

Copyright © Mara Consulting

Confidentiality

All information, concepts, strategies and ideas and all other information contained in this document is provided on a commercial in confidence basis, remaining the intellectual property and copyright of Mara Consulting. This document may contain information of a commercially sensitive nature and should not be made available to any individual or organisation outside of Mara Consulting without the written authority of the Managing Director or Communication and Stakeholder Engagement Manager.

Contents

1. Introduction	4
1.1 Overview	4
1.2 Regulatory context	4
2. Existing environment.....	6
2.1 Community and social baseline.....	6
3. Potential positive and negative impacts	10
3.1 Community attitudes to renewable energy	10
3.2 Access to renewable energy	10
3.3 Population.....	11
3.4 Social amenity (noise, dust and visual impacts).....	11
3.5 Personal and property rights.....	12
3.6 Land use management	12
3.7 Traffic impacts	13
3.8 Local economy and employment opportunities.....	13
3.9 Intergenerational equity.....	14
4. Conclusion and Recommendations.....	15
5. References	16

1. Introduction

1.1 Overview

Providence Asset Group (Providence) is seeking development consent from Tamworth Regional Council to develop a solar farm at Lot A DP 442930, 4133 Manilla NSW (the Proposal). The Manilla Community Renewable Energy Inc. has been created to encourage local investment in the proposal.

The proposed site is located on the western side of Manilla Road, Manilla approximately 600 metres north of Melrose Lane and approximately 3.6 kilometres (km) southeast of Manilla within the Tamworth Local Government Area (LGA).

The site currently contains agricultural paddocks and a dwelling that is not within the development area. The development area for the proposal is approximately 20 hectares and currently zoned RU1 – Primary Production pursuant to the Tamworth Regional LEP (2010).

The proposal includes a no larger than 5-MegaWatt (MW) grid-connected solar installation. It is proposed to connect into the existing Essential Energy Manilla Zone Substation located approximately 2km to the north. The network connection configuration remains subject to Essential Energy's connection application process.

A 5 metre(m) wide access road is proposed connecting the solar farm to Manilla Road at the northern most extent of the lot. The solar farm will be fully fenced with a gate for access in the north west corner.

The project would operate 24 hours a day, 7 days a week, with no permanent staff on site.

Mara Consulting has been engaged by KDC Planners to undertake a Social Impact Statement (SIS) for the Proposal. AAP Consulting was a sub-consultant on the project and developed the first draft.

This SIS includes consideration of:

- the social baseline of Manilla State Suburb, as well as the wider Tamworth Regional LGA
- assessment of the likely social impacts of the proposed development based on the scale, intensity and duration of the potential impacts
- proposed mitigation and enhancement strategies of impacts that may have a potentially significant impact on the community.
- conclusions and recommendations that arise from the assessment in relation to the project.

1.2 Regulatory context

The proposed solar farm is defined as 'electricity generating works' which is a permissible form of development in accordance with the State Environmental Planning Policy (Infrastructure) 2007.

The site is zoned RU1 Primary Production under the Tamworth Regional Local Environmental Plan 2010 (LEP 2010).

The proposed development is private infrastructure with a capital investment value (CIV) greater than \$5 million and as a result the development is deemed to be regionally significant development and the application will be referred to the Joint Regional Planning Panel (JRPP) for determination.

2. Existing environment

2.1 Community and social baseline

The project is located within the State Suburb of Manilla (SSC), within the Tamworth Regional Local Government Area (LGA) in the southern area of North West Region of NSW.

Tamworth is a regional city that provides one in three of the region's homes and jobs and a variety of high-level services, including civic, entertainment and cultural venues. These include Tamworth Base Hospital, TAFE NSW and national sporting facilities like the Australian Equine and Livestock Events Centre. The balance of the urban population lives in surrounding smaller settlements including Manilla, Kootingal, Barraba, Nundle and Moonbi.¹

Tamworth's strong agricultural foundations in industries such as poultry, beef cattle and cropping, are well serviced by rail, road and air networks. The manufacturing industry, retail and commercial services, aviation and tourism are also important economic generators. The Tamworth Country Music Festival attracts more than 50,000 festival goers each year.

Manilla is a small town (population 2,550) established in the 1850's. It is located approximately 45 kilometres northwest of Tamworth. It was formerly the centre of Manilla Shire local government area prior to amalgamation in 2004 with Tamworth City Council and portions of Parry, Barraba and Nundle Shire Councils to form Tamworth Regional Council.

According to the Tamworth Regional Council Economic Profile (June 2019), Manilla and District has an estimated population of 3,338 (2019) and is expected to have a gradual growth over the coming years, with a forecasted population of 3,390 in 2021. Population projections indicate that the population of Tamworth Regional is estimated to increase by 7,900 people between 2016 and 2041, from 61,000 to 68,900.

A social baseline of Manilla and the Tamworth LGA was developed to provide context for the assessment of potential impacts on the community as a result of the project. Key demographics are shown in Table 1 and summarised below. The state of NSW has also been shown in the assessment for comparative purposes.

At the 2016 census, there were 1,084 dwellings in the Manilla SSC with the majority occupied (973). The median weekly rent for the suburb is \$225, which is much lower when compared to the NSW median of \$380. At \$1,083 per week, median mortgage repayments in the suburb were also much lower than the state average (\$1,986).

The median weekly household income for the suburb is also lower than the NSW median (\$837 compared to \$1,486) with the majority of homes being owned (either outright or with a mortgage) and only 26.9 per cent being rented.

The unemployment rate in Manilla was higher than the state average (9.5% compared to 6.3%) however the wider Tamworth Region recorded a lower unemployment rate than the state average

¹ <https://www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/New-England-North-West/New-England-North-West-Regional-Plan/Local-Government-Narratives>

(5.8%). The top industries of employment of those residing in the suburb and also the LGA were consistent and included hospitals, education and supermarket and grocery stores.

The most common occupations of residents in Manilla are labourers (15.5%), technicians and trade workers (14.5%) and community and personal service workers (13.9%). This is somewhat consistent with the most common occupations in the Tamworth Regional LGA - professionals (17.5%), technicians and trades workers (14.4%), and labourers (14.1%).

In Manilla and Tamworth Region, the majority of the population was born in Australia (84.3% and 84.6% respectively) and primarily only spoke English at home (89.2% and 88.7%). This shows that the communities residing in the Tamworth Region are not necessarily as culturally and linguistically diverse (CALD) when compared to the state average, where 26.5 per cent of the population speaks a language other than English at home.

At the 2016 census, there were 59,663 people in the Tamworth Regional local government area, of these 48.7 per cent were male and 51.3 per cent were female. Aboriginal and Torres Strait Islander people made up 10.1 per cent of the population, which was greater than three times higher than the NSW average of 2.9 per cent.

There is a large number of working age people in Manilla, with the median age being 47 years old. However, the most prevalent age groups are 60-64 and 65-69 years (both 7.4%), confirming that there are a number of potentially employed persons looking towards retirement age. In Tamworth Region, the median age is 40 years old which is also currently higher than the NSW state average of 38 years

Table 1 Socio-economic overview of Manilla SSC, Tamworth LGA and NSW (ABS 2016)

Statistic	Manilla SSC	Tamworth LGA	NSW
Population	2,550	59,633	7,480,228
Median age (years)	47	40	38
Top three industries of employment (%)	Hospitals (7.7), Combined primary and secondary education (3.7), Supermarket and grocery Stores (3.3)	Hospitals (5.3), Secondary education (3), Supermarket and grocery Stores (2.5)	Health care and social assistance (12.5) Retail trade (9.7) Education and training (8.4)
Largest occupation of employment (%)	Labourers (15.5), Technicians and Trades Workers (14.5), Community and Personal Service Workers (13.9)	Professionals (17.5), Technicians and Trades Workers (14.4), Labourers (14.1)	Professionals (23.6), Clerical and administrative workers (13.8), Managers (13.5)
Unemployed (%)	9.5	5.8	6.3

Statistic	Manilla SSC	Tamworth LGA	NSW
Median weekly household income (\$)	837	753	1,486
Couple family without children (%)	42.1	40.7	36.6
Couple family with children (%)	32.2	38.8	45.7
Tenure – owned (%)	41.8	33.9	32.2
Tenure – mortgage (%)	25.9	31.1	32.3
Tenure – rented (%)	26.9	30.9	31.8
Occupied private dwellings (%)	89.8	89.4	90.1
Travel to work – one method (largest %)	Car, as driver (69.3)	Car, as driver (70.7)	Car, as driver (57.8)
Marital status (married %)	44.1	47.6	48.7
Born overseas (%)	15.7	15.4	34.5
English only spoken at home	89.2	88.7	68.5
Households where a non-English language is spoken (%)	2	4.6	26.5
Aboriginal and Torres Strait Islander (%)	14.1	10.1	2.9
Volunteering (%)	21.4	21.8	18.1

The project area is under the Tamworth Regional LGA and Council planning is guided by the 'The Community Strategies Plan 2017 – 2027'. This is the major strategic document developed to guide the delivery of services and facilities over the next decade and outlines the goals of the elected council. The plan has the following vision:

"A region of opportunity and prosperity, a place to call home"

The Plan identifies five key themes that bring together what the community has asked for and the priorities for the region. These themes include a spirit of community, a prosperous region, an accessible region, a region for the future and a region of progressive leadership and include a strategy to 'encourage efficient use of resources to improve environmental sustainability' (Tamworth Regional Council, 2017).

The New England North West Regional Plan 2036 describes one of the key goals for the region as becoming a strong and dynamic regional economy and identifies growing New England North West as a renewable energy hub. One of the key goals is to deliver:

"A diversified economy through the management of mineral and energy resources, including renewable energy generation" (NSW Government, 2016).

Establishing solar farms in the region aligns with Council's strategic planning and the direction of the New England North West Regional Plan.

3. Potential positive and negative impacts

3.1 Community attitudes to renewable energy

A review of recent media in the Tamworth Region and outcomes of similar Solar Farm Projects (including the Moree Solar Farm that was opened in 2017) depicts that generally, solar energy developments enjoy community support. This is further supported by the outcomes of community research commissioned in 2015 by the former NSW Office of Environment and Heritage regarding attitudes to renewable energy.

The research found that 89 per cent of people support the use of renewable energy in the form of solar farms in NSW and that 78 per cent of respondents supported having a solar farm within 1-2 km of where they lived. Among the reasons for this were benefits to the environment and local economy.

Specific to the North West Region:

- 94 per cent of respondents supported using renewables to generate electricity in NSW
- 81 per cent believed NSW should increase the use of renewables over the next five years
- 95 per cent supported the use of solar farms in NSW, 92 per cent in their local region, and 84 per cent within 1–2 kilometres of where they lived.

The most common perceived advantages of renewables (unprompted) included environmental benefits and lower cost of electricity. The most common perceived disadvantages (unprompted) included higher cost and concerns about efficiency and reliability. In the North West, 74 per cent were prepared to use renewables 'provided I don't have to pay more for my electricity' and 22 per cent were prepared to pay more to support them.

3.2 Access to renewable energy

Electricity consumption in Australia is exceptionally high, resulting in costly electricity bills and frequent disruptions to electricity supply during peak times. The renewable energy sector has responded to this high demand and to the need for viable alternative options for electricity generation contributing to 17 per cent of Australia's overall electricity (Clean Energy Council, 2018).

An analysis of electricity price increases between 2006 and 2016 was undertaken by the Australian National University (ANU). The ANU reported that those states with relatively low levels renewable energy experienced higher electricity prices (NSW, QLD and VIC). States with higher levels of renewable energy, in particular South Australia which generated almost half of its energy from renewables, had a far lower electricity price.

The solar farm's potential to generate 5MW of electricity with the potential to power 2,000 homes during daylight hours and reduce CO2 emissions by about 200,000 tonnes over the 25-year life of the project. Due to the changing nature of government incentive schemes for renewable energy generation, the Manilla solar farm has been developed so it is not reliant on these schemes for profitability.

3.3 Population

Due to the nature of the development, there is not an expected population change associated with the site either temporarily in the construction of the development or permanently once the development is complete.

3.4 Social amenity (noise, dust and visual impacts)

The impact of the project on social amenity, including those related to noise, dust and visual impacts are key issues to consider in relation to both construction and operation of the proposed solar farm.

The potential for noise during construction and operation are primarily key issues for near neighbours with noise affecting their quality and duration of sleep and their way of life. An assessment of noise and associated impacts has been undertaken as part of the development application. The assessment found that construction noise levels have potential to exceed relevant construction noise management levels at three receiver locations and recommends mitigation measures to minimise the potential noise impacts from construction, albeit of a temporary nature during the daytime over a six-month construction period. In regard to operational and road noise, the assessment found that noise criteria would be satisfied.

Given the outcomes of the assessment, the project should implement an effective noise management plan for construction and consult with nearby receivers to minimise the potential impact on nearest receivers. Assuming adequate construction management is implemented, the potential impact for noise on the surrounding community is considered low.

Visual amenity in terms of glare and reflectivity and changes to the visual landscape can be perceived issues of the community in relation to the potential impacts of solar farms. Furthermore, landholders may be potentially concerned about the time it would take for vegetation screens to establish, whether they would be tall enough to screen the panels and whether they would be watered and maintained.

The location of this proposal is located approximately 3.5km south-southeast of Manilla and approximately 250m from the closest residential dwelling. The character of the immediate visual environment is strongly influenced rural type lots which are predominantly cleared of trees resulting in mostly low grassland. Trees are generally clustered around the residence in the south eastern corner of the site. The western boundary of the lot is formed by Greenhatch Creek which flows into the Namoi River. Power transmission lines run along the eastern boundary alongside Manilla Road.

A visual impact and reflective glare assessment for the project have been conducted and assessed the likely visual impacts of the proposal (including any glare, reflectivity and night lighting) on surrounding residences and other potentially impacted stakeholders.

The visual impact assessment found that the in the immediate vicinity of the proposal (<1.5km), the proposal would likely have a high visual impact from the adjacent roads due to the close proximity and the lack of a visual buffer. This visual impact can be mitigated by introducing new trees and screen planting along northern, eastern and southern boundaries. The project has a minimal visual impact from distances greater than 1.5km.

The reflective glare assessment found that the potential for adverse glare from the proposed facility will be negligible. This is primarily due to the selection of the single-axis tracking system for the mounting of the ground-based array panels. The visual impact assessment noted that in terms of glare, given the parameters of reflection and the movement of the solar panels, there are no locations surrounding the site where glint or glare are geometrically possible.

In terms of air quality, the nuisance of dust on stakeholder's way of life and amenity, are primarily experienced during construction. A construction management plan should be developed to mitigate potential impacts

It should be noted that the area is still considered to be drought affected, despite recent rainfall. Given that water is generally a mitigation measure used to control dust, this could result in a negative social impact. The use of water during drought should be minimised and other innovative methods for controlling dust should be considered.

3.5 Personal and property rights

A review of media articles shows that there is a perceived risk in some communities that solar farms could have a negative impact on property values. In Bathurst, NSW, a community is opposing a proposed Solar Farm with one of the identified fears being that the facility will lead to a drop-in land values (Western Advocate, September 2017).

A similar concern is also reflected in the Environmental Impact Statement for the Tamworth Solar Farm (ProjectE, 2020) and the potential impact of the development on the visual amenity and what affect that might have on the property values. Landholders expressed concerns about the time it would take for vegetation screens to establish, whether they would be tall enough to screen the panels and whether they would be watered and maintained. If landholders wanted or needed to sell in the near future, the rate of establishment of the vegetation screens might influence the selling price and the likelihood of sale.

Outcomes of community research commissioned in 2015 by the former NSW Office of Environment and Heritage regarding attitudes to renewable energy identified that Property values identified that a small number of survey respondents raised concerns about decreased land/house values and often mentioned this in conjunction with the visual impact they perceived local wind and solar farms would have ('Could be ugly and decrease land value'; 'Visual impact - impact on property prices arising from that visual impact').

There is insufficient sales data to provide a definitive answer to the question of whether solar farm development in NSW impacts on surrounding land values, however, the size and scale of the proposal lends itself to mitigating potential risks and designing the proposal to prevent, minimize and/or offset adverse environmental impacts and impacts on the community.

3.6 Land use management

Solar farms have the potential to impacts on neighbouring agricultural operations including impacts on grazing livestock and cropping from the spread of weeds from the project site and soil and groundwater contamination.

Provisions have been made within the proposal to allow the site to potentially double up as pastureland for sheep grazing. With the implementation of adequate management plans and ensuring that the trackers are of appropriate height to allow for grazing, it is not considered that the project would not significantly impact the agricultural operations of neighbouring landholders given the relatively low impacts associated with the solar farm.

The land itself is not classified as flood-prone land and is outside the Manilla Flood Study (2017). A flood impact assessment for the proposal has been undertaken. This assessment indicates that the flood impacts of the proposed solar farm development are effectively contained within the site boundary and suggest some mitigation measures to consider scour protection measures for the access road embankment to prevent erosion by overtopping floodwaters and to prevent access to the site following the issuing of a severe weather or flood warning by the Bureau of Meteorology (BoM).

3.7 Traffic impacts

While the project is unlikely to result in any changes to population, due to additional workforce requirements during construction there is the potential for traffic associated with the Project to affect the way of life of near neighbours, local business and community members. These impacts relate to disruption associated with additional traffic movements and the potential changes to accesses.

As part of the proposal, site access will increase from two to three crossovers and there may be a new intersection required at the junction of the site with Manilla Road. A traffic assessment has been carried out and notes that, overall, the proposal will not adversely impact on the efficiency and effectiveness of the local and state road network during construction or operation. As such, the impact on traffic from a social perspective is considered low.

3.8 Local economy and employment opportunities

Construction of the proposal is expected to take up to 6 months and involve a workforce of up to 30 people.

Currently in Manilla, the unemployment rate is significantly higher than the state average (9.5% compared to 6.3%). Manilla was given an affluence score of two out of 10 on the Microburbs rating system due to the number of people earning below \$1000 a week and the low rate of high school graduates (NationMaster, 2019).

The top occupation of employment in the area is labourers (15.5%); therefore, the construction of the development would have the potential to increase employment opportunities of locals for the period of construction only.

It is also plausible that existing businesses proximal to the development experience higher rates of business as a flow on effect during construction. To enhance the positive impact employment opportunities will have on the community, it is recommended that local contractors be used for any construction needs.

Given there would be no permanent staff on site during operations, the potential positive benefit on the economy in terms of employment opportunities is considered negligible. The model put forward by Providence gives the local community the opportunity to invest in the development.

3.9 Intergenerational equity

Consideration of intergenerational equity is an emerging key theme in project development processes. Primarily, concerns relate to environmental impacts, including climate change and the costs to future generations. In the context of the Proposal, notions of Intergenerational Equity can relate to the rehabilitation of land to facilitate future land use, and broader climatic issues regionally and internationally.

In terms of climate change, greenhouse gas and energy the construction and operation of the Manilla Solar Farm proposal would contribute to Australia's efforts to meet its greenhouse gas commitments while continuing to provide a reliable supply of electricity for industry and consumers. Specifically, it would provide the following benefits:

- directly contribute to helping Australia in meeting the Renewable Energy Target
- reduce greenhouse gas emissions required to meet Australia's international climate conditions
- assist in the transition towards cleaner electricity generation.

4. Conclusion and Recommendations

Overall, it is considered that the development:

- is consistent with the regulatory and business development framework, including state government legislation and the Tamworth Regional Council strategic plans (summarised in Section 2)
- will have positive impacts intergenerational equity, with the provision of cleaner energy in the future
- supports Commonwealth and NSW climate change commitments
- will generate enough clean, renewable energy for about 2000 homes
- is an appropriate development in relation to the projected changes to population and demographics in the region
- is unlikely to have significant negative social impacts to the locality and region
- would be a benefit contributing to the overall community sustainability of the Manilla community.

In order to maximise the social benefits anticipated through the development it is recommended that:

- liaison with local industry representatives to maximise the use of local contractors, manufacturing facilities, materials
- establish visual screening early to minimise the visual impact on the solar farm. Visual screening should be done in consultation with closest property holders in accordance with Visual Impact Assessment and Landscaping Plan
- establish good relations with people living in the vicinity of the proposal site at the beginning of the proposal and maintain
- implement a community consultation plan to manage impacts to community stakeholders, including but not limited to:
 - mitigation measures to reduce potential construction impacts
 - protocols to keep the community updated about the progress of the Proposal and proposal benefits
 - protocols to inform relevant stakeholders of potential impacts (haulage, noise, air quality etc.)
 - protocols to respond to any complaints received
 - information on how potential customers can access the renewable energy source
 - a process to monitor the predicted social impacts and amend mitigation and management measures as required*.

* Providence contacted neighbouring properties to inform them of the proposal via a letterbox drop, face-to-face meetings and phone calls. They also held a meeting with Tamworth Regional Council

5. References

- Australian Bureau of Statistics, accessed March 2020 at <https://www.abs.gov.au>
- Clean Energy Council (2019), Australia's Clean Energy Investment Outlook
- Microburbs, accessed March 2020 at <https://www.microburbs.com.au/NSW/Tamworth-Regional-Municipality/Manilla>
- NSW Government (2017), New England North West Regional Plan 2036.
- NSW Government (2015), Attitudes Towards Renewable Energy
- ProjectE (2020), Environmental Impact Statement, Tamworth Solar Farm
- Tamworth Regional Council (2019), Economic Profile
- Tamworth Regional Council (2017), KeyChange 2017-2027, Community Strategic Plan
- Western Advocate (2017), Brewongle Solar Farm: Opposition from residents. Accessed March 2020 at <https://www.westernadvocate.com.au/story/4920308/solar-plant-will-lead-to-property-value-drop-real-estate-agent/>



Page left blank intentionally.



Creating vibrant communities through powerful conversations

Consultation and urban design working together

Level 1, 161 King Street
Newcastle, NSW, 2300

Level 6, 307 Queen Street
Brisbane, QLD, 4000

Phone 02 4965 4317
mara@maraconsulting.com.au
maraconsulting.com.au
ABN 13 168 093 918



Creating vibrant communities through powerful conversations