APPENDIX 4

Updated Flood Impact and Risk Assessment

GUNDARY SOLAR FARM

Flood Impact and Risk Assessment

Umwelt (Australia) Pty Ltd

17 June 2025

2067-02-B6

DETAILS

Report Title	Gundary solar farm, Flood Impact and Risk Assessment
Client	Umwelt (Australia) Pty Ltd

THIS REVISION

Report Number	2067-02-B6
Date	17 June 2025
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Reviewer	DN

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NOTE ON FLOOD FREQUENCY TERMINOLOGY

A design flood is a probabilistic or statistical estimate, being generally based on some form of probability analysis of flood or rainfall data. An Annual Exceedance Probability (AEP) is attributed to the estimate. The frequency of flood events is expressed as an AEP, for example, a flood magnitude having 10% AEP, there is a 10% probability (or 1 in 10 chance) that there would be floods of that magnitude or greater each year. While a related concept Annual Recurrence Interval (ARI) is now outmoded due to the confusion it generates. A flood with a 10 year ARI, refers to floods that equal or of greater magnitude once in ten years on average. For very frequent events, the concept is referred to as Exceedances per Year (EY). The approximate correspondence between terminology, in particular the relationship between AEP and ARI applies to this study (ARR, 2019). The frequency of flood events can be grouped into five broad descriptive categories, as shown below.

Frequency Descriptor	EY	AEP (%)	AEP (1 in x)	ARI
Very Frequent	12			
	6	99.75	1.002	0.17
	4	98.17	1.02	0.25
	3	95.02	1.05	0.33
	2	86.47	1.16	0.5
	1	63.21	1.58	1
Frequent	0.69	50	2	1.44
	0.5	39.35	2.54	2
	0.22	20	5	4.48
	0.2	18.13	5.52	5
	0.11	10	10	9.49
Rare	0.05	5	20	19.5
	0.02	2	50	49.5
	0.01	1	100	99.5
Very Rare	0.005	0.5	200	199.5
	0.002	0.2	500	499.5
	0.001	0.1	1000	999.5
	0.0005	0.05	2000	1999.5
Extreme	0.0002	0.02	5000	4999.5
			↓	
			PMP/ PMP Flood	

Source: Australian Rainfall and Runoff Guidelines (Ball et al, 2019)

In this report, the frequency of flood events is referred to in terms of AEP for floods categorised as very rare, for example 1%, 0.2% or 0.5% AEP. These floods were calculated using the historical climate records. Over recent years, the climate record is showing the influence of non-stationarity. Evidence now exists that the magnitude of floods, i.e. those based on the historical record, are becoming more frequent. It is considered that this will continue as a warming climate will lead to more moisture being held in the atmosphere. For planning purposes, it is prudent to consider a 0.5% AEP based on the historical record as a proxy of the 1% AEP flood event based on future climate depths.

The 1 in 2000 (0.05%) AEP event is considered the limit of credible extrapolation of the historical record. These floods are categorised as extreme, with the limit being the concept of the Probable Maximum Flood (PMF). The PMF occurs as a result of the Probable Maximum Precipitation (PMP) and the PMP is the result of the maximum atmospheric carrying capacity of moisture and the efficiency of the storm mechanism to produce rainfall in a region. A PMF flood is not shown above as it is extreme and beyond the statistical limit. A PMF flood cannot have an AEP assigned to its magnitude as it applies the most conservative assumptions related to temporal patterns, losses and so on. Note also, that the PMF is not the same as the PMP Flood.

Very rare design events, such as floods, are useful for planning purposes as there is a remote chance that they may occur. Extreme floods are considered so far beyond the credible limit of record and contain so much inherent uncertainty that they exist only to provide a theoretical limit.

The approach to estimating an actual (or historic) flood from a particular rainfall event is quite different in concept and is deterministic. All causes and effects are directly related to the specific event under consideration. The actual antecedent conditions prevailing at the time of the rain are directly reflected in the resulting flood and must be allowed for in its estimation. No real information on the probability of the historic flood can be gained from consideration of a single actual flood event.

ABBREVIATIONS AND DEFINITIONS

Term/ Abbreviation	Definition
ABS	Australian Bureau of Statistics
AEP (Annual Exceedance Probability)	Annual Exceedance Probability. The change of a flood of a given or large size occurring in any one year, usually expressed as a percentage. In this study AEP has been used consistently to define the probability of occurrence of flooding.
ADWG	Australian Drinking Water Guidelines.
AHD (mAHD)	Australian Height Datum. A common national surface level datum approximately corresponding to mean sea level.
ARR	Australian Rainfall and Runoff. Guidelines prepared by Engineers Australia for the estimation of design floods. The latest being ARR2019 (Ball et al, 2019)
ASC	Australian Soil Classification (Isbell, R. F.,2021)
BESS	Battery Energy Storage System
BFEMOP	Bush Fire Emergency Management and Operations Plan.
BGL (mBGL)	Below Ground Level. A relative datum used in bore holes to measure depth to groundwater.
BSAL	Biophysical Strategic Agricultural Land
CEMP	Construction Environment Management Plan
CSWMP	Construction Soil and Water Management Plan
DEM	Digital Elevation Model
Development Footprint	This is the disturbance area required for the Project. Quantification of the Project impacts are to be based on the disturbance footprint as a realistic estimate of the disturbance required to construct the Project.
Discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
EIS	Environmental Impact Statement
EP&A Act	*NSW Environmental Planning and Assessment Act* 1979
ESCP	Erosion Sediment Control Plan
EV	Environmental Value
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.

Term/ Abbreviation	Definition
Flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future and continuing risks. They are described below: Existing flood risk: the risk a community is exposed to as a result of its location on the floodplain. Future flood risk: the risk a community may be exposed to as a result of new development on the floodplain. Continuing flood risk: the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.
Flood storage areas	Those parts of the floodplain that are important for the temporary storage of floodwaters during passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.
Floodplain	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is flood prone land.
GDE	Groundwater Dependent Ecosystem.
GHG	Greenhouse Gas
GW	Gigawatts
Hazard	A source of potential harm or situation with a potential to cause loss. In relation to this manual the hazard is flooding which has the potential to cause damage to the community.
Hydrology	The study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
kL	Kilolitre, one thousand litres.
km	Kilometres.
kV	Kilovolt.
LEP	Local Environmental Plan
LGA	Local Government Area
LSC	Land and Soil Capability.
mAHD	Metres Australian Height Datum (AHD).
m/s	Metres per second. Unit used to describe the velocity of floodwaters.
m^3/s	Cubic metres per second or “cumecs”. A unit of measurement of creek or river flows or discharges. It is the rate of flow of water measured in terms of volume per unit time.
ML	Megalitre, one million litres.
MNES	Matters of Nationale Environmental Significance.
MW	Megawatt.

Term/ Abbreviation	Definition
PMF (Probable maximum flood)	The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The probable maximum flood defines the extent of flood prone land, that is, the floodplain.
PMP (Probable maximum precipitation)	The greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends.
Project Area	The Project Area encompasses all land within and including the Project Boundary.
Project Boundary	The outer boundary of the Project Area. The Project Boundary is the maximum spatial extent of the potential land access defined by the boundaries of the host landholder properties (i.e. all agreed lots owned by host landholders)
REZ	Renewable Energy Zone. The equivalent of modern-day power stations, combing new renewable energy infrastructure, including generators (such as solar and wind farms), storage (such as batteries and pumped hydro) and then high-voltage transmission infrastructure
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual, it is the likelihood of consequences arising from the interaction of floods, communities, and the environment.
Runoff	The amount of rainfall which ends up as a streamflow, also known as rainfall excess.
RUSLE	Revised Universal Soil Loss Equation.
Scour	Erosion by mechanical action of water, typically of soil.
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development
SSP (Shared Socioeconomic Pathways)	SSPs are climate change scenarios of projected socioeconomic global changes up to 2100 as defined in the IPCC Sixth Assessment Report on climate change in 2021. In terms of quantitative elements, they provide data accompanying the scenarios on national population, urbanization and GDP (per capita). The five scenarios are: SSP1: Sustainability ("Taking the Green Road") SSP2: "Middle of the Road" SSP3: Regional Rivalry ("A Rocky Road") SSP4: Inequality ("A Road Divided") SSP5: Fossil-fuelled Development ("Taking the Highway").
TUFLOW	TUFLOW is a computer program which is used to simulate free-surface flow for flood and tidal wave propagation. It provides coupled 1D and 2D hydraulic solutions using a powerful and robust computation. The engine has seamless interfacing with GIS and is widely used across Australia.
Umwelt	Umwelt (Australia) Pty Ltd
WM Act	*NSW Water Management Act* 2000
WRIA	Water Resources Impact Assessment
WSP	Water Sharing Plan

1 INTRODUCTION

1.1 OVERVIEW

An Environmental Impact Statement (EIS) for Gundary Solar Farm, including a Flood Impact and Risk Assessment (FIRA, 2024), was submitted to the Department of Planning, Housing and Infrastructure (DPHI), and publicly exhibited in late 2024. During the exhibition period, a total of 174 submissions were made on the Project. This included a submission from NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) Conservation Programs, Heritage and Regulation NSW (CPHR) (the former Biodiversity, Conservation and Science (BCS)) in relation to the FIRA, 2024, which has been addressed in Appendix E of this Amended FIRA. Comment from NSW SES were also received during the Response to Submissions (RTS) phase, which is also addressed in Appendix E.

This amended Flood Impact and Risk Assessment (FIRA) was prepared for the Gundary Solar Farm (the Project). The Project involves the construction, operation and decommissioning of a renewable energy generation facility and associated transmission infrastructure. The Project Area is near Gundary, approximately 10 kilometres south of Goulburn in the Goulburn Mulwaree local government area (refer to Figure 1.1).

The Project Area falls within the Hawkesbury-Nepean catchment and drains into Lake Burragorang (Warragamba Dam) some 120 km downstream. Lake Burragorang is a key water supply for the Sydney drinking water catchment. On a local scale, the Project Area falls within the 107 km^2 Gundary Creek catchment. There are several mapped creeks traversing the Project Area.

As shown in Figure 2.1, Bullamalito Creek and Quialigo Creek converge just outside the south-western boundary of the Project Area to form Gundary Creek, which flows to the Mulwaree River, then to the Wollondilly River and eventually to the Hawkesbury-Nepean Rivers. Both Gundary Creek and Bullamalito Creek flow in a northerly direction through the Project Area.

This report details the methodology and results of a flood impact assessment and risk assessment of the Project, including flood modelling of drainage paths through the Project Area, with and without the Project in place.

1.2 PURPOSE

This amended FIRA is based on a risk management approach and outlines operations for effective management across all four phases of disaster management:

- Prevention – the taking of preventative measures to reduce the likelihood of an event occurring or, if an event occurs, to reduce the severity of the event.
- Preparedness – the taking of preparatory measures to ensure that, if an event occurs, communities, resources and services are able to cope with the effects of the event.
- Response – the taking of appropriate measures to respond to an event, including action taken and measures planned in anticipation of, during and immediately after an event to ensure that its effects are minimised and that persons affected by the event are given immediate relief and support.
- Recovery – the taking of appropriate measures to recover from an event, including action taken to support disaster-affected communities in the reconstruction of infrastructure, the restoration of emotional, social, economic and physical wellbeing, and the restoration of the environment.

The amended FIRA includes a risk assessment based on the following tasks:

- Identification of risk;
- Analysis of risk;

- Evaluation of risk; and
- Identification and evaluation of risk amelioration options.

1.3 PROJECT DETAILS

The Project's conceptual layout is provided in Figure 3.3. The Project will include the construction, operation, maintenance and decommissioning of:

- 400 Megawatt peak (MWp) solar photovoltaic (PV) generation
- A Battery Energy Storage System (BESS) of up to 555 MW and 1570 Megawatt hour (MWh) capacity
- Ancillary infrastructure, an onsite substation and connection to an existing 330 kilovolt (kV) transmission line.

The Project also proposes intersection upgrade works on Windellama Road to improve Project access. The Project is expected to operate for up to 40 years. After its operational life, the Project would either be decommissioned (by removing all infrastructure and returning the site to its existing land capability) or repurposed with new PV equipment subject to technical feasibility and planning consents.

The project's conceptual layout has been designed to maximise solar efficiency while avoiding impacts on areas of high biodiversity value and minimising impacts to surface water resources (including flooding), cultural heritage constraints, and proximal landholders in regard to noise and visibility.

1.4 SITE EVACUATION

Once constructed, the Project will be remotely monitored and controlled from an offsite operations centre 24 hours a day. The main access point is via the existing entrance at 961 Windellama Road, see Figure 1.1. Direct access from Goulburn to the Project will be via Windellama and Bungonia Road. Personnel (up to four) are proposed to attend the site during business hours to undertake scheduled maintenance and inspection activities.

Access from Goulburn requires the crossing of the Mulwaree River and Gundary Creek near the Hume Highway. The *Goulburn Flood Risk Management Study and Plan* (GFRMSP) (GRC, 2022) classifies Bungonia Road, near Forbes Street, as a H5 flood hazard during a 5% AEP Mulwaree River flood event. This demonstrates how access from Goulburn to the Project Area is not feasible during a Mulwaree River flood event. Alternative access to the south along Windellama Road will reach other towns. In addition, the catchment size of the Mulwaree River (760 km^2) allows for more than eight hours (a working day) from the onset of heavy rainfall prior to flood levels rising to their peak. If inclement or severe weather is forecasted, the requirement for on-site operational staff will be rescheduled. GFRMSP does provide flood mapping for the Goulburn Mulwaree Local Government Area (LGA), but it does not extend to the Project Area.

1.5 REPORT STRUCTURE

This report is structured as follows:

- Section 2 provides details of the drainage network and catchment characteristics;
- Section 3 provides details of the Project configuration and flood-related requirements;
- Section 4 outlines the hydrological modelling undertaken to estimate design discharges;
- Section 5 describes the hydraulic modelling development;
- Section 6 presents the modelling results and impacts of the Project;
- Section 7 summarises the key risks to be managed;
- Section 8 contains the summary of findings;
- Section 9 is a list of references;
- Section 10 is a list of abbreviations and definitions;
- Appendix A contains flood maps for existing conditions.
- Appendix B contains flood maps for developed conditions.
- Appendix C contains flood maps showing the impacts of the Project.
- Appendix D contains the SEARs agency advice table.

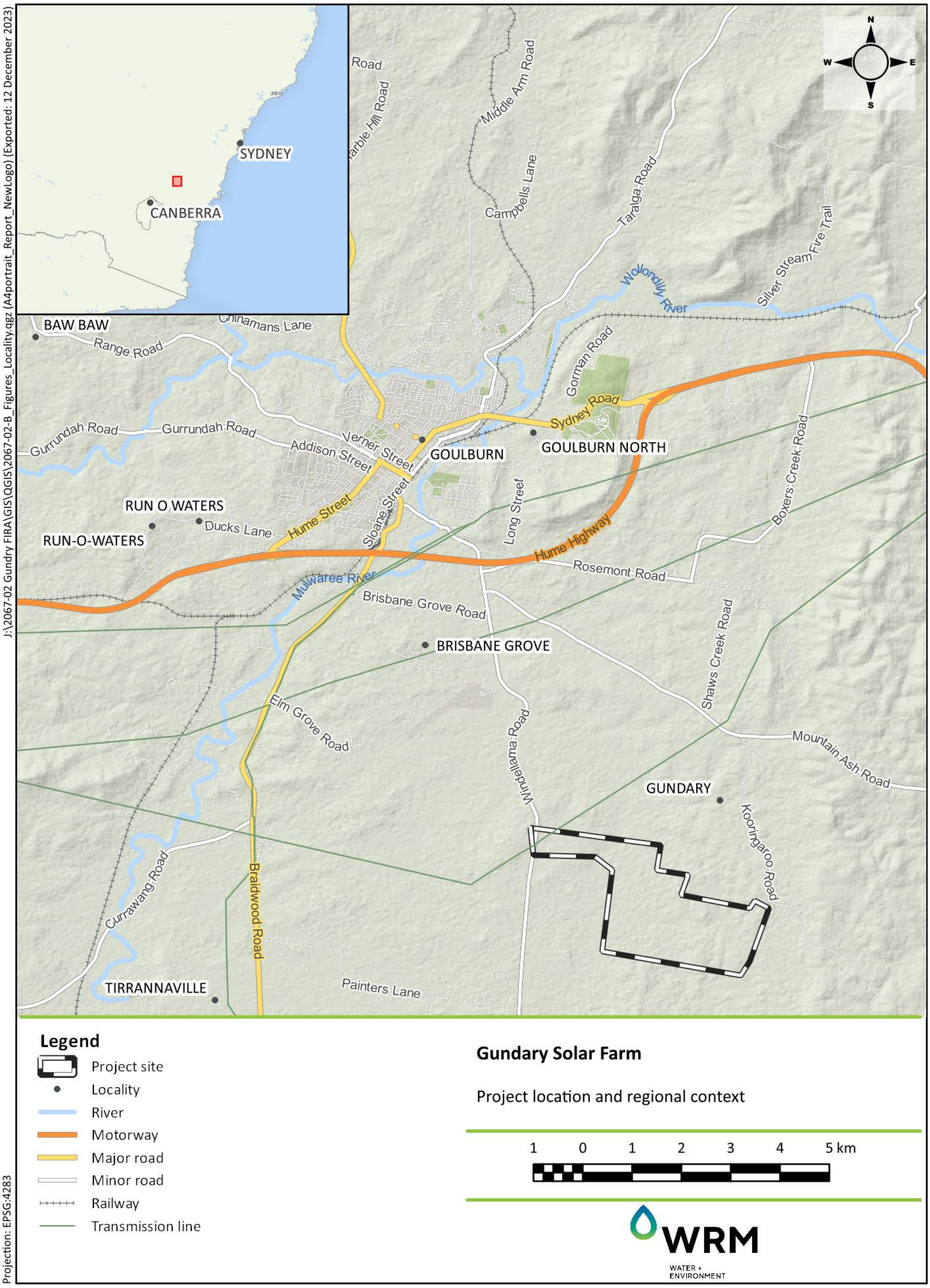

Figure 1.1 Location map

2 CATCHMENT AND DRAINAGE NETWORK

2.1 CATCHMENT AND STUDY AREA

The Project Area is located within the Gundary Creek catchment within the Hawkesbury-Nepean catchment and is within the Sydney drinking water catchment. Elevations within the Project Area range between 710 mAHD from the ranges along the eastern boundary, to approximately 645 mAHD on the Gundary Creek floodplain. Gundary Creek (perennial), Bullamalito Creek (perennial) and an unnamed 4th order tributary of Bullamalito Creek (non-perennial) drain from east to west across the southern portion of the Project Area.

Gundary Creek is formed at the confluence of the Quialigo Creek (perennial) and Bullamalito Creek, immediately to the west of the Project Area, and drains in a northerly direction through the northern portion of the Project Area. Gundary Creek flows into the Mulwaree River approximately 10 km north-northwest of the Project Area at the southern end of Goulburn. The regional drainage network in the vicinity of the Project is shown in Figure 2.1. The local drainage and topography of the Project Area based on the latest high resolution LiDAR is shown in Figure 2.2.

2.2 REGIONAL FLOOD HISTORY

Flooding at Goulburn due to the Wollondilly and Mulwaree Rivers is an infrequent occurrence. No long-term gauge is available in the region on either river. However, historic newspaper articles indicate that major flood events, known to have caused flooding of properties at Goulburn, occurred in April 1870, July 1900, June 1925, June 1950, October 1959, November 1961 and August 1974. More recently, significant flooding in Goulburn has occurred in August 1990, December 2010, March 2012 and June 2012.

Flooding within the Project Area is not recorded and no anecdotal information, such as surveyed flood debris marks on landmarks such as fencing, were available for this study. Gundary Creek, which drains in the Project Area, is a tributary of the Mulwaree River. Ground levels in the Project Area are about 15 m above the bank level of the Mulwaree River, at the Gundary Creek confluence and therefore, the Project Area would not be impacted by river flooding.

2.3 AVAILABLE INFORMATION

Flood studies have been undertaken for the Goulburn Local Government Area (LGA) in Wollondilly and Mulwaree Rivers (WMA 2016, GRC 2022), as shown in Table 2.1. However, the extent of the existing flood mapping for these studies only extends to a location about 8 km downstream of the Project Area.

Table 2.1 Available flood studies

GRC Hydro, 2022	Goulburn Floodplain Risk Management Study and Plan
WMAwater, 2016	Wollondilly and Mulwaree Rivers Flood Study Final Report

2.3.1 Topographic data

LiDAR topographic data for the Project Area was obtained from the ELVIS spatial data service (https://elevation.fsdf.org.au/). The data was available in GeoTIFF grid format with a resolution of two metres. This data was used for catchment delineation and catchment slope calculations.

2.3.2 Rainfall and stream flow data

There are no streamflow gauges or rainfall stations within the Project Area. As such, there is no streamflow gauge data to enable model calibration.

2.3.3 Relevant guidelines

This report was prepared as part of the broader Water Resources Impact Assessment (WRIA) completed by Umwelt. Both documents should be read in conjunction as they were prepared following the Secretary's Environmental Assessment Requirements (SEARs) (issued on 10 November 2022) issued by the then Department of Planning and Environment (DPE) (now the Department of Planning, Housing and Infrastructure (DPHI)) in respect to flood risk. In particular, the SEARs require:

assessing the impacts of the development, including any changes to flood risk and overland flows on-site or off-site, and detail design solutions and operational procedures to mitigate flood risk where required.

The SEARS agency advice, and where in this report it has been addressed, is included in Appendix D.

This Flood Impact and Risk Assessment was undertaken in accordance with the associated technical guides listed in Table 2.2.

Table 2.2 Guidelines and References utilised as part of scope of works

NSW, 2023	Flood risk management guideline LU01[1]
NSW, 2022	State significant infrastructure guidelines
NSW, 2022	Large scale Solar Energy Guideline
NSW, 2023	Flood Risk Management Manual

[1] https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Water/Floodplains/flood-risk-management-impact-risk-assessment-230234.pdf

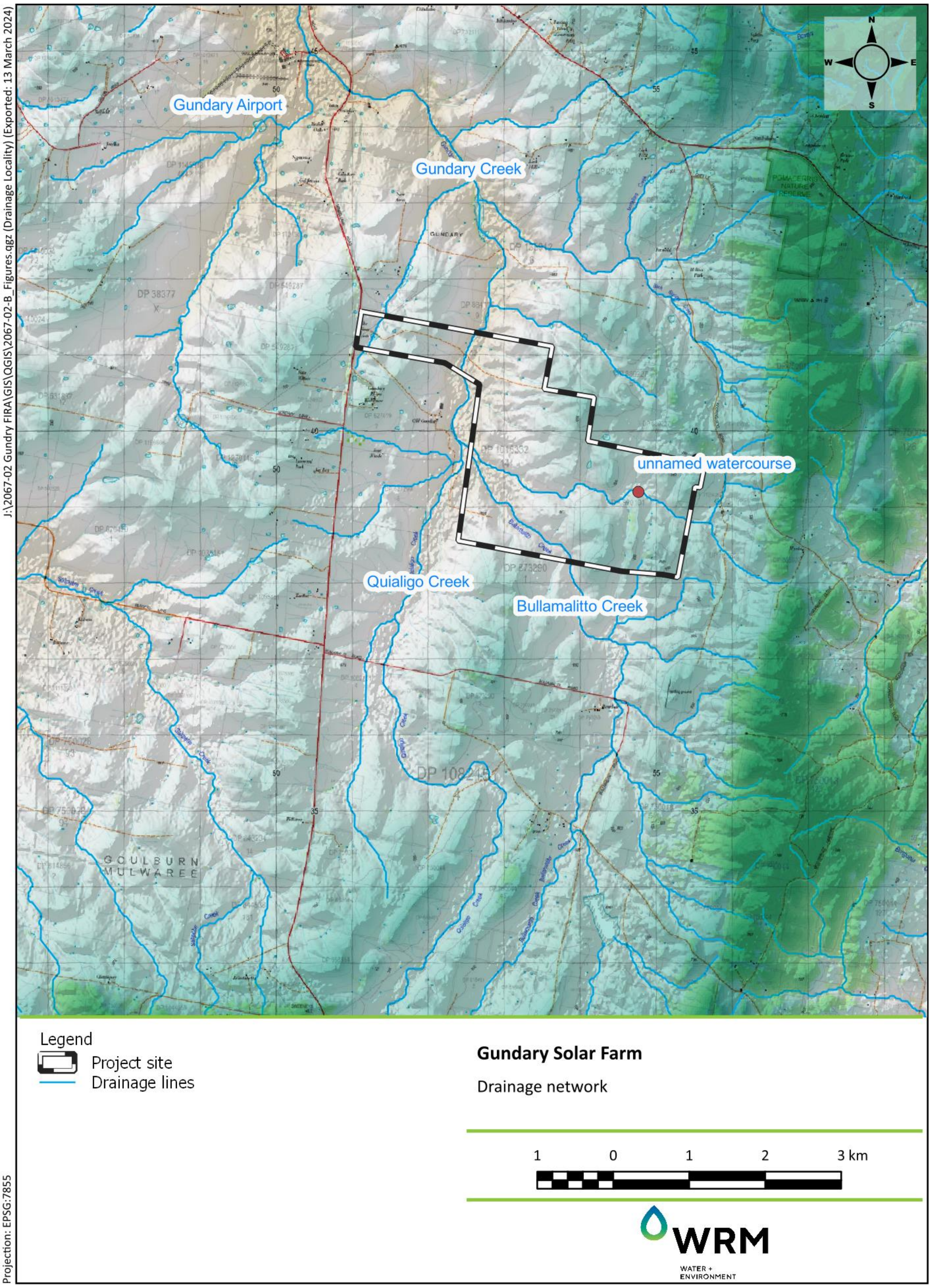

Figure 2.1 Regional Drainage network

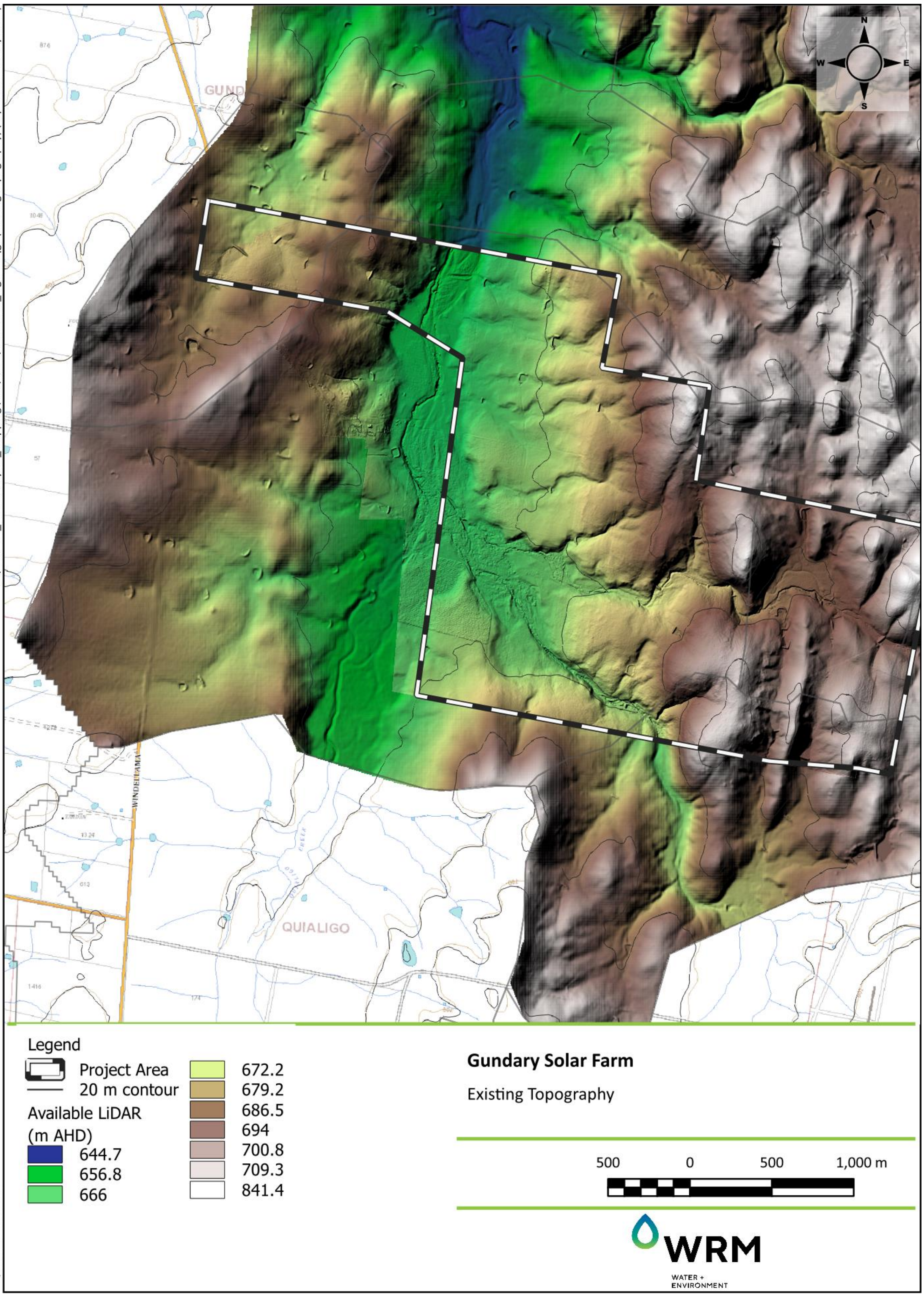

Figure 2.2 Topography and drainage

3 PROJECT CONFIGURATION

3.1 OVERVIEW

Section 3 presents the site configuration and highlights key aspects of the Project. The following briefly explains these aspects as they relate to flooding. The elevation of the lowest edge on the solar panel arrays was designed to provide 500 mm of freeboard to the peak modelled 1% AEP flood event. The elevation of the hardstands for the substations was to provide at least the 0.5% AEP flood event level. The electrical infrastructure will be set on levelling plinths.

Figure 3.3 presents a preliminary general arrangement of the Project as it was proposed in May 2024. Since that time, further refinement and the ultimate configuration of that particular concept design's layout are expected to have matured, subject to other technical constraints beyond the scope of this report. The modelling presented within this document is based on the preliminary concept layout to develop an understanding of flood behaviour within the Project Area.

3.2 PROJECT COMPONENTS

3.2.1 Substation / switching station

A site substation and switch yard will be located at the northwestern corner of the Project Area. A switching station is proposed to be located adjacent to the substation. A typical arrangement is shown as Figure 3.1. This will be located as close as possible to the existing high-voltage transmission line at the site access from Windellema Road. Figure 3.4 presents a plan view arrangement of the typical substation arrangement.

The substation will feature a busbar, circuit breakers, current transformers, voltage transformers, switchgear/electrical protection, and a step-up transformer. The substation will be surrounded by security fencing to restrict access.

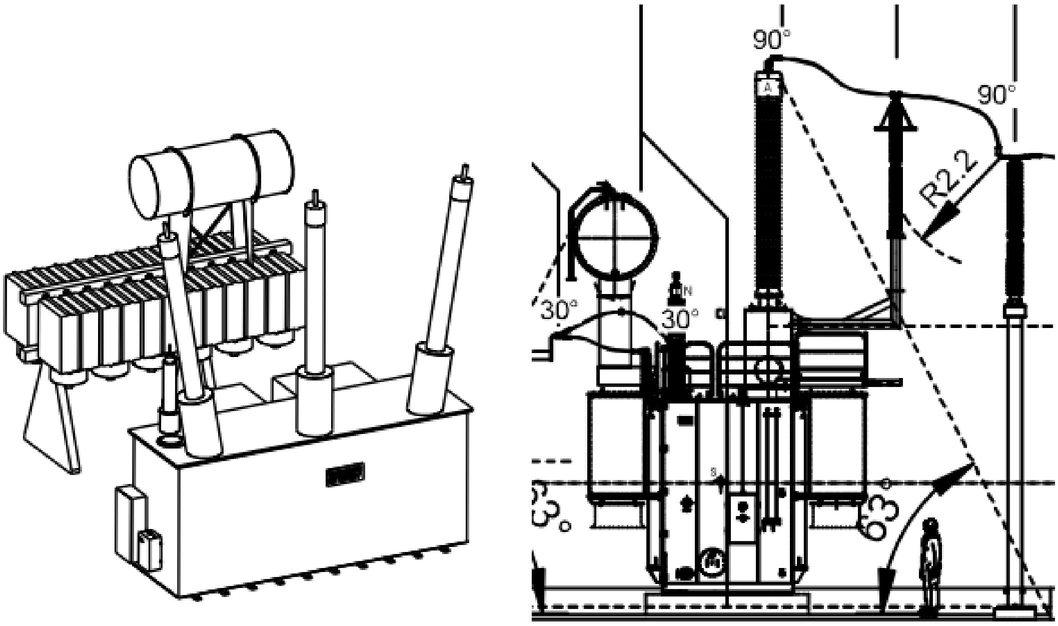

Figure 3.1 Switching and Substation typical arrangement

3.2.2 Access and internal tracks

The Project's primary access point would be via the existing driveway at 961 Windellama Road. Intersection works are proposed to upgrade the primary access to accommodate heavy vehicles. There would be an emergency access point on the eastern side of the Project Area via the existing access at 400 Kooringaroo Road. This access would only be used for emergencies.

Approximately 20 km of internal all weather access tracks would be constructed within the Project's development footprint to provide access to the various areas of the site for construction as well as on-going operations and maintenance.

The tracks, comprising of compacted gravel, would be approximately 4 m wide with a main access track of 6 m wide to the substation/switchyard to allow for the safe delivery, unloading and installation of key components.

The access tracks will enable access throughout the site during construction and operational life of the project. The access tracks would be designed and constructed to ensure that it is capable of accommodating construction vehicles and fully loaded firefighting appliances.

During the construction phase, there would be a requirement to construct watercourse crossings (in the form of culverts and bed level crossings) to allow for access across creek lines within the Project Area. In particular, the watercourse crossings over Gundary Creek and Bullamalito Creek would involve installing culverts designed to accommodate heavy vehicles, including 19 m semi-trailer vehicles and various farm machinery.

3.2.3 Ancillary facility and construction compound

Ancillary facilities will include:

- Temporary material laydown areas;
- Temporary construction site offices;
- Vehicle parking areas for construction workers' transportation;
- Staff amenities including chemical sanitary modules, water tank, administrative office, undercover storage area, emergency muster point and Parking for staff and visitors.

3.2.4 Security fencing

The perimeter of the site is to be fenced with an approximately 2.3 metre-high security fence around the Project infrastructure, subject to final design. Double gates are to be installed at the primary access point to the site.

A security barrier will be constructed along the perimeter of the project infrastructure. For locations where the security fence will traverse a waterway, a flood permeable configuration will be utilised to ensure low afflux. The selection of security fencing arrangement reduces the likelihood that debris will be captured. The minimisation of trapped debris is a mitigation of the risk that debris loading resulting in afflux. The proposed design is called a latched tubes waterway crossing and an indicative configuration is shown in Figure 3.2.

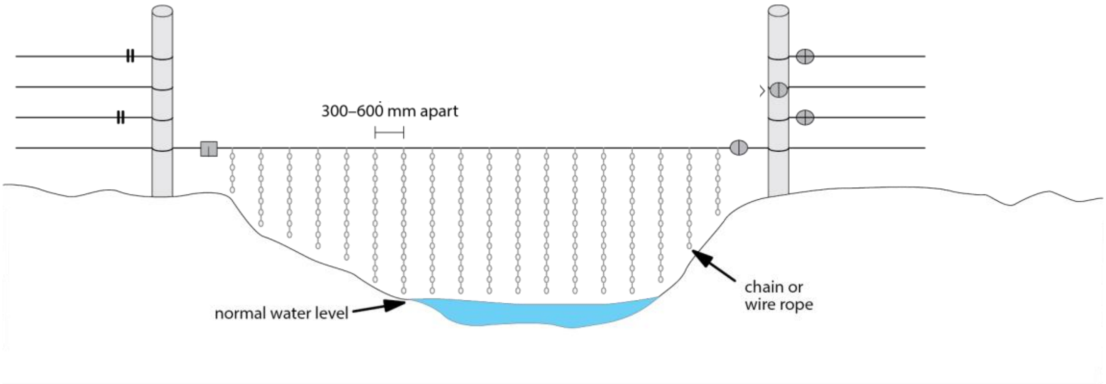

Figure 3.2 Latched tubes waterway crossing – indicative

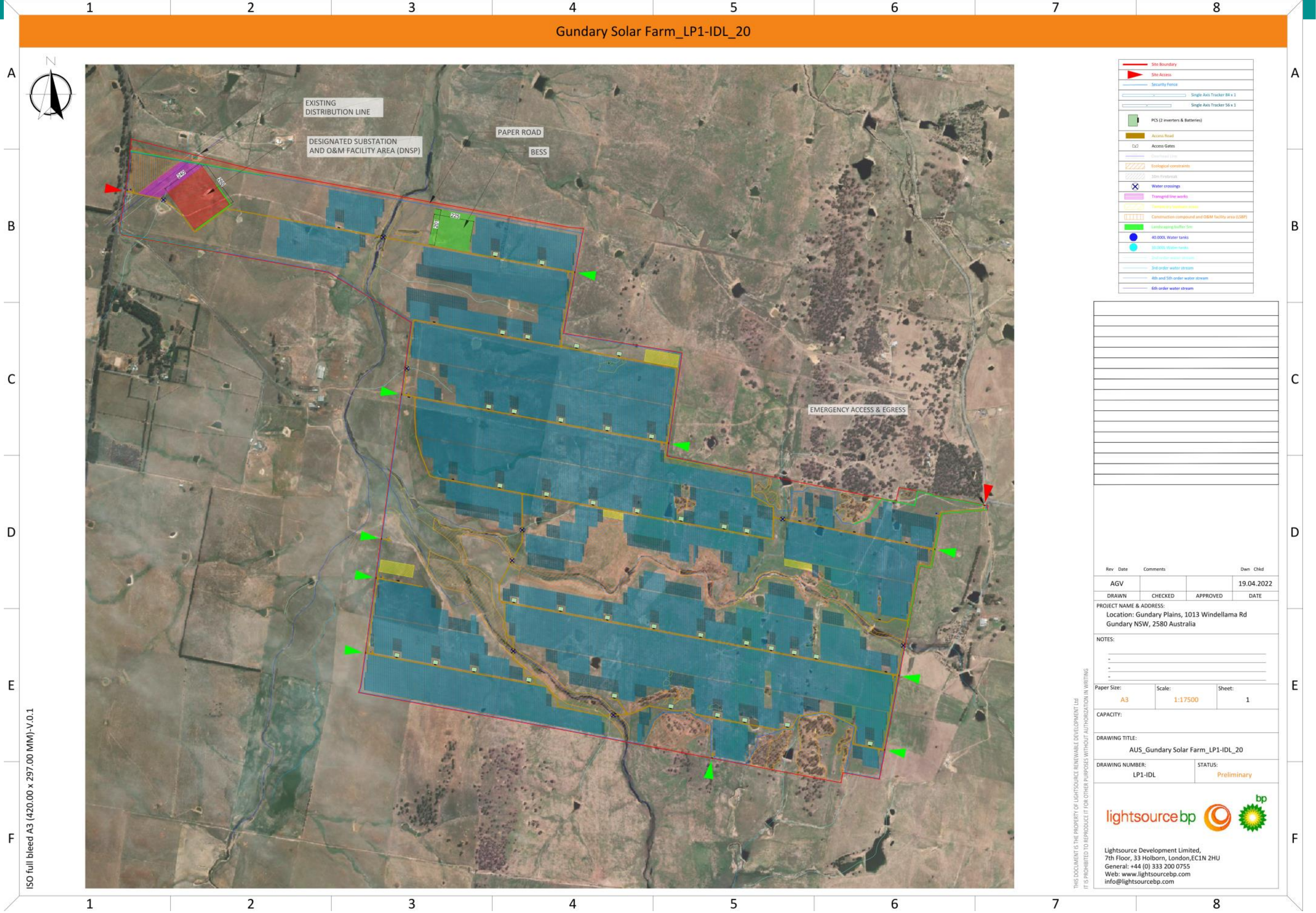

Figure 3.3 Proposed Project Layout

Source: AUS_Gundary_LP1-IDL_20.pdf 20 May 2024

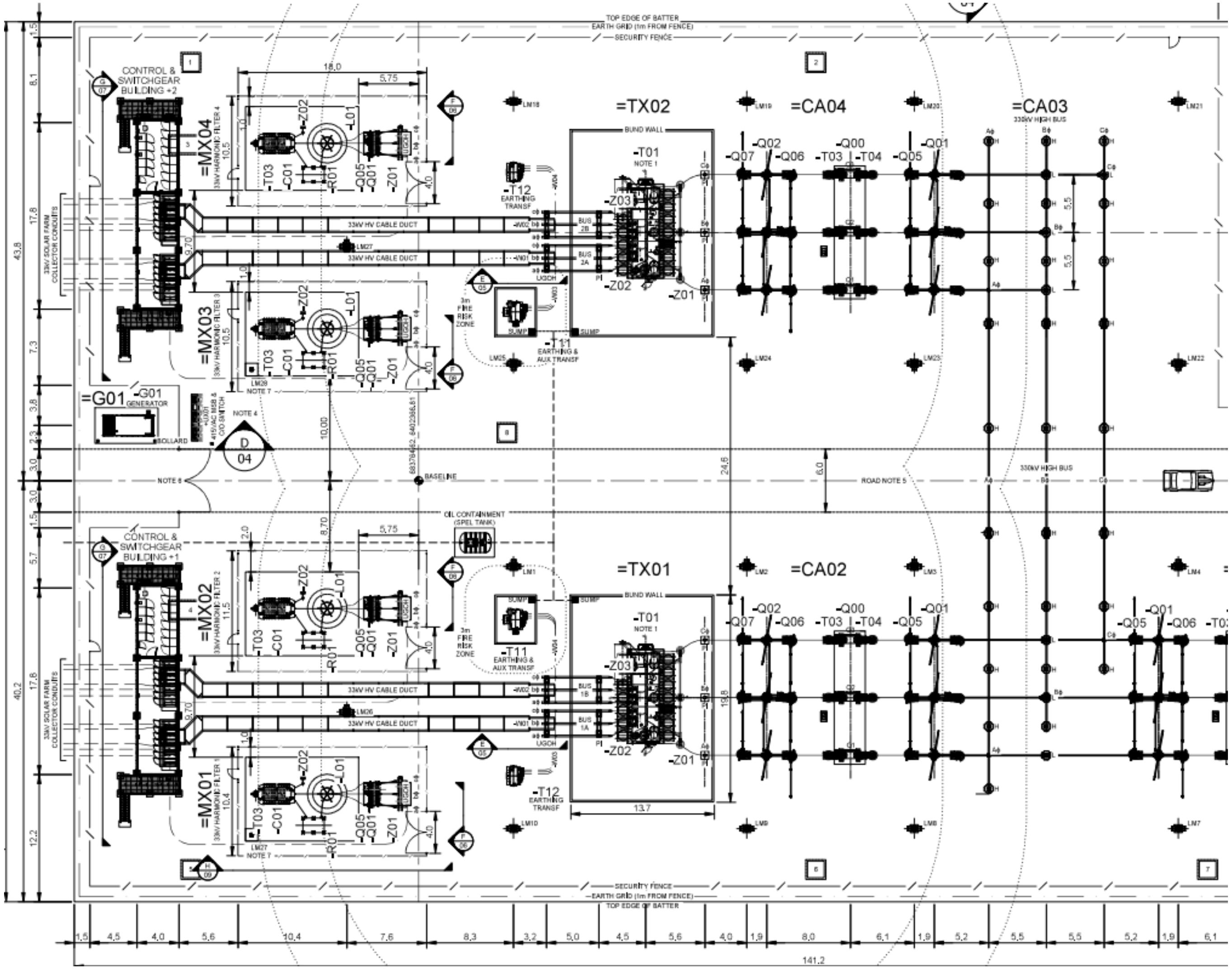

Figure 3.4 Typical arrangement plan view of substation and switch yard

3.3 SITE OPERATION AND PERSONNEL

The Project will be remotely monitored and controlled from an offsite operations centre 24 hours a day. Up to four personnel are proposed to attend the site during business hours to undertake scheduled maintenance and inspection activities. The operations centre and site personnel are not necessarily based in Goulburn, and may also be travelling from the south to reach the site. To undertake site-based work, personnel will access the existing entrance at 961 Windellama Road. Direct access, if travelling from Goulburn to the site, is via Windellama and Bungonia Road.

3.4 SITE ACCESS AND EVACUATION ROUTE

The nearest high ground is located east and south of the Project Area. Access to Windellama Road is available from the west of the Project Area. Windellama Road reaches Goulburn, but it is subject to flooding of Bungonia Road by the Mulwaree River at a location immediately to the south of Goulburn. Once flooded by the Mulwaree River, Bungonia Road may be submerged for 24-36 hours (GRC, 2022).

Evacuation to the south along the rising elevations of Windellama Road remains free from sources of flooding. To the east is Mountain Ash Road, which connects to the township of Gundary and Bungonia. Historically, flooding within the Gundary Creek at the Project Area and closure of the Bungonia Road by the Mulwaree River are not coincidental. Access from the Project Area to Goulburn remained open during previous Gundary Creek flood events.

Due to the long duration of submergence at Bungonia Road, access from the Project Area to Goulburn will require evacuation, commencing in response to floods forecast within the Mulwaree River. This is discussed further in Section 3.5 below.

3.5 EVACUATION TIMELINE

In accordance with floodplain best management practice (Handbook 7, Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia, Australian Institute for Disaster Resilience, 2017), evacuation from the Project Area would be the principal means of managing flood risk in the event of Mulwaree River flooding. The Guide (Section 9.2.2) notes that shelter-in-place solutions should be a last resort option, and states:

Experience has shown that it is poor emergency management practice, particularly in urban areas, to leave people isolated in houses surrounded by floodwaters.

This is primarily because of the potential loss of power supply during a major flood event. In this case, sufficient time is expected to organise and carry out self-evacuation for all staff and visitors prior to Bungonia Road evacuation routes becoming non-trafficable during later stages of a large flood event in the Mulwaree River.

The New South Wales (NSW) State Emergency Service (SES) Traffic Evacuation Model estimates the time required to safely evacuate a site. The time required is comprised of four components.

- Warning Acceptance Factor: the time it takes for residents to act following the instruction to evacuate. The NSW SES recommends a value of one hour.
- Warning Lag Factor: the time residents take to prepare to evacuate. The NSW SES recommends a value of one hour.
- Travel Time: the time taken for all vehicles to evacuate and pass a point given the capacity of the road. It would, therefore, take less than one hour for all vehicles to evacuate.
- Traffic Safety Factor: time to allow for possible delays, such as accidents or breakdowns, fallen trees or power lines or water across the road. For a travel time of up to 3 hours, the NSW SES recommends a value of one hour.

Therefore, the total time required to completely evacuate the Project Area to Goulburn following the instruction to leave is estimated to be between two and four hours.

3.5.1 Mulwaree River warning time

The possibility of major flooding in the Mulwaree River at Goulburn is typically known in advance of the flooding actually occurring (GRC, 2022). In addition, the Bureau of Meteorology (BoM) Flood Warning Service will issue forecasts of peak flood levels in the Mulwaree River. Once rainfall bursts occur, the travel time for the Mulwaree Flood event to Goulburn is between six and nine hours (GRC, 2022). The warning time available is greater than the time required to evacuate.

4 ESTIMATION OF DESIGN DISCHARGES

4.1 METHODOLOGY

Design flood discharges and flood levels in watercourses draining the Project Area were estimated using a RORB hydrologic model (detailed below) and a TUFLOW hydraulic model (detailed in Section 5). The hydrologic model was used to estimate discharges from the contributing catchments outside the Project Area. Discharges within the Project Area were estimated by applying rainfall directly to the topographic surface in the hydraulic model.

The hydrological model was developed using the RORBwin v6.45 (RORB) software. RORB simulates the catchment rainfall-runoff process in the contributing catchments, producing the design discharges used for inflows to the hydraulic model.

Design discharges were determined using the ensemble methodology defined in Australian Rainfall & Runoff (ARR) (Ball et al., 2019). An ensemble of 10 temporal patterns is modelled for each storm duration to derive a range of estimated peak discharges for storms of different severity, represented by an annual exceedance probability (AEP). The storm duration with the highest median peak discharge of the ensemble is selected and the temporal pattern that produces the peak discharge just above the ensemble median is used for design event modelling.

The design discharges were used to select the storm duration producing the maximum discharge (referred to as the critical duration) for each AEP at the downstream boundary of the Project Area on Gundary Creek. The representative event was then used to inform the direct rainfall applied within the hydraulic model domain.

Design discharges were determined for the 10%, 5%, 1% (1 in 100), 0.5% (1 in 200) and 0.2% (1 in 500) AEPs and the Probable Maximum Flood (PMF) for current climatic conditions. Design rainfall intensities were derived in accordance with ARR. In the absence of site-specific calibration data, the RORB predicted flood discharges were validated using the Regional Flood Frequency Estimation (RFFE) model[2] .

4.2 HYDROLOGIC MODEL DEVELOPMENT

4.2.1 Subcatchment configuration

Figure 4.1 shows the hydrologic model's configuration. The model consists of 16 sub-catchments. The subcatchment parameters are presented in Table 4.1. The model covers a catchment area of approximately 107 km^2, primarily covered by light vegetation. Topographical maps at 1:100,000 scale and Hydro-enforced SRTM data at approximately 30 m grid resolution were used to delineate the sub-catchments draining to the study area.

[2] https://rffe.arr-software.org/

Table 4.1 Subcatchment area

Catchment ID	Area (ha)
1	1422
2	672
3	369.5
4	1062
5	1103
5-1a	179
5-2a	325
5-2b	1047
5-2c	285
5-2c-1	670.8
5-2d	589
6	509
7	792
7-1	223
7-2	1269

4.2.2 Adopted RORB model parameters

Table 4.2 shows the adopted RORB modelling parameters. Catchment slopes and percentage of rural area were determined from available topographic data and aerial imagery. The adopted RORB model parameters are based on the recommended guidance equation provided within ARR (Ball, 2019) for usage within NSW catchments.

Table 4.2 Hydrologic model parameters

RORB Parameter	Adopted Value
M (Catchment non-linearity)	0.8
kc	10

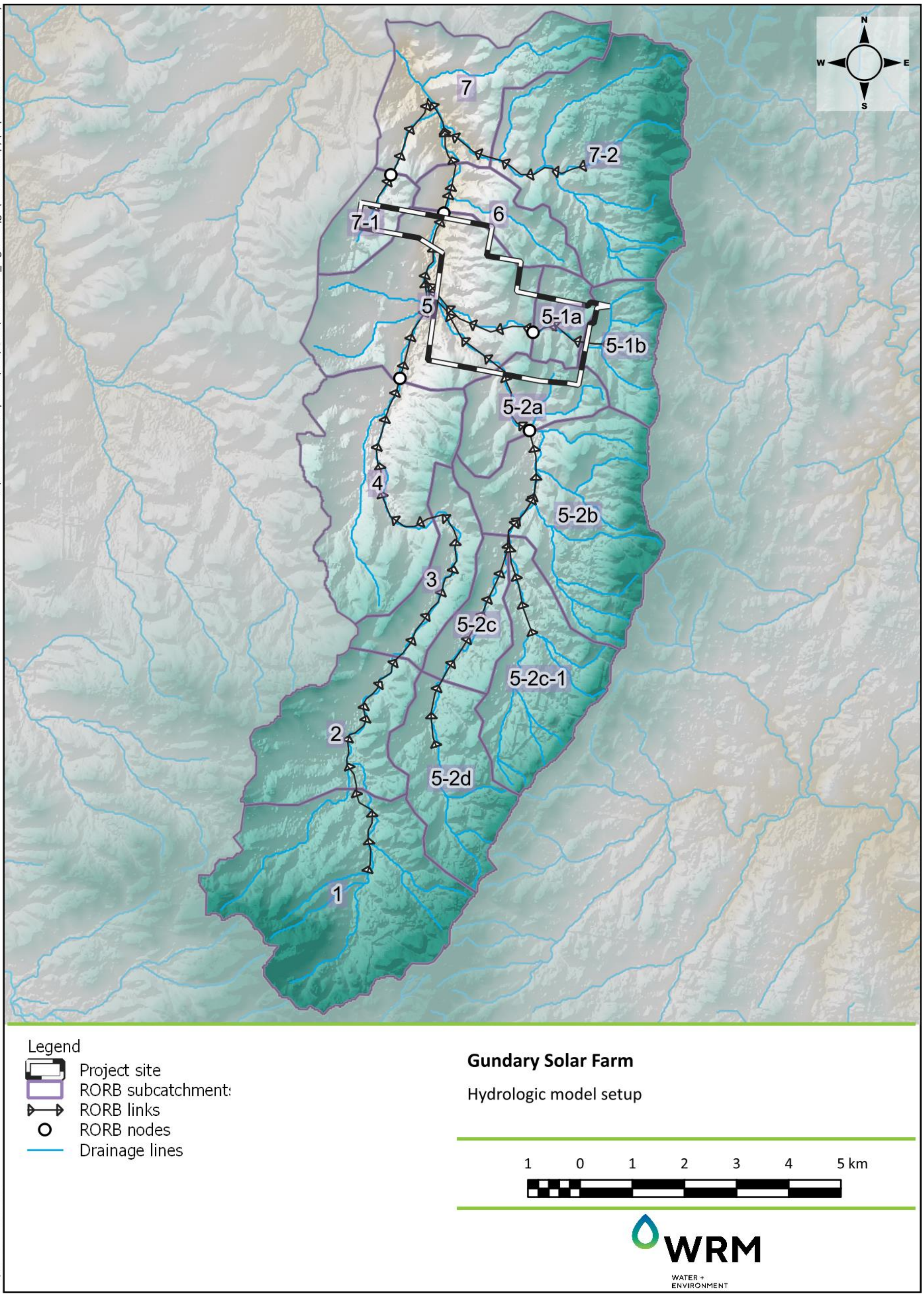

Figure 4.1 Hydrologic catchments

4.3 DESIGN RAINFALL DEPTHS

Design rainfall depths were obtained using the following methodology:

- Design rainfalls for the 10% (1 in 10) to 0.2% (1 in 500) AEP were obtained from Design Rainfall Data System[3] based on a single point location at the centroid of the Project Area.
- Rainfall depths for the 0.1% (1 in 1,000) and 0.05% (1 in 2,000) AEP events were obtained from the Bureau of Meteorology (BOM) for the point location at the catchment centroid of the Project Area. Areal reduction factors derived for the total Project Area catchment were applied to these design rainfalls.
- Probable Maximum Precipitation (PMP) rainfall depths were estimated based on the total Project Area River Dam catchment, using the methodologies given in:
    - *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short Duration Method* - GSDM (BoM, 2003) for durations up to 6 hours
- The AEP of the PMP was estimated based on a relationship between catchment area and AEP recommended by Laurenson and Kuczera (1999) in Book 8 Chapter 3 of ARR 2019 (Ball et al, 2019) and shown on Figure 4.2. Based on the Project's catchment area of 107 km^2, the AEP of the PMP was estimated to be approximately 1 in 10 million AEP event.

Table 4.3 shows the design rainfall depths for the 10% (1 in 10) to 0.2% (1 in 500) AEP and the PMP for durations from 60 minutes to 24 hours.

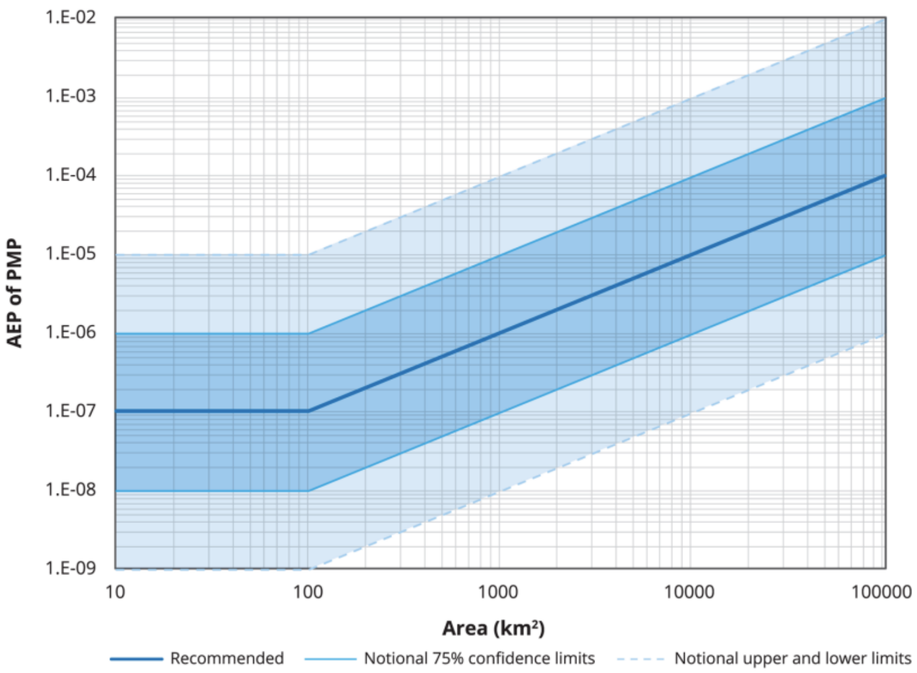

Figure 4.2 Recommended regional estimates for the AEP of PMP (Ball et al, 2019)

[3] http://www.bom.gov.au/water/designRainfalls/revised-ifd/

Table 4.3 Adopted design rainfall depths

Duration (hrs)	Areally reduced design rainfall depths (mm)						
	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	0.2% AEP	PMP*
1	30.9	35.5	41.5	46.1	51.9	60	260
2	37.8	43.2	50.5	56.1	63.1	72.9	380
3	43.1	49.2	57.5	64	72	83.2	460
6	55.4	63.6	74.9	84	94.4	109	520
9	65.3	75.3	89.4	101	113	131	570
12	73.7	85.4	102	115	129	150	610
18	87.4	102	122	139	156	181	790
24	98.2	115	139	158	178	205	880

Source: BOM.gov.au, 25.172S, 151.746E

*Hours 1-6 represent GSDM PMP rainfall depths while 24-96 hours represent GSAM coastal

4.3.1 ARR data hub

Recommended design rainfall parameters were based on current ARR guidelines (referred to as ARR 2019) (Ball et al, 2019), available from the ARR Data Hub portal[4]. Key design rainfall parameters include:

- Initial and continuous loss rates;
- Design storm pre-burst depths;
- Areal reduction factors; and,
- Design storm temporal patterns.

4.3.2 Design rainfall losses and pre-burst rainfall

Storm initial loss (IL) and continuing loss (CL) method of accounting for rainfall losses was adopted based on ARR Data Hub recommendations. An initial loss (IL) and a continuing loss (CL) were adopted, the median pre-burst depths, obtained from the Data Hub, wereused to adjust the initial loss for the 1% AEP.

IL and CL losses were derived by interpolating between rainfall losses adopted for infrequent events (up to 1% AEP) and the PMP rainfall losses, noting that:

- Initial losses (ILs) for infrequent events were derived based on the Probability Neutral Burst ILs provided by ARR datahub. This approach results in a unique Initial Loss for each duration;
- Continuing losses (CLs) for infrequent events were derived based on the suggested data hub and regional flood study CLs; and
- For the PMF event, an IL of zero and CL of 1 mm/h were adopted.

Table 4.4 provides the initial and continuing losses used for the infrequent events and PMP used to interpolate the 0.5% and 0.2% AEP rainfall losses. Table 4.5 provides the Probability Neutral Burst Initial Loss values referred to by Table 4.4

[4] https://data.arr-software.org/

Table 4.4 Adopted design rainfall losses

Losses	Infrequent (to 1% AEP)	PMP
Initial loss (mm)	Probability Neutral Burst Initial Loss	0
Continuing loss (mm/h)	1.96	0.1

Table 4.5 Probability Neutral Burst Initial Loss

Storm duration	Probability Neutral Burst Initial Loss (mm)	
	2% AEP	1% AEP
1 hour	7.9	4.2
1.50 hour	8.5	4.8
2 hours	7.7	3.5
3 hours	6.9	1.7
6 hours	7.1	2.3
12 hours	6.0	3.0
18 hours	7.0	3.6
24 hours	7.9	4.3

4.3.3 Design temporal patterns

Temporal patterns were obtained from the ARR data hub based on a point location at the centroid of the catchment. As per ARR guidelines, 10 temporal patterns which result in 10 design storms for each critical duration for each AEP were used. The hydrologic model was run for all 10 temporal patterns for storm durations between 1 hours and 24 hours for the 10% to 0.2% AEP events. The critical storm duration was identified as the duration which produces the highest median peak discharge from the 10 design storms for each storm duration.

Design event hydrology was undertaken using the ensemble of temporal patterns approach in accordance with ARR 2019. The design temporal patterns were adopted from the following sources:

- Up to the 1% AEP event:
  - The areal temporal patterns from ARR 2019 were used;
- For events rarer than 1% AEP up to the PMF:
  - for durations up to 6 hours, the ten ensemble temporal patterns were adopted from Jordan et al (2005) and the GSDM pattern were used for each duration.

4.4 SELECTION REPRESENTATIVE DESIGN DISCHARGES

Table 4.6 shows the adopted design discharge, critical durations and temporal patterns adopted for the study area. The temporal pattern that produced the peak discharge just greater than the mean was adopted.

Table 4.6 Design discharge at proposed BESS location, critical durations and temporal patterns

AEP (%)	Design discharge (m^3/s)	Critical duration (hrs)	Adopted temporal pattern
10	122.4	9	TP7
5	152.8	9	TP7
1	237.6	12	TP4
0.5	301.8	12	TP1
0.2	357.3	12	TP1
PMF	2844	4	TP1

4.5 DESIGN FLOW VERIFICATION

4.5.1 Overview

The following section outlines the method used to check the results with independent methods. Validation of the hydrologic model was undertaken by comparing results with more frequent flood events where estimates have greater confidence.

4.5.2 Regional flood frequency estimation method

The Regional flood frequency estimation (RFFE) is an online tool[5] developed for Australian Rainfall and Runoff to estimate design flows for ungauged catchments. It is based on gauged data using a region-of-influence approach. Comparisons between hydrologic model's design peak discharges and RFFE estimates are given in Table 4.7. Overall, the hydrologic model results are in reasonable agreement with the RFFE estimates.

The inputs used for the RFFE were design rainfall intensities of 6 mm/h and 12.5 mm/h for a 6 hour rainfall intensity of the 50% (1 in 2) and 2% (1 in 50) AEP events. The catchment's centroid is located at -34.914, 149.763 and the outlet is at -34.807, 149.752. Distance to the nearest gauged catchment is 21 km.

The RORB model parameters adopted for this study were those recommended by the ARR guidelines for NSW catchments and site-specific IFD rainfalls. The methods for calculating the hydrologic model results were those specified by ARR and OEH guidelines for NSW. As an independent check, the hydrologic model results were compared RFFE. The modelled discharges were comparatively higher, but were within the uncertainty bands for an RFFE peak discharge. These moderately higher values provided a level of conservatism in the assessment.

Table 4.7 Comparison of hydrologic model's design peak discharges at proposed BESS location with RFFE

AEP (%)	RFFE design peak discharge (m^3/s)			Modelled design peak discharge (m^3/s)
	Expected parameter quantile	5th %ile confidence limit	95th %ile confidence limit	
10	78.9	26.0	219	122
5	110	32.2	325	152

[5] https://rffe.arr-software.org/

AEP (%)	RFFE design peak discharge (m^3/s)			Modelled design peak discharge (m^3/s)
	Expected parameter quantile	5th %ile confidence limit	95th %ile confidence limit	
1	189	41.0	714	237

4.5.3 PMPF and PMF relationship

Several relationships exist for undertaking rapid checks of the PMF and PMPF derived from Australian studies. The most recently documented relationship is available in Watt, et al. (2018) that built on the work reported by Malone (2011) and Nathan, et al. (1994).

The Malone (2011) relationship based on 26 dams in Southeast Queensland, many using the GTSMR and GSDM approach with an URBS model. Watt, et al. (2018) revised the relationship above using 52 catchments drawn from eastern Australia. The standard error from the study was -29% to 41%.

$$Q_{PMPF} = 226*Area^{0.586} \quad \& \quad Q_{PMF} = 327*Area^{0.562}$$

Comparisons between hydrologic models peak discharges and quick estimate methods are given in Table 4.8. Overall, RORB model results are in reasonable agreement with these independent PMF estimates.

Table 4.8 Comparison of PMPF design peak inflows at proposed BESS location with Watt (2018)

AEP (%)	Watt (2018) quick method peak discharge (m^3/s)			Modelled design peak discharge (m^3/s)
	Expected	-1 standard error	+1 standard error	
PMPF	3494	2480	4927	2844

5 HYDRAULIC MODEL DEVELOPMENT

5.1 OVERVIEW

The two-dimensional TUFLOW hydraulic model (BMT, 2020) was used to simulate the flow behaviour through the Project Area. TUFLOW represents hydraulic behaviour on a fixed grid by solving the full two-dimensional depth-averaged momentum and continuity equations for free surface flow. TUFLOW can represent complex hydraulic structures, floodplain storage and floodplain/channel interaction. The model was compiled and simulated with build version: 2023-03-AA-iSP-w64 using subgrid sampling. The model automatically calculates breakout points and flow direction within the study area. The computational engine uses an adaptive time step to maintain simulation stability.

The hydraulic model was run for the 10%, 1%, 0.5% (1 in 200) and 0.2% (1 in 500) AEP design events and PMF for their respective critical durations. The model results were used to assess flooding behaviour for the existing conditions. The existing conditions model was then adapted to represent the proposed developed conditions, to assess the potential extent and magnitude of impacts of the Project.

A description of the development of the TUFLOW models is outlined below.

5.2 MODEL DEVELOPMENT – EXISTING CONDITIONS

Figure 5.1 shows the adopted TUFLOW model extent. The hydraulic model's domain is 46 km^2. Also shown is the adopted TUFLOW model configuration for the Project Area. The model uses a five-metre cell size with a subgrid sampling distance of one metre. This grid size configuration is to ensure a good representation of major drainage features (including road embankments and channels or gullies), while achieving reasonable model simulation durations.

5.2.1 Topographic data

Model topography was extracted from the available topographic data described in Section 2.3.1 and comprises 1 m and 5 m LIDAR survey data supplied via ELVIS[6].

5.2.2 Structures and blockage

Culverts, bridges and perimeter fencing can block during events and significantly affect peak flood levels both upstream and downstream of these hydraulic structures. Blockage of hydraulic structures can occur with the transportation of materials by flood waters. Near to the Project Area the vegetation is most likely to be logs and fallen trees. While this vegetation debris may mobilise and travel towards the Project Area, the latched tube fencing shown in Figure 3.2 was selected for its ability to avoid capturing or trapping mobilised debris. The debris, if present and generated from the surrounding cleared land, would be conveyed through the latched tube fencing and continue without accumulating.

Current guidance on culvert blockage is dependent on debris loading and the size of the culverts. The proposed culverts are located well inside the Project Area. The Project Area will comprise cleared land that will have solar panel arrays installed. The debris loading reaching the culverts would most likely only be the low vegetation and grass covering that would be maintained around the solar panel arrays. Assuming the Project adopts reinforced concrete box culverts for the crossing of Gundary

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[6] https://elevation.fsdf.org.au/

https://nsw-elvis.s3-ap-southeast-2.amazonaws.com/elevation/5m-dem/z55/Goulburn201312/metadata/Goulburn201312-PHO3-AHD_7406172_55_0002_0002_5m.html

Creek, the allowance for blockage from this type of debris would be negligible. For this reason, and given the conceptual nature of the project, no structure blockages were assumed.

5.2.3 Hydraulic roughness

The TUFLOW model uses Manning's 'n' values to represent hydraulic resistance across the TUFLOW model area. The adopted Manning's 'n' values corresponding to each land use type are the same as detailed in the *Goulburn Mulwaree Flood Study* (GRC, 2022). The adopted Manning's 'n' values are shown in Table 5.1. In the absence of recorded water level data, it was not possible to calibrate the hydraulic model.

The classification of land use areas for hydraulic modelling was based on the aerial imagery (NearMap). The adopted existing conditions land use mapping is shown in Figure 5.2.

Table 5.1 Adopted hydraulic roughness coefficients

Land use description	Manning's 'n' coefficient
Open Areas (grazing, cropping)	0.06
Medium Vegetation	0.08
Thick Vegetation	0.10
Waterways	0.04
Substation and Battery	0.04

Source: Table 33 (WMA, 2016)

5.2.4 Inflow and outflow boundaries

A combination of approaches was utilised to model flow and rainfall arriving at the Project area. The hydrologic model generated catchment flows that reached the extent of the hydraulic model. Within the hydraulic model, excess rainfall was directly applied to every grid cell. This fully distributed approach to applying rainfall is a preferable way to model rainfall over a solar farm. The alternative would require local numerous subcatchments within RORB. Design flow hydrographs produced by the hydrologic model were applied to the TUFLOW model as inflow hydrographs as shown in Figure 5.1, using the 'Flow-Time' (QT) inflow approach. The QT inflow approach was used to apply local catchment inflows at the top of a flow path. Normal flow (HQ) type boundary conditions were adopted for downstream model boundary, based on the downstream channel slope. The downstream boundaries of the models were set well downstream of the Project Area to minimise influence on flood behaviour predicted near the Project Area. The downstream boundary conditions assumed a normal depth slope of 0.01 m/m. This normal depth slope is typical of the bed slopes found in each of the creek systems.

5.3 DEVELOPED CASE CONFIGURATION

Figure 5.2 shows the assumed landform configuration for the proposed development configuration included for the Project as of 20 May 2024, refer to Figure 3.3. As noted earlier, the preliminary concept design does not specify any significant earthworks and none are indicated on Figure 3.3. The modelling presented within this document has assumed that there would only be minor infill adjustments required as proposed design would be adjusted to not interfere with existing flow paths. The main works would involve levelling to create a smooth development footprint for solar panel installations. This levelling includes the removal of existing minor farm dams, and as such the model was adjusted to allow for contiguous flow paths. Access roads planned within the development footprint are to be designed to ensure overland flow is not re-directed. Building and infrastructure pads will not be impacted by or positioned near concentrated overland flow.

The key differences from the existing conditions model to represent the proposed development, as provided on 20 May 2024 and shown on Figure 3.4 are:

- Smoothing of landform and infill of existing small dams;
- Minor site drains that redirect runoff around the solar panel infrastructure;
- Perimeter security fencing and latched tubes crossing of waterways;
- Gravel pads around substation and entrance works; and,
- Access road from the entrance to the rest of the Project Area, including minor culvert crossings.

The proposed conditions use the same hydrologic inputs and locations as the existing conditions hydraulic model. The developed conditions hydraulic model includes the additional culverts and access track configuration. The culverts were represented as one-dimensional network structures in TUFLOW. Blockage of hydraulic structures (culverts and bridges) for design events was determined based on guidelines in Book 6 – Chapter 6 of AR&R 2019 (Ball et al., 2019). The debris potential classification for structures within the model extent was determined as “Low” given the velocities and low vegetation coverage.

The finished surface elevations for the pads are based on the design flood event and required immunity. To ensure the surface of the pad remains flood-free the model raised the pad elevation above the PMF flood level, as shown on Figure 6.3.

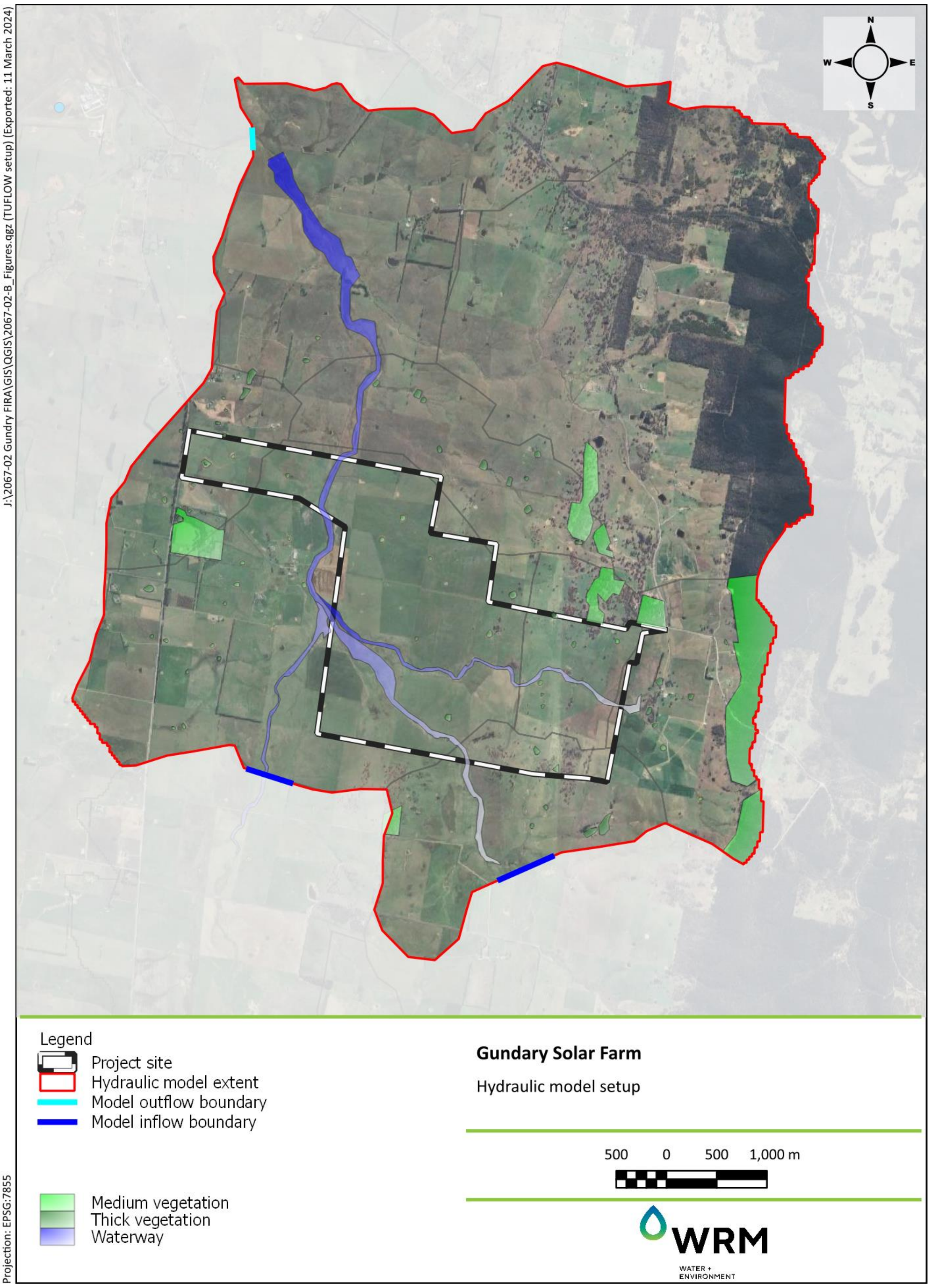

Figure 5.1 TUFLOW model configuration of existing case

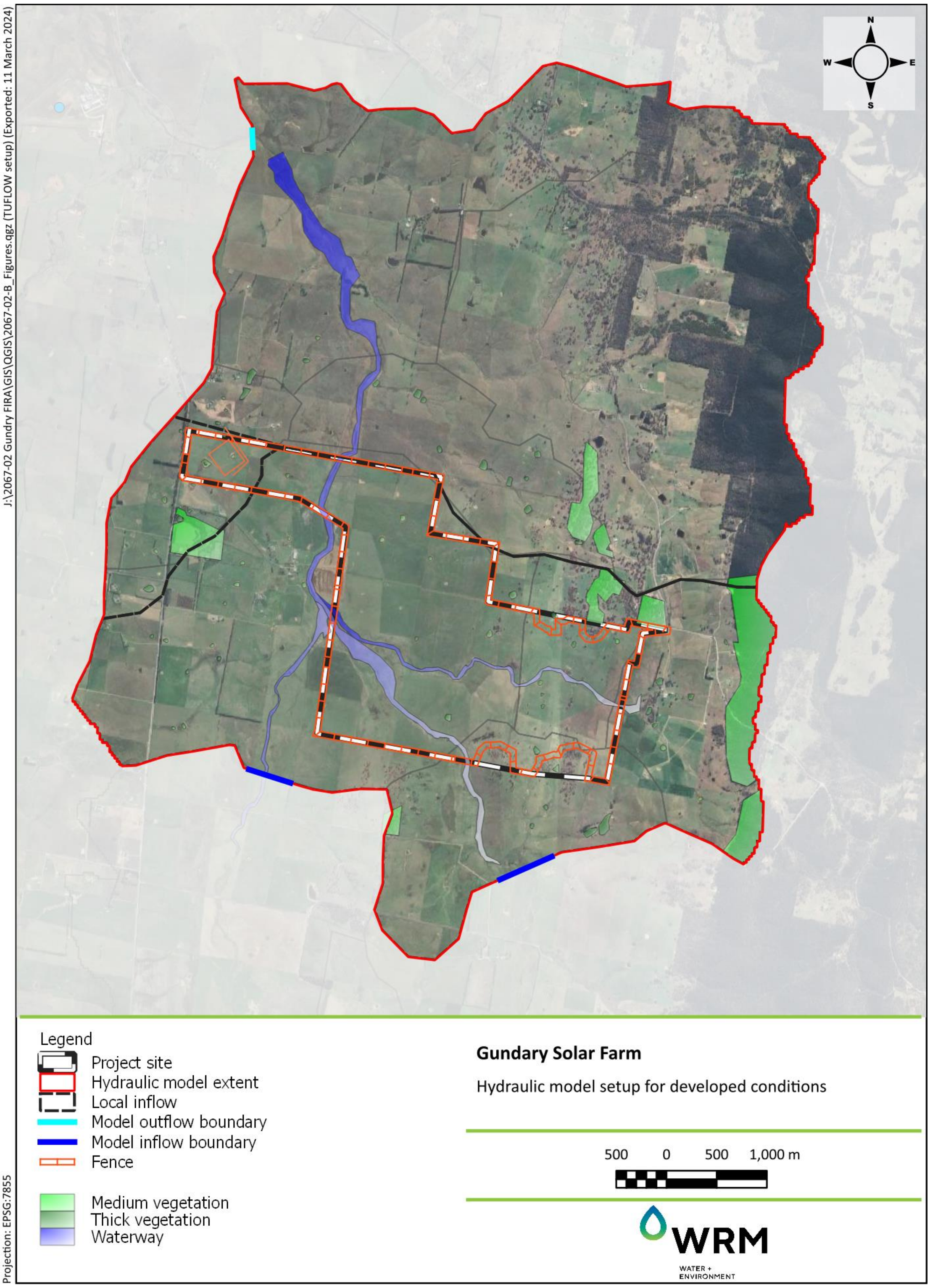

Figure 5.2 TUFLOW model configuration of developed case

6 FLOOD MODEL RESULTS AND ANALYSIS

6.1 OVERVIEW

The assessment considered the impacts of the Project on flood depth, velocity and hazard for the 10%, 1 %, 0.5 %, 0.2 %, and 0.05 % AEP events and PMF event. The peak modelled results are shown in Appendix A for the existing case, Appendix B for the developed case and Appendix C contains the flood impact results. For ease of reference, the flood extent for the Probable Maximum Flood is shown on Figure 6.2.

Due to the minor modifications to landform and hydrological regime, the impacts of the development on flood depth and velocities are negligible. The site infrastructure are proposed to be located outside of the primary flowpaths. As result, flood impacts are considered to be minor in all modelled events.

6.2 LIMITATIONS

Modelling accuracy is subject to numerous sources of uncertainty. Some potential sources of inaccuracy leading to uncertainty in the hydraulic model are as follows:

- Inaccurate topographic information – The hydraulic model relies upon the representation of the ground topography to model the movement of water across the land. The DEM used to inform the model topography was captured at different times and with differing resolutions. This also implies a variance in vertical and horizontal accuracy for the survey. The accuracy of model results may be impacted by the accuracy of the DEM. For example, the model may not be well-represented in minor flow paths smaller than the DEM resolution.
- No calibration to historical events—It is best practice to calibrate a hydraulic model to an historical event. However, calibration data for historical events is not available, making model calibration impossible. While the model parameters have been chosen in line with ARR 2019 recommendations and within industry-accepted bounds, the ability of the model to reproduce actual flood behaviour is untested.
- Critical duration—A representative critical duration and temporal pattern have been selected to represent the flood behaviour across the project area. Given the broadscale nature of this impact assessment, this is an appropriate simplification. However, future detailed design (e.g., of waterway crossings) may need to model additional durations to determine whether the critical duration at the location of interest should be updated.

6.3 DESIGN FLOOD EVENTS

The modelled flood behaviour within the hydraulic model's domain is shown in Figure 5.1 and Figure 5.2. The flood modelling results are discussed below, and the mapped results are available in Appendix A and Appendix B.

The flood maps show overland flow paths. For clarity, minor shallow depths (< 50mm) were removed from the maps. This depth would normally be managed via stormwater infrastructure. The purpose was a preliminary investigation to appraise flood risk that can inform the layout of site infrastructure.

The resulting output grids are statistically analysed to generate maximum water surface (depth) and velocity values from the median of the ensemble of temporal patterns from each set of storm durations.

Summary observations about of existing condition flood behaviour are as follows:

- 10% AEP: Results show the water is confined to Quialigo, Bullamalito and Gundary Creeks and other minor drainage features throughout the Project Area. The active flow paths through the

Project Area are shallow and confined within the watercourses and local depressions. General overland flood flow depths outside the primary waterway alignments are typically shallow at less than 0.1 m. The greatest depths within the watercourses within the Project Area are up to 1.5 m.

- 5% AEP: Results show the water remains confined to Quialigo and Bullamalito Creek and other minor drainage features throughout the Project Area. The active flow paths through the Project Area are beginning to fill to bankfull. The local depressions are showing that they are becoming quite deep. General overland flood flow depths outside the Bullamilto Creek alignment are typically less than 0.5 m. The greatest depths within the Project Area are up to 1.75 m.
- 1% AEP: Within the Project Area the flood inundation extents Quialigo and Gundary Creeks are well developed with peak modelled depths reaching two metres in the Project Area. The small farm dam at the western periphery of the Project Area indicating that flow paths have developed on either side of the dam's embankment. The depths, velocities, and hazards associated with the higher flows within the Project Area have all increased. While flood flows in Gundary Creek have bisected the Project Area, the northeastern and southern locations are still flood-free, and evacuation to roads on the east of the Project Area is possible. The Project Area remains free from the formation of 'flood islands'.
- 0.5% AEP and 0.2% AEP: Similar to the 1% AEP, the Project Area faces increased flood inundation extents, with peak modelled depths reaching 2.5 metres downstream of the Project Area. Three small farm dams on the western edge of the Project Area are currently flooded, with flow paths emerging around each dam's embankment. Floodwaters in Gundary Creek have consumed the middle portion of the Project Area. The higher ground to the northeast and south remains unaffected by flooding. Evacuation routes to the east remain open, and there are no 'flood islands' forming in the area.
- PMF: Flood mapping of the PMF within Project Area shows depths exceeding 3.5 metres in Qualigo, Bullamalito and Gundary Creeks. Small farm dams and local depressions have filled and overtopped. Flood flows through the Project Area in Gundary Creek have broken out of the creek banks and consumed over a hundred metres in width through the middle portion of the Project Area. The higher ground to the northeast and south is experiencing flooding as it breaks out of the watercourses. Evacuation from the Project Area to higher ground remains possible.

Assessing the PMF of any site within a catchment is highly uncertain. The PMF is the largest flood that could conceivably occur at a particular location. While the PMF defines the extent of flood-prone land, NSW guidance states that it is '*it is not physically or economically possible to provide complete protection against this event*'. As PMF is the worst flood possible, and there are numerous dams upstream of the Project Area whose releases, survival and timing of failure make the arrival of a flood wave at the Project Area difficult to determine. Flooding can be expected to be extensive and devastating.

The Large-Scale Solar Guideline (NSW, 2022) requires that any flood hazard or risks associated with the construction, operation and decommissioning of the solar energy project be assessed. The location of solar energy infrastructure should avoid any land subject to a flooding hazard and should not contribute to an increase in the risk of the flooding hazard.

6.4 FLOOD HAZARD AND FLOOD RISKS

Flood hazards were considered in accordance with NSW Government 2023 *Flood Risk Management Guidelines*, which present several hazard categories for flood modelling results as shown in Figure 6.1. Appendix A and Appendix B contain the flood hazard results for existing and developed conditions. The peak modelled results show that the Project Area's flood hazard reaches high hazard in the deeper central flow path locations, with shallower and overbank areas considered low hazard. There was minimal change in risk to the internal and external waterway flows between existing and developed conditions.

Access points to the Project Area were also predicted to be low flood hazard. At the detailed design phase, waterway crossings for access points and crossings within the Project Area will be designed.

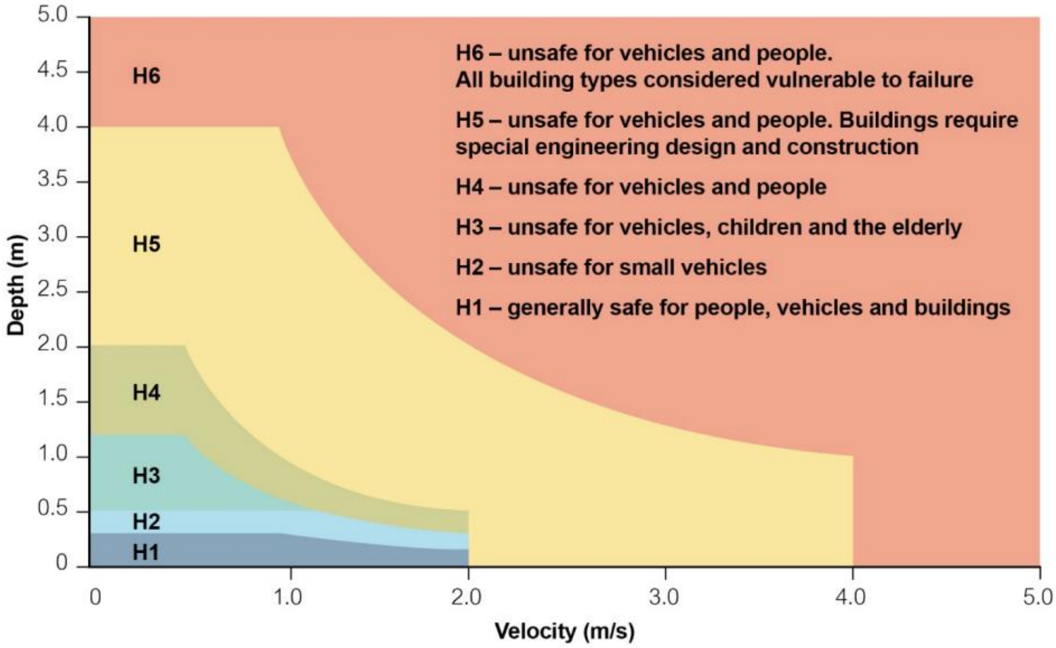

Figure 6.1 Flood hazard map (DPE, 2023)

The creek watercourses are areas of higher flood hazard, and the installation of PV arrays in these areas will be avoided in Detailed Design. As such, mitigating the minor flood impacts shown in the flood modelling results is recommended by maintaining a waterway corridor buffer where the baseline hydraulic roughness will remain unchanged. Although the reaches of creeks within the development footprint do not have substantial riparian vegetation, avoiding installing PV arrays in the waterway corridor will reduce and likely eliminate off-site impacts.

There will also be security fencing situated around the perimeter of the site, with setbacks from the creeks based on the adopted waterway buffer. Due to the presence of multiple flow paths across the site, the fencing is unlikely to become a trap for loose vegetation in high-flow events. In very rare and extreme flood events, coupled with unanticipated debris loading, there may be additional structural loading on the fence, which may cause damage.

The results of the flood impact assessment show that the infrastructure and solar panels within the Project Area are located outside areas of major flood hazard. Peak stormwater discharges from the Project Area for impervious areas may increase slightly by creating compacted gravel roads and some small operational buildings. However, potential impacts to drainage features and downstream watercourses are likely to be minimal due to the relative size of the Project Area in relation to the size of the receiving catchments and the distributed nature of minor impacts.

6.5 FLOOD IMPACTS

Based on the outcomes of the flood modelling, the Project is predicted to result in minor impacts on flooding, including flow rates, velocities and depths. Flood impacts are mapped in Appendix C. Typically, infrastructure upgrades for the Project did not increase flood depths or velocities due to the interaction with diffuse flows and the use of unsealed roads in the developed conditions.

The proposed infrastructure located within the Project Area is not expected to increase runoff, provided that the ground cover established for the developed case provides similar levels of infiltration. The minor increase in imperviousness within the proposed infrastructure area does not create off-site impacts. The project earthworks do not include any infilling or reduction in floodplain storage. The filling and levelling of small farm dams within the development footprint is not anticipated to impact peak flows as they fill early in a storm event and are located outside the floodplain in overland flow paths.

Implementation of standard erosion and sediment control practices will ensure that the Project will not directly or indirectly increase erosion or siltation in watercourses. The volume of runoff and velocity of flow will not change with any significance as the developed case vegetation is expected to provide similar hydraulic roughness to existing conditions.

Areas where layered flow constrictions were applied to represent fenced restrictions and latched tubes interacting on the channels had slight reductions in velocity entering the Project area. No notable increases in water level occurred in the main channel because of layered flow constrictions. However, the far eastern creek tributary experiences an increase in water level of up to 40 mm, 10 to 30 m upstream of the entrance (shown in Appendix C). Along the far west flow path, redirection of water around the transmission substation has caused a net decrease of downstream water level with a small area of water level increase (shown in Appendix C) due to the realignment of drainage around the substation. In all other modelled events, the location, extent and magnitude of the impacts are very similar. There are no other locations where the development adversely increases or redirects flooding at neighbouring properties.

6.5.1 Flood impacts relating to Solar Arrays and BESS

Published literature (Muller, 2023) regarding the surface water impact of PV arrays indicates that additional runoff from solar PV projects is unlikely. While solar panels are wholly impervious, runoff from panels is not directly connected to the downstream drainage system and will drain onto the existing pervious landform and soils. Therefore, the modelled existing hydrologic conditions are likely to be unaffected by the project infrastructure.

The flood modelling results show that the proposed solar farm is not predicted to cause external impacts on water surface levels and peak discharges.

The construction of PV arrays to fill/level some minor areas included within the flood inundation extent is required. In relation to rare event flood volumes, the farm dams within the Project Area do not hold significant volumes of water. Filling these minor dams will not adversely impact the flood behaviour of receiving watercourses.

The flood modelling results also show that the proposed solar array's location and access from Windellama Road are suitable in terms of flooding constraints. Areas with a high flood depth and velocity are considered inappropriate for solar panel installation. The locations where the overland flow path exceeds depth and velocity values are expected to be high risk for infrastructure are being excluded from future layout configuration. These are now identified as 'exclusion' areas in the development layout. For the remaining areas, the probability of erosion and scour is expected to be minimal.

Panel footings located in high velocity areas create the potential for localised scouring around the solar panel poles, which can lead to deflection of the array and cracking of solar panels. To reduce the likelihood of erosion and damage to the solar panels, the foundations for all project infrastructure (in particular the photovoltaic arrays and transmission lines) are located away from areas that exceed flood depths of 0.3 m and flow velocities greater than 1.5 m/s. However, in areas where higher flood depths are predicted, these locations could include solar panels, but they would require raising the solar panel poles, which can be confirmed as part of the detailed design.

The solar panels were designed to provide a minimum of 500 mm freeboard for the lowest edge above the maximum 1% AEP flood level. The panel post and footings are being designed to withstand the flood velocities described in this report, which are mostly low in the areas proposed for solar panels. To provide guidance on the areas that are most appropriate for PV arrays and other site infrastructure (e.g., substation, the operational facility and BESS) the waterways and constraint areas were defined using the flood depths and velocities from the 1% AEP event as described below:

- Area of higher flood hazard: consider flood constraints in the Project's detailed design and avoid installation of PV arrays or BESS infrastructure in this area unless the hazard can be mitigated. This area includes depths above 0.3 m and velocities above 1.5 m/s.
- Area of low flood hazard: the Project's detailed design would adopt a minimum of 300 mm freeboard to the 1% AEP flood level for any infrastructure. This area includes depths above 0.1 m and velocities above 1.0 m/s.
- Unconstrained: All other areas.

Note that existing farm dams were included in the flood model as these are to be filled and levelled meaning that depths will generally be shallow, and most will not form part of the area of higher flood hazard.

The location of the proposed substation is outside of the flood extent and is considered appropriate in terms of flood risk.

6.5.2 Flood impacts relating to other Infrastructure and Access Roads

Access tracks, waterway crossings (i.e., minor culvert crossings or causeways) and buried cable reticulation are the only works proposed within or near the watercourses. Security fencing around the perimeter of the development footprint has the potential to trap and accumulate flood debris and impede flows. The use of a latched tube fencing, as shown in Figure 3.2 will mitigate the risk of afflux that may result from debris loading. Should minor debris loading occur at the perimeter, this is only likely to result in a localised and minor (< 10mm) increase in water level upstream of the blockage and potential redistribution of flow at the boundary. Given the local topography and minor nature of the identified watercourses in the Project Area, any redistribution of flow through fence blockage would be localised, and the risk of any potential blockages is low. Any inundation outside of the mapped flood extents would be minor. Fence maintenance and clearing of debris after each flood event will further minimise any potential impacts.

6.5.2.1 Access roads

The Project requires construction of a network of internal unsealed all-weather roads, which will provide access to the solar arrays for construction and ongoing operational maintenance. The location of the roads will be finalised during detailed design for the Project, but the indicative design is presented in Figure 6.2.

The indicative configuration of access roads will require waterway crossings listed in Table 6.1. The locations of these crossings are shown on Figure 6.2. This table summarises the peak depth and flow velocities for the 1% AEP event.

Table 6.1 Waterway crossings

Point ID	Road	Waterway Crossing	Peak modelled 1% AEP depth (m)	Peak modelled 1% AEP velocity (m/s)
1	Internal crossing (south)	Creek	1.5	1.6
2	Internal crossing (centre)	Creek	0.3	0.9
3	Fencing (southwest)	Creek	1.4	1.0
4	Fencing (east)	Creek	0.6	1.7
5	Internal access (minor)	Creek	0.2	0.3
6	Internal access (main)	Upstream of Dam	1.3	0.1
7	Internal crossing (culvert location)	Creek	1.6	1.6
8	Fencing (south)	Creek	1.0	1.3
9	Lateral Fencing (south)	Creek	0.9	1.4

Site specific designs will be finalised during detailed design and constructed generally in compliance with the guidelines listed above, and in accordance with the development consent conditions.

Peak flood velocities crossing access tracks will be managed during construction to ensure sediment is not mobilised in a significant rain event. Inspection after storm events will be required to ensure erosion does not impact the access roads through the life of the Project. Erosion and sediment controls will be implemented during construction in accordance with the Landcom guidelines for *Managing Urban Stormwater: Soils and construction* (Landcom, 2004) that provide for industry to reduce the impacts of land disturbance activities on waterways.

6.6 FLOOD MITIGATIONS

The design layout shown in Figure 3.3 is understood to be preliminary in nature and does not incorporate the expected adjustments to allow for flood flows within the Project Area. At the time of writing, various technical constraints and other design iterations are being worked through.
Figure 6.3 depicts a summary of the flood mitigations expected to be incorporated in future revisions of the design as it matures.

Figure 6.2 PMF extent and sample points

Figure 6.3 Flood mitigated design modifications

7 FLOOD RISK MANAGEMENT

7.1 OVERVIEW

This section summarises the risk evaluation undertaken to assess the potential risks associated with the Project qualitatively. Flood mapping from the modelling discussed in Section 6 is available in Appendices A and B. The potential impacts of the Project are shown in Appendix C.

This report adopted the risk assessment framework set out in Australian Standard/New Zealand Standard (AS/NZS) ISO 31000:2018 Risk Management—Principles and Guidelines (2009). The risk assessment comprised the following steps:

- Risk Identification of the vulnerable element and consequence,
- Risk Analysis to appraise the likelihood and consequence ratings,
- Risk Evaluation of the risk rating and priority, and
- Identification of treatment options.

7.2 METHODOLOGY

Risk assessment involves considering the sources of risk, their consequence and the likelihood of the defined incident occurring. Likelihood and consequences are combined to determine the level of risk.

Therefore, risk criteria were developed to evaluate risks by differentiating between the risk's likelihood and the event's consequence. Likelihood is defined as a qualitative description of probability and frequency. Consequence is defined as the event's outcome expressed in terms of death, injury, loss, or some form of disadvantage.

The criteria used to rank the likelihood and consequences of potential impacts and how they are combined to determine the level of impact are set out in Table 7.1 through Table 7.3. The degree of likelihood is outlined in Table 7.1, while the magnitude of impacts/consequences is described in Table 7.2. Finally, the likelihood and impact magnitude are combined to be classified for the significance of impacts in Table 7.3.

Table 7.1 Qualitative measure of likelihood

Qualitative measure of likelihood (how likely is it that this event/issue will occur after control strategies have been put in place	
Highly likely	Is expected to occur in most circumstances
Likely	Will probably occur during the life of the development
Possible	Might occur during the life of the development
Unlikely	Could occur but considered unlikely or doubtful
Rare	May occur in exceptional circumstances
Very rare	Likely to occur within a credible limit of extrapolation of observed events

Table 7.2 Qualitative measure of consequence

Qualitative measure of consequences (what will be the consequence/result if this issue does occur rating)	
Minor	Minor incident of environmental damage that can be reversed
Moderate	Medial treatment of people, short duration and displacement of people. Isolated and short term environmental damage
High	Fatality, Substantial instances of environmental damage .
Major	Large number of injuries/fatalities, Widespread displacement of people. Major loss of environmental amenity and real danger of continuing.
Critical	Severe widespread loss of environmental amenity and irrecoverable environmental damage

The level of risk depends on the likelihood of the risk occurring, and its consequence. The risk criteria employed for this assessment, which was drawn from the ranking criteria presented in the Safety in Design (Consult Australia, August 2010) (p10) are shown in Table 7.3.

Table 7.3 Semi-qualitative risk rating matrix

		Level of consequence				
Likelihood	AEP range	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain		Medium	High	Extreme	Extreme	Extreme
Likely	>10%	Medium	Medium	High	Extreme	Extreme
Possible	0.5% to 10%	Low	Medium	Medium	High	Extreme
Unlikely	0.05% to 0.5%	Very Low	Low	Medium	Medium	High
Rare	1 in 2000	Negligible	Very Low	Low	Medium	Medium

Source: Table 9 Flood risk management after AIDR, 2020a

7.3 RISK ASSESSMENT

7.3.1 Overview

Risk identification was based on the following:

- Undertaking flood mapping and impact assessment
- Reviewing Goulburn FRMSP (GRC, 2022) in particular evacuation routes
- seeking input from the Project Team and
- consulting with the NSW SES on Flood Risks in Goulburn regions.

The risk identification has considered the safety of on-site staff and the flood risk posed by the Project to the broader community.

Based on the Project Area's use being a remotely operated solar energy infrastructure site), the primary risks relate to damage to Project infrastructure, vehicles and safety of site personnel. Risk management measures suitable for the Project Area include:

- Hazard warning signs for personnel attending site

- An early warning system that alerts personnel and the operations centre of the potential for flood inundation at the site (Gundary Creek) and the evacuation route to Goulburn (Mulwaree River).
- An Emergency Action Plan (EAP).

The risks associated with the Project were identified as increased frequency and magnitude of inundation. These risks were then given a rating in terms of likelihood and consequence using the criteria in Table 7.1 and Table 7.2. These ratings were then combined using the criteria in Table 7.3. generate a risk rating.

7.3.2 Risk of personnel trying to drive or wade through floodwater

- Vulnerable element – Personnel, site visitors
- Consequence – Personnel may be injured or drown
- Likelihood rating – Unlikely
- Consequence rating - Major
- Risk rating - Medium
- Risk evaluation – sufficient warning time to prevent travelling to site. Personnel would not be allowed to enter site until after flood peak recedes and safety walk through

7.3.3 Risk of personnel being trapped on site by rising floodwaters

- Vulnerable element – Personnel, site visitors
- Consequence – Personnel may be injured or drown
- Likelihood rating – Unlikely
- Consequence rating - Major
- Risk rating - Medium
- Priority - High
- Risk evaluation – sufficient warning time to prevent travelling to site. Personnel would not be allowed to enter site until after flood peak recedes and a safety walk-through

7.3.4 Risk of inundation of vehicles

- Vulnerable element – Vehicles
- Consequence – Damage or loss of vehicles
- Likelihood rating – Unlikely
- Consequence rating - Minor
- Risk rating - Low
- Risk evaluation – sufficient warning time to prevent travelling to site. Designated parking away from flood water flow paths. Parking and driving on site won’t occur until after flood peak recedes and safety walk through

7.3.5 Risk of damage to electrical generation plant

- Vulnerable element – Electrical infrastructure
- Consequence – Potential for damage and destruction of switchyard and electrical generation capacity. Potential for assets to be offline for a significant period of time awaiting repair.
- Likelihood rating – Unlikely
- Consequence rating - Major
- Risk rating - Medium
- Risk evaluation – equipment is placed on elevated hardstands above 0.5% AEP and located on higher ground away from Gundary Creek PMF extent. Design has incorporated site drainage to redirect flowpaths near substation. Sufficient warning time exists to shutdown and make safe electrical equipment. Sandbags and drainage flowpaths exist.
- Treatment - All electrical infrastructure will be located on hardstands built to a minimum of a 0.5% (1 in 200) AEP event. Additional freeboard and plinths will raise high-consequence equipment above the 0.2% (1 in 500) AEP flood level.
- Provision of electrical infrastructure above the 0.5% AEP level minimises the risk of electrical infrastructure being damaged and therefore reduces the time for buildings to become operational following an extreme flood event.

7.3.6 Risk of inundation of access and evacuation routes

- Vulnerable element – Access
- Consequence – Isolation of people and vehicles.
- Likelihood rating – Possible
- Consequence rating - Moderate
- Risk rating - Medium
- Risk evaluation – sufficient warning time exists to enable personnel to evacuate site to Goulburn. Warning systems exist to alert personnel that travel to site should be deferred during onset of a major weather event. Evacuation to south and east remains possible to reach higher ground and locations not at risk from Mulwaree River flooding.
- Treatment – Notification of all personnel of potential for flooding and isolation. All personnel to be made aware of the recommendation to evacuate site prior to a large Mulwaree River flood event. Preparation of an emergency action plan to be implemented in the event of flooding.
- The adoption of an evacuation strategy will minimise the need for personnel to remain at site.

7.3.7 Risk to emergency services accessing site during flood event

- Vulnerable element – Emergency service personnel and vehicles
- Consequence – Potential inability to reach sick or injured personnel requiring the attendance of emergency services.
- Likelihood rating – Unlikely
- Consequence rating - Minor
- Risk rating - Low

- Risk evaluation – Staff being injured whilst visting the site is possible, however personnel attending the site at the same time as the Mulwaree River has the potential to flood is unlikely. As noted above, warning times are sufficient to enable the evacuation of staff and prevent them from travelling to site. Emergency vehicles based in Goulburn may not be able to reach and return from the Project Area if inundation at Bungonia Road exceeds 500 mm.
- The adoption of an evacuation strategy will minimise the need for emergency services to access the site.

7.4 FLOOD MITIGATION MEASURES

In particular, to withstand potential flood events, the following is recommended:

- Maintaining the natural state of the drainage flow paths whenever possible. Internal access roads, where crossing watercourses, should be designed for 10% AEP design flow and could include compacted rock causeways to provide low maintenance access with limited impact on the waterway or culvert structures.
- Foundations for all project infrastructure, including photovoltaic arrays and transmission lines, should be located away from areas that exceed both flood depths of 0.3 m and flow velocities greater than 1.5 m/s. Detailed design of the project should consider the results of the flood models, in particular the 1% AEP scenario. For instance, solar panels would be designed to provide a minimum of 300 mm freeboard for the lowest edge above the maximum 0.5% AEP flood level.
- Infrastructure with the potential to cause pollution to waterways in the event of flooding, such as inverters and battery storage would be located with a minimum 300 mm freeboard above the maximum 0.5% AEP flood level. Given the shallow depths across the site, raising these small fill pads is highly unlikely to result in any adverse impacts offsite.
- BESS components are located on hardstand areas and are aligned with local overland flow paths to prevent flows being redirected which could lead to localised increased in flood level and higher risk of scour and erosion.
- The design and construction of waterway tracks and cable crossings and all internal tracks crossing watercourses within the proposed development footprint should be generally in accordance with the:
  - *Guidelines for controlled activities on waterfront land – riparian corridors* (NSW 2018),
  - *Guidelines for watercourse crossings on waterfront land* (NSW, Office of Water) and
  - *Guidelines for laying pipes and cables in watercourses on waterfront land* (NSW, 2012).
- The best practice principles for stormwater and sediment control outlined in *the Managing Urban Stormwater: Soils and construction* (Landcom, 2004) guidelines will be incorporated into the design, construction and operation phases of the solar farm site as part of a Stormwater Management Plan and Erosion and Sediment Control Plan.

7.5 FLOOD EMERGENCY MANAGEMENT PLAN

A detailed Flood Emergency Management Plan (FEMP) will be developed for the Project in consultation with NSW SES and other relevant agencies. The FEMP will be developed following project approval and prior to commencement of construction, covering but not limited to the following.

7.5.1 Flood Risk Triggers

The FEMP will be informed by the flood modelling presented and reference the Goulburn FRMSP. It will be guided by the following principles.

7.5.1.1 Severe Weather Warnings

The Bureau of Meteorology has a range of severe weather warning systems appropriate for use in the operation of the solar farm. It is recommended that operations staff have access to the following facilities for early severe weather warnings:

- The Bureau of Meteorology "MetEye" provides severe weather warnings, summaries listed by State, and live updates. Other information provided by the application, such as radar and forecasts, is also useful.
- The Bureau of Meteorology's "RSS feeds" (Really Simple Syndication) is an information system that provides the latest weather information and may be issued at any time. RSS feeds has a Land Warning feed for NSW, which can provide up-to-date information as soon as it becomes available to desktop and mobile devices. See: http://www.bom.gov.au/rss/

During heavy weather warnings, ABC Radio announces information on flood affected areas and road closures. Radio and Bureau of Meteorology information should be reviewed frequently for potential major flooding and road closures.

7.5.1.2 Notification of Staff at Risk from flooding

Staff are not required to be present at the Project Area, O&M facility during large flood events. Facility members and visitors can be notified of potential flooding, road and facility closure via several mechanisms:

- Staff access to severe weather applications;
- Message notification via mobile phone, sent to all group members;
- Group email;
- Individual telephone notifications.

7.5.1.3 Evacuation Route

The Project Area is free from regional riverine flooding from the Mulwaree River, and flood risks are from flooding of the local creeks. This flood assessment confirms that flood evacuation routes are realistically achievable for the Project Area, without placing additional burden on emergency services. The detailed designer will plan the evacuation routes, taking into account the zones of flood hazard shown in Appendix B.

7.5.1.4 Consultation

Consultation with Council's flood engineers, SES and NSW Government agencies was undertaken during the preparation of the Environmental Impact Statement.

7.5.2 Roles and Responsibilities

Further details and specific procedures need to be developed for the Study Area, and this report clearly lays the foundation for these procedures and demonstrates that flood warning and evacuation of the Project Area are realistically achievable. The initial requirement for the procedures will need to identify roles and responsibilities:

- Who has legal responsibility for the maintenance and implementation of the FEMP;
- The specific roles and responsibilities of the business owner or facility manager;
- Whether there are Flood Duty Officers on-site and their roles and responsibilities;
- Roles and responsibilities of all facility users, including the public and members.

7.5.3 Emergency Action Plan and Procedures

An Emergency Action Plan (EAP) provides a road map of activities based on the risks and consequences of the event. The plan should appropriately balance the need for site operations and prioritising the safety of the personnel.

Flood emergency management procedures and training should be provided for staff and management working at the facility. A formalised induction will also be required for new members. The development of future Workplace Health and Safety (WHS) Procedures (recommended to be undertaken by a WHS specialist), Staff Training and Inductions should include:

1. At all times

- Annual testing (e.g., drills) of FEMP procedures, including annual review and update;
- Adequate resourcing of the FEMP, including designated trained flood duty officers;
- Staff and club member induction accreditation;
- Monitoring of weather conditions and warnings, weather forecasts;
- Create and annually update the emergency contact list;
- Ensure all equipment and resources to implement the FMERP are available and in working order.

2. When a flood is likely

- The FMERP manager monitors the official warnings, selected response triggers and warning system;
- Facility occupants are notified of the possibility of flooding and reminded of actions and procedures should an emergency response be required;
- If early evacuation is the selected response action, the selected means of transport is provided, and evacuation occurs before cut off time;
- If sheltering in place is the selected response action stocking of food and medications is undertaken by occupants according to the maximum possible duration of isolation;
- Other resources are brought in as required by the FEMP;
- Movable objects are secured;
- Outdoor activities are suspended;
- Safety equipment is checked.

3. During a Flood

- The FEMP manager monitors the official warnings, response triggers and warning system;
- Evacuations cease, and no one leaves the premises until all clear is given by emergency services;
- Members who are not on the premises at the time are notified not to try and reach the premise;
- The FEMP manager provides regular updates on the situation to members.

4. After a Flood

- Check the structural integrity of infrastructure before evacuees can return to the premises (a qualified structural engineer may be required);
- Check the safety and function of services before evacuees can return to the premises;
- Organise a safe clean-up;
- Review the FEMP to account for lessons learnt.

8 CONCLUSIONS AND RECOMMENDATIONS

This amended FIRA provides an assessment of existing flood behaviour and impacts relating to the Project in accordance with the SEARs and agency advice. Existing conditions flood modelling was undertaken for a range of events; 10%, 1%, 0.5%, and 0.2% AEP flood events and PMF for the Project Area to guide the planning of infrastructure and assess any external impacts.

This amended FIRA is based on a risk management approach and outlines operations for effective management across all four phases of disaster management:

- Prevention – the taking of preventative measures to reduce the likelihood of an event occurring or, if an event occurs, to reduce the severity of the event.
- Preparedness – the taking of preparatory measures to ensure that, if an event occurs, communities, resources and services are able to cope with the effects of the event.
- Response – the taking of appropriate measures to respond to an event, including action taken and measures planned in anticipation of, during and immediately after an event to ensure that its effects are minimised and that persons affected by the event are given immediate relief and support.
- Recovery – the taking of appropriate measures to recover from an event, including action taken to support disaster-affected communities in the reconstruction of infrastructure, the restoration of emotional, social, economic and physical wellbeing, and the restoration of the environment.

The amended FIRA has been conducted in accordance with the Australian Rainfall and Runoff 2019 guidelines. Comparison of the existing and developed scenarios, refer to the mapping provided within Appendix C, which shows no flood impact extends outside the Project Area, aside from:

- Upstream at the eastern flow path;
- Internally where diversion occurs upstream of the BESS; and
- Downstream of the western substation where a net decrease occurs.

There were no impacts on sensitive receptors or existing dwellings located nearby. The modelling indicates that the proposed solar farm does not cause significant external impacts in terms of water surface levels and peak discharges, and accordingly, no substantial mitigation measures such as detention basins are required. Additionally, proposed solar panels are within the bounds of low flooding risk (depth less than 0.9 metres and velocities less than 1 m/s), and other infrastructure, including the substation, is outside of the 1% AEP flood extent. The risk of adverse impacts to erosion and scour is considered minimal.

The amended FIRA includes a risk assessment based on the following tasks:

- Identification of risk;
- Analysis of risk;
- Evaluation of risk; and
- Identification and evaluation of risk amelioration options.

The Project would be remotely monitored and controlled from an offsite operations centre 24 hours a day. Up to four personnel are proposed to attend the site during business hours to undertake scheduled maintenance and inspection activities. Access from Goulburn requires the crossing of the Mulwaree River and Gundary Creek near the Hume Highway. The *Goulburn Flood Risk Management Study and Plan* (GFRMSP) (GRC, 2022) classifies Bungonia Road, near Forbes Street, as a H5 flood hazard during a 5% AEP Mulwaree River flood event. This demonstrates how access from Goulburn to the Project Area is not feasible during a Mulwaree River flood event which may submerge Bungonia

Road, and prevent access to site, for 24 – 36 hours. All personnel would be made aware of the need to evacuate site prior to a large Mulwaree River flood event. An Emergency Action Plan will be prepared in consultation with the NSW SES to be implemented in the event of flooding.

All proposed Project infrastructure are to be assessed for flood risk as part of detailed design, with infrastructure located outside the Gundary Creek's PMF flood extent. All electrical infrastructure will be located on hardstands built to a minimum of a 0.5% (1 in 200) AEP event. Additional freeboard and plinths will raise high-consequence equipment above the 0.2% (1 in 500) AEP flood level.

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10 ABREVIATIONS AND DEFINITIONS

Term/ Abbreviation	Definition
AEP (Annual Exceedance Probability)	Annual Exceedance Probability. The change of a flood of a given or large size occurring in any one year, usually expressed as a percentage. In this study AEP has been used consistently to define the probability of occurrence of flooding. The following relationships between AEP and ARI applies to this study (ARR, 2019).

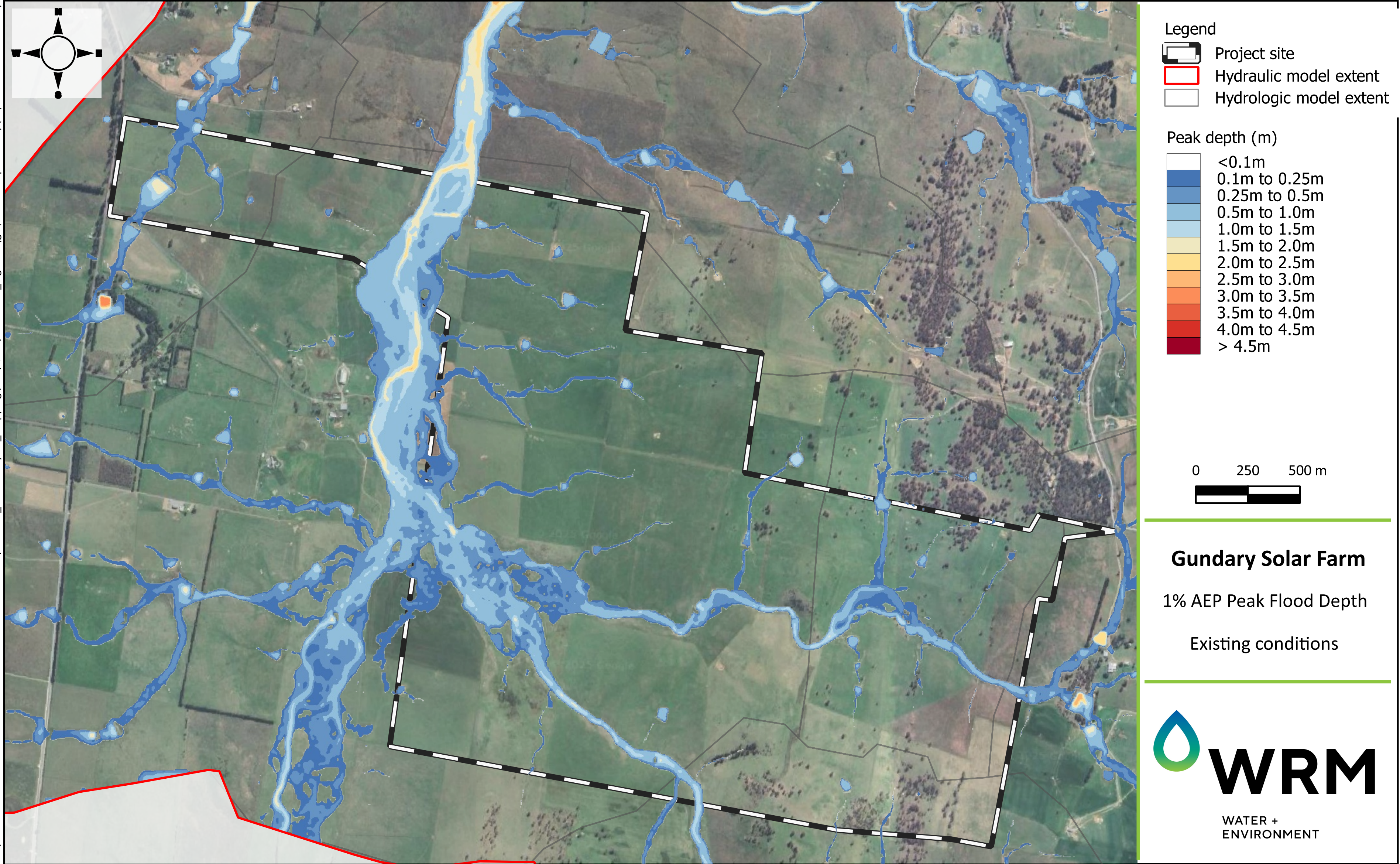
Frequency Descriptor	EY	AEP (%)	AEP (1 in x)	ARI
Very frequent	12			
	6	99.75	1.002	0.17
	4	98.17	1.02	0.25
	3	95.02	1.05	0.33
	2	86.47	1.16	0.50
	1	63.2	1.58	1.00
Frequent	0.69	50.00	2	1.44
	0.5	39.35	2.54	2.00
	0.22	20.00	5	4.48
	0.2	18.13	5.52	5.00
Infrequent	0.11	10.00	10.00	9.49
	0.05	5.00	20	20.0
	0.02	2.00	50	50.0
	0.01	1.00	100	100
Rare	0.005	0.50	200	200
	0.002	0.20	500	500
	0.001	0.10	1000	1000
	0.0005	0.05	2000	2000
Extremely Rare	0.0002	0.02	5000	5000
			↓	
Extreme			PMP	

Term/ Abbreviation	Definition
AHD	Australian Height Datum. A common national surface level datum approximately corresponding to mean sea level.
ARR	Australian Rainfall and Runoff. Guidelines prepared by the Engineers Australia for the estimation of design floods.
BESS	Battery Energy Storage System.
Development footprint	The maximum extent of ground disturbance associated with the construction and operation of the Project.
Discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).

Term/ Abbreviation	Definition
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
Flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future and continuing risks. They are described below: Existing flood risk: the risk a community is exposed to as a result of its location on the floodplain. Future flood risk: the risk a community may be exposed to as a result of new development on the floodplain.
Flood storage areas	Those parts of the floodplain that are important for the temporary storage of floodwaters during passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.
Floodplain	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is flood prone land.
Hazard	A source of potential harm or situation with a potential to cause loss. In relation to this manual the hazard is flooding which has the potential to cause damage to the community.
Hydrology	The study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
m AHD	Metres Australian Height Datum (AHD).
m^3/s	Cubic metres per second or “cumecs”. A unit of measurement of creek or river flows or discharges. It is the rate of flow of water measured in terms of volume per unit time.
PMF (Probable maximum flood)	The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The probable maximum flood defines the extent of flood prone land, that is, the floodplain.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual, it is the likelihood of consequences arising from the interaction of floods, communities, and the environment.
Runoff	The amount of rainfall which ends up as a streamflow, also known as rainfall excess.
Scour	Erosion by mechanical action of water, typically of soil.

Term/ Abbreviation	Definition
Sensitive receiver	Non-involved dwellings in proximity to the Project Area that may be sensitive to noise, visual, traffic and other impacts. Potential impacts to sensitive receivers are investigated in the EIS.

APPENDIX A EXISTING CASE RESULTS



Gundary Solar Farm

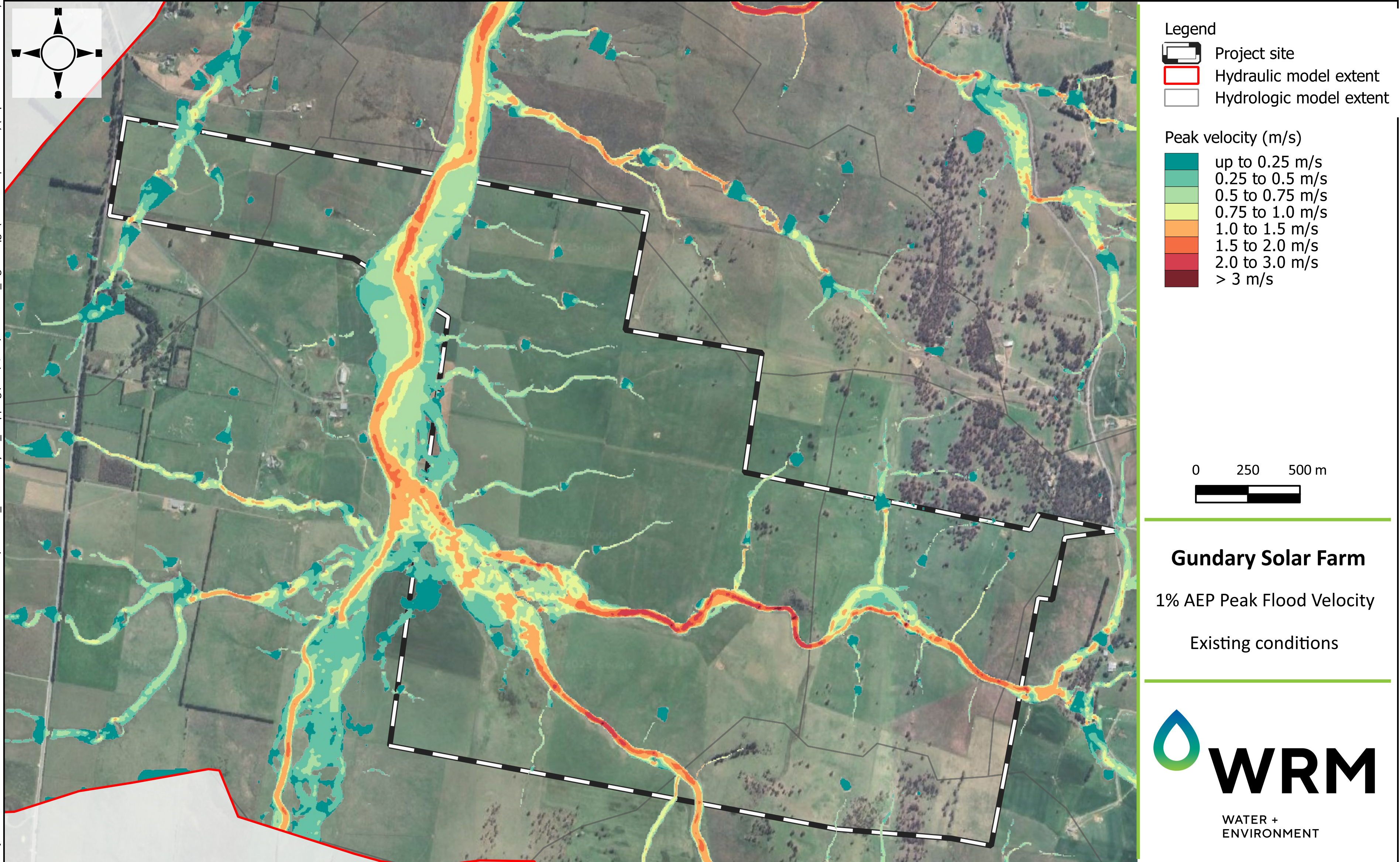
1% AEP Peak Flood Depth

Existing conditions

WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Gundary Solar Farm

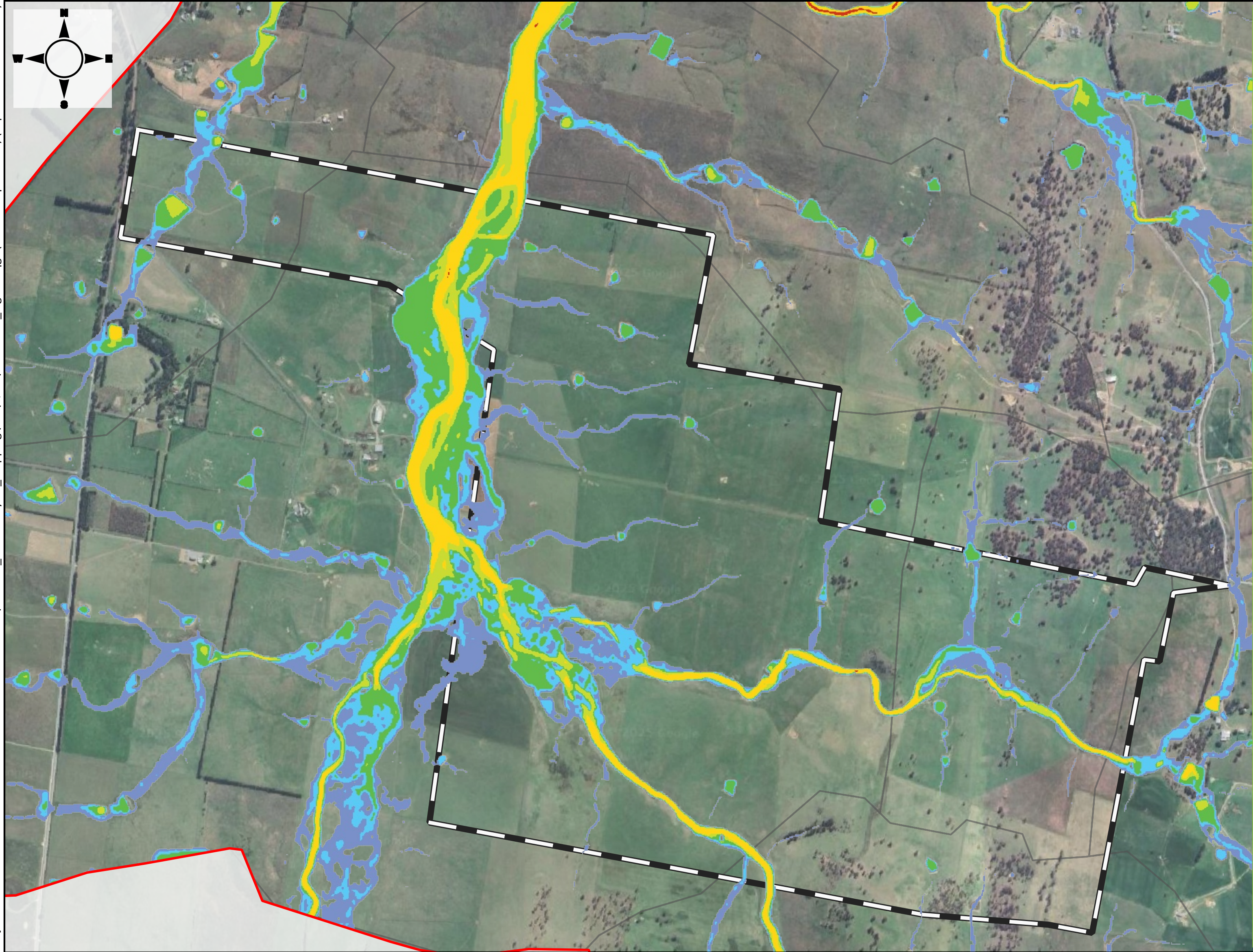
1% AEP Peak Flood Velocity

Existing conditions

WRM WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Legend

Project site

Hydraulic model extent

Hydrologic model extent

Hazard

H1

H2

H3

H4

H5

H6

0 250 500 m

Gundary Solar Farm

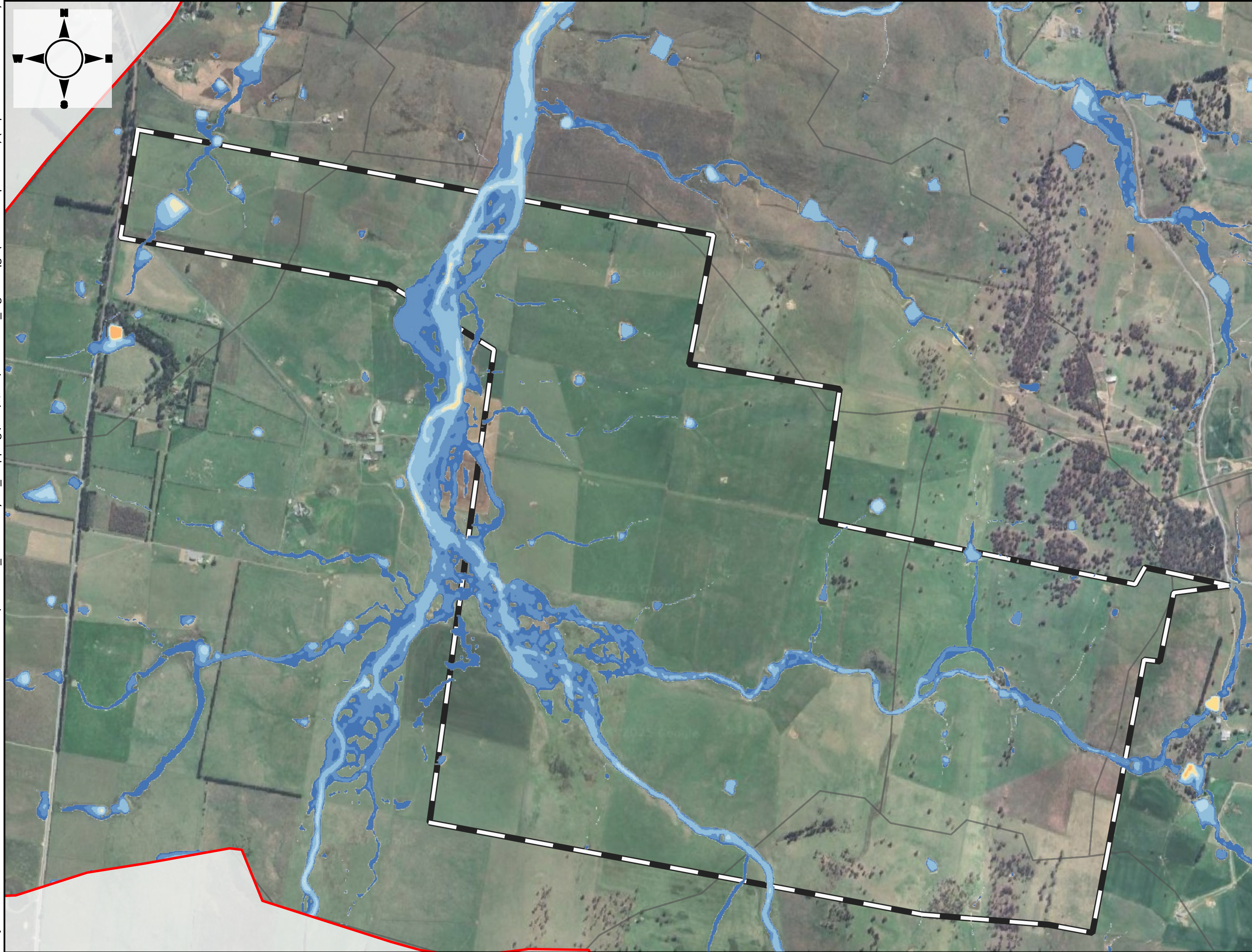
1% AEP Peak Flood Hazard

Existing conditions

WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Legend

Project site

Hydraulic model extent

Hydrologic model extent

Peak depth (m)

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- 1.5m to 2.0m
- 2.0m to 2.5m
- 2.5m to 3.0m
- 3.0m to 3.5m
- 3.5m to 4.0m
- 4.0m to 4.5m
- > 4.5m

0 250 500 m

Gundary Solar Farm

10% AEP Peak Flood Depth

Existing conditions

WRM WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

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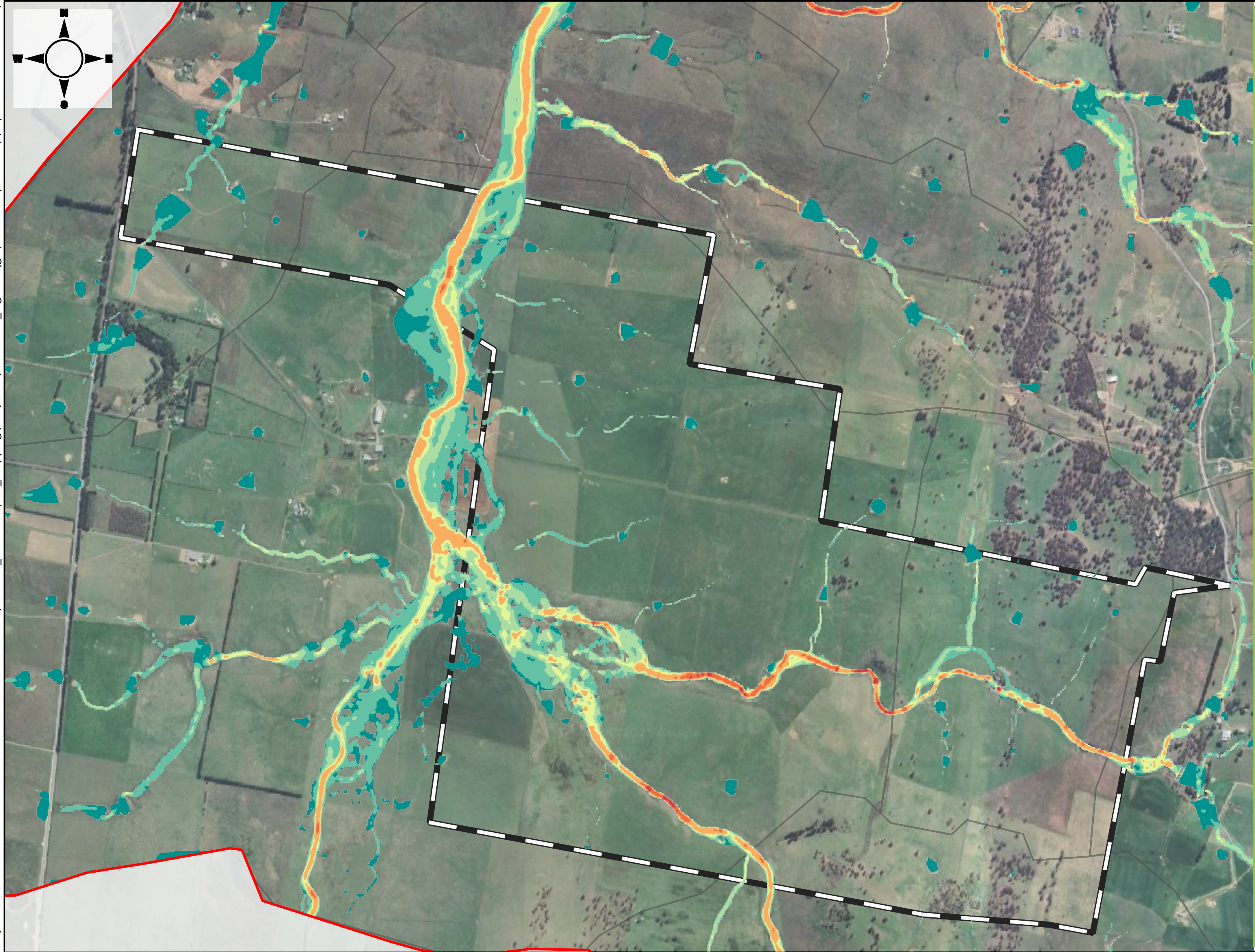


J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

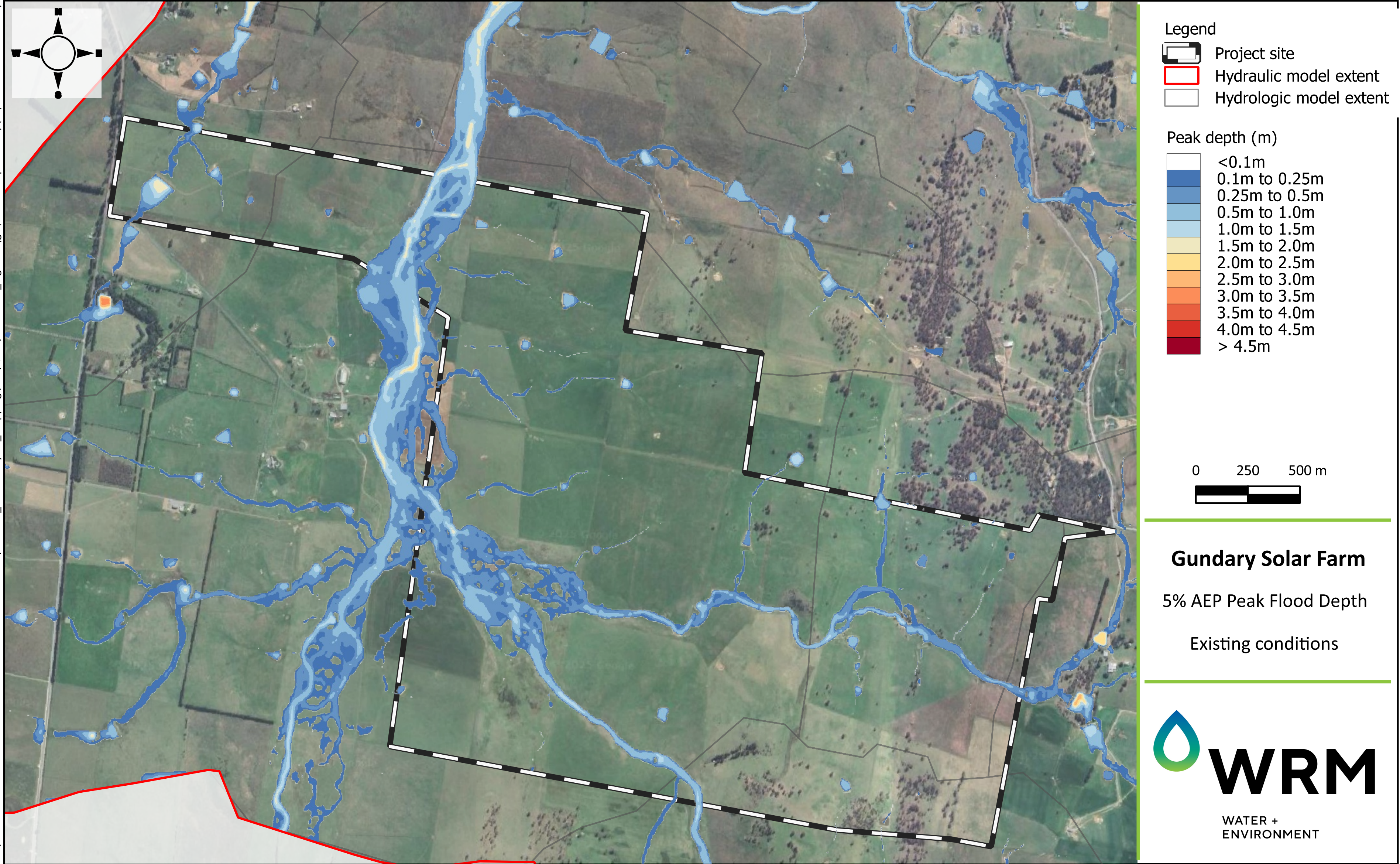
Projection: EPSG:7855

Gundary Solar Farm

10% AEP Peak Flood Velocity

Existing conditions

WRM WATER + ENVIRONMENT



Gundary Solar Farm

5% AEP Peak Flood Depth

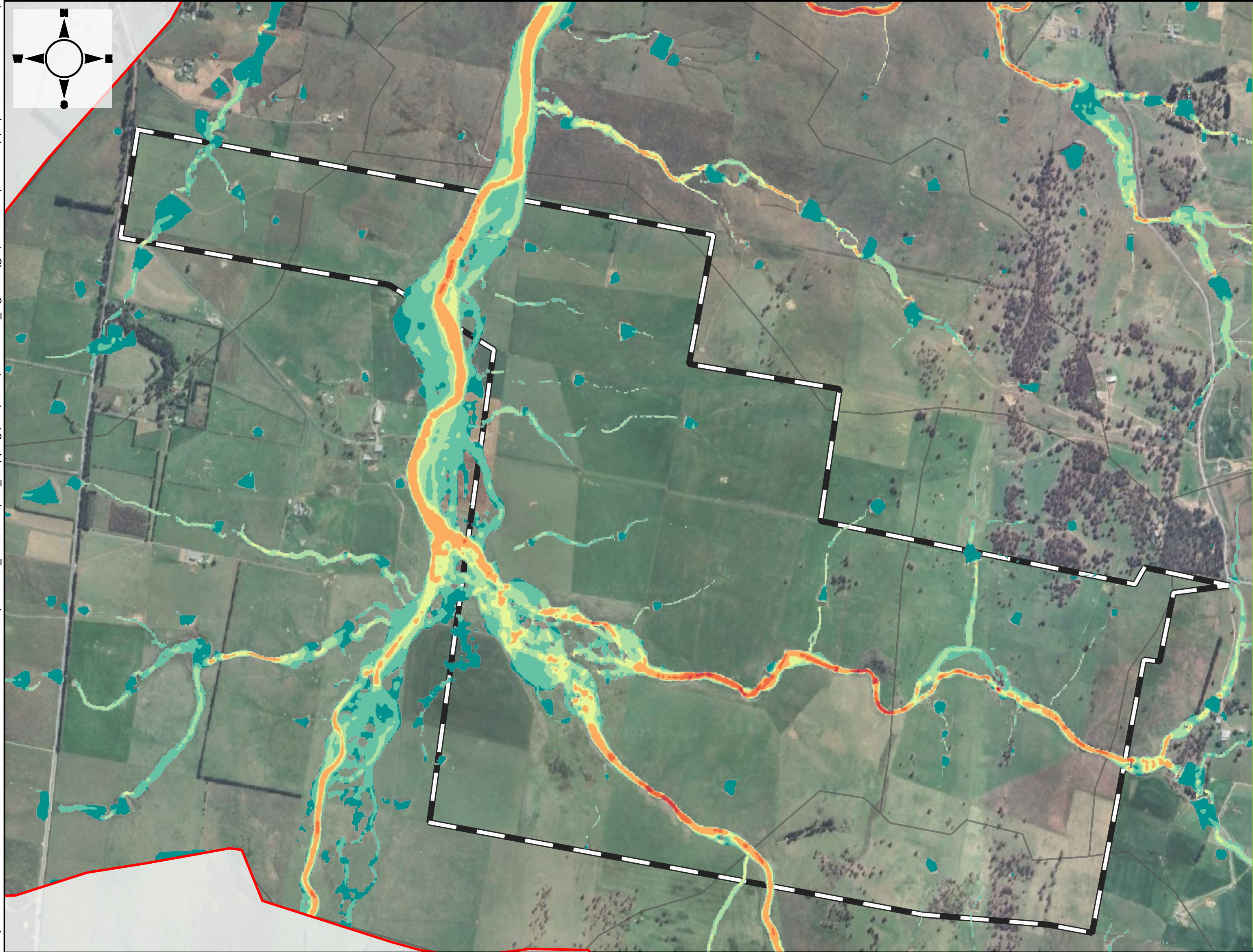
Existing conditions

WRM

WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Gundary Solar Farm

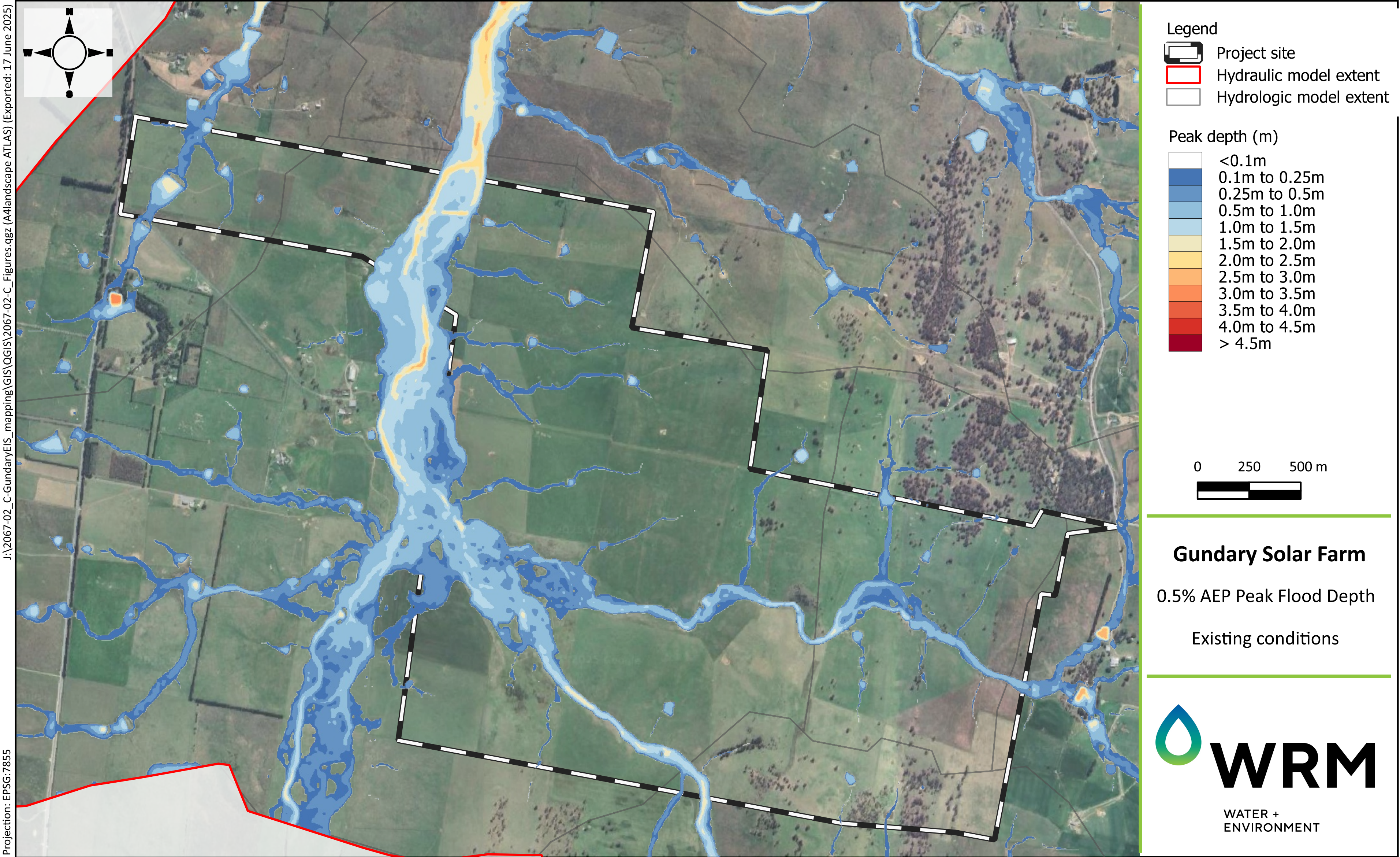
5% AEP Peak Flood Velocity

Existing conditions

WRM WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855

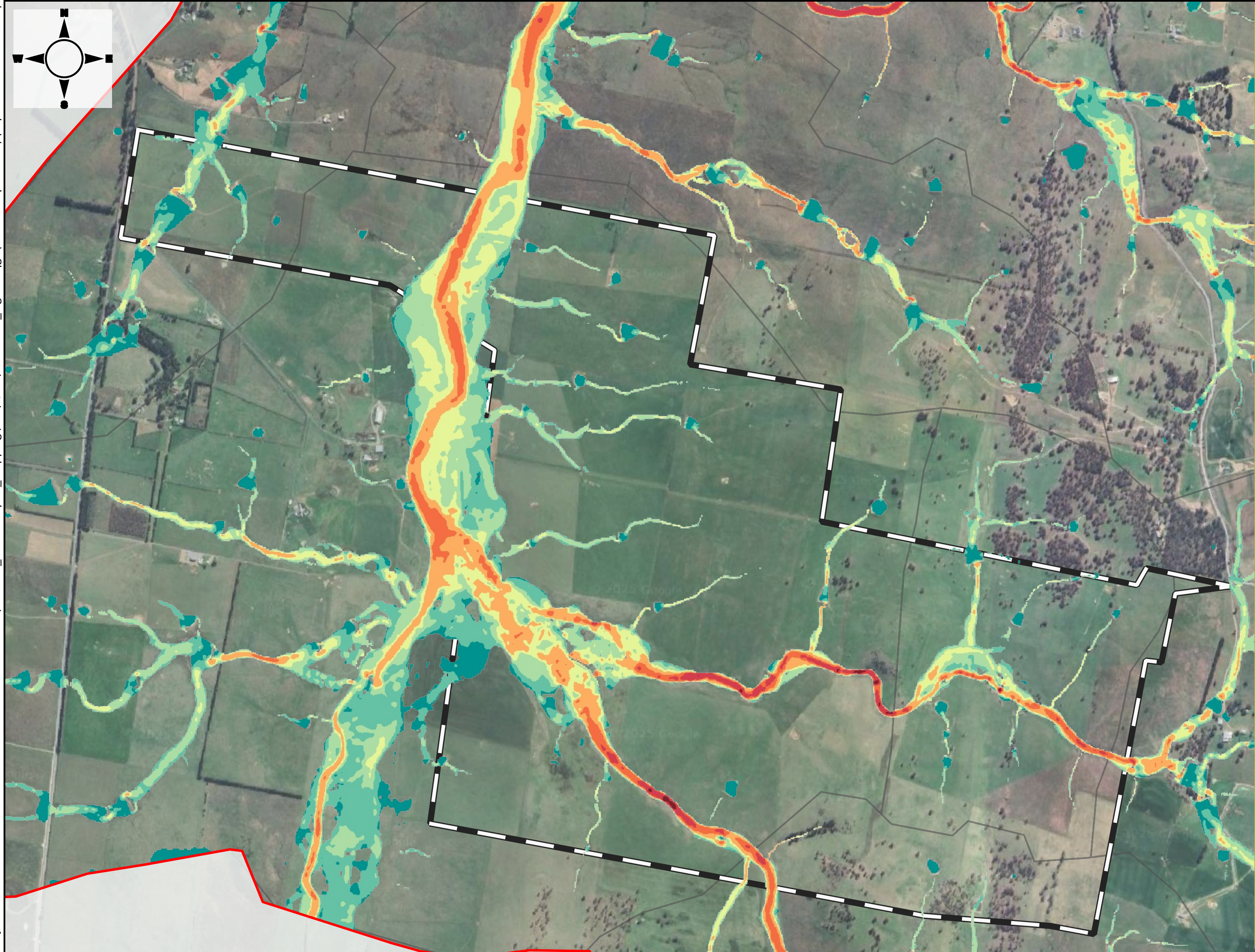


Gundary Solar Farm

0.5% AEP Peak Flood Depth

Existing conditions

WRM WATER + ENVIRONMENT



Legend
Project site
Hydraulic model extent
Hydrologic model extent

Peak velocity (m/s)
up to 0.25 m/s
0.25 to 0.5 m/s
0.5 to 0.75 m/s
0.75 to 1.0 m/s
1.0 to 1.5 m/s
1.5 to 2.0 m/s
2.0 to 3.0 m/s
> 3 m/s

0 250 500 m

Gundary Solar Farm

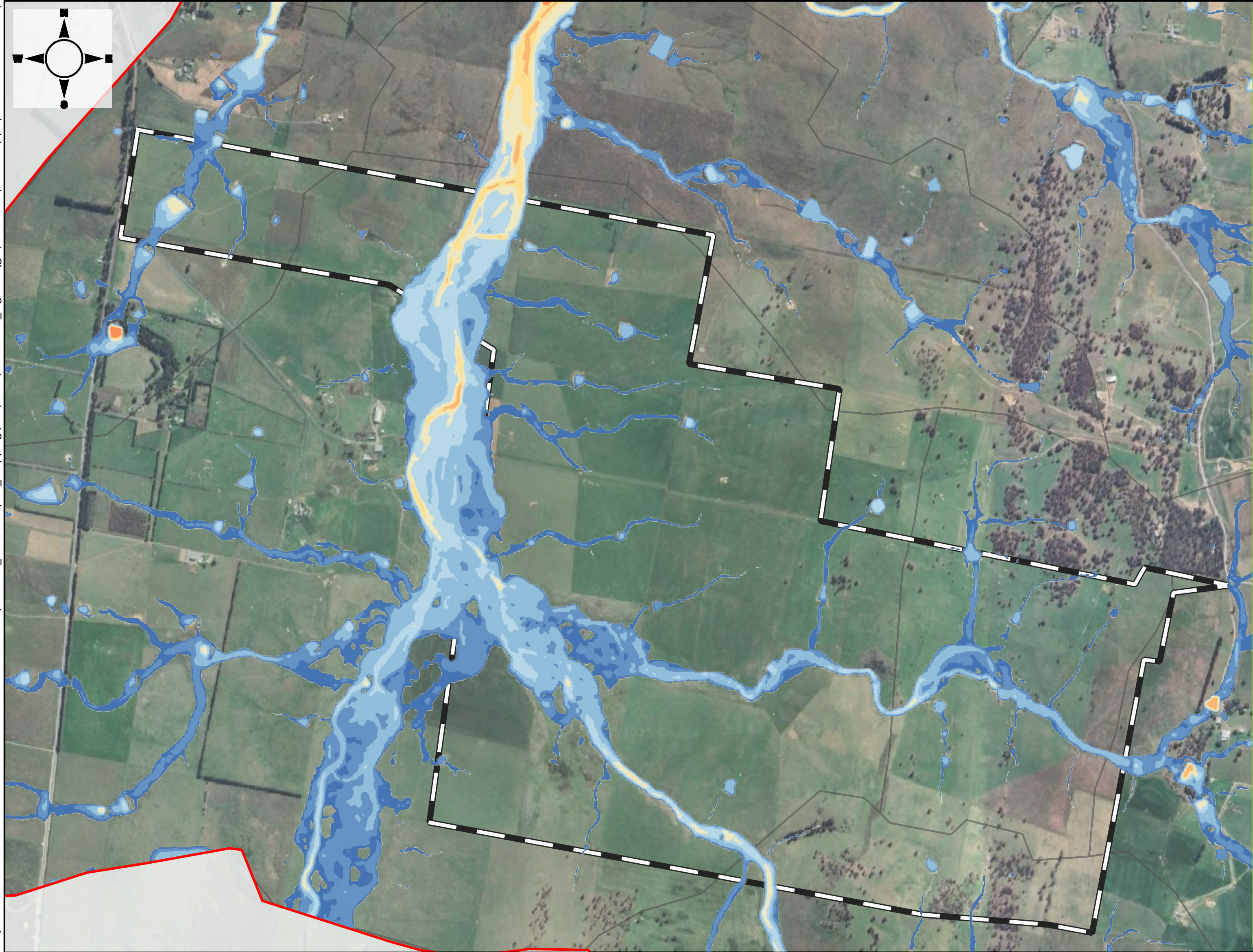
0.5% AEP Peak Flood Velocity

Existing conditions

WRM
WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Gundary Solar Farm

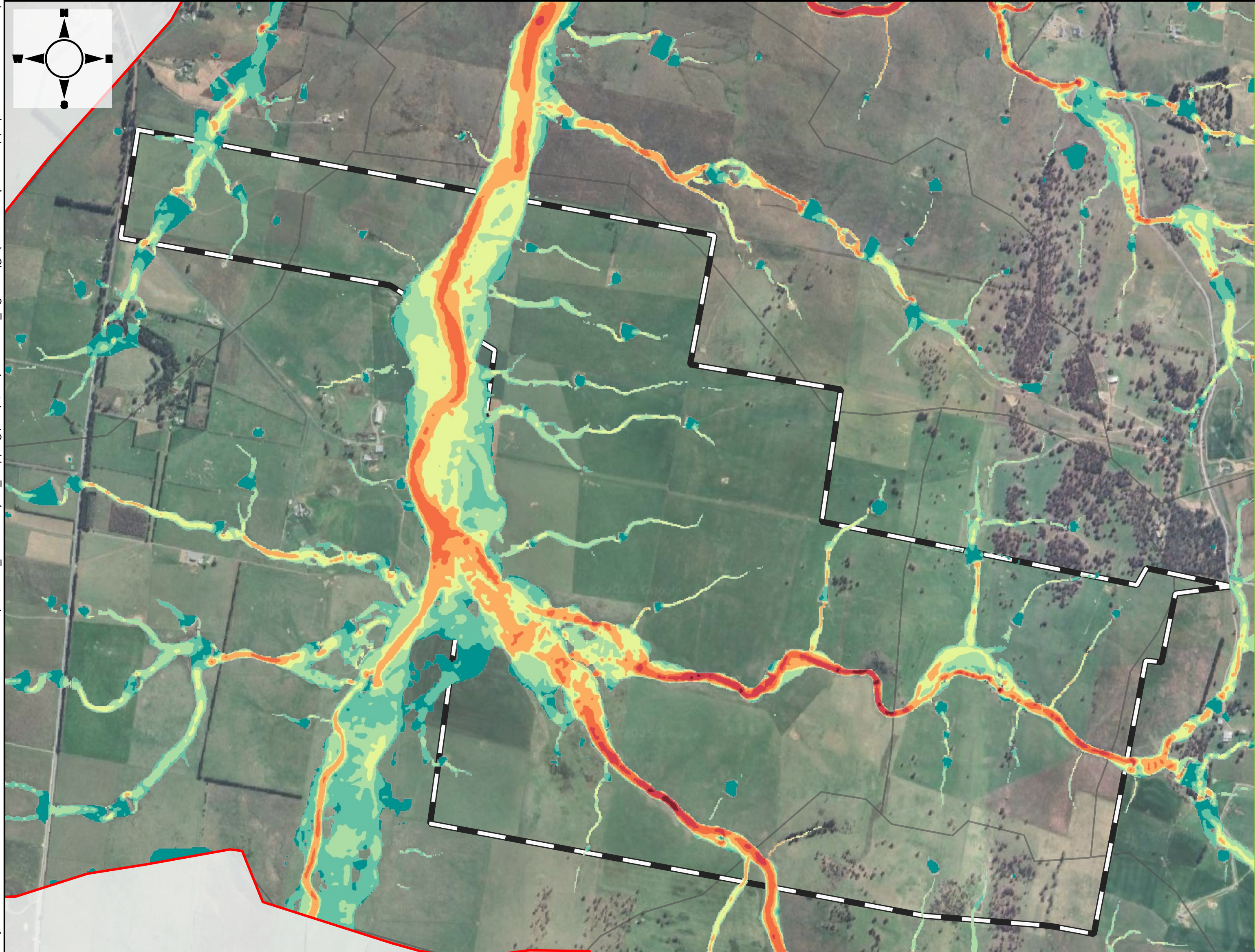
0.2% AEP Peak Flood Depth

Existing conditions

WRM WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Gundary Solar Farm

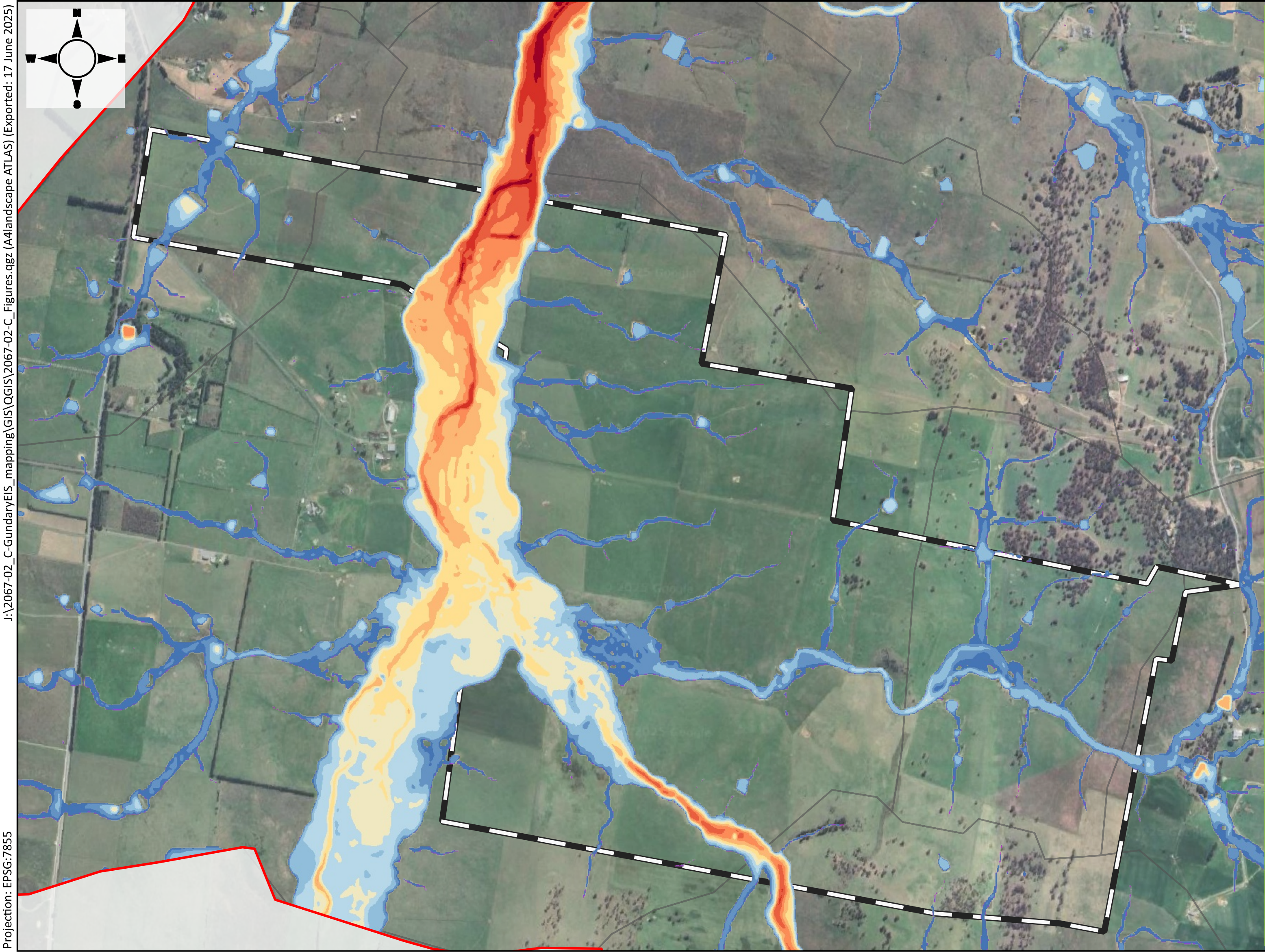
0.2% AEP Peak Flood Velocity

Existing conditions

WRM
WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Legend

- Project site
- Hydraulic model extent
- Hydrologic model extent

Peak depth (m)

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- 1.5m to 2.0m
- 2.0m to 2.5m
- 2.5m to 3.0m
- 3.0m to 3.5m
- 3.5m to 4.0m
- 4.0m to 4.5m
- > 4.5m

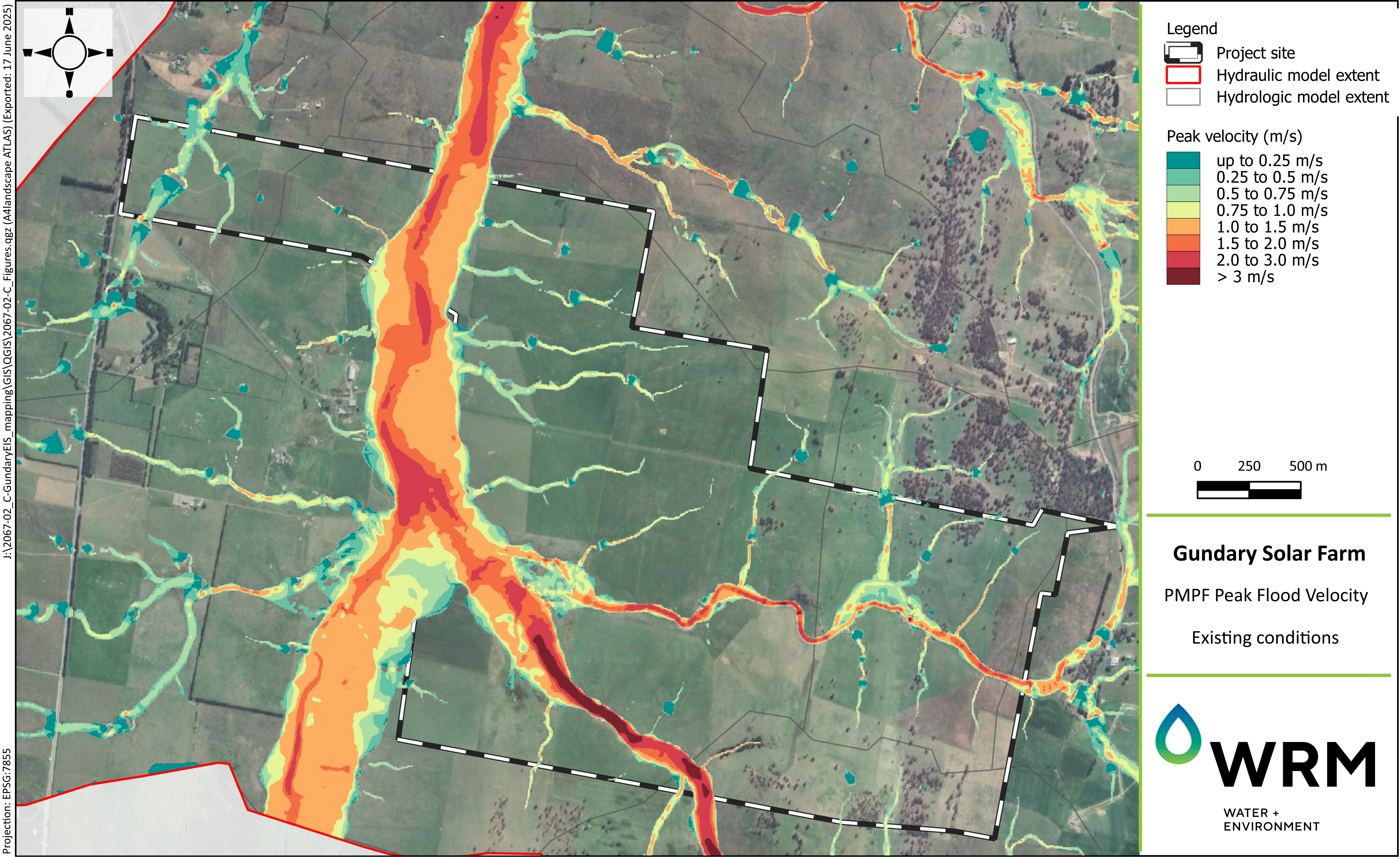
0 250 500 m

Gundary Solar Farm

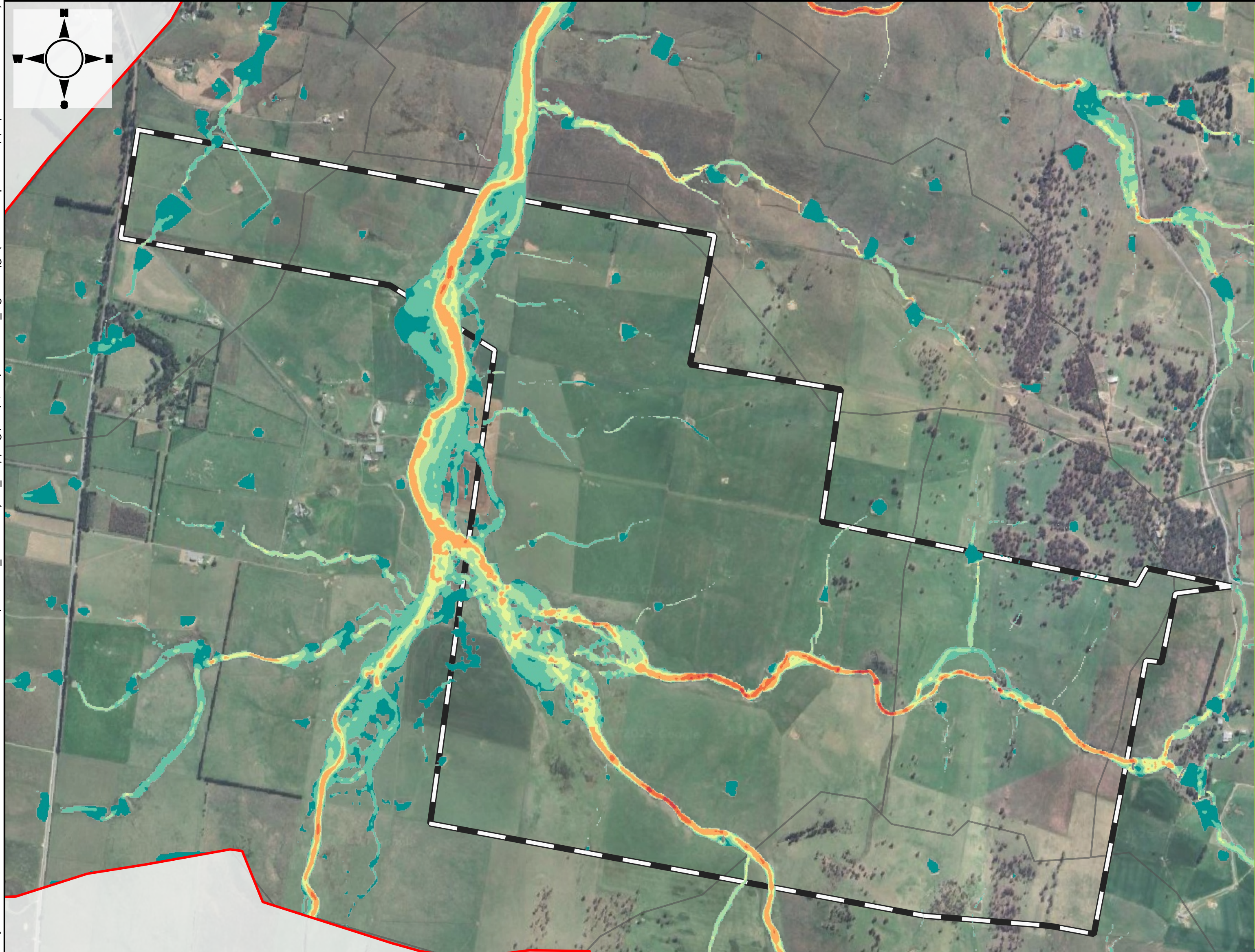
PMPF Peak Flood Depth

Existing conditions

WRM WATER + ENVIRONMENT


Legend
Project site
Hydraulic model extent
Hydrologic model extent
Peak velocity (m/s)
up to 0.25 m/s
0.25 to 0.5 m/s
0.5 to 0.75 m/s
0.75 to 1.0 m/s
1.0 to 1.5 m/s
1.5 to 2.0 m/s
2.0 to 3.0 m/s
> 3 m/s
0 250 500 m
Gundary Solar Farm
PMPF Peak Flood Velocity
Existing conditions
WRM
WATER + ENVIRONMENT
J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)
Projection: EPSG:7855

APPENDIX B MAY 2024 DESIGN CONFIGUREATION RESULTS



Gundary Solar Farm

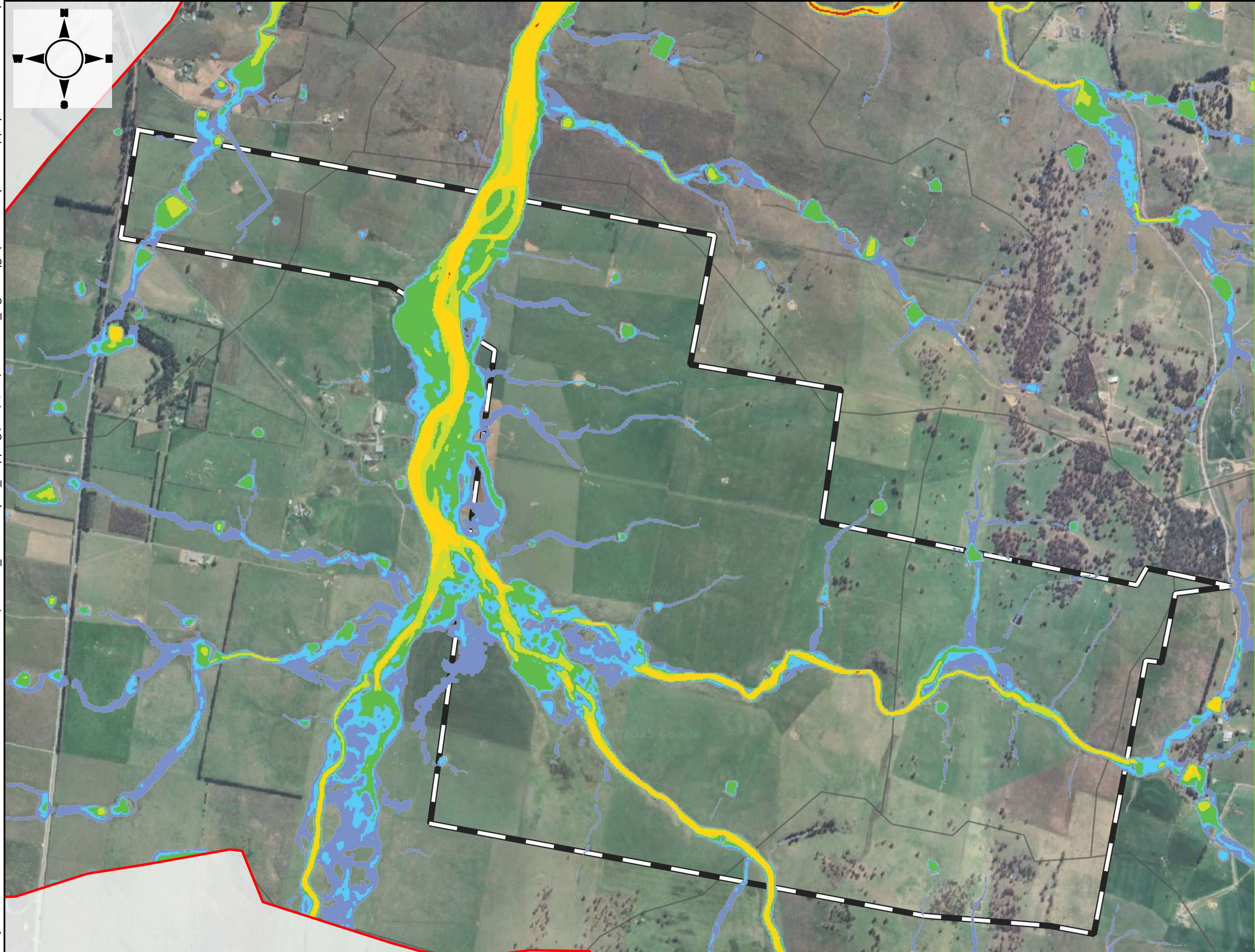
10% AEP Peak Flood Velocity

Developed conditions

WRM WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Legend
- Project site
- Hydraulic model extent
- Hydrologic model extent

Hazard
- H1
- H2
- H3
- H4
- H5
- H6

0 250 500 m

Gundary Solar Farm

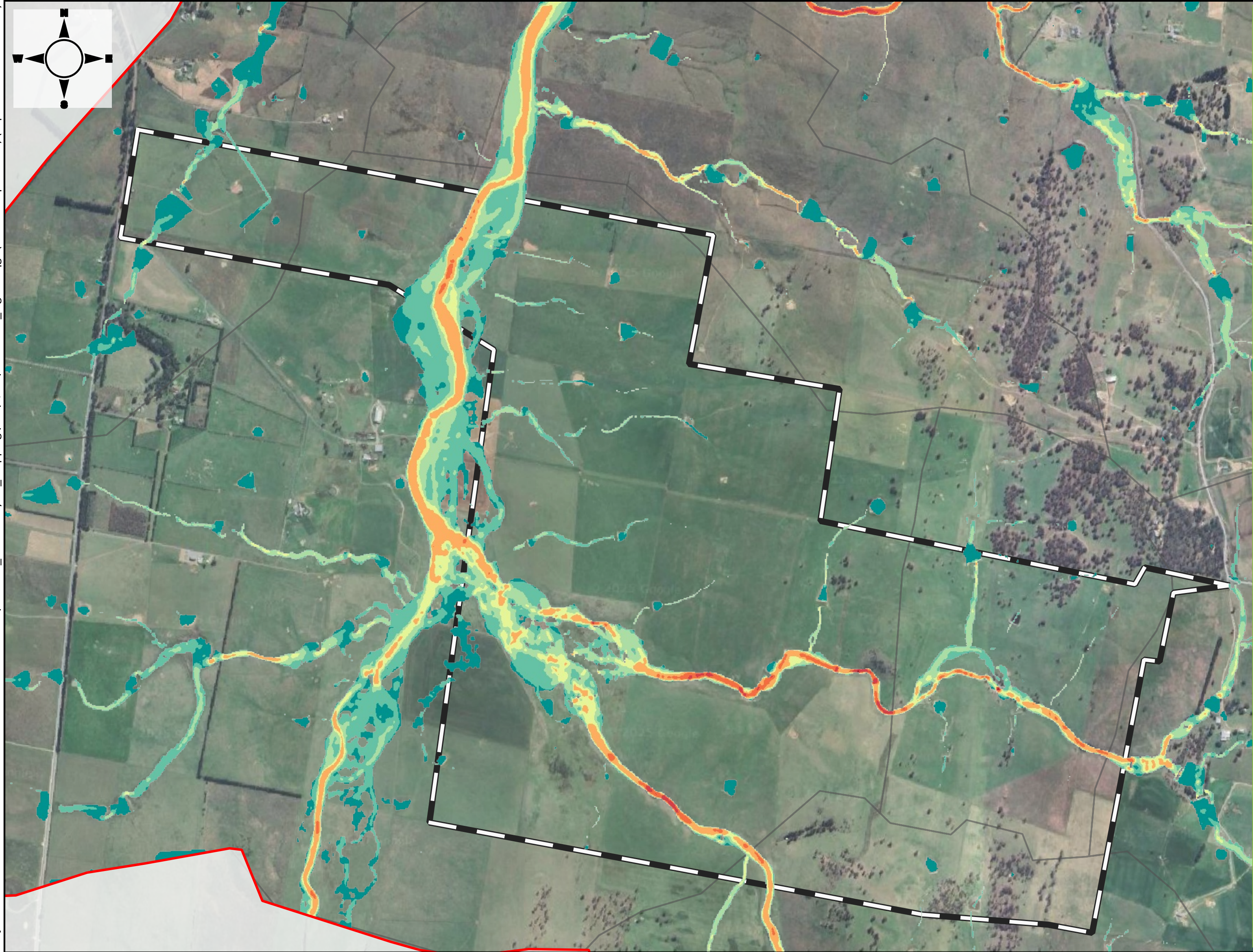
1% AEP Peak Flood Hazard

Developed conditions

WRM
WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Legend
Project site
Hydraulic model extent
Hydrologic model extent

Peak velocity (m/s)
up to 0.25 m/s
0.25 to 0.5 m/s
0.5 to 0.75 m/s
0.75 to 1.0 m/s
1.0 to 1.5 m/s
1.5 to 2.0 m/s
2.0 to 3.0 m/s
> 3 m/s

0 250 500 m

Gundary Solar Farm

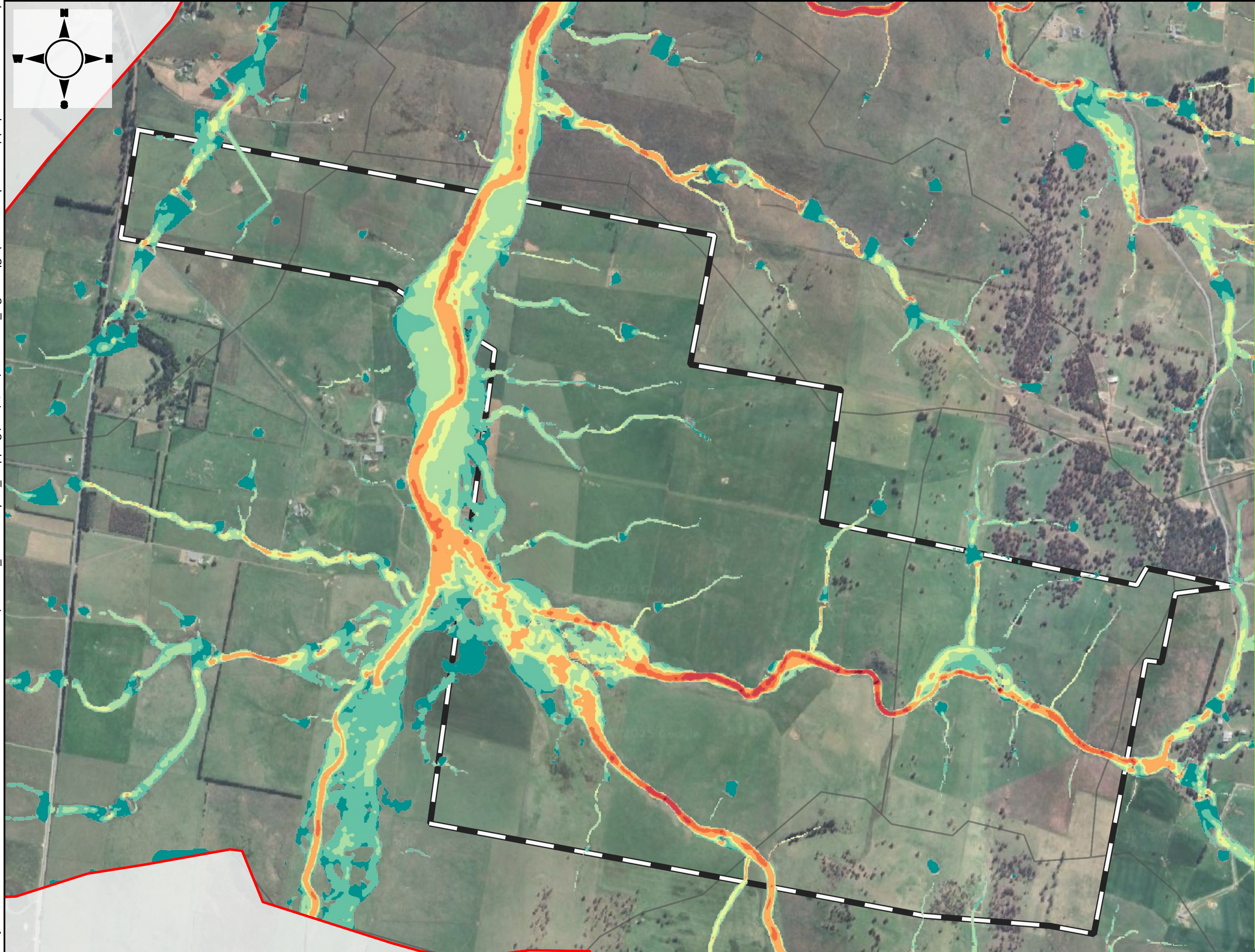
5% AEP Peak Flood Velocity

Developed conditions

WRM
WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Legend

Project site

Hydraulic model extent

Hydrologic model extent

Peak velocity (m/s)

up to 0.25 m/s

0.25 to 0.5 m/s

0.5 to 0.75 m/s

0.75 to 1.0 m/s

1.0 to 1.5 m/s

1.5 to 2.0 m/s

2.0 to 3.0 m/s

> 3 m/s

0 250 500 m

Gundary Solar Farm

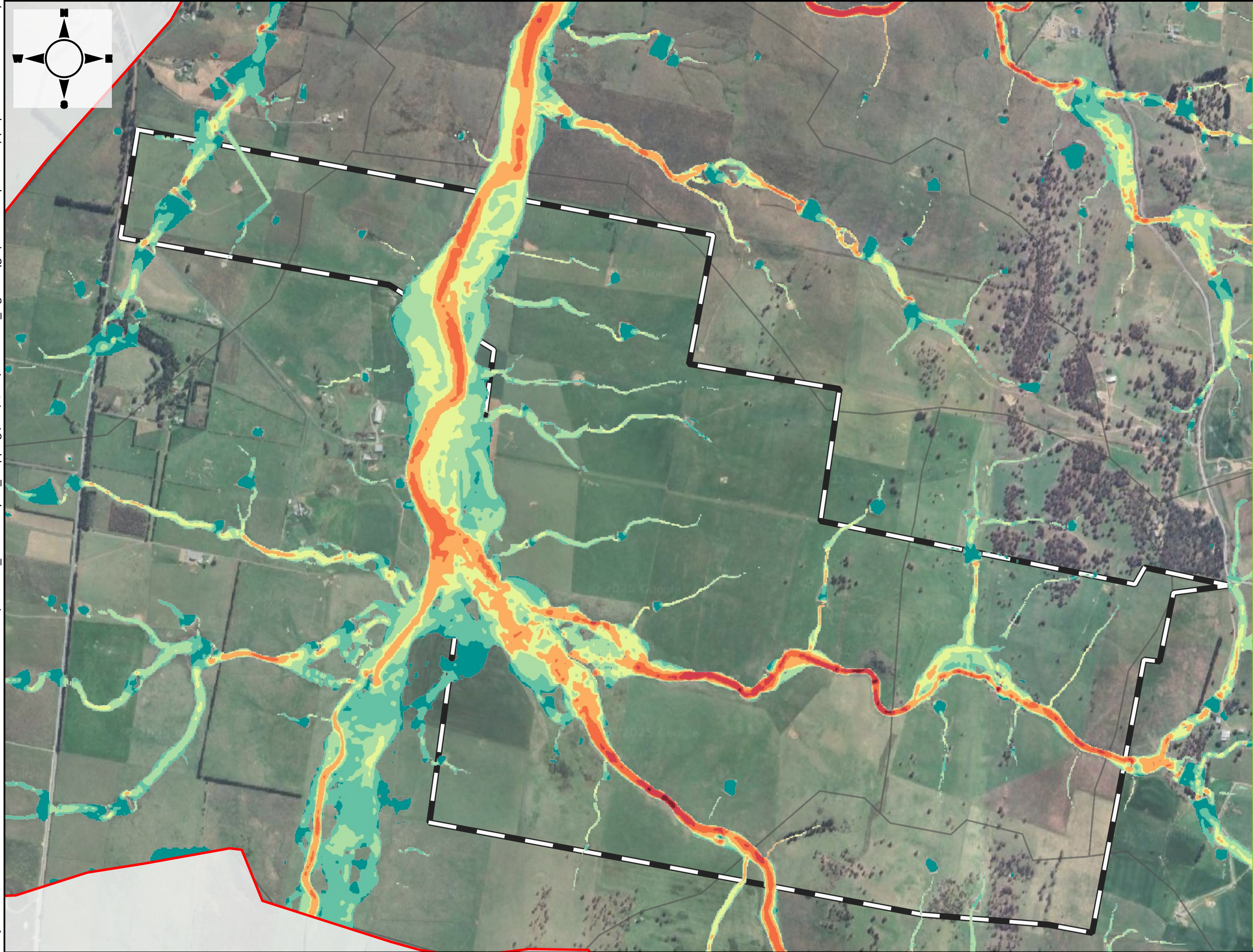
1% AEP Peak Flood Velocity

Developed conditions

WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Gundary Solar Farm

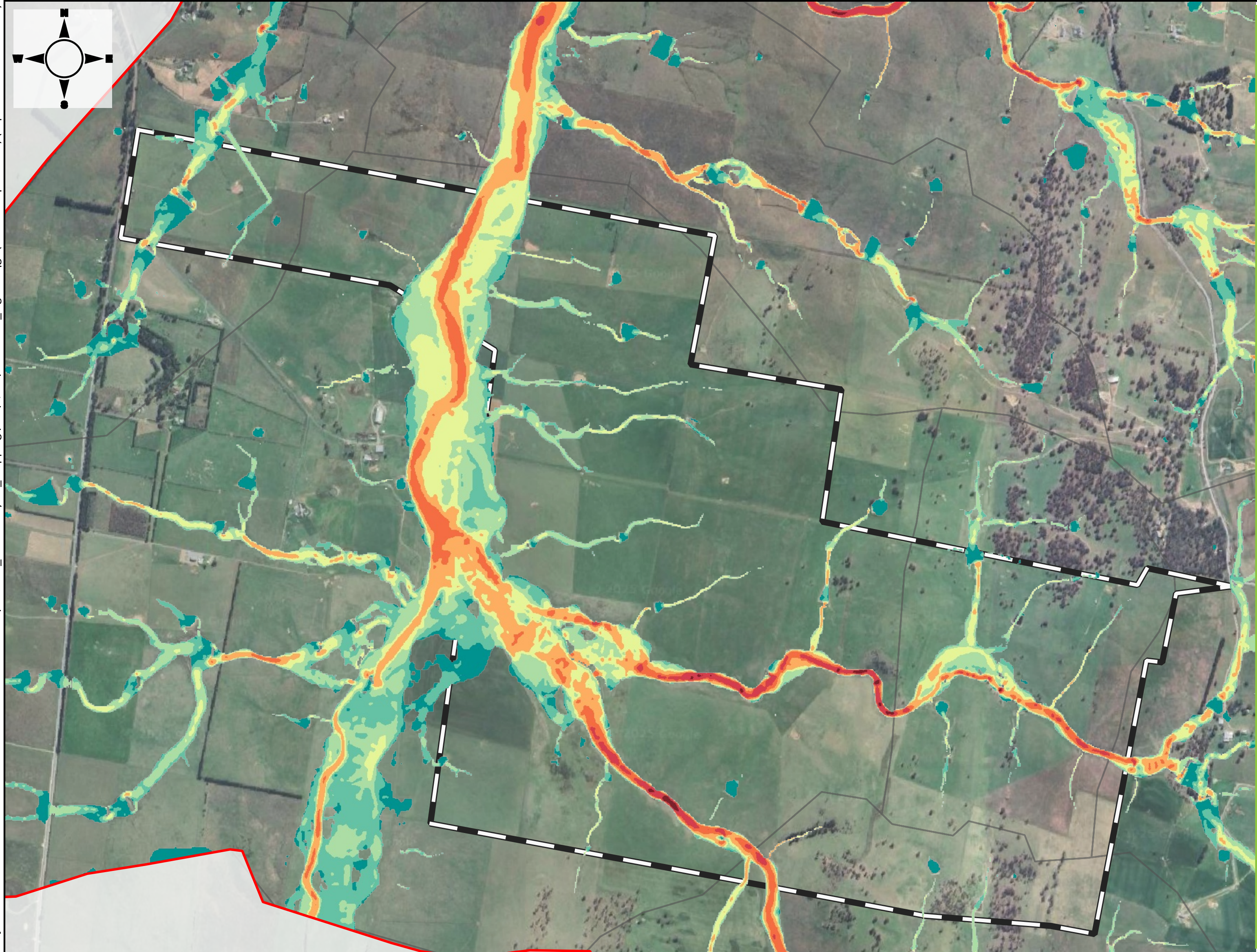
0.5% AEP Peak Flood Velocity

Developed conditions

WRM WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Gundary Solar Farm

0.2% AEP Peak Flood Velocity

Developed conditions

WRM WATER + ENVIRONMENT

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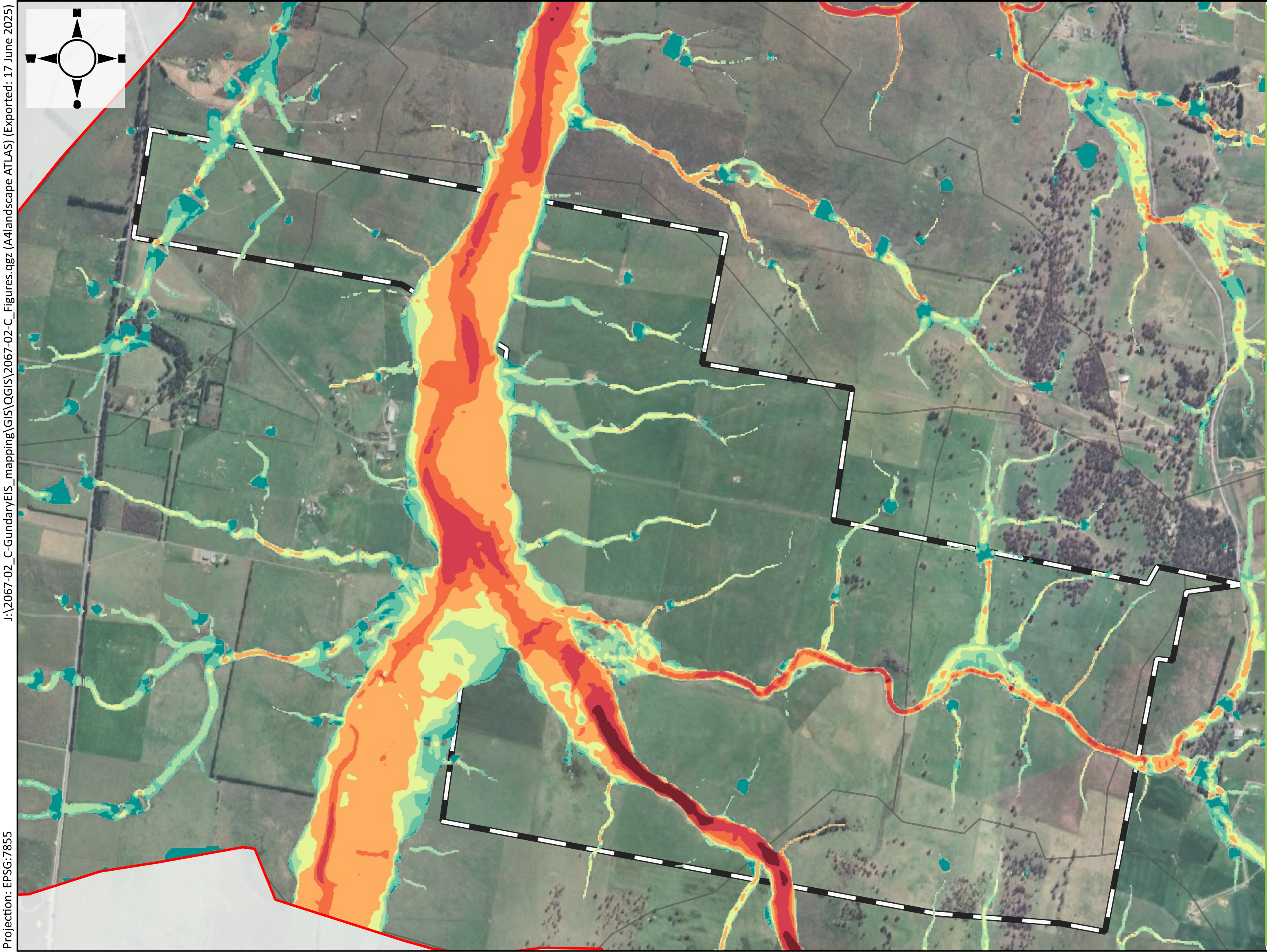
Projection: EPSG:7855



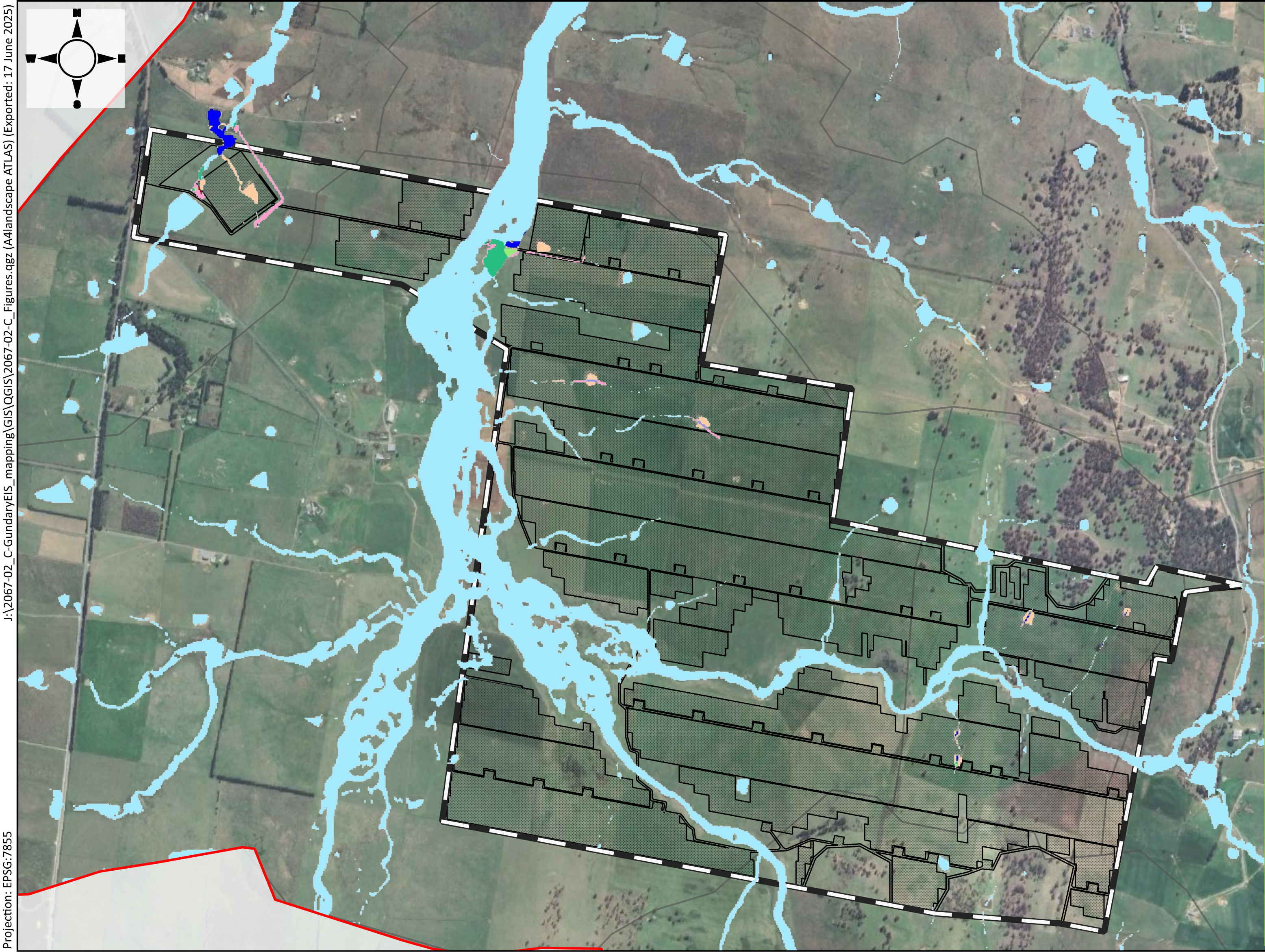
Gundary Solar Farm

PMPF Peak Flood Velocity

Developed conditions

WRM
WATER + ENVIRONMENT

APPENDIX C FLOOD IMPACT OF MAY 2024 DESIGN

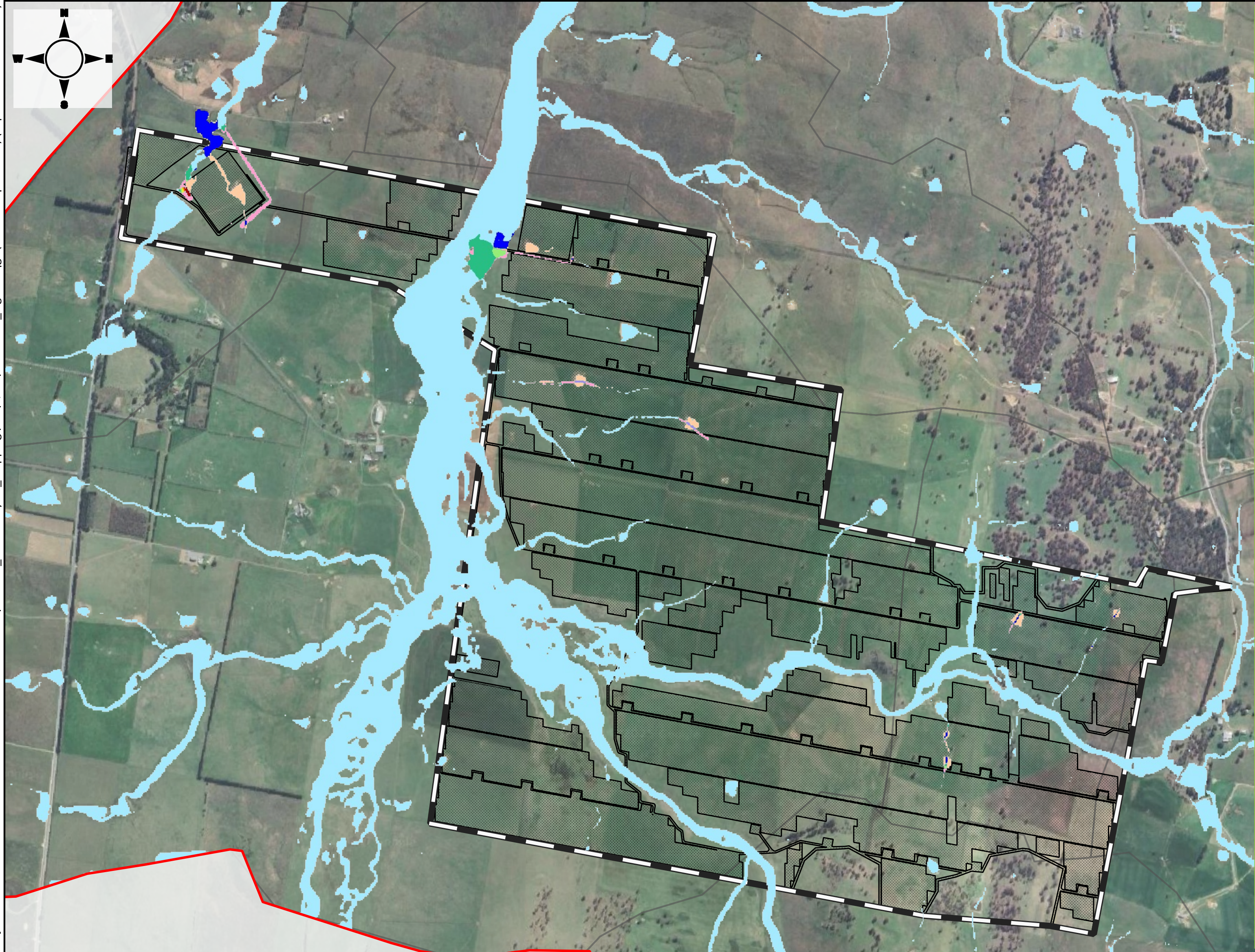


Gundary Solar Farm

10% AEP Afflux

Developed minus existing conditions

WRM WATER + ENVIRONMENT



Legend
- Project site
- Hydraulic model extent
- Hydrologic model extent

Afflux (m)
- < 1.00 m
- -1.00 m to -0.01 m
- -0.01 m to 0.01 m
- 0.01 m to 0.10 m
- 0.10 m to 0.20 m
- 0.20 m to 0.30 m
- 0.30 m to 0.40 m
- 0.40 m to 0.50 m
- 0.50 m to 1.00 m
- 1.00 m to 5.00 m
- > 5.00 m
- Was wet, now dry
- Was dry, now wet

0 250 500 m

Gundary Solar Farm

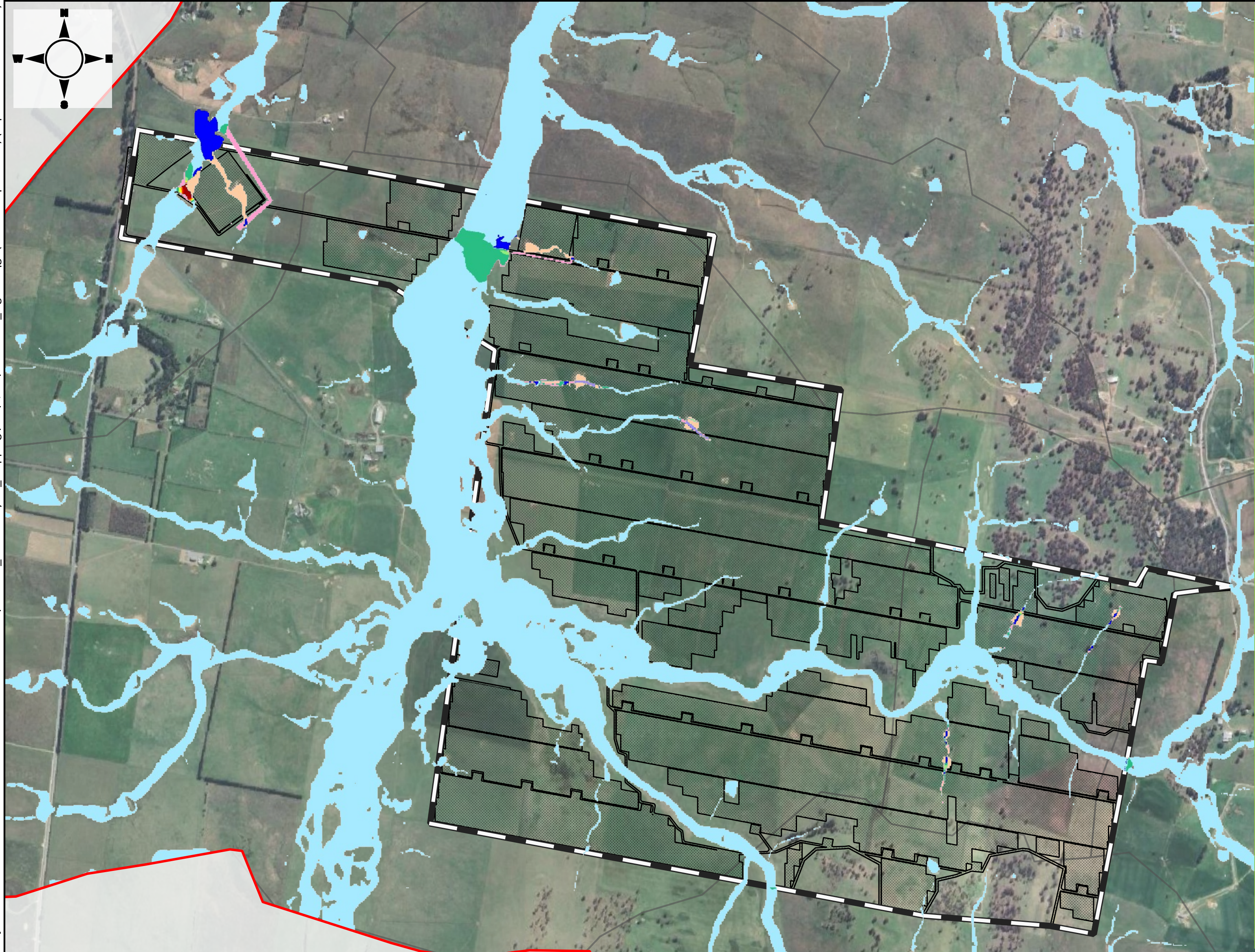
5% AEP Afflux

Developed minus existing conditions

WRM WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Legend

- Project site
- Hydraulic model extent
- Hydrologic model extent

Afflux (m)

- < 1.00 m
- -1.00 m to -0.01 m
- -0.01 m to 0.01 m
- 0.01 m to 0.10 m
- 0.10 m to 0.20 m
- 0.20 m to 0.30 m
- 0.30 m to 0.40 m
- 0.40 m to 0.50 m
- 0.50 m to 1.00 m
- 1.00 m to 5.00 m
- > 5.00 m
- Was wet, now dry
- Was dry, now wet

0 250 500 m

Gundary Solar Farm

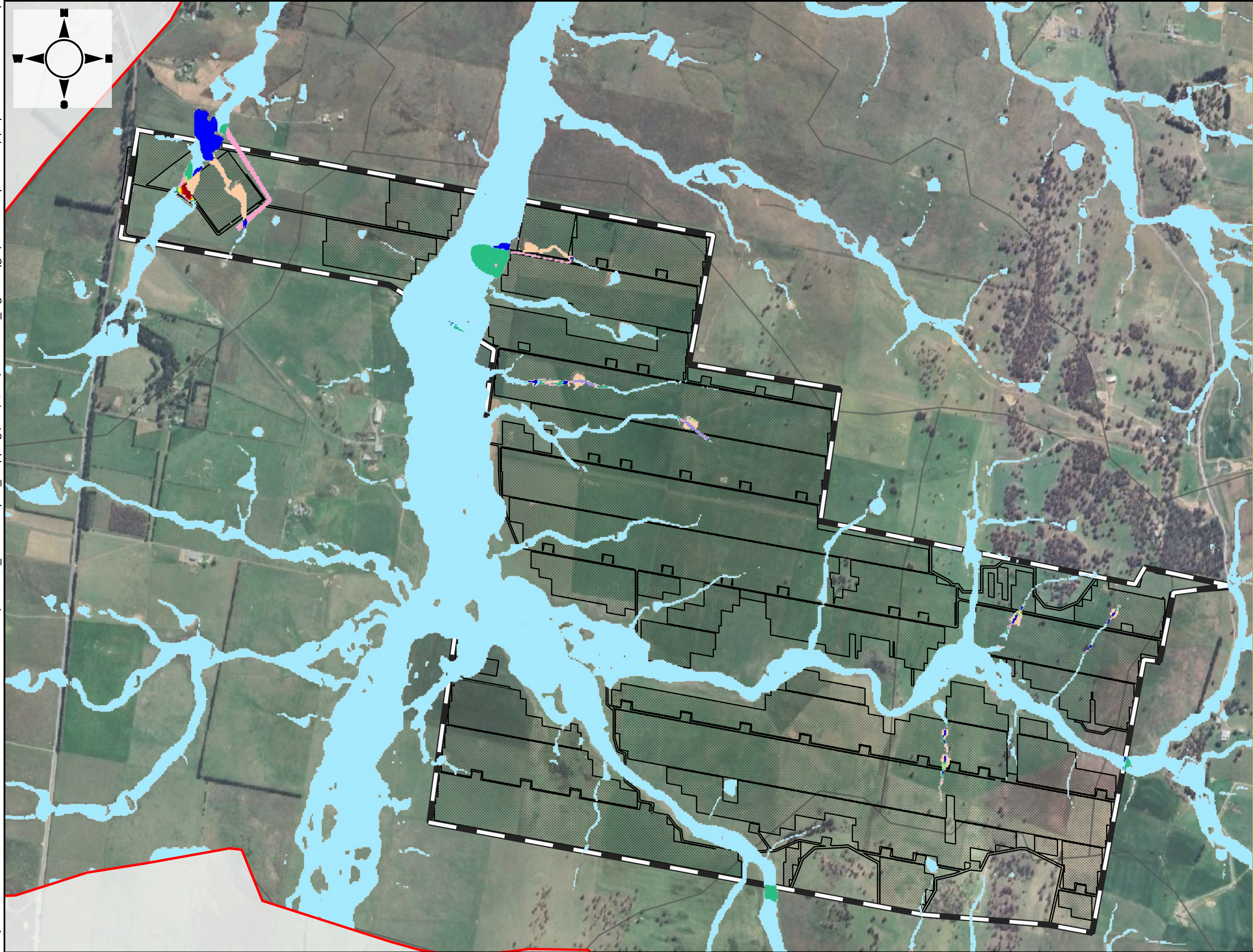
1% AEP Afflux

Developed minus existing conditions

WRM
WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Legend

Project site

Hydraulic model extent

Hydrologic model extent

Afflux (m)

- < 1.00 m
- -1.00 m to -0.01 m
- -0.01 m to 0.01 m
- 0.01 m to 0.10 m
- 0.10 m to 0.20 m
- 0.20 m to 0.30 m
- 0.30 m to 0.40 m
- 0.40 m to 0.50 m
- 0.50 m to 1.00 m
- 1.00 m to 5.00 m
- > 5.00 m
- Was wet, now dry
- Was dry, now wet

0 250 500 m

Gundary Solar Farm

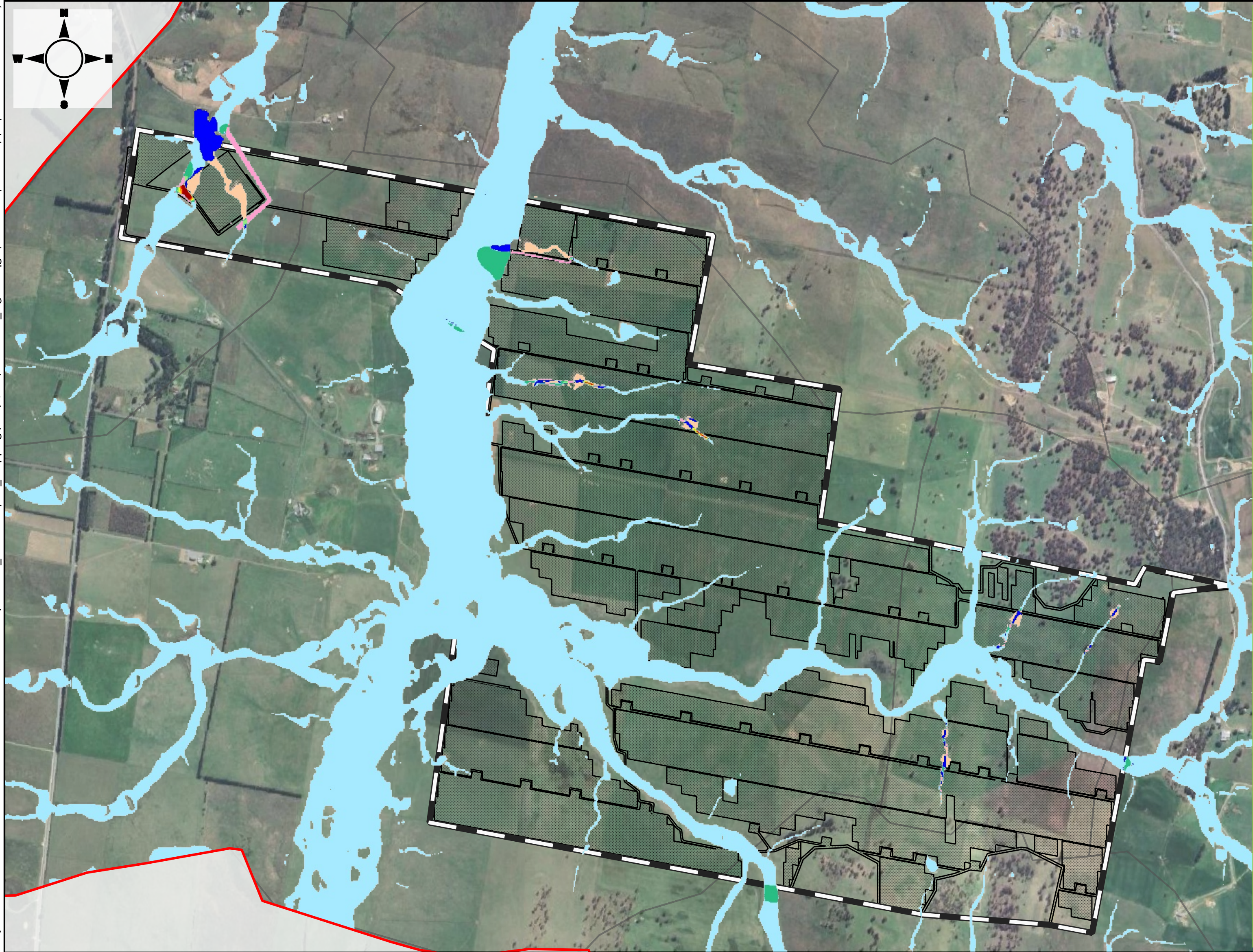
0.5% AEP Afflux

Developed minus existing conditions

WRM WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Legend

- Project site
- Hydraulic model extent
- Hydrologic model extent

Afflux (m)

- < 1.00 m
- -1.00 m to -0.01 m
- -0.01 m to 0.01 m
- 0.01 m to 0.10 m
- 0.10 m to 0.20 m
- 0.20 m to 0.30 m
- 0.30 m to 0.40 m
- 0.40 m to 0.50 m
- 0.50 m to 1.00 m
- 1.00 m to 5.00 m
- > 5.00 m
- Was wet, now dry
- Was dry, now wet

0 250 500 m

Gundary Solar Farm

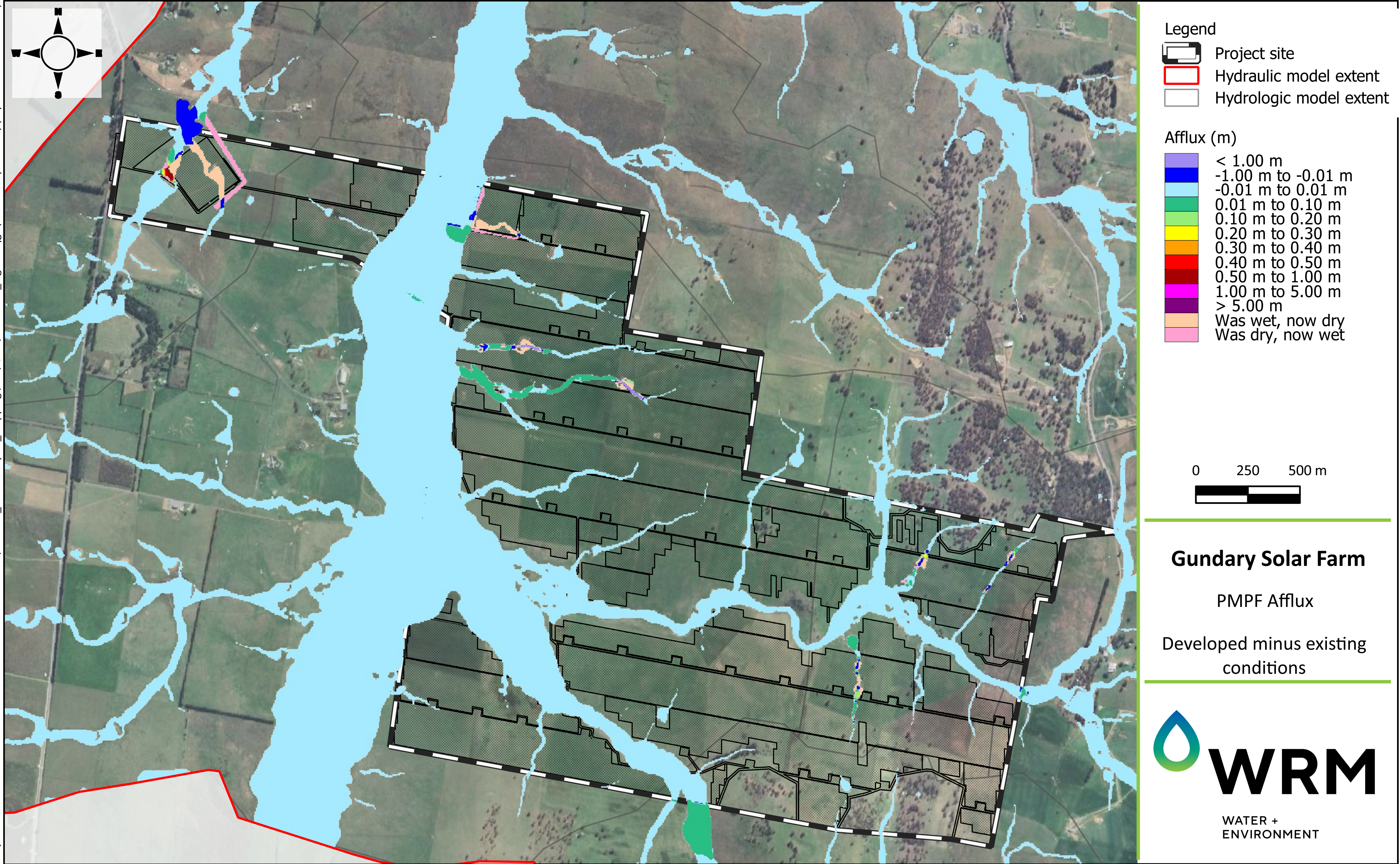
0.2% AEP Afflux

Developed minus existing conditions

WRM WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855



Gundary Solar Farm

PMPF Afflux

Developed minus existing conditions

WRM
WATER + ENVIRONMENT

J:\2067-02_C-GundaryEIS_mapping\GIS\QGIS\2067-02-C_Figures.qgz (A4landscape ATLAS) (Exported: 17 June 2025)

Projection: EPSG:7855

APPENDIX D SEARS AGENCY ADVICE TABLE

Table D.1 SEARs Agency Advice Table

Agency Advice and Where it has Been Addressed in the FIRA		
DPE Biodiversity and Conservation Division - Water and Soils		
5	The EIS must map the following features relevant to water and soils including:	
a.	Rivers, streams, wetlands, estuaries (as described in s4.2 of the Biodiversity Assessment Method).	Refer WRIA Section 3.1
b.	Wetlands as described in s4.2 of the Biodiversity Assessment Method.	No wetlands identified within the Project Area
c.	Groundwater.	Refer WRIA Section 3.7
d.	Groundwater dependent ecosystems.	Refer WRIA Section 3.7
e.	Proposed intake and discharge locations.	Refer WRIA Sections 3.0, 4.0 and 7.0
6	The EIS must describe background conditions for any water resource likely to be affected by the proposed Gundary Solar Farm, including:	
a.	Existing surface and groundwater.	Refer WRIA Section 3.0
b.	Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations.	Refer WRIA Sections 3.0, 4.0 and 7.0
c.	Water Quality Objectives (as endorsed by the NSW Government http://www.environment.nsw.gov.au/ieo/index.htm) including groundwater as appropriate that represent the community's uses and values for the receiving waters.	Refer WRIA Section 3.4
d.	Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government.	Refer WRIA Section 3.4
7	The EIS must assess the impacts of the proposed Gundary Solar Farm on water quality, including:	

Agency Advice and Where it has Been Addressed in the FIRA		
a.	The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the proposed Gundary Solar Farm protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction.	Refer WRIA Sections 4.0, 5.0 and 7.0.
b.	Identification of proposed monitoring of water quality or required changes to existing monitoring programs.	Refer WRIA Section 8.0
8	The EIS must assess the impact of the proposed Gundary Solar Farm on hydrology, including:	
a.	Water balance including quantity, quality and source.	Refer to WRIA Section 7.3
b.	Effects to downstream rivers, wetlands, and floodplain areas.	Refer to WRIA Section 7.0
c.	Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems.	Refer to WRIA Section 7.0
d.	Impacts to natural processes and functions within rivers, wetlands, and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches).	Refer to WRIA Section 7.0
e.	Changes to environmental water availability, both regulated/licensed and unregulated/rules based sources of such water.	Refer to WRIA Section 7.3
f.	Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options.	Refer to WRIA Sections 7.0 and 8.0
g.	Identification of proposed monitoring of hydrological attributes.	Refer to WRIA Section 8.0
DPE Biodiversity and Conservation Division - Flooding		
9	The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including:	
a.	Flood prone land.	Refer to Sections 5.0 and Section 6.0
b.	Flood planning area, the area below the flood planning level.	Refer to Sections 5.0 and Section 6.0.

Agency Advice and Where it has Been Addressed in the FIRA		
c.	Hydraulic categorisation (floodways and flood storage areas).	Refer to Section 6.2 and Appendix A and B
10	The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 1 in 10 year, 1 in 100 year flood levels and the probable maximum flood, or an equivalent extreme event.	Refer to Section 6 and Appendix A and B
11	The EIS must model the effect of the proposed Gundary Solar Farm (including fill) on the flood behaviour under the following scenarios:	
a.	Current flood behaviour for a range of design events as identified in 11 above. This includes the 1 in 200 and 1 in 500-year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.	Refer to Section 6 and Appendix A and B
12	Modelling in the EIS must consider and document:	
a.	The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood.	Refer to Section 6 and Appendix A and B
b.	Impacts of the development on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazards and hydraulic categories.	Refer to Section 6 and Appendix C
c.	Relevant provisions of the NSW Floodplain Development Manual 2005.	Refer to Section 6 and Appendix A and B
13	The EIS must assess the impacts on the proposed Gundary Solar Farm on flood behaviour, including:	
a.	Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure.	Refer to Section 6 and Appendix C
b.	Consistency with Council floodplain risk management plans.	Refer to Section 6 and Section 7
c.	Compatibility with the flood hazard of the land.	Refer to Section 6 and Section 7
d.	Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land.	Refer to Section 6 and Section 7

Agency Advice and Where it has Been Addressed in the FIRA		
e.	Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site.	Refer to Section 6 and Section 7
f.	Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.	Refer to WRIA Sections 5.0 and Section 7.0
g.	Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the SES and Council.	Refer to Section 7
h.	Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the SES and Council.	Refer to Section 7
i.	Emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the SES.	Refer to Section 7
j.	Any impacts the development may have on the social and economic costs to the community as consequence of flooding.	Also refer to WRIA Sections 5.0 and Section 7.0
DPE Water		
Water Take and Licensing		
1	A detailed and consolidated site water balance.	Water sourcing considered in WRIA Section 4.3
2	Description of all works/activities that may intercept, extract, use, divert or receive surface water and/or groundwater. This includes the description of any development, activities or structures that will intercept, interfere with or remove groundwater, both temporary and permanent.	Refer to WRIA Section 1.1
3	Details of all water take for the life of the project and post closure where applicable. This is to include water taken directly and indirectly, and the relevant water source where water entitlements are required to account for the water take. If the water is to be taken from an alternative source confirmation should be provided by the supplier that the appropriate volumes can be obtained.	Refer to WRIA Section 4.3

Agency Advice and Where it has Been Addressed in the FIRA		
4	Details of Water Access Licences (WALs) held to account for any take of water where required, or demonstration that WALs can be obtained prior to take of water occurring. This should include an assessment of the current market depth where water entitlement is required to be purchased. Any exemptions or exclusions to requiring approvals or licenses under the *Water Management Act 2000* should be detailed by the proponent.	Refer to WRIA Section 4.3
5	A description of groundwater conditions that provides an understanding of groundwater level across the site under a range of wet and dry conditions.	Refer to WRIA Section 3.7
6	Assessment of impacts on surface and ground water sources (both quality and quantity) including flooding, related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, groundwater dependent ecosystems, and ground water levels; including measures proposed to reduce and mitigate these impacts.	Refer to WRIA Section 7.0
7	Proposed surface and groundwater monitoring activities and methodologies.	Refer to WRIA Section 8.0
8	A description of the watercourses located within the vicinity of the development, including Strahler Stream Order as mapped by Spatial Services NSW, and appropriate riparian setbacks. Impact assessment of all works/activities located on waterfront land as defined by the Water Management Act 2000, including an assessment against the Guidelines for Controlled Activities.	Refer to WRIA Section 3.1
9	A description of erosion and sediment control measures to mitigate any impacts.	Refer to WRIA Section 3.0 and 7.0
Assessment against Policy and Guidelines		
10	Identification and impact assessment of all works/activities located on waterfront land including an assessment against Guidelines for Controlled Activities on Waterfront Land (NRAR 2018).	Refer to WRIA Section 3.2
11	Assessment of project against relevant policies and guidelines	Refer to WRIA Sections 2.0 and 7.0
DPI Fisheries		

Agency Advice and Where it has Been Addressed in the FIRA		
	Protection and revegetation of riparian buffer zones and where/if possible the management/rehabilitation of any eroded gullies on site DPI Fisheries policy advocates the use of terrestrial riparian buffer zone widths as defined in section 6.1.4 of DPI Policy.	Refer to WRIA Section 7.0
	Allowing fish passage in the design of waterway crossings and any cable crossings of waterways. The design and construction of crossing across key fish habitat watercourses on site should be undertaken in accordance with NSW DPIs Policy and Guidelines for Fish Friendly Waterway Crossings (2004) and Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (2004).	Refer to WRIA Sections 3.9 and 7.0
	Minimising erosion and sediment control impacts to key fish habitat during the construction and operation of the facility. DPI Fisheries recommends the use of best practice sediment and erosion control, and water quality and stormwater management provisions to safeguard and mitigate impacts on water quality at the site and downstream. Note that as this site is situated within the Sydney Drinking Water Catchment Lands, the project should be designed to have a neutral or beneficial impact on water quality.	Refer to WRIA Sections 4.0, 5.0 and 7.0
	A clear description of the location of works, including identification of the waterways present and all relevant plans	Refer to WRIA Sections 1.1 and 3.0
	A clear description of the works to be undertaken, including timing and duration of the works and all relevant plans. This needs to include detail on the: - location and design of any proposed or upgraded waterway crossings over key fish habitat; and - the methodology (e.g. trenching or underboring) for any underground cabling of transmission lines that pass through key fish habitat.	Refer to WRIA Sections 1.1
	Description of aquatic and riparian vegetation and instream aquatic vegetation in the vicinity of the development, particularly the extent and condition of riparian vegetation and instream aquatic vegetation, water depth, permanence of water flow and snags (large woody debris) within the footprint of the proposal area.	Refer to WRIA Section 3.9
	Identification and classification of key fish habitat in the area, according to section 3.2 of DPI Policy.	Refer to WRIA Section 3.9

Agency Advice and Where it has Been Addressed in the FIRA	
An assessment of all potential impacts to key fish habitat and riparian zones. The extent of aquatic habitat removal and riparian vegetation removal, modification or improvement that may result from the development is to be clearly defined. Potential impacts to water quality and fish passage must be clearly defined.	Refer to WRIA Section 7.5
An assessment of significance for any threatened species matters listed under the FM Act. Assessment of Significance Guidelines can be found at: Threatened Species Assessment Guidelines - Assessment of Significance (nsw.gov.au)	Refer to Biodiversity Impact Assessment Report for impacts to fauna and flora.
A clear description of all proposed safeguards to mitigate impacts on aquatic habitats, water quality and riparian buffer zones. This can include, but not be limited to: a clear map showing the riparian buffer zone width. a description of any riparian buffer zone revegetation or erosion control works. details on how fish passage will be provided for. a description of proposed erosion and sediment control techniques to be used during construction. detail on any onsite design measures to mitigate impacts on water quality and flow volumes.	Refer to WRIA Sections 7.5 and 8.0
Goulburn Mulwaree Council	
Flooding	
The Goulburn Floodplain Risk Management Study and Plan and overland flow mapping have identified access issues within this precinct (generally south of the Hume Highway) in a range of flood events.	Refer to Section 6 and Section 7
The impacts of the construction period on rural roads with poor drainage should be considered.	Refer to Section 6 and Appendix C
The development will increase runoff from the site due to the increase in impervious surfaces. The next stage of the development process should examine the hydrologic impacts of this development on runoff rates and volumes and how this impacts the local and broader catchment including runoff routing impacts on the town of Goulburn, culvert and bridge capacity and impacts on stream erosion and stability.	Refer to Section 6 and Section 7
WaterNSW	

Agency Advice and Where it has Been Addressed in the FIRA	
Regarding vegetation clearance and offsets: specific attention on measures to avoid and/or mitigate impacts to riparian zones and wetland vegetation.	Refer to Section 6 and Appendix C Also refer to WRIA Sections 7.5 and 8.0
Details of any existing erosion control measures (including Catchment Protection Scheme (CPS) works), and any other constraints such as any existing erosion gullies and the location of sodic and saline soils. The impact of any proposed changes to existing CPS works or gullies due to the proposal and possible mitigation measures should be included.	Refer to WRIA Section 3.1
A Water Cycle Management Study (WCMS) detailing:	
Site and Soil Evaluation for On-Site Wastewater Disposal if any on-site wastewater disposal is proposed, especially in the Construction Phase.	Not applicable, refer to Section 3.4
How potential water quality impacts will be avoided and/or minimized through project design, and route and site selections for the hardstand areas (including that required for the proposed construction period).	Refer to Section 7 Also refer to WRIA Section 8.0
Measures to limit the infiltration of water into highly erodible subsoils.	Refer to Section 6 Also refer to WRIA Section 7.0 and 8.0
A layout including water quality design measures that will be employed to treat the increased runoff from the increased impervious area of the panels, internal access tracks and hardstand areas (Substation and Battery Energy Storage System) (e.g. buffers, swales, dams, wetlands, rehabilitation/fencing off).	Conceptual stormwater treatment train described in WRIA Section 5.3.1 Conceptual Project layout presented in WRIA Figure 1.2. Detailed layout showing water management measures to be prepared during detailed design phase.
Stormwater quality modelling using MUSIC software showing a comparison of pre- and post-development scenarios on water quality parameters of key concern (Total Suspended Solids, Total Phosphorus and Total Nitrogen). WaterNSW will require an electronic copy of the MUSIC file in .sqz file, and	Refer to WRIA Section 5.0
Concept design plans of any stormwater quality treatment measures and required watercourse crossings (both temporary and permanent).	Conceptual stormwater treatment train described in WRIA Section 5.3.1 Watercourse crossings shown on Figure 1.2 within WRIA

APPENDIX E RESPONSE TABLE AND NSW SES LETTER

No	Detail	Where addressed in this Amended FIRA
CHPR Flooding		
1	The flood modelling completed for the FIRA shows that most of the infrastructure associated with the proposal is located outside the 1% AEP flood extent of the Gundary Creek and Bullamalito Creek. However, some solar panels appear to be located within the flood extent for events greater than the 1% AEP which should be addressed in the FIRA including operational risks during and after a large floods. Power supply during a flood is important for flood emergency response and telecommunications and it is also essential for community recovery just after large to extreme floods. As such, the risk assessment should consider the Solar Farm's operational functions over the full range of design events up to and including the Probable Maximum Flood (PMF) to establish an understanding of flood related shutdown risks and whether interruptions to the Solar Farm's operation by extreme floods can be avoided through design. Design elements of critical components may require using a higher design flood event such as the PMF level plus freeboard.	Refer to Section 6
2	The information provided identified a substation to the west near Windellama Road which is proposed to be built over an unnamed ephemeral creek. The flood maps provided with the FIRA show that this creek carries flood water during all design events and the proposed substation will be affected by flooding and has the potential to influence flood behaviour. Comparison of pre- and post development modelling results (Figures C.1-C.7 in Appendix C) show that flood water is re-directed east and west of the new substation. The re-direction of flood water around the eastern side of the substation raises questions around localised erosion and off-site flood impacts which the assessment does not address.	Refer to Section 6 and Appendix C
3	The discrepancies in flood maps between the flood impact (Figures C.1-C.7) and the developed case (Figures B.1-B.7) also creates doubt on the veracity of the model and the FIRA for assessing flood related risks from the proposal. In particular, the flood impact maps suggest that the footprint of the substation is dry post development, but the developed case flood maps show flood water is conveyed across the western end of the substation's footprint. The FIRA also notes that the solar panels will unlikely cause additional runoff, and that erosion and scour is expected to be minimal. However, the adequacy of how this has been demonstrated is unclear. This warrants further clarification to ensure the accuracy of the assessment and conclusions drawn.	Refer to Section 6, Appendix B and Appendix C
4	The FIRA states that evacuation would be arranged in times of flood warning and that evacuation routes will be determined during the detailed design stage of the project. Given the potential risk to public safety associated with flood isolation, consultation should occur with the NSW SES on the adequacy of any proposed flood emergency response measures, emergency access requirements and alignment with local emergency response planning. The FIRA should address any issues raised by the SES to establish that public safety risks due to flooding will be effectively managed.	Refer to Section 7

No	Detail	Where addressed in this Amended FIRA
NSW SES		
1	We note the proposal is not for residential dwellings. In summary, we: Support the consideration of flood events up to and including the probable maximum flood (PMF). It is unclear if floods larger than the 1% AEP have been used to inform the project layout and design. For emergency management, modelling of flooding up to and including the PMF should be considered to address any risks, including warnings and isolation, for workers and site users during flooding events. The Water Resources Impact Assessment report has referred to the PMF and PMP but only included figures for the 1% AEP. The Scoping Report and Biodiversity Development Assessment Report have only included consideration of flood constraints of an indicative 1% Annual Exceedance Probability (AEP) flood inundation extents.	Refer to Section 6, Section 7 and Appendix A
	Recommend pursuing site design and stormwater management that reduces the impact of flooding and minimises any risk to the site users and community. Any improvements that can be made to reduce flood risk will benefit the community. We support the design to avoid Gundary Creek, Bullamalito Creek and mapped unnamed creeks (second order and higher) within the Project area for drainage and any flooding risks.	Refer to Section 6, Section 7 and Appendix A
	Support Management and mitigation Measures (IDWR5 to IDWR8) which includes the development of a Flood Emergency Response Plan (FERP). See Attachment A Principle 1 for additional information on the development of a FERP, noting NSW SES does not have authority to endorse or approve such plans.	Noted
	Recommend consulting with the NSW Department of Climate Change, Energy, the Environment and Water regarding understanding the impacts of the development on flood behaviour and adjacent areas, particularly as there is a requirement for the construction of PV arrays to fill and or level some minor areas included within the flood inundation extent.	It is noted that NSW DCCEEW provided feedback on the EIS FIRA, which has been addressed in this report as identified above.
	Recommend that consideration should be given to the safety of access/egress to the site. NSW SES advise against driving through floodwater. There are known road closure points due to flooding along the proposed access roads including Bungonia Road (near Goulburn Brewery) which is flooded more frequently than the 20%AEP with duration approximately two days.8 Windellama Road has known road closure points at a creek crossing at the Mountain Ash Road intersection and the low-lying areas at Rosemont Road intersection.	Refer to Section 3 and Section 7
ATTACHMENT A: Principles Outlined in the Support for Emergency Management Planning Guideline		
1	Any proposed Emergency Management strategy should be compatible with any existing community Emergency Management strategy. Any proposed Emergency Management strategy for an area should be compatible with the	Refer to Sections 3 and Section 7

No	Detail	Where addressed in this Amended FIRA
	evacuation strategies identified in the NSW State Flood Plan and the Goulburn Mulwaree Local Flood Emergency Sub Plan 2021. Any plan developed as a part of the management strategy of the site should be thorough and detailed enough to address all aspects of a flood emergency including responsibilities, transportation, medical emergency, vulnerabilities, flood forecasting and warning, flood emergency response triggers, procedures, plan dissemination, testing, and review cycle. We recommend including triggers based on Severe Weather Warnings and consider closing the site ahead of the start of the operational day, particularly considering the flash flooding risk in the area. Bureau of Meteorology (BoM) rain gauges to monitor include the Lake Bathurst and Bullamalita (on the Gundary Creek) in the Wollondilly River catchment, however the site is not within a height-time forecast location. Any plan should include a review mechanism for updating the plan at regular intervals and whenever additional flood information is available or highlighted during a flood events. In addition, please note, the NSW SES does not have the statutory authority to endorse private evacuation plans. We understand that the site-specific designs will be finalised during detailed design and construction. We recommend that the site design considers rising road access where possible for access tracks and waterway crossings (i.e., minor culvert crossings or causeways).	
2	Decisions should be informed by understanding the full range of risks to the community. Decisions relating to future development should be risk-based and ensure Emergency Management risks to the community of the full range of floods are effectively understood and managed. Noting the proposal is not for residential use, site workers and visitors will need to be aware that during flood events access to the Goulburn CBD area is lost with multiple access roads being cut due to mainstream flooding of the Mulwaree and Wollondilly Rivers, in events as frequently as 20% AEP. Roads include the proposed site access routes of Bungonia Road and Windellama Road. The Hume Highway and Sydney Road bridges cut in >0.2% AEP events along with multiple other roads around the CBD. Isolation in this area due to riverine flooding can last up to 3 days.	Refer to Sections 3 and Section 7
3	Development of the floodplain does not impact on the ability of the existing community to safely and effectively respond to a flood.	Refer to Sections 3 and Section 7
4	Decisions on development within the floodplain does not increase risk to life from flooding.	Refer to Sections 3 and Section 7
5	Risks faced by the itinerant population need to be managed. Any Emergency Management strategy needs to consider people visiting the area or using a development.	Refer to Sections 3 and Section 7
6	Recognise the need for effective flood warning and associated limitations. An effective flood warning strategy with clear and concise messaging understood by the community is key to providing the community an opportunity to respond to a flood threat in an appropriate and timely manner.	Refer to Sections 3 and Section 7

No	Detail	Where addressed in this Amended FIRA
	NSW SES and the Bureau of Meteorology do not have the operational capacity to provide individualised flood warnings for each business site. Therefore, it is important that business owners and operators are weather aware and act early on severe weather warnings. NSW SES utilises the Australian Warning System, which is a nationally consistent, three-tiered approach to issue clear warnings and lead people to take action ahead of severe weather events. The three warning tiers consist of Advice, Watch and Act and Emergency Warning. These warnings can be viewed on the SES website and the HazardWatch website and app.	
7	Ongoing community awareness of flooding is critical to assist effective emergency response. The flood risk at the site and actions taken to reduce risk to life should be communicated to all site users (includes increasing risk awareness, community connections, preparedness actions, appropriate signage and emergency drills) during and after the construction phase.	Refer to Sections 2, 3 and Section 7

Our Ref: 2965
Your Ref: 22223_NSWSES_Ltr/ SSD-48225958

27 March 2025

Marion O'Neil
Umwelt Australia Pty Ltd
Suite 1101, Level 11
213 Miller Street
North Sydney NSW 2060

Via email

email: moneil@umwelt.com.au
CC: amanda.pollock@ses.nsw.gov.au

Dear Marion,

State Significant Development Application for Proposed Gundary Solar Farm

Thank you for the opportunity to provide comment on the State Significant Development Application for Gundary Solar Farm, at 961 Windellama Road, Gundary. It is understood that the proposed Gundary Solar Farm (the Project) development seeks to include the construction, operation, maintenance and decommissioning of an approximate 400 MWp solar farm and associated infrastructure including:

- Employment generation and the creation of approximately 400 jobs during the construction phase and **two to four permanent staff** during the operational phase[1].
- Approximately 740,740 solar panels bifacial flat plate solar photovoltaic (PV) modules each generating approximately 540 Watt (W) in single axis tracking arrangement with a maximum height of 5 m above ground level.
- A system of inverters and voltage step-up transformers positioned throughout the solar arrays.
- Onsite underground electrical conduits and cabling to connect inverter stations to the onsite substation to be built for the project.
- A lithium-ion BESS to store energy generated by the Project.
- An onsite switchyard, 33/330 kilovolt (kV) substation and ancillary infrastructure to connect the Project to the existing 330 kV transmission line. An additional transmission tower may be erected on the current line to accommodate the grid connection.
- Internal access tracks to allow for site maintenance.

[1] Umwelt, 2022. Gundary Solar Farm Scoping Report page 7

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- Site office and operations and maintenance building with parking for the operations team.
- Primary solar farm site access point from Windellama Road.
- Drainage line crossings if and where required to manage existing surface water flows (to be determined during further design development) and access points for construction purposes.
- Emergency access and egress points at select points on the project boundary.
- Perimeter security fencing, crossing gates, water tanks or dams, and access points to facilitate sheep grazing.

The NSW State Emergency Service (NSW SES) is the agency responsible for dealing with floods, storms and tsunami in NSW. This role includes, planning for, responding to and coordinating the initial recovery from floods. As such, the NSW SES has an interest in the public safety aspects of the development of flood prone land, particularly the potential for changes to land use to either exacerbate existing flood risk or create new flood risk for communities in NSW.

The NSW SES recommends that consideration of flooding issues is undertaken in accordance with the requirements of NSW Government's Flood Prone Land Policy as set out in the Flood Risk Management Manual 2023 (the Manual) and supporting guidelines, including the Support for Emergency Management Planning and relevant planning directions under the *Environmental Planning and Assessment Act, 1979*. Some of the key considerations relating to emergency management are further detailed in Appendix A.

The Project Area is free from regional riverine flooding from the Wollondilly and Mulwaree Rivers, however there are some flash flood risks associated with the local creeks, including Gundary Creek and Bullamalito Creek.[2] Flood depths are up to 3m in parts of the project area, but are variable.

We note the proposal is not for residential dwellings. **In summary**, we:

- **Support** the consideration of flood events up to and including the probable maximum flood (PMF). It is unclear if floods larger than the 1% AEP have been used to inform the project layout and design. For emergency management, modelling of flooding up to and including the PMF should be considered to address any risks, including warnings and isolation, for workers and site users during flooding events. The Water Resources Impact Assessment report has referred to the PMF and PMP but only included figures for the 1% AEP. The Scoping Report and Biodiversity Development Assessment Report have only included consideration of flood constraints of an indicative 1% Annual Exceedance Probability (AEP) flood inundation extents.[3,4]
- **Recommend** pursuing site design and stormwater management that reduces the impact of flooding and minimises any risk to the site users and community. Any improvements that can be made to reduce flood risk will benefit the community. We

[2] Umwelt, 2022. Gundary Solar Farm Scoping Report page 13
[3] Umwelt, 2022. Gundary Solar Farm Scoping Report page 64
[4] Umwelt, 2022. Gundary Solar Farm Scoping Report page 5

support the design to avoid Gundary Creek, Bullamalito Creek and mapped unnamed creeks (second order and higher) within the Project area for drainage and any flooding risks.[5]

- **Support** Management and mitigation Measures (IDWR5 to IDWR8) which includes the development of a Flood Emergency Response Plan (FERP). See Attachment A Principle 1 for additional information on the development of a FERP, noting NSW SES does not have authority to endorse or approve such plans. [6]
- **Recommend** consulting with the NSW Department of Climate Change, Energy, the Environment and Water regarding understanding the impacts of the development on flood behaviour and adjacent areas, particularly as there is a requirement for the construction of PV arrays to fill and or level some minor areas included within the flood inundation extent.[7]
- **Recommend** that consideration should be given to the safety of access/egress to the site. **NSW SES advise against driving through floodwater.** There are known road closure points due to flooding along the proposed access roads including Bungonia Road (near Goulburn Brewery) which is flooded more frequently than the 20%AEP with duration approximately two days.[8] Windellama Road has known road closure points at a creek crossing at the Mountain Ash Road intersection and the low-lying areas at Rosemont Road intersection.

Please feel free to contact Gillian Webber via email at rra@ses.nsw.gov.au should you wish to discuss any of the matters raised in this correspondence. The NSW SES would also be interested in receiving future correspondence regarding the outcome of this referral via this email address.

Yours sincerely,

Elspeth O'Shannessy
Manager Emergency Risk Assessment
NSW State Emergency Service

[5] Umwelt, 2022. Gundary Solar Farm Scoping Report page 14
[6] Umwelt, 2024. Gundary Solar Farm Management and Mitigation Measures page 50
[7] Umwelt, 2024. Gundary Solar Farm Flood Impact and Risk Assessment. page 31
[8] Goulburn Floodplain Risk Management Study and Plan page 41

ATTACHMENT A: Principles Outlined in the Support for Emergency Management Planning Guideline[9]

Principle 1 Any proposed Emergency Management strategy should be compatible with any existing community Emergency Management strategy.

Any proposed Emergency Management strategy for an area should be compatible with the evacuation strategies identified in the NSW State Flood Plan[10] and the Goulburn Mulwaree Local Flood Emergency Sub Plan 2021[11].

Any plan developed as a part of the management strategy of the site should be thorough and detailed enough to address all aspects of a flood emergency including responsibilities, transportation, medical emergency, vulnerabilities, flood forecasting and warning, flood emergency response triggers, procedures, plan dissemination, testing, and review cycle.

We recommend including triggers based on Severe Weather Warnings and consider closing the site ahead of the start of the operational day, particularly considering the flash flooding risk in the area. Bureau of Meteorology (BoM) rain gauges to monitor include the Lake Bathurst and Bullamalita (on the Gundary Creek) in the Wollondilly River catchment, however the site is not within a height-time forecast location.

Any plan should include a review mechanism for updating the plan at regular intervals and whenever additional flood information is available or highlighted during a flood events. In addition, please note, the NSW SES does not have the statutory authority to endorse private evacuation plans.[12]

We understand that the site-specific designs will be finalised during detailed design and construction. We recommend that the site design considers rising road access where possible for access tracks and waterway crossings (i.e., minor culvert crossings or causeways).[13] [14]

Principle 2 Decisions should be informed by understanding the full range of risks to the community.

Decisions relating to future development should be risk-based and ensure Emergency Management risks to the community of the full range of floods are effectively understood and managed.

Noting the proposal is not for residential use, site workers and visitors will need to be aware that during flood events access to the Goulburn CBD area is lost with multiple access roads being cut due to mainstream flooding of the Mulwaree and Wollondilly Rivers, in events as frequently as 20% AEP. Roads include the proposed site access routes of Bungonia Road and Windellama Road. The Hume Highway and Sydney Road bridges cut in >0.2% AEP events along

[9] NSW Government. 2023. Principles Outlined in the Support for Emergency Management Planning Guideline
[10] NSW Government. 2024. NSW State Flood Plan. Section 5.1.7, page 34
[11] NSW SES. 2021. Goulburn Mulwaree Local Flood Emergency Sub Plan.
[12] Umvelt, 2024. Gundary Solar Farm Management and Mitigation Measures page 50
[13] Umvelt, 2024. Gundary Solar Farm Water Resources Impact Assessment. page 97
[14] Umvelt, 2024. Gundary Solar Farm Flood Impact and Risk Assessment. page 40

with multiple other roads around the CBD.[15] [16] [17] Isolation in this area due to riverine flooding can last up to 3 days.[18]

Principle 3 Development of the floodplain does not impact on the ability of the existing community to safely and effectively respond to a flood.

Principle 4 Decisions on development within the floodplain does not increase risk to life from flooding.

Principle 5 Risks faced by the itinerant population need to be managed.

Any Emergency Management strategy needs to consider people visiting the area or using a development.

Principle 6 Recognise the need for effective flood warning and associated limitations.

An effective flood warning strategy with clear and concise messaging understood by the community is key to providing the community an opportunity to respond to a flood threat in an appropriate and timely manner.

NSW SES and the Bureau of Meteorology do not have the operational capacity to provide individualised flood warnings for each business site. Therefore, it is important that business owners and operators are weather aware and act early on severe weather warnings.

NSW SES utilises the Australian Warning System, which is a nationally consistent, three-tiered approach to issue clear warnings and lead people to take action ahead of severe weather events. The three warning tiers consist of Advice, Watch and Act and Emergency Warning. These warnings can be viewed on the SES website and the HazardWatch website and app.

Principle 7 Ongoing community awareness of flooding is critical to assist effective emergency response.

The flood risk at the site and actions taken to reduce risk to life should be communicated to all site users (includes increasing risk awareness, community connections, preparedness actions, appropriate signage and emergency drills) during and after the construction phase.

[15] GRC Hydro. 2022. Goulburn Floodplain Risk Management Study and Plan. Version 6 – Final Report, page 39 - 40
[16] GRC Hydro. 2022. Goulburn Floodplain Risk Management Study and Plan. Version 6 – Final Report, Appendix C
[17] WMA Water. 2016. Wollondilly and Mulwaree Rivers Flood Study, Figure 44
[18] GRC Hydro. 2022. Goulburn Floodplain Risk Management Study and Plan. Version 6 – Final Report, page 39

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