



ERM  
Garoo Solar Farm Project

Water Resources Impact Assessment

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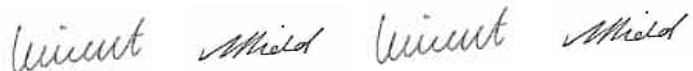
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Rev	Date	Description	Author	Reviewer	Project Mgr.	Approver
0	19/06/2025	Draft Issue	Laura Vincent	Susan Shield	Laura Vincent	Susan Shield
1	10/07/2025	Client Issue	Laura Vincent	Susan Shield	Laura Vincent	Susan Shield
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**Signatures:**



# EXECUTIVE SUMMARY

## OVERVIEW

The Trustee for the GreenPulse Solar Farm and BESS Unit Trust (the Applicant) proposes to develop the Garoo Solar Farm and BESS (the Project). The Project is proposed to involve the construction, operation and decommissioning of a solar farm and associated infrastructure with a targeted electricity generation capacity of approximately 133.76 megawatts (MW). The Project Area covers approximately 369 ha and is located 15 km south of Tamworth, NSW in the locality of Loomberah in north-eastern New South Wales (NSW).

The Project is State Significant Development (SSD) and therefore requires an environmental impact statement (EIS) to be prepared under Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979*. This Water Resources Impact Assessment (WRIA) supports the SSD application as an appendix of the EIS for the Project and provides an assessment of the potential impacts to surface water and groundwater as a result of the Project. The WRIA documents the assessment methods and results, initiatives to avoid and minimise surface water impacts, and additional mitigation and management measures proposed to address residual impacts not able to be avoided.

## BASELINE CHARACTERISTICS

### Surface Water Context

The Project is located within the Peel Valley of Namoi Catchment, within the broader Murray-Darling Basin. The Project Area is located approximately 37 km south of Tamworth and 14 km north-east of Wallabadah with local topography ranging from 560 mAHD to 640 mAHD.

Connectivity exists between the Namoi River and the Project Area via the Peel River, which is a major regulated tributary of the Namoi River flowing northeast. Two key creeks, Tamarang Creek and Sugarloaf Creek, and their tributaries, drain the Project Area. Tamarang Creek flows through the centre of the Project Area in a generally northern direction, joining Sugarloaf Creek approximately 1.2 km north of the Project Area. Sugarloaf Creek then flows north-west, ultimately contributing to Goonoo Goonoo Creek, which joins the Peel River downstream.

### Flooding

Detailed flood modelling of the Project Area was undertaken as part of the WRIA. The hydraulic modelling was undertaken using rain-on-grid (RoG) modelling techniques.

The flood modelling indicates that flooding through the Project Area is typically confined to Tamarang Creek and Sugarloaf Creek in the east, with broader flow paths flowing through the western portion of the Project Area.

### Water Supply

The Applicant will purchase water tanks and truck in water, in accordance with agreements with nearby Councils, for water sourcing. Although not anticipated, additional water may be sourced through runoff harvesting from farm dams (up to 29.52 ML/year), re-use of water from sediment basins, or acquiring relevant water access licences (WALs) where required. Ongoing coordination between the Applicant and landholders will ensure continued water availability for stock.

## POTENTIAL IMPACTS

### Watercourse Characteristics

The Project proposes to purchase water tanks and truck in water to support the minimal construction demands and does not anticipate the need to use existing water sources from within the Project Area.

### Flooding

The flood model was used to simulate the developed conditions for the 5% Annual Exceedance Probability (AEP), 1% AEP and the Probable Maximum Flood (PMF) events. Results indicate that predicted flooding increases within the Project Area associated with the Project infrastructure in the 5% AEP and 1% AEP flood events are typically minor and with appropriate design and erosion controls present negligible erosion or inundation risks.

A climate change sensitivity analysis was undertaken by modelling a long term 1% AEP climate change scenario and the 0.2% AEP design flood events under existing conditions. The climate change sensitivity modelling indicates that there is generally little difference in flood extent across the Project Area for the two climate change scenarios.

### Surface Water Quality

Construction, operation, and decommissioning phases pose potential risks to surface water quality, including:

- Soil erosion and sedimentation of downstream watercourses and crops.
- Spill of hydrocarbons or other pollutants used to support transportation and installation activities.
- Release of concrete by-products (dust, slurry, water) into downstream watercourses and crops.
- Discharge/spill of wastewater (treated or untreated) into downstream watercourses and crops.
- Release of tannins to downstream watercourses and crops.

These risks can cause harm to aquatic life, contaminate watercourses, and impact crops. Mitigation measures, such as a Construction Erosion and Sediment Control Plan (CESCP) and erosion controls, hydrocarbon storage controls, and wastewater management systems, are proposed. Through best practices and proposed measures, the overall impact on water quality is considered negligible, given the limited connectivity to adjacent watercourses. Operation and decommissioning phases share similar risks, however with appropriate management measures, the expected impact on water quality during these phases is also considered negligible.

### Cumulative Impacts

The cumulative impact assessment for the Project, in accordance with State Significant Project guidelines, acknowledges the potential cumulative effects arising from the incremental influence of multiple energy projects within the vicinity of the Project Area. Although individual impacts from specific projects may be minor or negligible, the collective influence can be more significant over time. The Project, is located within proximity (~50 km) to seven known energy projects, including wind, solar and BESS installations, and has undergone a comprehensive assessment considering potential cumulative impacts.

Based on the outcomes of this assessment, potential interactions with common surface water receptors, including the Peel River are considered unlikely, and will be mitigated through appropriate design and erosion and environmental management. Water quality, flooding, and surface water supply impacts are expected to be negligible due to limited direct connectivity, adherence with NSW licensing requirements, and the minor scale of operational water demands.

## MITIGATION AND MANAGEMENT MEASURES

Detailed environmental studies have been undertaken for the Project design. The consideration of the outcomes of these studies in the design and integration with the approved operations minimise the potential for impacts on surface water resources. These considerations include:

- The management of impacts within the existing water allocations.
- Project design to meet legislative requirements and relevant guidelines.

These factors reduce the potential for significant impacts on existing surface water resources. The range of potential impacts resulting from the Project and a summary of the proposed mitigation measures is included in Table 1. It should be emphasised that the majority of the proposed mitigation measures are consistent with best practices for the development of large-scale wind farms. This is appropriate and to be expected given the generally small incremental impact due to the minor disturbance associated with the Project infrastructure.

**TABLE 1: SUMMARY OF POTENTIAL IMPACTS AND MITIGATION MEASURES**

Potential Impacts	Mitigation Measure	Project Implementation Stage
<b>WATERCOURSE CHARACTERISTICS</b>		
Filling of streams for infrastructure / water crossings	Consider the following mitigation measures in the Project detailed design: <ul style="list-style-type: none"> <li>• Limit water crossing to existing access tracks where possible.</li> <li>• Arrange Project infrastructure such that stream disturbance and modifications (filling / diversions) are limited to minor watercourses.</li> </ul> In the event construction of waterway crossings is required, these will be designed, constructed and maintained to consider DPE <i>Guidelines for instream works on waterfront land</i> (DPE, 2022) and <i>Guidelines for riparian corridors on waterfront land</i> (DPE, 2022).	Detailed design
<b>FLOODING</b>		
Impacts to in-stream and overland flooding	Consider the following mitigation measures in the Project detailed design stage to minimise impacts to flooding possible: <ul style="list-style-type: none"> <li>• Minimise filling of substation and BESS sites and on-site facilities.</li> <li>• Minimise extent of Project infrastructure within the 1% AEP flood extent.</li> <li>• Design to manage flood impacts and flow conveyance at watercourse crossings (if any).</li> <li>• Underground transmission lines to minimise obstructions of flow paths.</li> </ul>	Detailed design
Impacts on the Project design due to predicted flooding	Optimisation of the Project design during detailed design to ensure: <ul style="list-style-type: none"> <li>• A minimum of 300 mm freeboard is maintained between the 1% AEP flood level and proposed solar arrays.</li> <li>• Permanent ancillary infrastructure (substations / BESS) raised above the 1% AEP flood level.</li> </ul>	Detailed design
Impacts to site personnel during a flood event	Floodplain management planning to determine site management protocols during flood events that could impact construction or access areas, including: <ul style="list-style-type: none"> <li>• Suitable early warning and communication protocols.</li> <li>• Triggers for closure, evacuation and recovery.</li> <li>• Emergency response and support.</li> </ul>	Post Approval / Pre-construction
Increased stormwater runoff from vegetation clearing and filling for infrastructure	Increased stormwater runoff during operations (due to clearing of vegetation and filling for infrastructure) will be managed through development of erosion and sediment control plan (ESCP). The ESCP will consider: <ul style="list-style-type: none"> <li>• Location of site infrastructure away from existing watercourses or areas subject to high levels of overland flow.</li> <li>• Diversion of upstream flows around site infrastructure as required, to minimise scouring and erosion.</li> <li>• Inspection and monitoring regimes to maintain stormwater and erosion and sediment control structures.</li> </ul>	Construction

Potential Impacts	Mitigation Measure	Project Implementation Stage
<b>WATER QUALITY</b>		
Erosion and sedimentation of downstream watercourses	<p>Development of erosion and sediment control plans (ESCP) through all project phases, in accordance with <i>Managing Urban Stormwater: Soils and Construction – Volume 1</i> (Landcom, 2004), <i>Volume 2A Installation of services</i> (DECC, 2008), <i>Volume 2C Unsealed roads</i> (DECC, 2008), <i>Volume 2D Main road construction</i> (DECC, 2008) and <i>Best Practice Erosion and Sediment Control</i> (IECA, 2008).</p> <p>The ESCPs will detail area specific erosion and sediment control measures to be implemented and maintained during construction, as well as ongoing monitoring and maintenance through operation and decommissioning of additional controls if identified as required.</p> <p>The total area of disturbance at any time should be minimised where possible and ongoing rehabilitation and stabilisation strategies implemented throughout construction.</p>	Construction
Release of sediment or construction by-products	<p>During construction, the following management measures will be considered to minimise the potential for mobilisation of sediment or dust from topsoil stockpile:</p> <ul style="list-style-type: none"> <li>• Locate stockpiles away from drainage lines, or areas subject to high levels of overland sheet flow and minimise stockpile size.</li> <li>• Develop and implement area specific erosion and sediment control measures including bunding and diversion drains as required.</li> <li>• Use stockpile stabilisation techniques such as covering or dust suppression.</li> </ul>	Construction
Contaminant spills	<p>Prior to commencing construction activities, a Construction Environment Management Plan (CEMP) will be developed to identify site specific controls and procedures to minimise the potential for hydrocarbons and other contaminants being discharged into the environment. This CEMP should consider:</p> <ul style="list-style-type: none"> <li>• Storage of hydrocarbons and other liquid chemicals within an above ground, bunded areas away from watercourses or area subject to high levels of overland sheet flow.</li> <li>• Re-fuelling of construction vehicles and equipment to be limited to designated areas, with adequate spill management controls.</li> <li>• Maintain an emergency spill kit and relevant emergency spill response procedures.</li> <li>• Transport and dispose of any hydrocarbons captured during Project construction and operation of the substations and switchyards at a suitable off-site licenced facility.</li> </ul>	Construction, Operation
Surface water and groundwater quality impacts	<p>The CEMP will consider the following management measures to minimise the potential impacts to surface water and groundwater quality within and surrounding the Project Area:</p> <ul style="list-style-type: none"> <li>• Develop and implement a suitable monitoring regime at sensitive downstream receivers, including visual inspections and routine monitoring of relevant physicochemical parameters.</li> <li>• Develop and implement a suitable monitoring regime of all stormwater and erosion and sediment control structures, particularly following large flow events.</li> </ul>	Construction, Decommissioning

Potential Impacts	Mitigation Measure	Project Implementation Stage
<b>WATER SUPPLY</b>		
Water licences to meet demands	All required water licensing and approvals will be coordinated with associated landholders and/or regulators (e.g. Council, others) if that source is needed to support water supply arrangements for during construction and operation.	Post Approval (Construction, Operation)
<b>WASTEWATER MANAGEMENT</b>		
Discharge of wastewater or effluent from site	Design and implement a wastewater treatment system that: <ul style="list-style-type: none"> <li>• Is appropriately sized for the Project infrastructure and operations.</li> <li>• Collects and treats wastewater from site offices and temporary accommodation facilities for re-use on site to fulfill non-potable construction and operation demands.</li> <li>• Be designed and operated in accordance with best practices.</li> </ul>	Detailed design

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# 1. INTRODUCTION

## 1.1 Overview

Engeny Australia Pty Ltd (Engeny) was engaged by ERM Australia Pty Ltd to conduct a Water Resources Impact Assessment (WRIA) of the Garoo Solar Farm and Battery Energy Storage System (BESS) (the Project) for the Trustee for the GreenPulse Solar Farm and BESS Unit Trust (the Applicant). Surface water and groundwater impacts from the construction, operation and decommissioning phases of the Project are addressed in this report in accordance with relevant regulatory requirements and guidelines.

This report supports a State Significant Development (SSD- 79747209) (SDD) Development Consent approval under Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979*, as part of the Environmental Impact Statement (EIS) for the Project.

The impacts and proposed mitigation for water resources from the proposed construction, operation and decommissioning phases of the Project are addressed in this report in accordance with relevant regulatory requirements and guidelines (this assessment).

## 1.2 Relevant Policies, Guidelines and Legislation

The following policies, guidelines and legislation have been considered in this assessment:

- *NSW Aquifer Interference Policy.*
- *Water Management Act 2000.*
- *Water Management (General) Regulation 2018.*
- *Water Sharing Plans.*
- *Guidelines for instream works on waterfront land (DPE, 2022).*
- *Waterfront Land e-tool (NRAR, 2020).*
- *NSW Water Quality and River Flow Objectives.*
- *Australian and New Zealand fresh and marine water quality guidelines (ANZG, 2018).*
- *Managing Urban Stormwater: Soils & Construction Volume 1 (Landcom 2004), Volume 2A, 2C and 2D (DECC, 2008).*
- *Renewable Energy Planning Framework (DPIE, 2025) and Large-scale Solar Energy Guideline (DPIE, 2022).*
- *Controlled Activities – Guidelines for Instream Works on Waterfront Land (DPE, 2022).*
- *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge, 2003).*
- *Policy & Guidelines for Fish Habitat Conservation & Management (DPI, 2013).*

### 1.2.1 SEARs and Agency Advice

The relevant Planning Secretary's Environmental Assessment Requirements (SEARs) and regulatory submissions to SEARs, including where each is addressed in this report, are listed in Table 1.1 and Table 1.2.

**TABLE 1.1: SEARS AND WHERE ADDRESSED**

SEAR	Issue	Section Addressed in this Report
Water	an assessment of the likely impacts of the development (including flooding and flood modelling) on surrounding watercourses (including their Strahler Stream Order), groundwater resources and surface water movements, and measures proposed to monitor, reduce and mitigate these impacts including water management, having regard to the Solar Guideline;	Section 5
	a site water balance for the development;	Section 3
	details of water requirements and supply arrangements for construction and operation (including consultation with suppliers);	Section 3.1.2
	a description of the erosion and sediment control measures that would be implemented to mitigate any impacts in accordance with <i>Managing Urban Stormwater: Soils &amp; Construction</i> (Landcom, 2004) and <i>Managing Urban Stormwater: Soils and construction – Volume 2A manual</i> (Landcom, 2008);	Section 5.3
	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;	Sections 5.1.3 and 8
	where the project involves works within 40 metres of any river, lake or wetlands (collectively waterfront land), identify likely impacts to the waterfront land and key fish habitat, and how the activities are to be designed and implemented in accordance with the DPI Guidelines for <i>Controlled Activities on Waterfront Land</i> (2018) and (if necessary) <i>Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings</i> (DPI 2003), and <i>Policy &amp; Guidelines for Fish Habitat Conservation &amp; Management</i> (DPE, 2013); and	Section 5.1.2
	<p>Flood Risk: identification of any flood risk on site having regard to adopted flood studies, the potential effects of climate change and any relevant provisions of the NSW Flood Risk Management Manual.</p> <ul style="list-style-type: none"> <li>• Where the development could alter flood behaviour, affect flood risk to the existing community or expose its users to flood risk, provide a flood impact and risk assessment (FIRA) prepared in accordance with the <i>Flood Impact and Risk Assessment – Flood Risk Management Guide LU01</i>.</li> <li>• Detailed design solutions and operational procedures to mitigate flood risk where required.</li> </ul>	Sections 4.4 and 5.1.3

**TABLE 1.2: RELEVANT REGULATORY SUBMISSION TO SEARS AND WHERE ADDRESSED**

<b>Regulator</b>	<b>Reference and Issue</b>	<b>Section Addressed in this Report</b>
NSW DCCEEW Water Group– Water Take and Licensing	A detailed and consolidated site water balance.	Section 3
	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.	Section 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.	Section 3
	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.	Section 2.8.4
NSW DCCEEW Water Group – Water Impacts	A description of groundwater conditions that provides an understanding of groundwater level across the site under a range of wet and dry conditions.	Section 2.4
	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.	Sections 5 and 6
	Proposed surface and groundwater monitoring activities and methodologies	Section 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.	Section 2.2.2
	A description of erosion and sediment control measures to mitigate any impacts.	Sections 5.3 and 8
NSW DCCEEW Water Group – Assessment against Policy and Guidelines	Identification and impact assessment of all works/activities located on waterfront land including an assessment against Guidelines for Controlled Activities on Waterfront Land (DPE 2022).	Section 5.1.2
	Assessment of project against relevant policies and guidelines	Section 2.8

Regulator	Reference and Issue	Section Addressed in this Report
NSW DCCEEW Conservation Programs, Heritage and Regulation Group (CPHR) – Water and Soils	<p>The EIS must map the following features relevant to water and soils including:</p> <ul style="list-style-type: none"> <li>(a) Existing surface and groundwater</li> <li>(b) Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations</li> <li>(c) Water Quality Objectives (<i>as endorsed by the NSW Government</i>) including groundwater as appropriate that represent the community's uses and values for the receiving waters</li> <li>(d) Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the <i>ANZECC (2000) Guidelines for Fresh and Marine Water Quality</i> and/or local objectives, criteria or targets endorsed by the NSW Government</li> <li>(e) <i>Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions.</i></li> </ul>	Section 2
	<p>The EIS must assess the impacts of the project on water quality, including:</p> <ul style="list-style-type: none"> <li>(a) The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the project 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.</li> <li>(b) Identification of proposed monitoring of water quality</li> </ul>	Sections 5 and 6
	<p>The EIS must assess the impact of the project on hydrology, including:</p> <ul style="list-style-type: none"> <li>(a) Water balance including quantity, quality and source</li> <li>(b) Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas</li> <li>(c) Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems</li> <li>(d) Impacts to natural processes and functions within rivers, wetlands, estuaries 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)</li> <li>(e) Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water</li> <li>(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</li> <li>(g) Identification of proposed monitoring and hydrological attributes.</li> </ul>	Sections 5

Regulator	Reference and Issue	Section Addressed in this Report
<p>NSW DCCEEW CPHR – Flooding</p>	<p>The EIS shall include a flood impact and risk assessment (FIRA). As a minimum the FIRA must:</p> <ul style="list-style-type: none"> <li>(a) Consider the relevant provisions of the NSW Flood Risk Management Manual (2023) and associated guides, and existing council and government studies, information and requirements.</li> <li>(b) Identify and describe existing flood behaviour on the site and its surrounding areas for the full range of events, including 5% Annual Exceedance Probability (AEP), 1% AEP, PMF and 0.5% AEP or 0.2% AEP and provide an assessment of the compatibility of the development and its users with flood behaviour. This may require flood modelling where existing flood information is not available.</li> <li>(c) Determine and describe changes in post development flood behaviour, impacts of flooding on existing community and on the development and its future community for full range of events, 5% AEP, 1% AEP, PMF and 0.5% AEP or 0.2% AEP. This will typically require flood modelling.</li> <li>(d) Consider impacts of climate change due to both sea level rise and increase in rainfall intensities considering relevant Council and government advice. The 0.5% AEP or 0.2% AEP events can be used to provide an understanding of the scale of change of flood behaviour relative to the 1% AEP event.</li> <li>(e) Propose and assess the effectiveness of management measures required to minimise the impacts and risks of flooding to the development and its users and existing community.</li> </ul> <p>Note:</p> <ul style="list-style-type: none"> <li>• The scope of a FIRA must be consistent with the Flood Risk Management Guideline LU01.</li> <li>• The FIRA will need to be tailored to suit the project being considered, whilst maintaining consistency with the FIRA guide.</li> </ul> <ul style="list-style-type: none"> <li>a. Flood prone land</li> <li>b. Flood planning area, the area below the flood planning level</li> <li>c. Hydraulic categorisation (floodways and flood storage areas)</li> <li>d. Flood hazard.</li> </ul>	<p>Section 4</p>
<p>DPI Fisheries – Waterway Crossings</p>	<p>The construction of permanent or temporary access tracks or underground cables through Key Fish Habitat should be in accordance with DPI Fisheries Guideline document: <i>Policy and Guidelines for Fish Habitat Conservation and Management</i> (Update 2013), and <i>Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings</i> (DPI 2003). This is to ensure that the works are designed and constructed in accordance with best management practice.</p>	<p>Section 5.1.2</p>
<p>Tamworth Regional Council - Water</p>	<p>EIS should investigate the impact of development to neighbouring bore water supplies, if it intends to use them as the applicant has identified in the scoping report. A water use plan to be developed in consultation with TRC and underlying landholders.</p>	<p>Section 6</p>
<p>Tamworth Regional Council – Stormwater and Flooding</p>	<p>An assessment shall be undertaken of the impact of minor and major stream events, an associated management / mitigation plans shall be prepared.</p>	<p>Section 5.1.1</p>

## 1.2.2 Large-Scale Solar Energy Guideline

The Large-scale Solar Energy Guideline (DPIE, 2022) (Solar Energy Guideline) provides clear and consistent guidance on how to measure and assess key environmental impacts of large-scale solar energy projects in NSW, declared as SSD. Key assessment issues covered by the Solar Energy Guideline include:

- Landscape and visual impacts.
- Agricultural land use.
- Infrastructure contributions, benefit sharing and agreements.
- Waste management and circular design.
- Decommissioning and rehabilitation.
- Glint and glare.

Several other assessment issues related to water resources are also identified in Section 5.7 of the Solar Energy Guideline for careful consideration. Table 1.3 lists the considerations relevant to this assessment and where each is addressed in this report.

**TABLE 1.3: SOLAR ENERGY GUIDELINE REQUIREMENTS RELEVANT TO WATER RESOURCES**

Issue	Assessment	Section addressed in this report
Water Management	Surface water-related impacts, such as flooding, discharge/run-off and erosion, must be assessed. Appropriate mitigation measures, such as sediment controls, must be proposed where warranted.	Sections 5, 6 and 8
	Applicants should consult with landholders regarding potential surface water related impacts of the project on neighbouring properties and any mitigation measures.	Sections 5, 6 Note: no significant impacts on neighbouring properties which require consultation with adjacent landholders.
	Any assessment of surface water-related impacts must be informed by a soil survey that considers the potential for erosion.	Refer to EIS Section 2.6.1
	If there is any water take associated with the project, the applicant should identify the source of water (both potable and non-potable) and may need to acquire water access licences if the project is approved.	Sections 2.8 and 3.1.2
Cumulative Impacts	Any cumulative impacts from any other developments (proposed, approved and operative), especially biodiversity, socio-economic and construction traffic impacts must be assessed in accordance with the department's Cumulative Impact Assessment Guidelines for State Significant Projects (July 2021, or its latest version).	Section 7

## 1.3 Project Description

The Project is situated in the rural locality of Garoo, approximately 40 kilometres (km) (by road) south of Tamworth and 370 km northwest of Sydney. Located entirely within the Tamworth Regional LGA, the Project Area extends across approximately 369 hectares (ha), comprising 17 freehold land parcel and one Crown Land lot. The land is currently used for agricultural activities, predominantly livestock grazing and irrigated cropping.

The Project will involve the construction, operation, maintenance and, where relevant, decommissioning of an AC solar farm, BESS and associated supporting ancillary infrastructure.

An overview of the proposed development is provided in Figure 1.1, with the workforce accommodation camp location and details shown on Figure 1.2 and Figure 1.3 respectively.

Key Project components are summarised in Table 1.4 and Table 1.5.

**TABLE 1.4: PROJECT SUMMARY**

<b>Component</b>	<b>Summary</b>
<b><i>Project Details</i></b>	
Project	Garoo Solar Farm and BESS
Applicant	GreenPulse Solar Farm and BESS Unit Trust
Project Address	291 Garoo Road, Garoo NSW 2340
Project Area	The Project Area extends over approximately 369 hectares (ha).
Development Footprint	Maximum directly impacted area by Project construction and operation, which is approximately 305.43 ha. The Development Footprint is located entirely in the Project Area. It includes all temporary and permanent disturbance areas, and all areas where vegetation may be removed during project construction and operations.
Study Area	Subject area for individual assessments will differ commensurate with the relevant legislation and guidelines for individual aspects.
EDC	Estimated total Project cost of \$500 million
<b><i>Project Elements</i></b>	
Solar Panels	<ul style="list-style-type: none"> <li>• Approximately 234,000 Solar photovoltaic (PV) modules (solar panels); and</li> <li>• Maximum generation capacity of 133.76 MW AC.</li> </ul>
BESS	<ul style="list-style-type: none"> <li>• Storage capacity of approximately 360 MW / 1,440 MWh; and</li> <li>• Located on Lot 16 DP755341;</li> </ul>
Electrical Reticulation Infrastructure	<ul style="list-style-type: none"> <li>• Two onsite substations (330 kV), including switching station, transformers and associated structures; and</li> <li>• Approximately 16.6 km of underground electrical reticulation connecting solar panels to the substations and associated infrastructure.</li> <li>• Conduits housing electrical reticulation will be attached to the Tamarang Creek bridge crossing.</li> </ul>
Access	<ul style="list-style-type: none"> <li>• The Project will be accessed via Garoo Road, at the northwest corner of the Project Area (refer Figure 1.1).</li> </ul>
Emergency Access	<ul style="list-style-type: none"> <li>• There are two emergency access points, one will be via Garoo Road, at the northwest corner of the Project Area and the second emergency access will be via Bulls Road from the southwest corner of the Project Area.</li> </ul>

Component	Summary
<i>On-site Supporting Infrastructure</i>	<ul style="list-style-type: none"> <li>• Permanent Operations &amp; Maintenance (O&amp;M) compound, including               <ul style="list-style-type: none"> <li>– A control room;</li> <li>– Storage facilities;</li> <li>– Supervisory Control and Data Acquisition (SCADA) facilities;</li> <li>– Basic office amenities; and</li> <li>– Car parking area.</li> </ul> </li> <li>• Laydown area;</li> <li>• New or upgraded access roads;               <ul style="list-style-type: none"> <li>– Single bridge across Tamarang Creek (Lot 1 and Lot 2, DP 755341);</li> </ul> </li> <li>• New or upgraded drainage system; and</li> <li>• Security fencing (approximately 2.4 m high) and lighting.</li> </ul>
<i>Off-site Supporting Infrastructure</i>	<ul style="list-style-type: none"> <li>• Existing transport network;</li> <li>• Existing telecommunications network;</li> <li>• Waste and wastewater disposal facilities</li> <li>• Temporary quarry for construction material (if required); and</li> <li>• Temporary accommodation/housing for construction workers (if required).</li> </ul>
<b>Construction</b>	
<i>Construction Duration</i>	<ul style="list-style-type: none"> <li>• Approximately 18 months.</li> </ul>
<i>Construction Hours</i>	<ul style="list-style-type: none"> <li>• As per standard daytime construction working hours (or as defined in Section 3.5 of the EIS).</li> </ul>
<i>Construction Workforce</i>	<ul style="list-style-type: none"> <li>• Approximately 250 Full Time Equivalent (FTE) during peak construction.</li> </ul>
<i>On-site Temporary Infrastructure</i>	<ul style="list-style-type: none"> <li>• Temporary construction compounds with offices, car parking and amenities;</li> <li>• Temporary workers accommodation camp (capacity 250 FTE) for 15 months (refer Figure 1.2);</li> <li>• On-site borrow pits, laydown and storage areas, fencing, and access; and</li> <li>• Utilities, including water sourcing, power supply, and communications</li> </ul>
<i>Ancillary Activities</i>	<ul style="list-style-type: none"> <li>• Delivery of Project components, including solar panels, battery modules, substations, transformers and associated components;</li> <li>• Installation of underground and overhead cabling, maintenance and environmental managements processes and equipment;</li> <li>• Access road upgrades; and</li> <li>• Earthworks, as required.</li> </ul>
<i>Services and Utilities</i>	<ul style="list-style-type: none"> <li>• Adjustment, protection or relocation of existing utilities, including:</li> <li>• Liddell-Tamworth transmission line; and</li> <li>• Public roads.</li> </ul>

Component	Summary
<i>Transport Route</i>	<ul style="list-style-type: none"> <li>• Main equipment and Over Size, Over Mass (OSOM) deliveries via Port of Newcastle; and</li> <li>• Associated external road upgrades (also used for operational maintenance or decommissioning activities)</li> </ul>
<b>Operations</b>	
<i>Duration</i>	<ul style="list-style-type: none"> <li>• Development Consent in perpetuity; and</li> <li>• Infrastructure life minimum of 30 years</li> </ul>
<i>Hours of Operation</i>	<ul style="list-style-type: none"> <li>• 24 hours a day, seven days a week.</li> </ul>
<i>Operational Workforce</i>	<ul style="list-style-type: none"> <li>• Approximately ten FTE staff to operate the Project, once constructed.</li> </ul>

**TABLE 1.5: TEMPORARY WORKFORCE ACCOMMODATION CAMP**

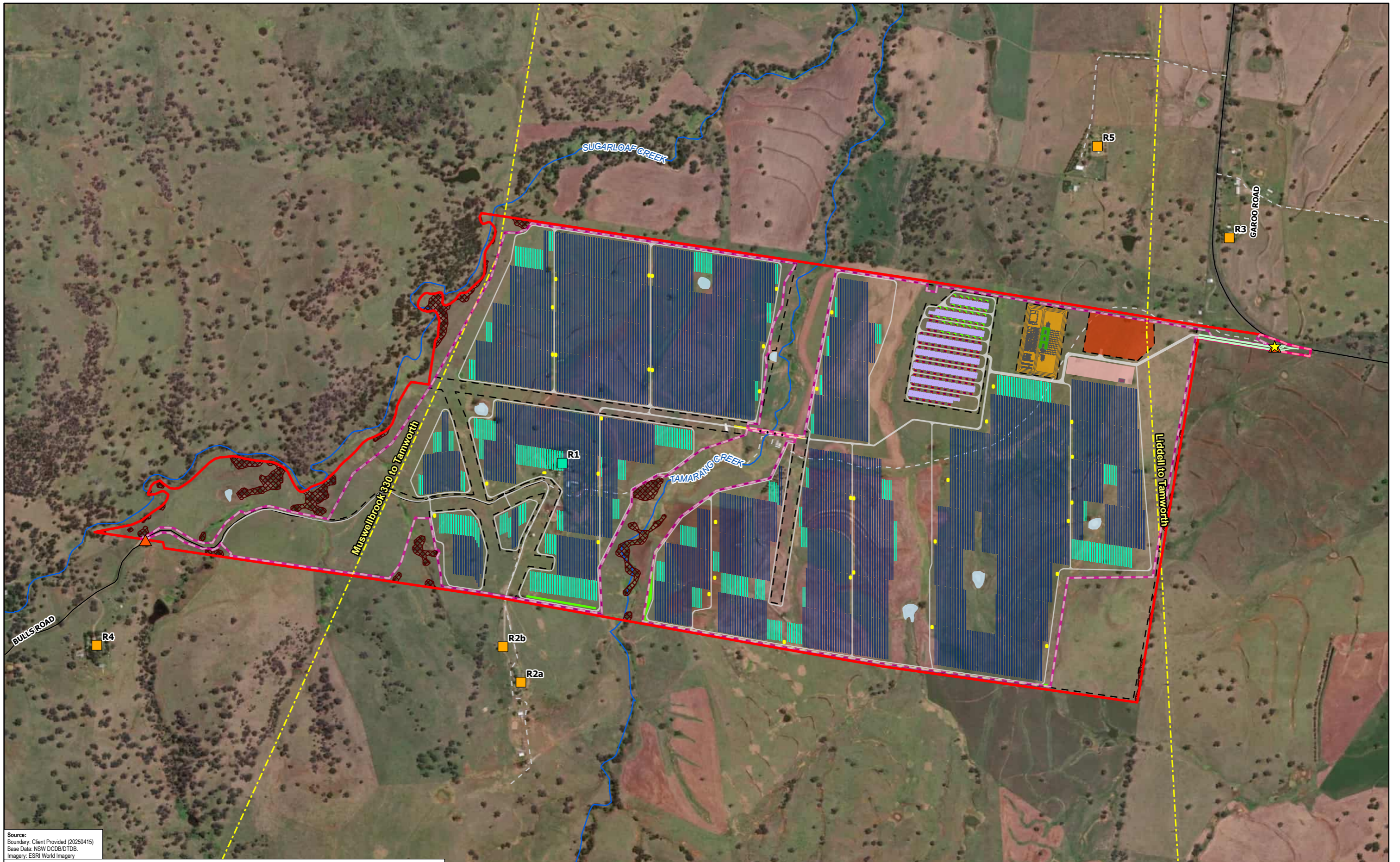
Facilities / Items	Description
Accommodation	<ul style="list-style-type: none"> <li>• Portable cabins (4x 4x15 m).</li> </ul>
Ancillary buildings	<ul style="list-style-type: none"> <li>• Laundry, amenities blocks (Showers / washrooms), gymnasiums, recreation facilities, site office, storage, training room, retail shop and maintenance container; and</li> <li>• First aid facilities with an on-site nurse.</li> </ul>
Amenities infrastructure	<ul style="list-style-type: none"> <li>• The following infrastructure would be provided to the amenities:</li> <li>• Electricity – generator with solar panels, A/C unit;</li> <li>• Water – Water storage for potable water, fire water, fire pump and fire hydrant;</li> <li>• Sewerage – Grey wastewater treatment plant, including compost toilets; and</li> <li>• Internet and telecommunication services – mobile facilities.</li> </ul>
Waste Facilities	<ul style="list-style-type: none"> <li>• Grease trap; and</li> <li>• Waste collection area.</li> </ul>
Fuel / Gas / Chemical Storage	<ul style="list-style-type: none"> <li>• Storage facility for generator fuel;</li> <li>• 210kg Gas container; and</li> <li>• Chemical container for WWTP.</li> </ul>
Transport and Parking	<ul style="list-style-type: none"> <li>• The camp will be accessed via two site access points connected to internal access roads;</li> <li>• Car parking for up to 125 car spaces;</li> <li>• Four shuttle bus parking; and</li> <li>• Truck loading / unloading area</li> </ul>

## 1.4 Project Terminology

Technical terminology and acronyms used throughout the report are detailed and defined in Table 1.6.

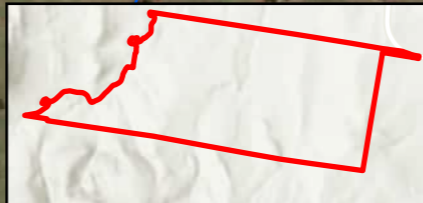
**TABLE 1.6: PROJECT TERMINOLOGY**

Term	Definition
Project	A Solar Farm and BESS as described in Section 1.3 to which the Application applies.
Project Area	Red boundary shown on key figures to which the Application applies (unless otherwise stipulated).
Disturbance Area	The area of land that will be subject to alteration during the construction, operation and decommissioning of Project infrastructure (~320 ha).
Applicant	Green Pulse Pty Ltd.
Application	Application for Development Consent under Part 4.7 of the EP&A Act; and Determination under Part 9 of the EPBC Act.



Source:  
 Boundary: Client Provided (20250415)  
 Base Data: NSW DCDB/DTDB  
 Imagery: ESRI World Imagery

Legend			
Project Area	Transmission Lines (existing)	PV (Mounting Structure - Half Table)	Customer Substation
Development Footprint	Maintained Existing Water Dams	PV (Mounting Structure - Full Table)	Transgrid Substation Upgrade
Preferred access point	Avoidance Area	Internal Road	Inverters
Emergency Access point	Associated Dwelling	Parking and Laydown Area	Bridge
	Non-Associated Dwelling		PCS Station
			OHL Interconnection
			BESS Container
			Strategic Road Upgrade
			Fence
			O&M Building
			Bridge Piers
			Noise Walls - PCS Stations
			Noise Wall - High Voltage Transformer
			Mitigation Planting Areas
			Local Road
			Local Track-Vehicular



Coordinate System:  
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 Date: 28/10/2025  
 Created By: NB  
 Drawing Size: A3

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**Project Layout** FIGURE1.1  
**Map 1 of 7**

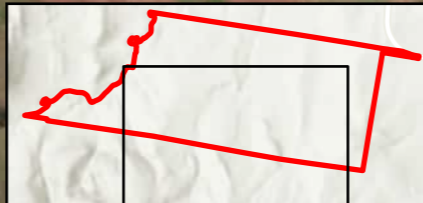
**Garoo Solar Farm and BESS**  
**Environmental Impact Assessment**  
 GreenPulse Solar Farm and BESS Unit Trust





Sources:  
 Boundary: Client Provided (20250415)  
 Base Data: NSW DCDB/DTDB  
 Imagery: ESRI World Imagery

Legend	
Project Area	Maintained Existing Water Dams
Development Footprint	Avoidance Area
Transmission Lines (existing)	Associated Dwelling
Non-Associated Dwelling	Internal Road
Inverters	Fence
Bridge	Bridge Piers
PCS Station	Mitigation Planting Areas
OHL Interconnection	Local Road
BESS Container	Local Track-Vehicular
PV (Mounting Structure - Half Table)	
PV (Mounting Structure - Full Table)	



Coordinate System:  
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**Project Layout  
 Map 2 of 7**

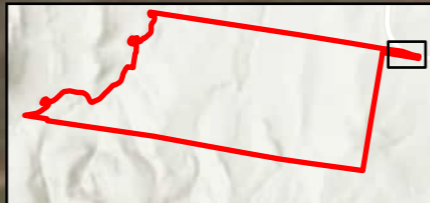
**Garoo Solar Farm and BESS  
 Environmental Impact Assessment**  
 GreenPulse Solar Farm and BESS Unit Trust





Source:  
 Boundary: Client Provided (20250415)  
 Base Data: NSW DCDB/DTDB  
 Imagery: ESRI World Imagery

Legend		
	Project Area	
	Development Footprint	
	Preferred access point	
	Emergency Access point	



Coordinate System:  
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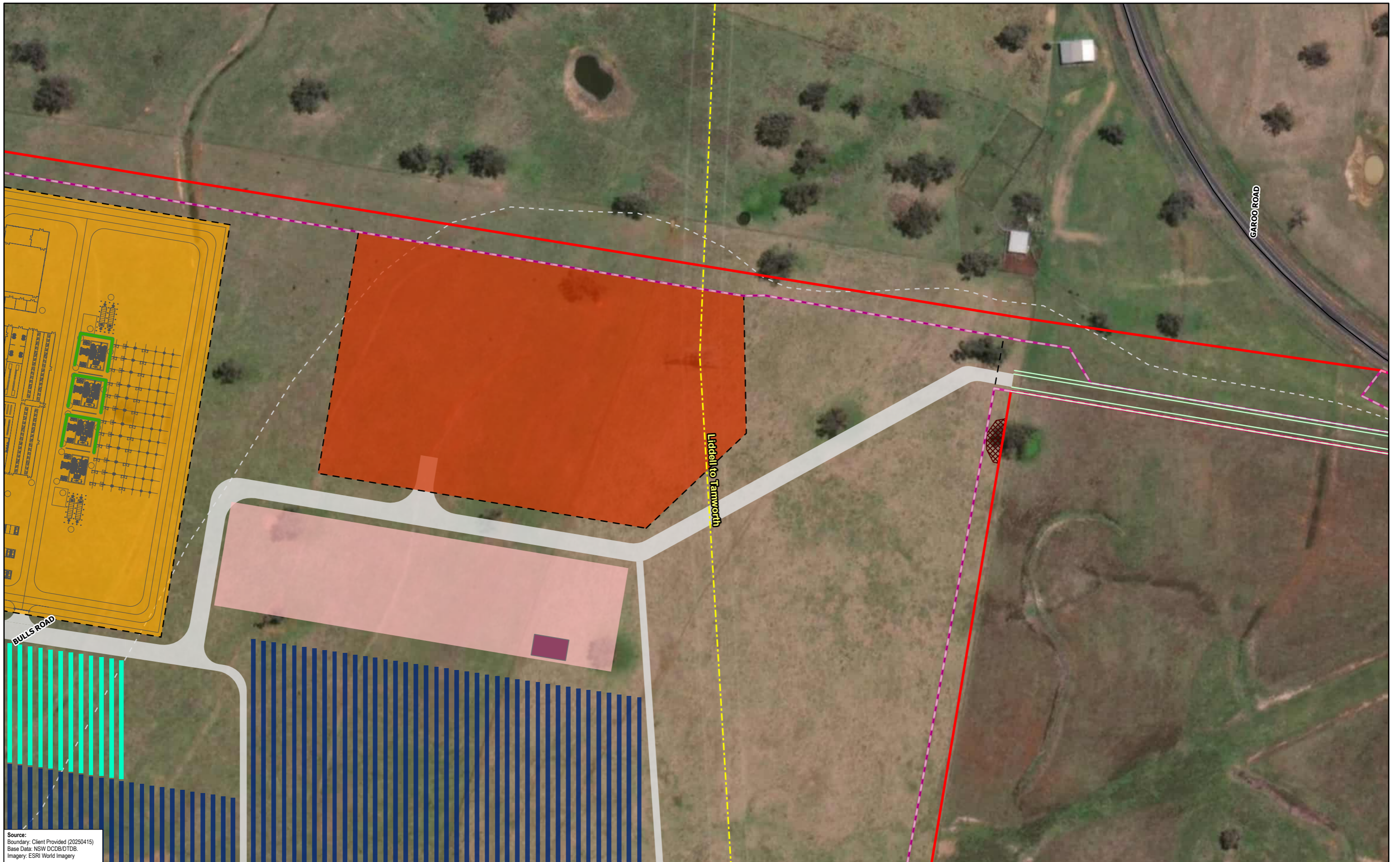


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**Project Layout  
 Map 3 of 7**

**Garoo Solar Farm and BESS  
 Environmental Impact Assessment**  
 GreenPulse Solar Farm and BESS Unit Trust





Source:  
 Boundary: Client Provided (20250415)  
 Base Data: NSW DCDB/DTDB  
 Imagery: ESRI World Imagery

Legend	
Project Area	PV (Mounting Structure - Half Table)
Development Footprint	PV (Mounting Structure - Full Table)
Transmission Lines (existing)	Internal Road
Avoidance Area	Parking and Laydown Area
Transgrid Substation Area	Customer Substation Area
O&M Building	Strategic Road Upgrade
Noise Wall - High Voltage Transformer	Fence
Local Road	Local Track-Vehicular



Coordinate System:  
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**Project Layout  
 Map 4 of 7**

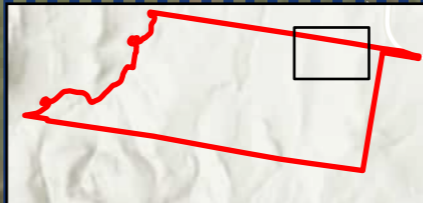
**Garoo Solar Farm and BESS  
 Environmental Impact Assessment**  
 GreenPulse Solar Farm and BESS Unit Trust





Source:  
 Boundary: Client Provided (20250415)  
 Base Data: NSW DCDB/DTDB  
 Imagery: ESRI World Imagery

Legend			
	Project Area		PV (Mounting Structure - Half Table)
	Development Footprint		Parking and Laydown Area
	Transmission Lines (existing)		Customer Substation Area
	Internal Road		Transgrid Substation Area
	Inverters		O&M Building
	PCS Station		Noise Walls - PCS Stations
	OHL Interconnection		Noise Wall - High Voltage Transformer
	BESS Container		Local Track-Vehicular
	Fence		



Coordinate System:  
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**Project Layout  
 Map 5 of 7**

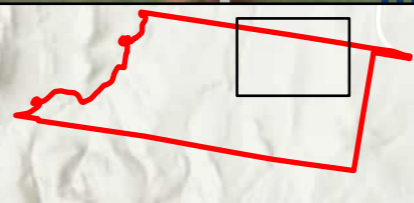
**Garoo Solar Farm and BESS  
 Environmental Impact Assessment**  
 GreenPulse Solar Farm and BESS Unit Trust





Source:  
 Boundary: Client Provided (20250415)  
 Base Data: NSW DCDB/DTDB  
 Imagery: ESRI World Imagery

Legend				
Project Area	PV (Mounting Structure - Full Table)	Customer Substation Area	PCS Station	Bridge Piers
Development Footprint	Internal Road	Transgrid Substation Area	OHL Interconnection	Noise Walls - PCS Stations
PV (Mounting Structure - Half Table)	Parking and Laydown Area	Inverters	BESS Container	Noise Wall - High Voltage Transformer
		Bridge	Fence	Local Track-Vehicular
			O&M Building	



Coordinate System:  
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 Date: 28/10/2025  
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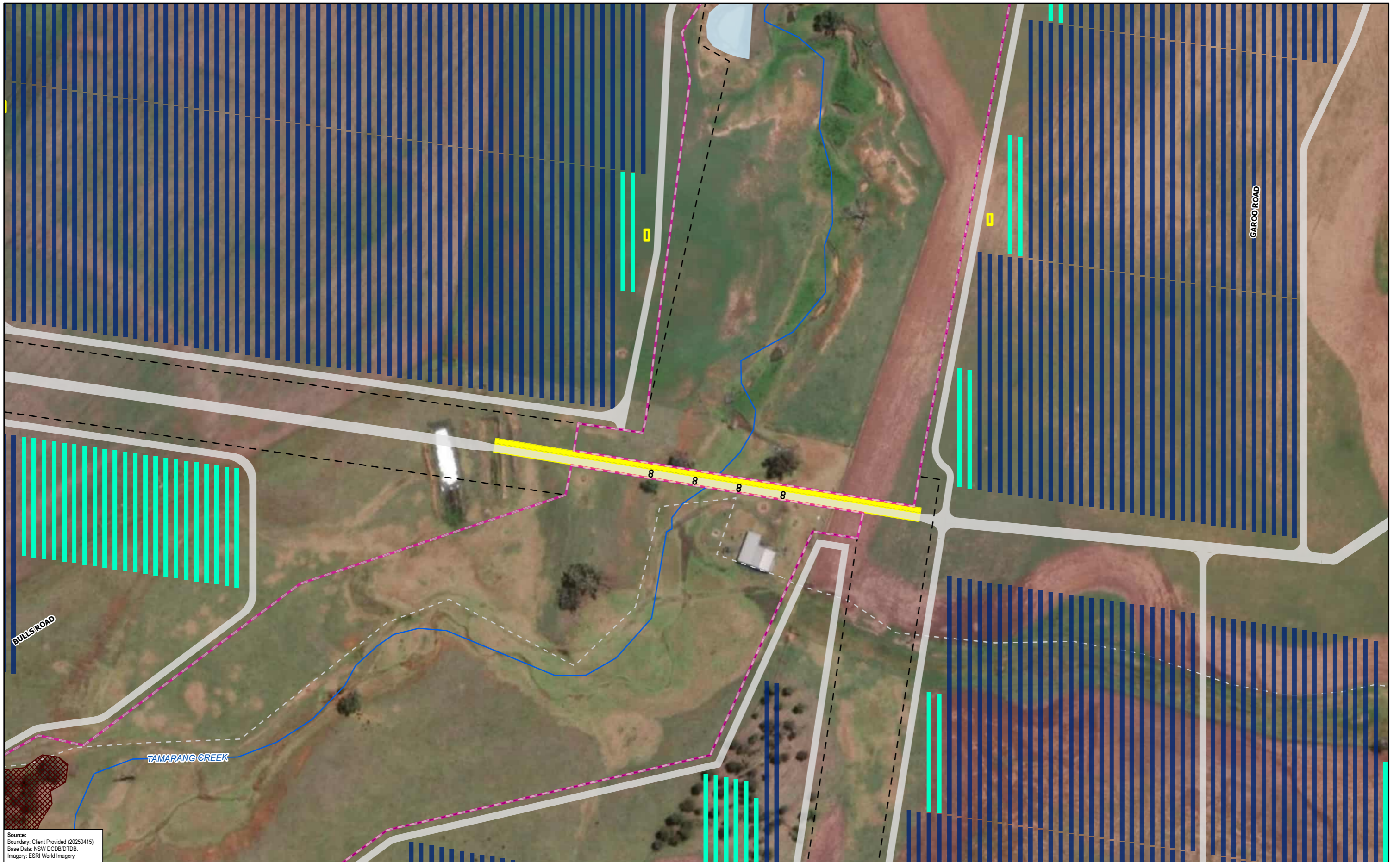
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**Project Layout  
 Map 6 of 7**

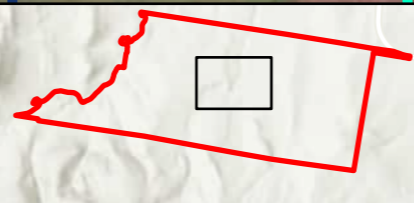
**Garoo Solar Farm and BESS  
 Environmental Impact Assessment**  
 GreenPulse Solar Farm and BESS Unit Trust





Source:  
 Boundary: Client Provided (20250415)  
 Base Data: NSW DCDB/DTDB  
 Imagery: ESRI World Imagery

Legend			
Project Area	Avoidance Area	PV (Mounting Structure - Full Table)	Bridge
Development Footprint	PV (Mounting Structure - Half Table)	Internal Road	Fence
Maintained Existing Water Dams	Inverters	Bridge Piers	Local Track-Vehicular

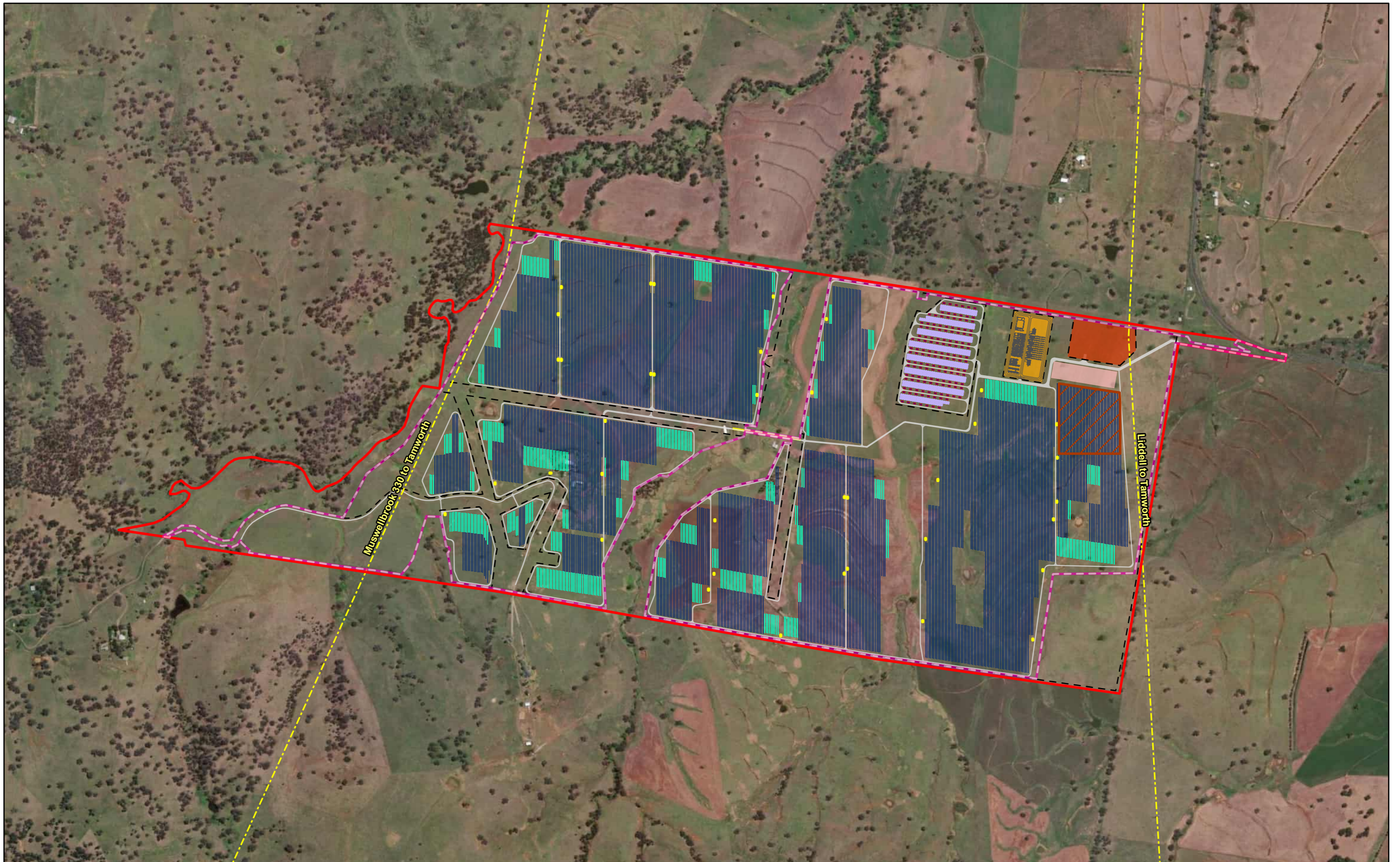


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**Project Layout  
 Map 7 of 7**

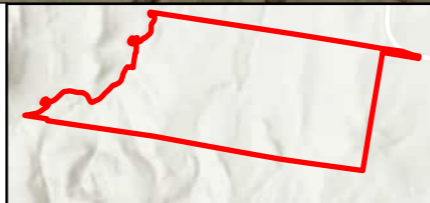
**Garoo Solar Farm and BESS  
 Environmental Impact Assessment**  
 GreenPulse Solar Farm and BESS Unit Trust





Legend			
Project Area	PV (Mounting Structure - Full Table)	Transgrid Substation Area	BESS Container
Development Footprint	Internal Road	Inverters	Fence
Transmission Lines (existing)	Parking and Laydown Area	Bridge	Temporary Workers Accommodation Camp
PV (Mounting Structure - Half Table)	Customer Substation Area	PCS Station	OHL Interconnection

Source:  
 Boundary: Client Provided (20250415)  
 Base Data: NSW DCDB/DTDB  
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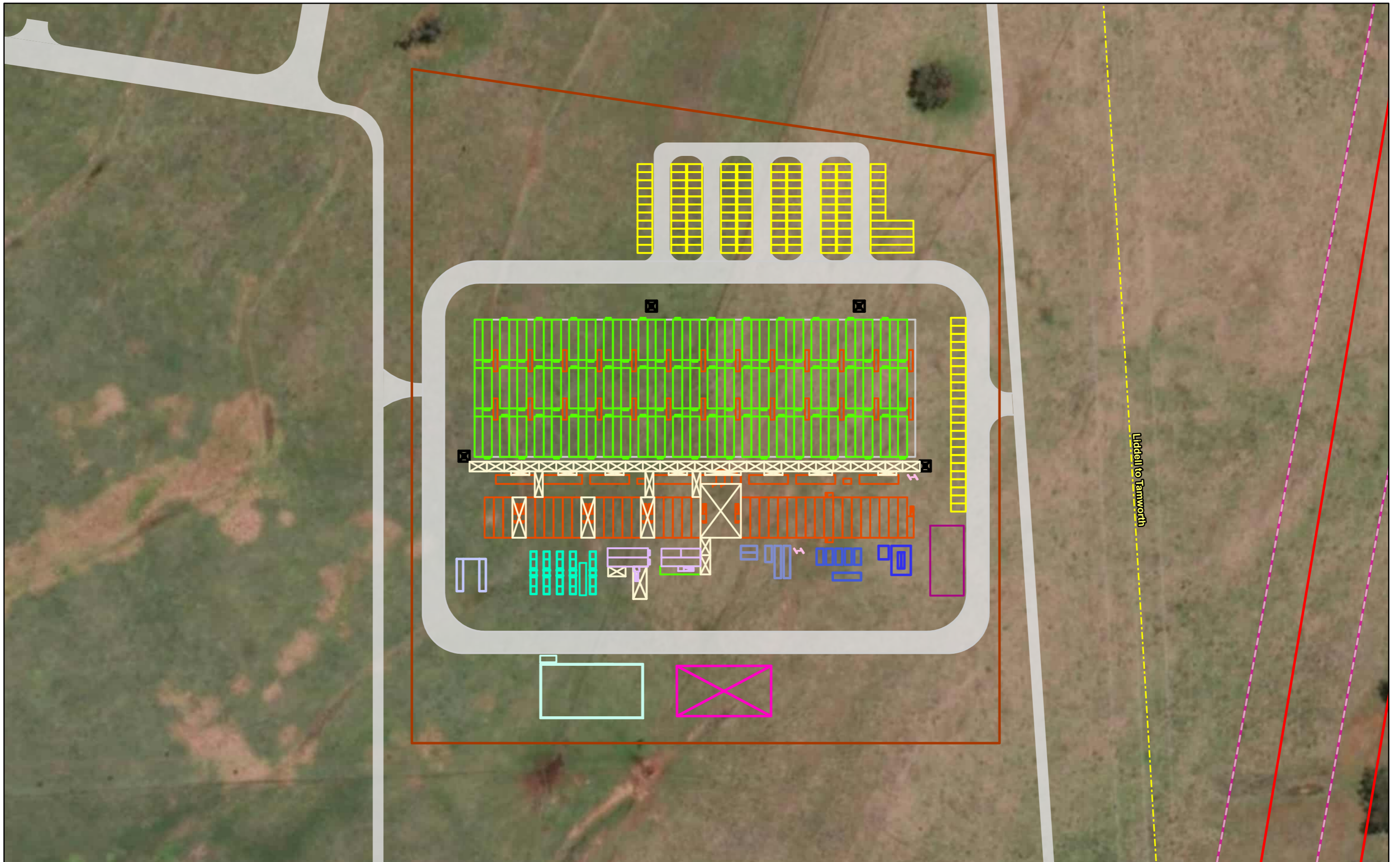


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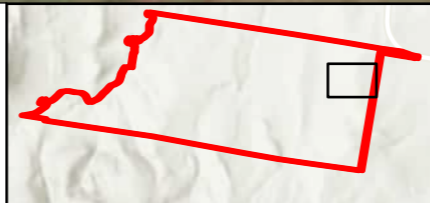
**Workforce Accommodation Camp Location**

**Garoo Solar Farm and BESS Environmental Impact Assessment**  
 GreenPulse Solar Farm and BESS Unit Trust



Legend			
	Project Area		Verandah
	Development Footprint		Potable Water
	Transmission Lines (existing)		WWTP
	Internal Road		Car Parking
	Admin & First Aid		Amenities & Services
	Loading Area		Accommodation Area
	Smoking Area		Accommodation Area
	Waste Area		Accommodation Area
	Fire Suppression		Fence
	Gas hazard area		Accommodation Area
	Generators and fuel store		Accommodation Area
	Maintenance containers		Accommodation Area

Source:  
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Base Data: NSW DCDB/DTDB.  
Imagery: ESRI World Imagery



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**Workforce Accommodation Area**

**Garoo Solar Farm and BESS**  
Environmental Impact Assessment  
GreenPulse Solar Farm and BESS Unit Trust

## 2. BASELINE CHARACTERISTICS

### 2.1 Climate

The Project is located in the south-eastern corner of the Namoi River Region which is characterised as a temperate climate zone that varies across the region, with cooler and wetter conditions in the east, and rainfall typically occurring during summer (Australian Government, 2019). The region is characterised by hot dry summers and cool winters (ABCB, 2024).

The local area is generally dry with limited water pooling around farm dams and waterways during wet periods recorded from April to October, observed through Digital Earth Australia (DEA) Water Observation Landsat data (Geoscience Australia, 2023).

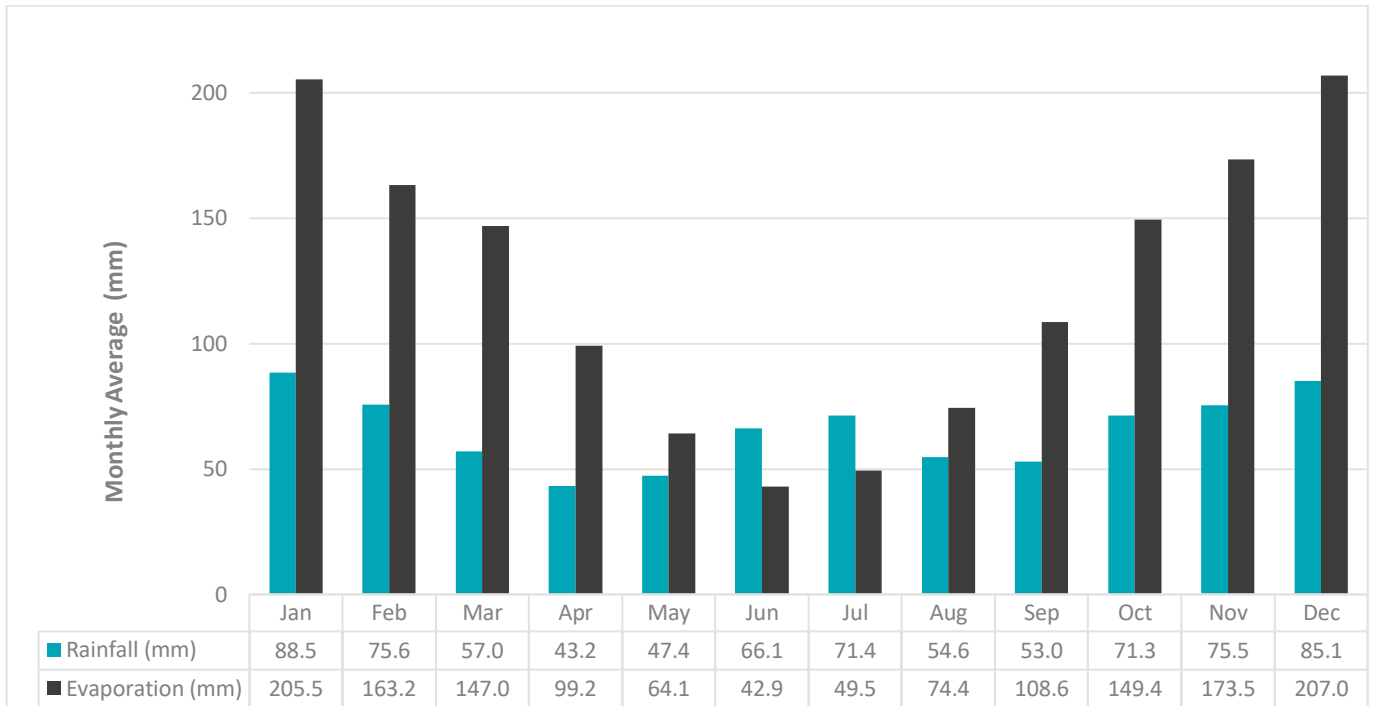
Four key Bureau of Meteorology (BoM) long-term rainfall gauges with current data are located near the Project Area and are listed in Table 2.1. Climate data for the Project Area was also sourced from the Queensland Government Department of Environment, Science and Innovation (DESI) Synthetic Information for Landholders (SILO) database. This database interpolates raw rainfall and evaporation data from gauges managed by the BoM to provide spatially and temporally complete datasets. Rainfall and evaporation (Class A evaporation pan) data was sourced for the SILO grid point closest to the site (-31.45 latitude, 150.90 longitude) for the period between 01/01/1889 to 31/12/2024.

There is minor variation only between the average daily rainfall recorded at each of the gauging stations and the SILO datapoint, indicating that the SILO dataset is suitable to be used to represent long-term rainfall data

Evaporation data obtained from the SILO database is based on using a Class A evaporation pan which indicates the amount of water evaporating from bare ground or open water. The rate of evaporation depends on factors such as cloudiness, air temperature and wind speed. The daily average rainfall and pan evaporation within the Project Area are presented in Figure 2.1, indicating that monthly evaporation typically exceeds monthly rainfall. However, during June and July, rainfall typically exceeds evaporation, reflecting the seasonal change into winter, being typically the wetter and cooler months of the year.

**TABLE 2.1: NEARBY WEATHER STATIONS AND SILO DATAPPOINT**

Station	Proximity to Project Area	Data Range
Gowrie (Lallybroch) (55195)	500 m south	1958-2023
Nundle (Keeva) (55245)	11.9 km south-east	1984-2024
Gowrie South (55190)	7.8 km north-west	1958-2024
Quirindi (Spring Vale) (55255)	15.6 km south-west	1965-2024
SILO Datapoint (-31.45, 150.90)	Project Area	1889-2024



**FIGURE 2.1: SILO MONTHLY RAINFALL AND PAN EVAPORATION WITHIN THE PROJECT AREA**

## 2.2 Surface Water Context

### 2.2.1 Regional Systems

The Project is located within the Namoi catchment and regional water strategy area as part of the broader Murray Darling Basin catchment. A tributary to the Darling and Murray Rivers, the Namoi River flows in a north-eastern direction, passing approximately km north-west of the Project Area. Connectivity exists between the Namoi River and the Project Area via the Peel River, which is a major regulated tributary of the Namoi River flowing north-east. The Peel River passes approximately 30 km north-east of the Project Area at its nearest point.

The Namoi River catchment comprises approximately 4% of the Murray Darling Basin and covers an area of approximately 42,000 km<sup>2</sup> (MDBA, 2023; NSW Government, 2022). The local catchment area for the Project is approximately 18 km<sup>2</sup>, draining Tamarang Creek and Sugarloaf Creek and their tributaries.

An overview of the Project Area and its proximity to key regional drainage features is provided in Figure 2.2.

### 2.2.2 Local Systems

The Project Area is located in a moderately hilly area with ranges in elevation from approximately 560 mAHD to 640 mAHD (refer to Figure 2.3), with the landform is generally sloping towards the north.

Sugarloaf Creek flows in a north-westerly direction along the western border of the Project Area, and Tamarang Creek flows through the centre of the Project Area. Tamarang Creek flows into Sugarloaf creek approximately 1.2 km north of the Project Area, which joins Goonoo Goonoo Creek approximately 30 km upstream of its confluence with the Peel River.

All mapped “defined” watercourses within the Project Area have been identified from the Department of Customer Service (Spatial Service) (NSW SS) dataset (NSW SS, 2016). There are two non-minor (i.e. Strahler order of three or greater) watercourses mapped within the Project Area including Tamarang Creek (4<sup>th</sup> order within the Project Area) and an unnamed hydroline to the east of Tamarang Creek (4<sup>th</sup> order within the Project Area). Sugarloaf Creek is also a 4<sup>th</sup> order watercourse and flows adjacent to the western Project boundary. The remaining tributaries to these watercourses and those within the Project area are identified to have a Strahler order of two or less and are thus, minor streams.

The *Harvestable Rights (central inland-draining catchments) Order 2022* under the *Water Management Act 2000* defines a minor stream as:

- (f) *Any stream or part of a stream:*
- (i) *identified as a watercourse in the hydroline spatial data, and*
  - (ii) *that is a first or second order stream, or part of such a stream, determined in accordance with the Strahler system set out in Schedule 2 to the Water Management (General) Regulation 2018, and*
  - (iii) *that does not maintain a permanent flow of water, being a visible flow which occurs on a continuous basis, or which would so occur if there were no water extractions, diversions or obstructions of flows upstream, and*
- (g) *any stream or part of a stream which is not identified as a watercourse in the hydroline spatial data.*

There are 34 mapped hydroline segments (each segment representing a reach to the next confluence) that lie within the Project Area. All mapped hydrolines within the Project Area are ephemeral watercourses and include:

- Seventeen 1<sup>st</sup> order.
- Five 2<sup>nd</sup> order.
- Four 3<sup>rd</sup> order.
- Eight 4<sup>th</sup> order.

The majority of these watercourses flow into or comprise the Sugarloaf Creek or Tamarang Creek, which flow in a north-easterly direction towards Goonoo Goonoo Creek (refer to Figure 2.2).

Characterisation of the local drainage catchments and flow paths within the Project Area was undertaken primarily using the NSW SS hydroline dataset, with confirmation of local topography from the following Digital Elevation Model (DEM) sources, in order of priority:

- High resolution 1 m DEM, provided by the Applicant, flown January 2025.
- 5 m DEM, derived from NSW Spatial Services LiDAR data, flown February 2016.

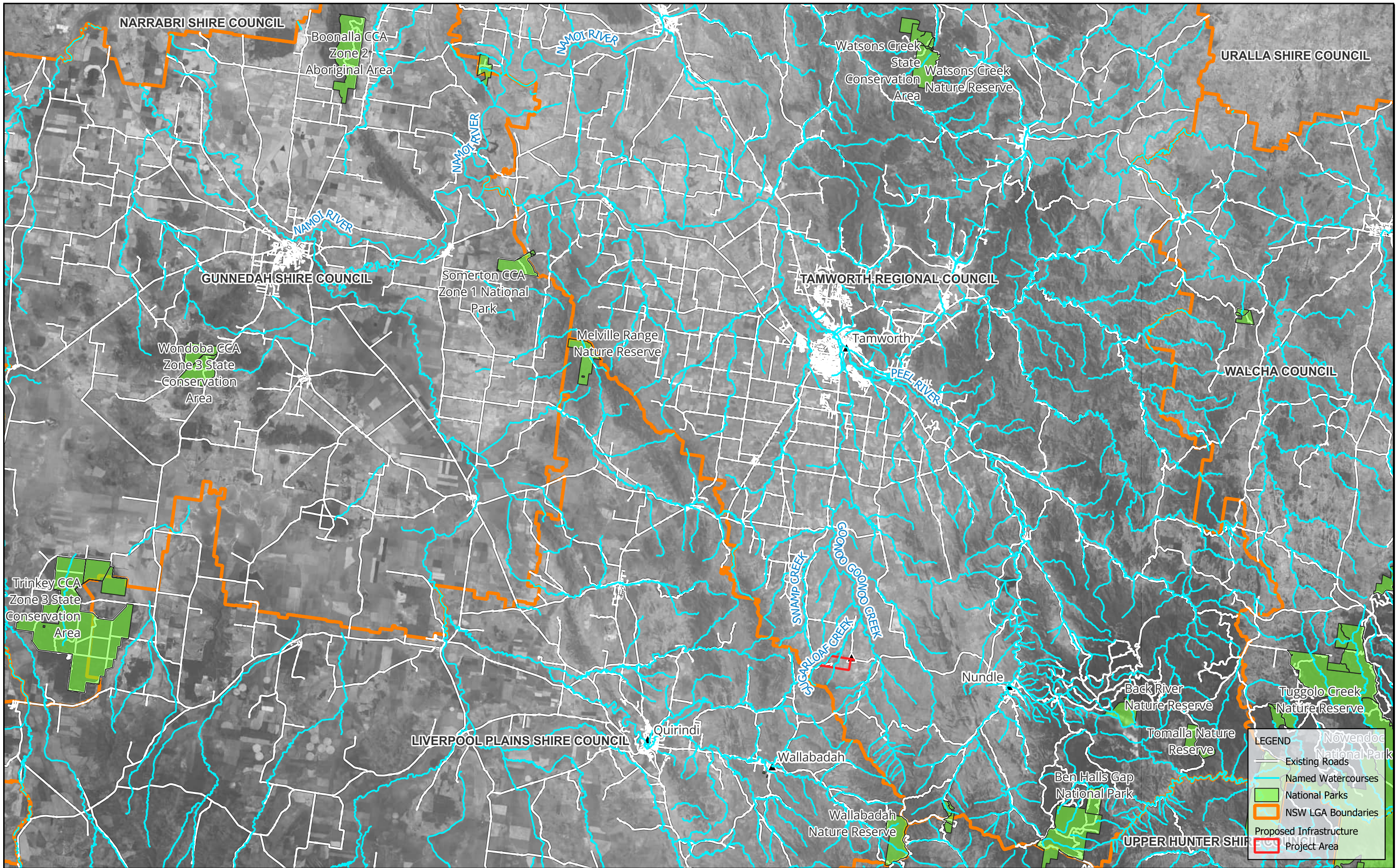
### 2.2.3 Waterfront Land

Waterfront land is defined as any river, lake or estuary, and the land within 40 m of the riverbanks, lake shore or estuary mean high-water mark (NRAR, 2020). Waterfront land exists for any watercourse or lake with a defined bed and bank and for any third order or above mapped hydroline. An assessment of waterfront land was undertaken using the NSW SS hydroline spatial data (2016) and DEM.

The hydrolines were assessed using the DEM to define partial or fully defined bed and bank as well as the Strahler order. The initial assessment of the Project Area defined several watercourses associated with the natural drainage channels throughout the landscape as having waterfront land.

When reviewing potential waterfront land along the mapped hydrolines the following outcomes were found:

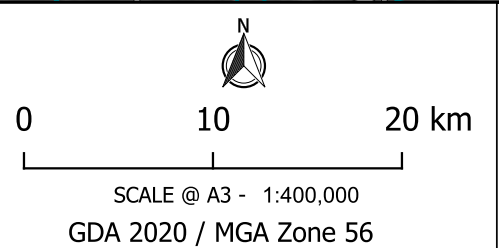
- Four 1<sup>st</sup> and 2<sup>nd</sup> order hydrolines were assessed with having partially or fully defined bed and banks, indicating waterfront land.
- Twelve 3<sup>rd</sup> order or above hydrolines (automatically classed as having waterfront land).



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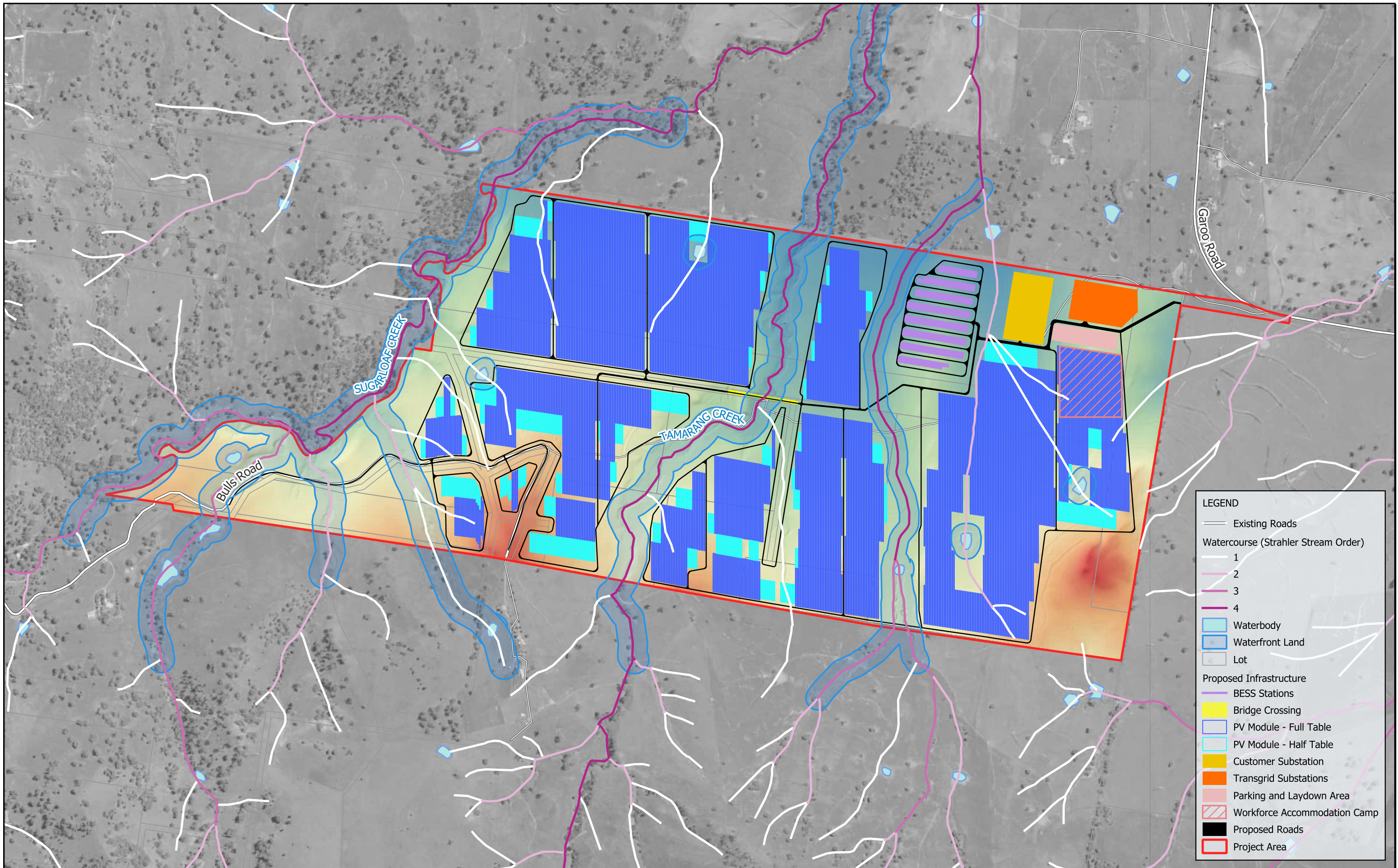
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Figure 2.2: Regional Water Context

Drg Ref. BNTL00206\_0019-FIG-008



**LEGEND**

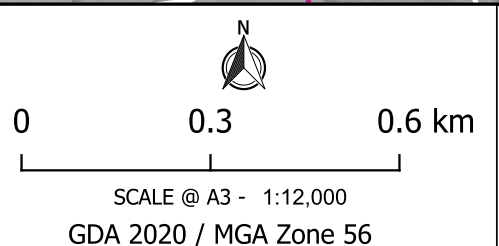
- Existing Roads
- Watercourse (Strahler Stream Order)
  - 1
  - 2
  - 3
  - 4
- Waterbody
- Waterfront Land
- Lot
- Proposed Infrastructure
  - BESS Stations
  - Bridge Crossing
  - PV Module - Full Table
  - PV Module - Half Table
  - Customer Substation
  - Transgrid Substations
  - Parking and Laydown Area
  - Workforce Accommodation Camp
  - Proposed Roads
  - Project Area

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Figure 2.3: Local Water Context

Drg Ref. BNTL00206\_0019-FIG-009

## 2.3 Flooding

### 2.3.1 Approach

An assessment of flooding regimes within the Project Area has been undertaken, in accordance with the methodology described in Section 4. This included:

- Review of available nearby flood studies.
- Development of a local TUFLOW model, with runoff for the Project Area determined using a Rain-on-Grid (RoG) approach.
- Simulation of design flood events for the 5% and 1% annual exceedance probability (AEP) and the Probable Maximum Flood (PMF) flood events to determine flood behaviour through the Project Area under both existing and developed scenarios.
- Simulation of the 0.2% AEP and a future climate change scenario in accordance with ARR2019v4.2 (1% AEP with long-term climate factors applied) for the baseline scenario to provide an understanding of the scale of change of flood behaviour relative to the 1% AEP event.

### 2.3.2 Existing Flood Behaviour

Detailed mapping of flood conditions including depth, velocity and hazard is provided in Appendix B for the Project baseline conditions (i.e. existing land uses). The existing flood behaviour is discussed in detail in Section 4.3 and impacts predicted with the Project are detailed in Section 5.1.3.

The existing conditions flood modelling results indicate that the upstream catchment flows are typically confined within the mapped watercourses, particularly Tamarang Creek through the Project Area and Sugarloaf Creek to the west. However, the eastern portion of the Project Area exhibits flatter terrain that has been modified for agricultural grazing. As a result, wider flow paths and areas of sheet flow are observed. The existing flood conditions were taken into consideration in the proposed placement of key Project infrastructure.

## 2.4 Groundwater Context

The *Water Management Act 2000* protects groundwater quality where groundwater works and activities have the potential to degrade groundwater sources and dependent ecosystems. SSDs must address the *Aquifer Interference Policy 2012* where high risk activities requiring a water licence such as dewatering for construction could potentially impact water-dependent assets. However, if the landowner holds existing water licences, they have the lawful right to utilise local groundwater resources. No existing groundwater licences are available within the Project Boundary.

The spatial data mapping application MinView developed by the Department of Primary Industries and Regional Development (2024) indicates there is six groundwater bores within the Project Area, primarily for water supply and stock and domestic use. Standing water level (SWL) values were available at two of these bores (GW062830 and GW055378) reporting levels of 3.6 m below ground level (BGL) and 20.4 m BGL. Three monitoring bores located within 30 km of the Project Area were analysed to provide indication of groundwater levels and flow across the area, including:

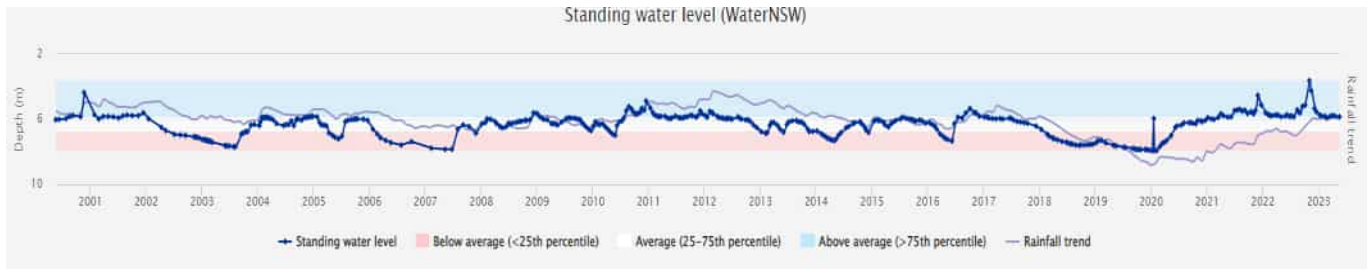
- GW030024 – 24 km south-west of the Project Area boundary.
- GW093026 – 25 km north-east of the Project Area boundary.
- GW093017 – 29 km north of the Project Area boundary.

All groundwater bore locations within the area are mapped in Figure 2.7. Recent data from the key monitoring bores indicate groundwater levels (SWL) of 5.96 m BGL (352.48 mAHD) at GW030024 (05 May 2023), 5.84 m BGL (468.43 mAHD) at GW093026 (17 May 2023), and 4.40 m BGL (395.30 mAHD) at GW093017 (17 May 2023) – refer to Figure 2.4, Figure 2.5, and Figure 2.6, respectively.

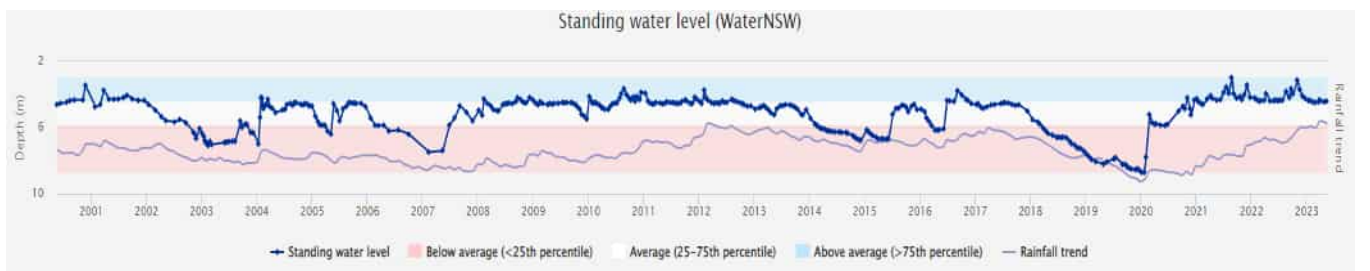
Bores GW093026 and GW093017 are located along Goonoo Goonoo Creek and the Peel River and therefore within the same surface water catchment as the Project. The available groundwater monitoring data at these locations indicates that flow of groundwater is expected to be in a north-westerly direction, consistent with the general flow direction of surface water drainage across the broader landscape.



**FIGURE 2.4: DEPTH TO WATER RESULTS: BORE GW030024 (BOM, 2024)**



**FIGURE 2.5: DEPTH TO WATER RESULTS: DOWNSTREAM BORE GW093026 (BOM, 2024)**



**FIGURE 2.6: DEPTH TO WATER RESULTS: DOWNSTREAM BORE GW093017 (BOM, 2024)**

The Project Area demonstrates zones of high potential terrestrial groundwater dependent ecosystems (GDEs) and low potential terrestrial GDEs as determined from regional studies (BoM, 2019) mapped in Figure 2.9.

The Project is located within the Peel catchment which is managed by the Water Sharing Plan (WSP) for the *NSW Murray Darling Fractured Rock Groundwater Sources 2020* under the Peel Fractured Rock Groundwater Source. The nearest alluvial groundwater source is located approximately 2.3 km east of the Project Area over Goonoo Goonoo Creek and its riparian zone, which contain the Peel Alluvium Water Source and Goonoo Goonoo Creek Alluvium Management Zone under the *Namoi Alluvial Groundwater Sources 2020* WSP. Annual long-term extraction limits for the defined water sources in the preceding Water Sharing Plans are listed in Table 2.2.

**TABLE 2.2: EXTRACTION LIMITS FOR WATER SOURCES LOCATED WITHIN THE PROJECT AREA**

Water Source	Extraction Limit (ML/year)
Peel Fractured Rock	15,874
Peel Alluvium	9,344

Extraction is not compliant if within the assessment period, being the average annual extraction over 5 years, extraction is more than 105% of the extraction limit. This compliance trigger determines if the aquifer access licences for the following water year reduces the total extractable amount of water to return the subsequent total water extraction to the extraction limit.

The Peel Alluvium represents the alluvial aquifers occurring adjacent to the Peel Regulated River and several associated creeks, the flow of which is highly affected by groundwater levels. This alluvium is generally no greater than 15 m in thickness, and demonstrates relatively high connectivity between the adjacent waterways, including Goonoo Goonoo Creek.

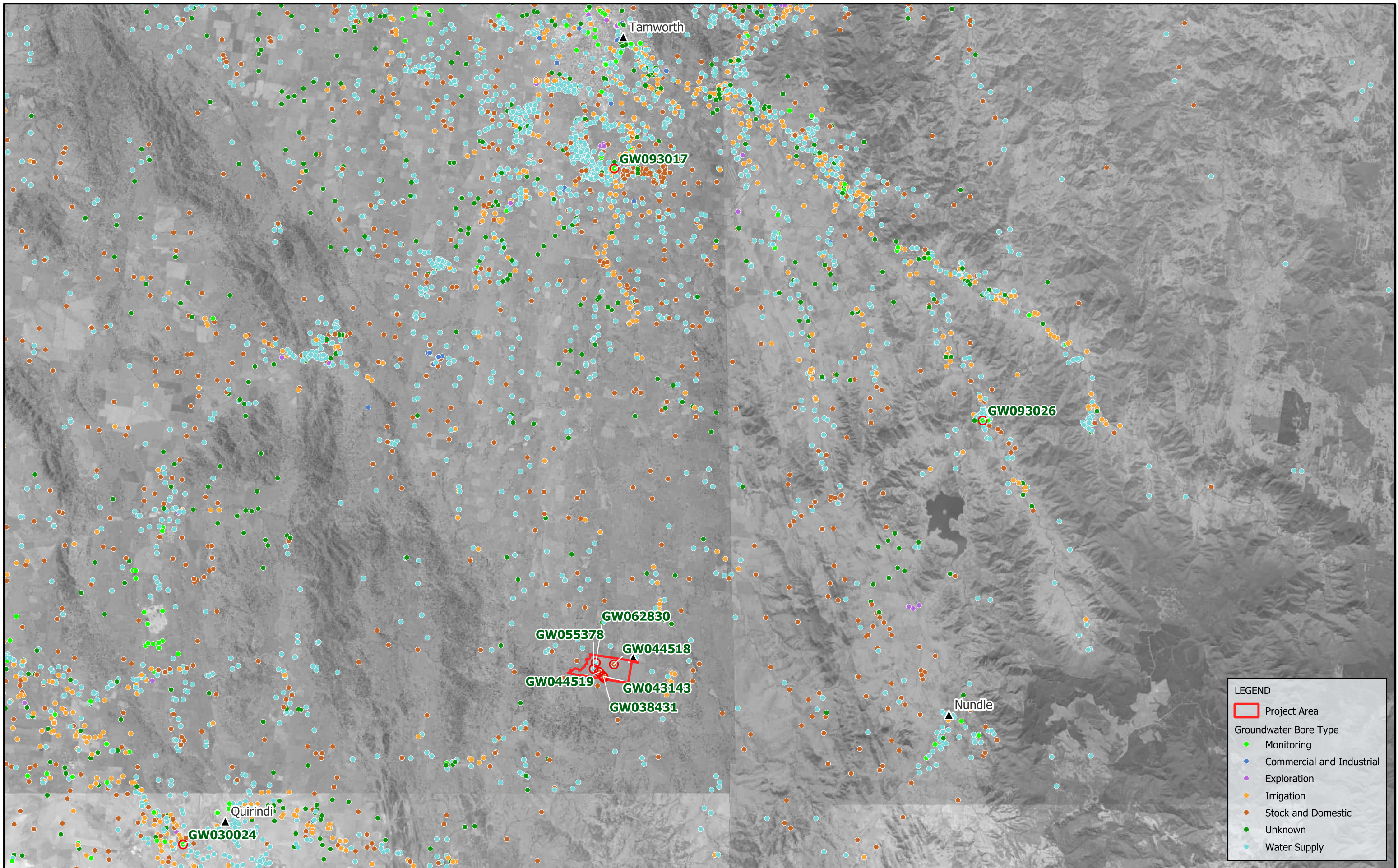
The Peel Fractured Rock covers a broad area within the Peel Valley and represents the remaining groundwater not identified by alluvium sources. This groundwater source is classified as not highly connected to surface waters for planning purposes.

### 2.4.1 Surface-Groundwater Interactions

The Project Area generally includes soils with low water infiltration potential and high-water retention, consistent with the surrounding catchment characteristics (discussed further in Section 2.6.1). Potential surface to groundwater interactions could occur through waterways and waterbodies that exist within the site and throughout surrounding landscape, in addition to downstream waterbodies underlain by the Peel Alluvium Water Source which tend to run dry in areas where the water table drops below the river or creek bed. Considering this, it is noted that Goonoo Goonoo Creek is classified as a perennial waterbody.

The downstream monitoring bore for the Peel Alluvium Water Source, receiving water flows from the Project (GW093017) is located approximately 29 km north of the Project Area on Goonoo Goonoo Creek. Groundwater depths at this bore were approximately 2.6 m BGL in latest values from 29 August 2024.

While the Peel Alluvium Water Source has a shallow thickness of approximately less than 15 m, the ground water level and high potential GDE identified over the perennial Goonoo Goonoo Creek east of the Project Area indicate that caution should be taken when undertaking activities affecting potential surface-groundwater interactions in the area.



**LEGEND**

- Project Area
- Groundwater Bore Type**
- Monitoring
- Commercial and Industrial
- Exploration
- Irrigation
- Stock and Domestic
- Unknown
- Water Supply

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Figure 2.7: Groundwater Bores

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## 2.5 Water Quality and Flow Regimes

### 2.5.1 Water Quality and River Flow Objectives

The NSW Water Quality and River Flow Objectives (as published by the then Office of Environment and Heritage (OEH)) are the agreed environmental values and long-term goals for NSW surface waters (OEH, 2006). The objectives consist of the NSW Water Quality Objectives (WQOs) and the NSW River Flow Objectives (RFOs), which aim to achieve the right water quality for different land uses and improve environmental results from managing the riverine system.

Flow patterns in the Project Area catchments are typically natural and are uncontrolled (i.e. not regulated by a dam), and flows can occur in these streams from local runoff. These streams are typically ephemeral and frequently open into or flow through wetlands and billabongs.

The different WQOs and RFOs relevant to the Project are detailed in Sections 2.5.2 and 2.5.3.4.

### 2.5.2 Water Quality Objectives

The NSW WQOs are consistent with the agreed national framework for assessing water quality as set out in the Australian and New Zealand Guidelines (ANZG) for Fresh and Marine Water Quality (ANZG, 2018). The WQOs most applicable to the Project are associated with aquatic ecosystems and are summarised in Table 2.3.

Based on the topography of the Project and surrounding catchment, the ANZG default guideline values for Upland Rivers (i.e. > 150 mAHD) in south-east Australia provide suitable guidance on acceptable levels (trigger values) of key water quality indicators associated with the Project.

**TABLE 2.3: RELEVANT NSW WATER QUALITY OBJECTIVES – NAMOI CATCHMENT**

Objective	Indicator	Guideline / Trigger Value	Applicability to the Project
<b>Aquatic Ecosystems -</b> <i>Maintaining or improving the ecological condition of waterbodies and their riparian zones over the long term.</i>	pH	6.5 to 8	High Relevance – All mapped watercourses within the Project Area are classified as non-perennial, with low flows or flows primarily in higher rainfall conditions. The Project Area therefore has the potential to support aquatic ecosystems and WQOs should be met.
	Total phosphorus (TP)	20 µg/L	
	Total nitrogen (TN)	250 µg/L	
	Chlorophyll-a	Not applicable	
	Turbidity	2 to 25 NTU	
	Salinity (electrical conductivity) (EC)	30 to 350 µS/cm	
	Dissolved oxygen (DO)	90 to 110%	
<b>Irrigation water supply -</b> <i>Protecting the quality of waters applied to crops and pasture.</i>	Algae & blue-green algae	Should not be visible. No more than low algal levels are desired to protect irrigation equipment.	High Relevance – The project area and surrounds are currently utilised by landholders for agricultural purposes.

Objective	Indicator	Guideline / Trigger Value	Applicability to the Project
	Salinity (electrical conductivity)	To assess the salinity and sodicity of water for irrigation use, a number of interactive factors must be considered including irrigation water quality, soil properties, plant salt tolerance, climate, landscape and water and soil management. For more information, refer to Chapter 4.2.4 of ANZECC 2000 Guidelines (ANZECC & ARMCANZ, 2000).	As the Project Area has the potential to supply and impact irrigation water over the duration of the project life and the WQOs should be met.
	Thermotolerant coliforms (faecal coliforms)	Trigger values for thermotolerant coliforms in irrigation water used for food and non-food crops are provided in Table 4.2.2 of the ANZECC Guidelines (ANZECC & ARMCANZ, 2000).	
	Heavy metals and metalloids	Long term trigger values (LTV) and short-term trigger values (STV) for heavy metals and metalloids in irrigation water are presented in Table 4.2.10 of the ANZECC 2000 Guidelines (ANZECC & ARMCANZ, 2000).	
<b>Livestock water supply -</b> <i>Protecting water quality to maximise the production of healthy livestock.</i>	Algae & blue-green algae	Increasing risk to livestock health is likely when microcystins cell counts exceed 11,500 cells/mL and/or microcystin concentrations exceed 2.3 µg/L (expressed as microcystin-LR toxicity equivalents).	High Relevance – The Project Area and surrounds are currently utilised by landholders for pastoral purposes. The Project Area therefore has the potential to impact surrounding water supplies or directly supply livestock water supply at the site via waterbodies and groundwater systems spread throughout the area and in this circumstance, the WQOs should be met. The Applicant should allow for sheep grazing within the Project Area to manage groundcovers and maintain agricultural productivity in the area.
	Salinity (electrical conductivity)	Recommended concentrations of total dissolved solids in drinking water for livestock are given in Table 4.3.1 of the ANZECC 2000 Guidelines (ANZECC & ARMCANZ, 2000).	
	Thermotolerant coliforms (faecal coliforms)	Drinking water for livestock should contain less than 100 thermotolerant coliforms per 100 mL (median value).	
	Chemical contaminants	Refer to Table 4.3.2 of the ANZECC 2000 Guidelines for heavy metals and metalloids in livestock drinking water (ANZECC & ARMCANZ, 2000). Refer to Australian Drinking Water Guidelines (NHMRC and NRMCC, 2011) for information regarding pesticides and other organic contaminants, using criteria for raw drinking water.	

Objective	Indicator	Guideline / Trigger Value	Applicability to the Project
<b>Homestead water supply</b> <i>- Protecting water quality for domestic use in homesteads, including drinking, cooking and bathing.</i>	Blue-green algae	Recommend twice weekly inspections during danger period for storages with history of algal blooms. No guideline values are set for cyanobacteria in drinking water. In water storages, counts of < 1000 algal cells/mL are of no concern.  >500 algal cells/mL - increase monitoring.  >2000 algal cells/mL - immediate action indicated; seek expert advice.  >6500 algal cells/mL - seek advice from health authority.	High Relevance – Residences within and surrounding the project area within the local catchment are primarily small dwellings or homesteads associated with the agricultural land use within the area. Water used for domestic purposes at these residences may be via existing landowner access rights or water access licences applying to local bores and waterways.  As the Project Area has the potential to impact domestic water supplies over the duration of the project life, the WQOs should be met.
	Turbidity	5 NTU; <1 NTU desirable for effective disinfection; >1 NTU may shield some micro-organisms from disinfection. (see supporting information).	
	Total Dissolved Solids	< 500 mg/L is regarded as good quality drinking water based on taste.  500-1000 mg/L is acceptable based on taste.  >1000 mg/L may be associated with excessive scaling, corrosion and unsatisfactory taste.	
	Faecal coliforms	0 faecal coliforms per 100 mL (0/100 mL). If micro-organisms are detected in water, advice should be sought from the relevant health authority.	
	pH	6.5-8.5 (see supporting information).	
	Chemical contaminants	See Guidelines for Inorganic Chemicals in the Australian Drinking Water Guidelines (NHMRC & NRMCC, 2011).	
	Supporting information	See listed under Homestead Water Supply at <a href="https://www.environment.nsw.gov.au/ieo/Namoi/maptext-03.htm#support3">https://www.environment.nsw.gov.au/ieo/Namoi/maptext-03.htm#support3</a>	

Objective	Indicator	Guideline / Trigger Value	Applicability to the Project
<b>Drinking water (Disinfection only, or Clarification and disinfection, or Groundwater) - Refers to the quality of drinking water drawn from the raw surface and groundwater sources before any treatment.</b>	Blue-green algae	<p>Recommend twice weekly inspections during danger period for storages with history of algal blooms.</p> <p>&gt;500 algal cells/mL - increase monitoring.</p> <p>&lt; 2000 algal cells/mL - water may be used for potable supply.</p> <p>&gt;2000 algal cells/mL - immediate action indicated; seek expert advice.</p> <p>&gt;6500 algal cells/mL - seek advice from health authority.</p> <p>&gt;15 000 algal cells/mL - may not be used for potable supply except with full water treatment, which incorporates filtration and activated carbon.</p> <p>Source: Australian Drinking Water Guidelines (NHMRC &amp; NRMCC, 2011).</p>	<p>High Relevance – Numerous groundwater bores registered for water supply are located within and surrounding the project area, nearby dwellings or residences associated with agriculture in the area. Water used for domestic purposes at these residences may be via existing landowner access rights applying to these bores.</p> <p>As the Project Area has the potential to impact drinking water supplies over the duration of the project life, the WQOs should be met.</p>
	Turbidity	Site-specific determinant.	
	Salinity (electrical conductivity)	<p>&lt;1500 <math>\mu</math>S/cm</p> <p>&gt; 800 <math>\mu</math>S/cm causes a deterioration in taste.</p>	
	Faecal coliforms*	0 faecal coliforms per 100 mL (0/100 mL).	
	Total coliforms*	<p>95% of samples should be 0 coliforms/ 100 mL throughout the year.</p> <p>Up to 10 coliform organisms may be accepted occasionally in 100 mL.</p> <p>Coliform organisms should not be detected in 100 mL in any two consecutive samples.</p>	
	Dissolved oxygen	> 6.5 mg/L (> 80% saturation).	
	pH	6.5-8.5.	
	Chemical contaminants	See ANZECC 2000 guidelines, section 6.2.2.	

\* Values given are NHMRC criteria for raw waters before disinfection or clarification. Raw waters can have concentrations of faecal coliforms above the NHMRC criteria, even in pristine ecosystems. Slightly greater faecal coliform or total coliform contamination may therefore be acceptable in raw waters that are to be disinfected before delivery to the consumer. For a full discussion of drinking water system management and criteria, see the Australian Drinking Water Guidelines (NHMRC & NRMCC, 2011).

Additionally, Managing Urban Stormwater: Soils and Construction Volume 1 (the ‘Blue Book’) (Landcom, 2004), Volume 2A Installation of services (DECC, 2008) and Volume 2C Unsealed roads (DECC, 2008) provide guidance on acceptable practice in NSW to mitigate the impacts of land disturbance activities (involving changes in land uses from rural, open space or bushland settings to other forms) on soils, landforms and receiving waters by focussing on erosion and sediment control. The Blue Book provides guidance on typically accepted total suspended solids (TSS) to be < 50 mg/L.

Toxicant default guideline values for protecting aquatic ecosystems were published by ANZG in 2018. A summary of the default guideline values (DGVs) for metals/metalloids in freshwater are included in Table 2.4 for differing levels of species protection (LOSP) (%), including:

- High ecological/conservation value system – 99% species protection DGV.
- Slightly to moderately disturbed system – 95% species protection DGV.
- Highly disturbed system – 90% or 80% species protection DGV.

The Project Area and downstream watercourses are assumed to be ‘slightly to moderately disturbed systems’ due to agricultural activities, which, in accordance with the ANZG, are ecosystems in which aquatic biological diversity may have been adversely affected to a relatively small but measurable degree by human activity. For example, rural streams receiving runoff from land disturbed to varying degrees by grazing or pastoralism. It is therefore assumed that the 95% LOSP is relevant to the Project.

**TABLE 2.4: TOXICANT DEFAULT GUIDELINE VALUES**

Toxicant name	Tox LOSP 95	Tox LOSP Unit
Aluminium (pH >6.5)	55	µg/L
Arsenic (AsIII)	24	µg/L
Arsenic (AsV)	13	µg/L
Boron	940	µg/L
Cadmium	0.2	µg/L
Chromium (CrVI)	1	µg/L
Copper	1.4	µg/L
Lead	3.4	µg/L
Manganese	1900	µg/L
Mercury (inorganic)	0.6	µg/L
Nickel	11	µg/L
Selenium (total)	11	µg/L
Silver	0.05	µg/L
Zinc	8	µg/L

Additionally, the Murray Darling Basin Authority (MDBA) aims to prioritise proper management of salinity. The Basin Salinity Management 2030 strategy (BSM2030), which has been in place since 2015, has the following focus listed on the MDBA website:

- Maintain the cap on salinity through the existing Basin Salinity Target and the existing accountability framework.
- Bring environmental water fully into the accountability framework in a practical and pragmatic way.

- Explore opportunities to responsively manage salt interception schemes so that operations can be further optimised and costs can be reduced when River salinity is forecast to be low.
- Support Basin Plan flow management obligations to have regard to the salinity targets for managing water flows.
- Support basin states managing salinity in their catchments through their land and water management plans and be consistent with their Basin Plan water resource plan obligations.
- Develop fit-for-purpose governance arrangements which reduce the frequency of audit, reporting and reviews.
- Invest in knowledge to reduce uncertainty and potentially avoid the need for future capital investment in new joint works and measures.
- Undertake a major strategic review to ensure the strategy continues to guide effective management of salinity in the basin.

Specific elements of the BSM2030 (i.e. mandatory elements) have been incorporated into Schedule B to the Murray–Darling Basin Agreement – Schedule 1 to the *Water Act 2007* (Commonwealth).

As part of the BSM2030 there are river and end-of-valley salinity targets that are required to be met by the NSW, Victoria and South Australia governments.

## 2.5.3 Background Regional Surface Water Quality

### 2.5.3.1 Water Quality Index

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) publishes annual state-wide water quality reports incorporating monitored water quality at nearly 200 sites on a monthly basis within the major rivers and streams of NSW. This data is used to understand long-term trends in water quality throughout NSW and to develop scores for the Water Quality Index (WaQI). An annual report is produced for every major river and its tributaries.

The *Namoi Valley annual surface water quality report: 2023–2024* (DCCEEW, 2025) provides an overview of existing surface water quality within the Namoi catchment, based on monthly data collected from 11 sites within the region. The closest monitoring site to the Project Area was Station Number 419024 on the Peel River upstream of Paradise Weir. The WaQI classification for this site was ‘moderate’, with a rating of 63 out of 100.

### 2.5.3.2 Statement of the Catchments

The State of the Catchments (SOC) 2010 Riverine Ecosystems report for the Namoi region was developed by the Department of Environment, Climate Change and Water NSW (DCCEEW NSW) in 2010 and provides a holistic water quality report for the 42,000 km<sup>2</sup> catchment located in north-western NSW. The report assesses the water quality condition and trend across the Macdonald, Peel, Manilla, and Mooki Rivers and Coxes Creek, in addition to smaller tributaries and anabranches. Castlereagh, Bogan, and Macquarie River Valleys. The SOC for the Namoi region has been reviewed to provide an understanding of existing surface water quality surrounding the Project (DCCEEW NSW, 2010).

The SOC describes water quality condition as the percentage of samples exceeding the ANZECC / ANZG water quality guidelines for turbidity and total phosphorus. Additionally, fish, macroinvertebrates, and hydrology are used to indicate water quality condition, and trend based on the Sustainable Rivers Audit (SRA).

Water quality findings relevant to the Project Area within the Macquarie River catchment were recorded at the following locations:

- Peel River at Paradise Weir, north of the Project Area. This site represents water quality within the Peel River prior to its confluence with Goonoo Goonoo Creek, with little to no potential impact by the Project.
- Goonoo Goonoo Creek at Meadows Lane, located north of the Project Area. This site represents water quality within Goonoo Goonoo Creek downstream of the Project Area, providing an overview of potential inputs from the Project.

A summary of the guideline values for phosphorus and turbidity at an upland site (altitude > 150 mAHD) and results from the SOC are summarised in Table 2.5.

**TABLE 2.5: STATEMENT OF CATCHMENTS WATER QUALITY RESULTS**

Location	Catchment	Total Phosphorus - Guideline Value (mg/L)	Percentage of Results Exceeding Guideline Value (%)	Turbidity - Guideline Value (NTU)	Percentage of Results Exceeding Guideline Value (%)
Peel River at Paradise Weir	Namoi	0.02	94%	25	14%
Goonoo Goonoo Creek at Meadows Lane	Namoi	0.02	100%	25	25%

Further, the waterway health was characterised by data recorded for aquatic biota including fish and macroinvertebrates. Macroinvertebrate data indicates that the Project Area is in poor condition, supported by fish data which suggests it to contain ‘poor’ to ‘moderate’ conditions due to moderate nativeness and expectedness of the fish species in the catchment’s upland areas, with increasing poorness moving towards lower elevations.

Findings indicate that the Namoi Catchment relevant to the Project Area generally exceeds guideline values for total phosphorus and sometimes exceeds guideline values for turbidity. This is supported by the agricultural land use within the area and the moderately vegetated nature of its waterways.

### 2.5.3.3 NSW River Styles Framework

The River Styles Framework (Macquarie University, 2025) is an approach to geomorphologically informed river management. It guides the description of river morphology, interpretation of behaviour, assessment of condition, prediction of river recovery potential and prioritisation of river management. NSW River Styles mapping is used to identify rare and threatened river forms across the state.

Within and adjacent to the Project Area, key watercourses have been classified according to the NSW River Styles Framework. These classifications are summarised in Table 2.6 and indicate that the Project Area is characterised by geomorphic conditions ranging from ‘moderate’ to ‘poor’. This suggests existing disturbance within the watercourses, which may contribute to lower water quality and ecological function.

**TABLE 2.6: NSW RIVER STYLES CLASSIFICATIONS**

Watercourse	River Style	Geomorphic stream condition	Potential to recover from its current condition	Priority for river management
Tamarang Creek (within Project Area)	Partly confined, planform controlled, low sinuosity, terrace constrained, discontinuous floodplain, gravel bed.	Moderate	High recovery potential	High priority rehabilitation
Sugarloaf Creek (Adjacent to Project Area)	Partly confined, planform controlled, low sinuosity, terrace constrained, discontinuous floodplain, gravel bed	Poor	Low recovery potential	Low priority rehabilitation

### 2.5.3.4 River Condition Index

The NSW River Condition Index (RCI) is the primary long term reporting tool for assessing riverine condition. It is used to combine a range of indicators into a single condition score. The indicators include riparian vegetation, geomorphic condition, hydrologic stress, biodiversity, catchment disturbance and water quality.

The RCI was developed using the Framework for the Assessment of River and Wetland Health (FARWH) approach, which is an accepted Australian wide approach. The FARWH method uses existing data collection activities across Australia and converts them into a standardised and nationally comparable representation of river health.

Under the RCI, the Project is located in the Namoi Catchment (Catchment ID: 162) with an overall RCI classifications of ‘moderate’. Similarly, the sub catchment covering the Project Area has a Water Quality Sub Index classification of ‘moderate’.

## 2.5.4 River Flow Objectives

Key River Flow Objectives (RFOs) and their relevance to the Project are summarised in in Table 2.7.

**TABLE 2.7: RELEVANT NSW RIVER FLOW OBJECTIVES – MACQUARIE-BOGAN CATCHMENT**

Objective	Description	Measures to Achieve Objective	Applicability to the Project
<b>Protect natural low flows -</b> <i>Protect natural low flows</i>	Water extraction and storage are high in dry times and impose long artificial droughts that increase the stress on aquatic plants and animals.	<ul style="list-style-type: none"> <li>• Share low flows between the environment and water users and fully protect all very low natural flows.               <ul style="list-style-type: none"> <li>– Very low flows: flows below the level naturally exceeded on 95% of all days with flow.</li> <li>– Low flows: flows below the level naturally exceeded on 80% of all days with flow.</li> </ul> </li> <li>• Unless environmental, social and economic evaluations give an appropriate alternative, the following limits on water extraction apply:               <ul style="list-style-type: none"> <li>– Environmental share in high-conservation-value streams: to be all very low flows and most of the low flows. There should be no increase in extraction of low flows.</li> <li>– Environmental share in other streams: all very low flows and 50-70% of daily low levels.</li> </ul> </li> <li>• New or transferred licences should not allow extraction during low flows below the 80th percentile.</li> <li>• In streams with little water use or important conservation values, minimise risks to ecosystems during low flows.</li> <li>• Review management of town water supplies to assess whether changes may help achieve the objective without significantly affecting reliability.</li> </ul>	Moderate Relevance – the Project Area contains a network of ephemeral streams through valley landscape formations. The Namoi Catchment experiences variations in rainfall with potential for long dry periods.  The Project layout is designed to avoid mapped watercourses, however, has potential to impact surface water flows within the Project Area and downstream watercourses, some of which are classified as ephemeral.
<b>Protect pools in dry times -</b> <i>Protect natural water levels in pools of creeks and rivers and wetlands during periods of no flows</i>	During dry times, some streams stop flowing and form pools. Pools and wetlands are refuges for aquatic plants and animals. Pumping water from these areas can make it more difficult for many species to recover after a drought.	<ul style="list-style-type: none"> <li>• There should be no water extraction from streams or wetlands in periods of no flow.</li> <li>• If conditions on water licences do not provide for this objective to be met, priority should be given to implementing it by actions appropriate to local circumstances.</li> </ul>	Moderate Relevance – the Project Area contains numerous hydro areas and non-minor ephemeral Creeks within distinct valley areas. The Namoi Catchment experiences variations in rainfall with potential for long dry periods.  The Project layout is designed to avoid mapped watercourses, however, has potential to impact surface water flows within the Project Area and downstream watercourses, some of which are classified as ephemeral.

Objective	Description	Measures to Achieve Objective	Applicability to the Project
<b>Maintain wetland and floodplain inundation -</b> <i>Maintain or restore the natural inundation patterns and distribution of floodwaters supporting natural wetland and floodplain ecosystems</i>	Floodplain and wetland ecosystems develop in response to flow patterns and the nature of the landscape between the river and wetlands or floodplains. Floodplain works can change the flooding patterns, which will lead to changes in habitat and vegetation. These changes can be expected to result in reduced or different species diversity and abundance, particularly reduced numbers of native fish, and water quality problems.	<ul style="list-style-type: none"> <li>• WSPs and actions need to include strategies to:               <ul style="list-style-type: none"> <li>– maintain, restore or mimic natural inundation and drying patterns in natural and semi-natural wetlands and remaining native floodplain ecosystems</li> <li>– ensure adequate access for native fish to and from floodplain wetlands.</li> </ul> </li> <li>• Flooding patterns should not be altered without proper environment assessment.</li> </ul>	Moderate Relevance – The Namoi Catchment is an important water supply for floodplain and wetland areas downstream of the Project Area.  The Project has potential to impact surface water flows in downstream watercourses / floodplain areas.
<b>Manage groundwater for ecosystems -</b> <i>Maintain groundwater within natural levels and variability, critical to surface flows and ecosystems</i>	Some shallow groundwaters are directly linked to flows in streams and wetlands. They may provide base flows in rivers during dry periods and may be primary sources of water for wetland, floodplain and riparian vegetation. Seriously depleting groundwater in dry times may lead to unnatural recharge of groundwater from surface waters during the next flow.	<ul style="list-style-type: none"> <li>• Implement the State Groundwater Policy (DLWC 1997a, 1998b).</li> <li>• Identify any streams or ecosystems that may depend on high groundwater levels and assess impacts of reduced recharge or excessive pumping.</li> <li>• Identify where groundwaters may be rising and likely to threaten ecosystems or surface water quality.</li> <li>• Determine appropriate action to keep groundwater level changes within acceptable bounds.</li> </ul>	Low Relevance – Historical groundwater depths in the Project Area and GDE mapping indicate potential surface water -groundwater interactions and therefore potential impacts to aquatic and terrestrial GDEs (see Sections 2.4.1 and 2.6.2).  The Project does not propose to intercept the regional groundwater table or extract groundwater to meet construction and operational demands, minimising potential impacts to natural groundwater levels.

## 2.6 Soils, Vegetation and Land Use

### 2.6.1 Soils

The Australian Soil Classification (ASC) type mapping (DCCEEW, 2022) was used to analyse soil types within the Project Area. The primary ASC soil type identified was Chromosols, as shown in Figure 2.8. Dermosols are mapped over a minor section at the southern boundary of the Project Area. These soil types generally have slow water infiltration and high-water retention potential supporting the network of waterways draining the variable topography of the Project Area.

The Project Area exists near the Duri Hills soil monitoring unit, which contains red Chromosols, primarily falling under cropping and grazing land use. Sheet erosion is the primary limiting indicator of soil condition within the unit, which demonstrates no change in soil condition and a good soil condition index (3.6). Slight loss of soil function with noticeable but not significant deterioration is expected in comparison to reference conditions (DCCEEW NSW, 2010).

### 2.6.2 Vegetation

The BoM Groundwater Dependent Ecosystem (GDE) Atlas tool was used to gain a high-level understanding of the potential GDEs located at and surrounding the Project Area. Figure 2.9 provides the mapped potential terrestrial and aquatic GDEs which surround the Project Area (BoM, 2022). There are no identified subterranean GDEs.

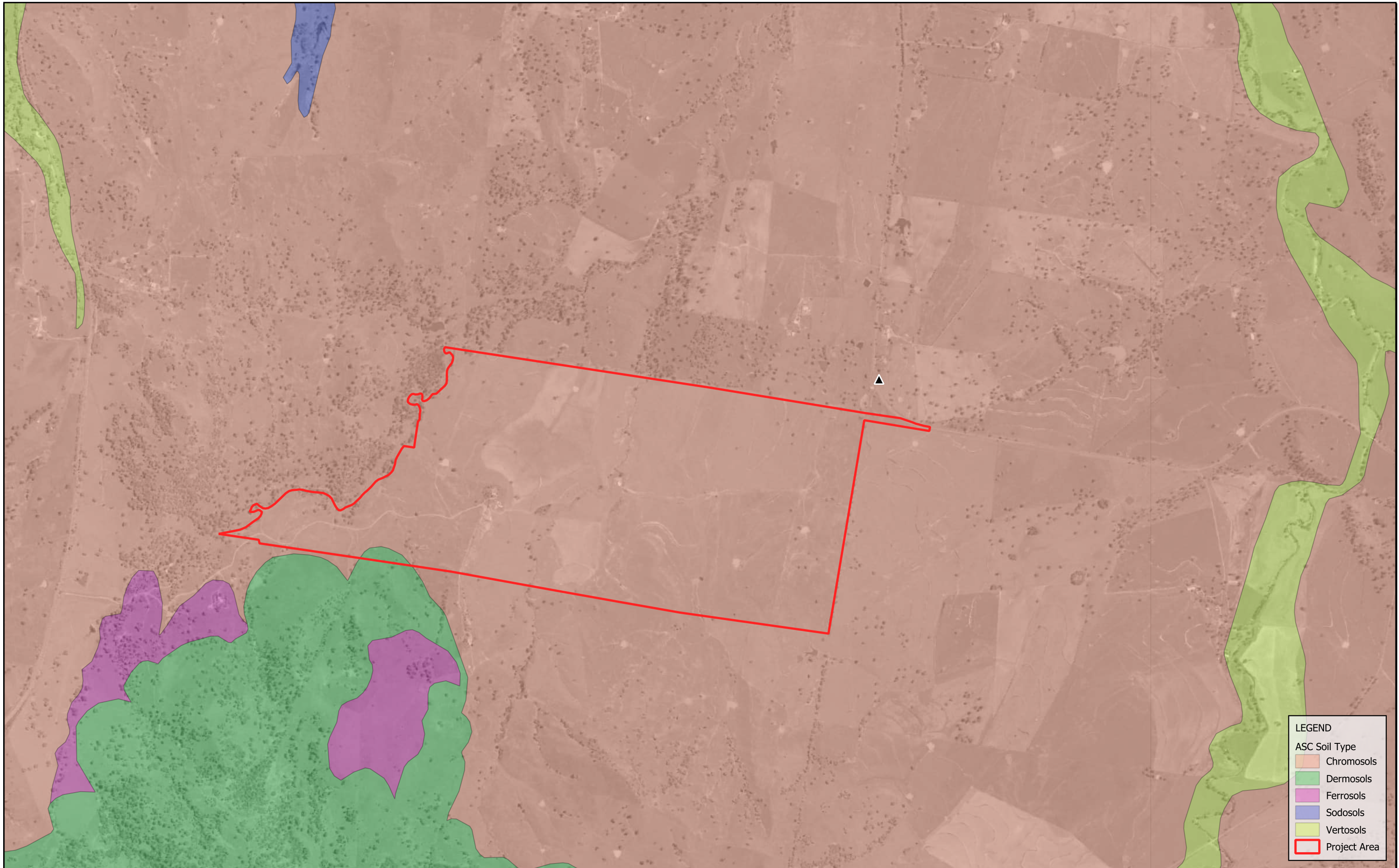
- **Terrestrial** – There are high and low potential terrestrial GDEs mapped within the Project Area. These areas are identified as potential GDEs due to the presence of the following ecosystem types:
  - Blakely's Red Gum - Yellow Box grassy tall woodland (High potential).
  - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland (Low potential).
  - White Box grassy woodland to open woodland on basalt flats and rises (High potential).
- **Aquatic** – There are no potential aquatic GDEs mapped within the Project Area. The nearest potential aquatic GDE is mapped as moderate potential and occurs approximately 2.5 km east over Goonoo Goonoo Creek.

Considering the relatively shallow groundwater depths identified in Section 2.4, the potential GDEs identified within and surrounding the Project Area will likely be dependent on the regional groundwater table as well as local groundwater pockets recharged by rainfall and runoff.

### 2.6.3 Land Use

Land use in the Namoi catchment is dominated by extensive livestock grazing activities. Land uses within and immediately surrounding the Project Area include pastoral and agricultural land (both dryland and irrigated cropping including grain, cereals, oilseed, cotton, legumes and Lucerne), environmental management, and rural residential land holdings, public roads, access tracks and electricity transmission lines. The region supports downstream environments in major Barwon and Darling Rivers (MDBA, 2023).

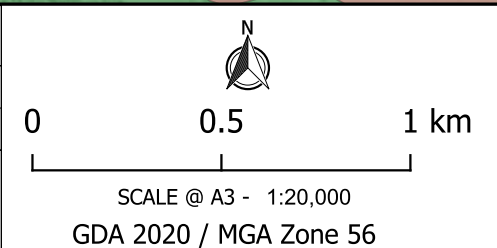
The Project Area is zoned for primary production (RU1) and is comprised primarily of pastures (improved and native) and livestock associated infrastructure land. The nearest National Parks and Wildlife Service owned land is located approximately 18 km south-east of the Project Area at Wallabadah Nature Reserve (NSW DPHI, 2018; NSW DCCEEW, 2024).



LEGEND	
ASC Soil Type	
	Chromosols
	Dermosols
	Ferrosols
	Sodosols
	Vertosols
	Project Area

R	DETAILS	DATE
0	Final Issue	10-06-2025

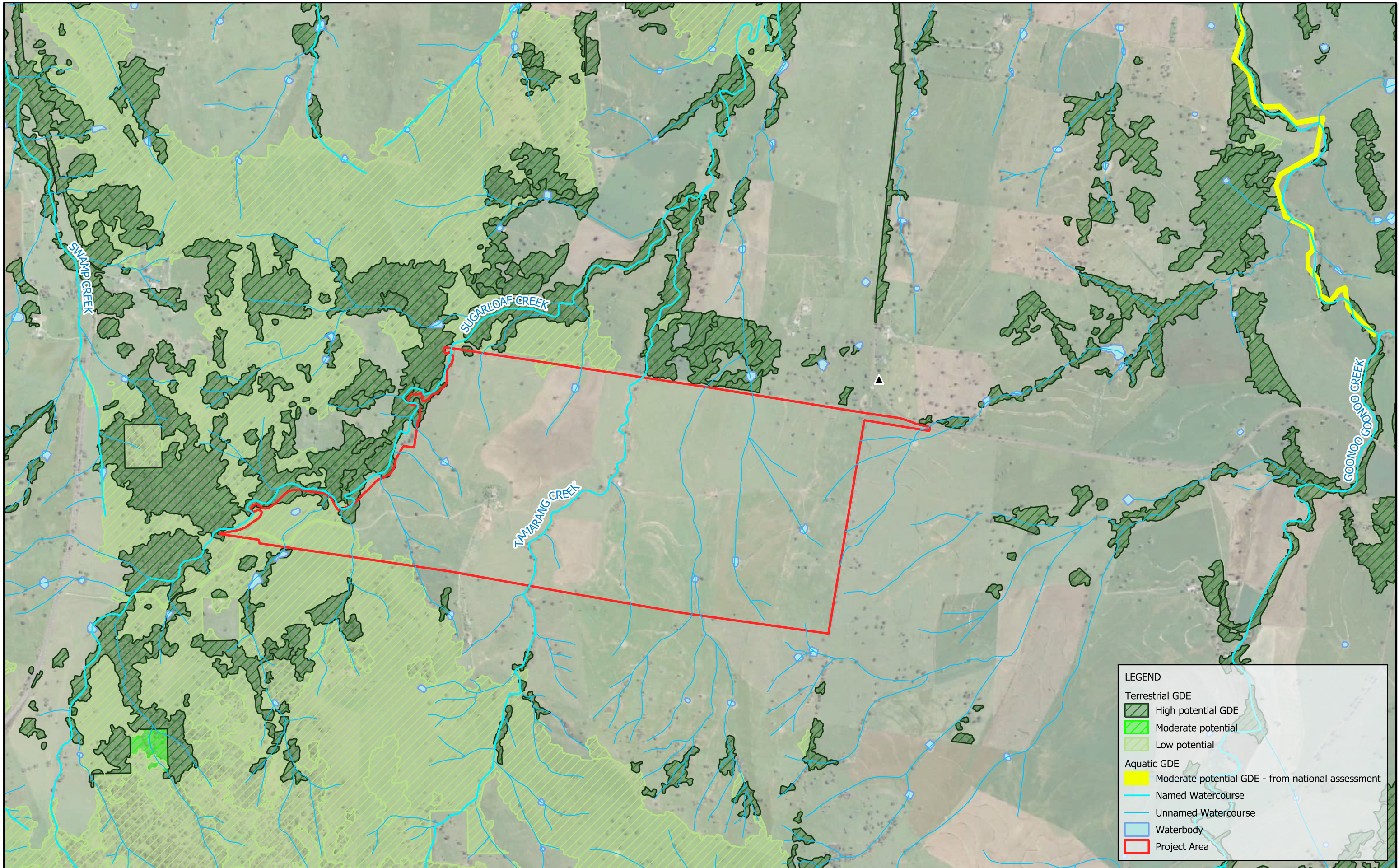
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**DATA SOURCE**  
 Google Maps



Garoo Solar Farm & BESS
Figure 2.8: Soil Classification
Drg Ref. BNTL00206_0019-FIG-011



**LEGEND**

**Terrestrial GDE**

- High potential GDE
- Moderate potential
- Low potential

**Aquatic GDE**

- Moderate potential GDE - from national assessment

**Watercourse**

- Named Watercourse
- Unnamed Watercourse

**Waterbody**

- Waterbody

**Project Area**

- Project Area

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0	Final Issue	10-06-2025

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**DATA SOURCE**  
Google Maps



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Figure 2.9: Groundwater Dependent Ecosystems

Drg Ref. BNTL00206\_0019-FIG-012

## 2.7 Published Studies

The Project Area is located within the northern region of the Murray-Darling Basin, within the Namoi catchment. The Project Area is located within the Tamworth Regional Council Local Government Area (LGA) (refer to Figure 2.2). The Project Area is not covered by any existing flood studies undertaken by council and is not identified as flood prone land within the Tamworth Regional Local Environmental Plan (LEP) 2010.

Other published studies in the area are summarised in Table 2.8.

**TABLE 2.8: PUBLISHED STUDIES**

Source	Dataset(s)	Applicability
Tamworth Regional Local Environment Plan 2010	Flood Planning Maps	No interaction with Project Area
Tamworth City-Wide Flooding Investigation – Volumes 1 & 2	Flood Modelling across Tamworth City and some surrounding areas	No interaction with Project Area
Nundle and Woolomin Flood Study and Floodplain Risk Management Study	Flood Modelling across the Nundle and Woolomin areas upstream of the Project	No interaction with Project Area

## 2.8 Water Regulatory Framework

### 2.8.1 Commonwealth Water Licensing and Approvals

The *Commonwealth Water Act 2007* was developed to manage the Murray-Darling Basin water resources in the national interest in a way that will optimise economic, social and environmental outcomes. The Murray-Darling Basin Authority (MDBA) is established by the *Water Act 2007* to prepare and implement the *Commonwealth Basin Plan 2012* (the Basin Plan).

The Basin Plan sets sustainable diversion limits for the Basin as a whole and for each individual water management area, sets water trading rules, and contains an Environmental Watering Plan and a Water Quality and Salinity Management Plan. The Basin Plan covers 1,000,000 km<sup>2</sup> across NSW, Queensland, Victoria and the Australia Capital Territory. The Basin Plan has the following key elements, which are to be managed under the WRPs:

- Water limits for consumption – managed by setting sustainable diversion limits, and WRPs.
- Water for the environment – environmental water and recovery of water from communities, industries and irrigators to sustain the natural ecosystems of the Murray-Darling Basin.
- Infrastructure development, operation and maintenance – relating to dams, barrages and weirs to regulate water flows and deliver water to communities, irrigators and the environment.
- Managing groundwater – to preserve and improve water quality.
- Maintaining water quality to be suitable for drinking, agriculture, recreation and the environment.
- Water markets and trade – via WRPs.
- Monitoring and enforcing compliance, via the Inspector-General of Water Compliance.
- Monitoring and evaluating the effectiveness of water management, via annual and 5 yearly cycles.

### 2.8.2 Water Resource and Water Sharing Plans

Water Resource Plans (WRP) are a key requirement of the Basin Plan, indicating limits on water take, water for the environment, and how to meet water quality standards. The WRPs rely heavily on the NSW water sharing plans (WSPs) to provide a clear framework and rule-set for managing NSW Basin water resources. The objectives of WRPs and the relationship with the Basin Plan are outlined below and in Figure 2.10.

### Overarching Objectives

- To give effect to relevant international agreements through the integrated management of Basin water resources.
- To establish a sustainable and long-term adaptive management framework for the Basin water resources, that takes into account the broader management of natural resources in the Murray-Darling Basin.
- To optimise social, economic and environmental outcomes arising from the use of the Basin water resources in the national interest.
- To improve water security for all uses of Basin water resources.

### Outcomes

- Communities with sufficient and reliable water supplies that are fit for a range of intended purposes, including domestic, recreational and cultural use.
- Productive and resilient water-dependent industries, and communities with confidence in their long-term future.
- Healthy and resilient ecosystems with rivers and creeks regularly connected to their floodplains and, ultimately, the ocean.

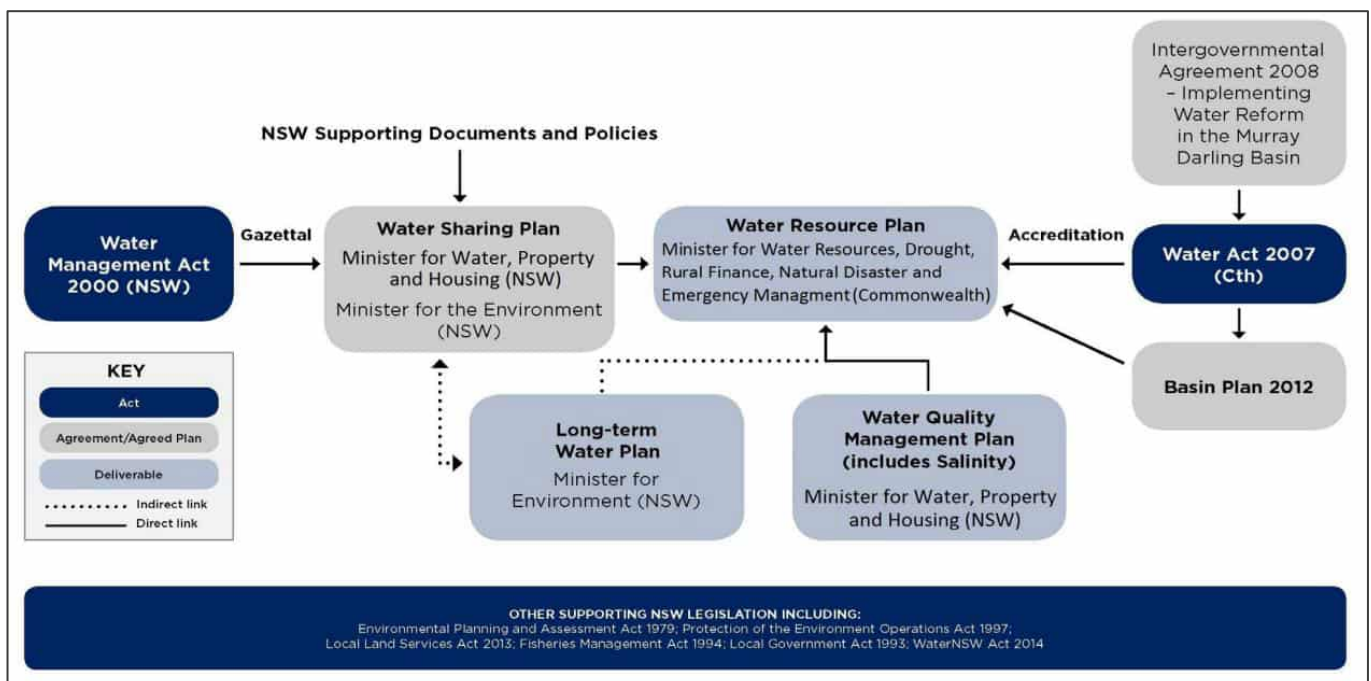


FIGURE 2.10: RELATIONSHIP BETWEEN BASIN PLAN, WRP, AND OTHER INSTRUMENTS

Source: NSW Murray and Lower Darling Surface Water Resource Plan (2024)

The Water Resource and Water Sharing Plans applicable to the Project Area are summarised in Table 2.9.

TABLE 2.9: APPLICABLE PLAN AREAS

Area / Zone	Plan
<b>Water Resource Plans</b>	
Surface Water Resource Plan Area	Namoi – withdrawn May 2023
Surface water sustainable diversion limit area	Namoi
Groundwater resource plan area	Murray-Darling Basin Fractured Rock (GW11)
Groundwater sustainable diversion limit area	New England Fold Belt MDB (GS37)
Water quality zone	Upland (B2) Montane (C2)
<b>Water Sharing Plans</b>	

Area / Zone	Plan
Surface water sharing plan	Namoi and Peel Unregulated Rivers Water Sources 2012
Surface water source	Goonoo Goonoo Creek Water Source
Groundwater sharing plan	Murray Darling Fractured Rock Groundwater Sources 2020
Groundwater source	Peel Fractured Rock Groundwater Source

### 2.8.3 Water Take for Consumptive Use

As part of the Basin Plan, Basin-wide limits have been set on the amount of groundwater that can be taken from the Basin. These limits are called sustainable diversion limits (SDLs). The SDLs are managed as part of the WRPs.

SDLs are determined by the NSW WSP available water determinations (AWD) process. An AWD is an NSW ministerial order issued to allocate water to the accounts of licence holders. AWDs are made on 1 July each year (beginning of the water year) and as necessary then throughout the year.

### 2.8.4 Existing Local Water Sources

The Project Area supports agricultural land uses that are supported by existing water infrastructure and irrigation systems. Within the Project Area, there are six groundwater bores. It is understood that these bores are classed as either water supply or stock and domestic water use.

It is understood that there is no surface water access licence (WAL) owned by the local landholders or the Applicant. However, harvestable rights dams exist within the Project Area and may support the existing land use activities.

Project water sourcing options are further discussed in Section 3.1.2.

### 2.8.5 NSW Water Licensing and Approvals

The NSW state government controls the use and flow of all water in rivers, lakes, and aquifers. Some landholders can take water without a licence, this is known as basic land holder rights (refer to Section 2.8.5.1). You may need a water access licence or a water supply work and/or water use approval to take water from a river, lake or aquifer (refer to Section 2.8.5.2). Approvals can also be required for flood works that are likely to have an effect on the flow of water (refer to Section 2.8.5.3), and works within waterfront land (refer to Section 2.8.5.4).

The *Water Management Act 2000* applies to all regions where there is a WSP in operation.

The following sections discuss:

- Basic landholder rights, including the maximum harvestable right for the Applicant and associated land holdings.
- Water Access Licences, Water Use Approvals, and Water Supply Works, including those currently held by the Applicant and associated land holdings.
- Requirements for Flood Works and Controlled Activity Approvals, including what applies to the Project.

Future assessment will include:

- Calculation of Water take licensing requirements for the Project.
- Summary of Water use and Water supply works approvals required for the Project.

#### 2.8.5.1 Basic Landholder Rights

There are three types of basic landholder rights (BLR) in NSW (*Water Management Act 2000*):

- Domestic and stock rights – allows take and use of water for domestic consumption and non-intensive stock watering without the need for a water access licence (WAL) or water use approval. A water supply work approval (i.e. for a bore or dam, etc) is required.
- Harvestable rights – allows landholders to capture and store a proportion of the rainfall runoff from their landholding in one or more harvestable rights dams, without requiring a WAL, water use approval or water supply work approval.

- Native title rights- allows take and use of water in the exercise of native title rights (under the *Commonwealth Native Title Act 1993*), without requiring a WAL, water use approval or water supply work approval (unless the work is a dam or bore).

#### 2.8.5.1.1 Harvestable Rights

Harvestable Rights provisions for the capture and reuse of surface water runoff generated within a property, is subject to the following rules:

- (1) Landholdings (owned and leased) must be contiguous (generally omits public roads and easements).
- (2) Harvestable rights cannot be transferred between water sources – i.e. water captured within a water source must be covered by a harvestable right (or licence) in that source.
- (3) Water captured (in dams, mining pits, etc) from higher order (3<sup>rd</sup> order and above) watercourses and above or within 40 m (measured perpendicular), or on any floodplain, or on or within 3 km upstream of any Ramsar wetland, must be covered by a WAL, regardless of the Harvestable Right, unless exempt from licensing.

Harvestable rights dams do not require a WAL, water use approval or water supply work approval. However, if a harvestable rights dam also stores and/or captures water taken under another right or licence this dam is known as a Mixed-rights dam. Mixed-rights dams may require a WAL and water supply work approval prior to construction.

#### 2.8.5.1.2 Maximum Capacity of Harvestable Rights Dams – Method of Calculation

WaterNSW provides a tool to estimate harvestable rights, based on location and property area <sup>1</sup>. This method uses a simple average annual unit runoff rate. The volume of water a landholder can capture and store under harvestable rights is expressed as a maximum harvestable right dam capacity for a landholding. The combined volume of all dams (or parts thereof) that capture and store harvestable rights water cannot exceed the maximum dam capacity.

There are three different harvestable rights orders applying to three different regions in NSW. These are:

- Coastal-draining catchments.
- Central inland-draining catchments.
- Western division order.

The method is outlined below (refer to Section 7), with the following outcomes:

- The Project lies within Central inland-draining catchments.
- 369 ha of contiguous landholdings (by associated landowners) in one contiguous area.
- Maximum capacity of harvestable rights dams is **29.52 ML**. (Source: <https://www.waternsw.com.au/customer-services/water-licensing/maximum-harvestable-rights-calculator>).

#### 2.8.5.1.3 Central-inland draining catchments

To calculate the maximum capacity of harvestable rights on a landholding the method outlined in Schedule 1 of the Harvestable Rights (central inland-draining catchments) Order 2022 dated 12 May 2022 should be used. This method is summarised, as follows:

- (1) Identify the location and total size of the landholding in hectares (being only that part within the harvestable rights area).
- (2) Identify the area (in hectares) of the landholding from which water is captured, taken or otherwise impounded by means of an excluded work or works specified in clauses 1-4 in Schedule 1 to the *Water Management (General) Regulation 2018*.
- (3) Calculate the capacity for a harvestable rights dam or dams which represents up to 10% of the average annual regional rainfall runoff on the landholding – multiply (1) by the harvestable rights multiplier (Type 1).

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<sup>1</sup> [www.waternsw.com.au/customer-service/water-licensing/blr/harvestable-rights-dams/maximum-harvestable-right-calculator](https://www.waternsw.com.au/customer-service/water-licensing/blr/harvestable-rights-dams/maximum-harvestable-right-calculator)

## 2.8.5.2 Water Access Licences, Water Use Approvals, and Water Supply Works

### 2.8.5.2.1 Water Access License (WALs)

In water sharing plan (WSP) areas, a WAL authorises the holder of the WAL to take water from a water source.

There are a number of exemptions for WALs specified in the *Water Management (General) Regulation 2018*. Exemption categories include landholders, public authorities, and general exemptions.

There are three types of WALs:

- Zero share licence.
- Specific purpose access licence.
- Controlled allocation licence.

The Applicant currently hold no WALs.

A summary of the WALs issued for the water sources in which the Project lies is included in Table 2.10 and Table 2.11.

**TABLE 2.10: GOONOO GOONOO CREEK WATER SOURCE – TOTAL WALs 2024/2025**

Access Licence Category	No. of WAL(s)	Total Share Component	Total IDEC (Daily flow shares)	Cumulative AWD
Domestic and stock	1	6.5	N/A	1
Domestic and stock [stock]	3	15	N/A	1
Unregulated river	20	1033.5	N/A	1

**TABLE 2.11: PEEL FRACTURED ROCK GROUNDWATER SOURCE – TOTAL WALs 2024/2025**

Access Licence Category	No. of WAL(s)	Total Share Component	Total IDEC (Daily flow shares)	Cumulative AWD
Aquifer	220	11030	N/A	1
Domestic and stock	2	68	N/A	1
Domestic and stock [stock]	6	276	N/A	1
Domestic and stock [town water supply]	6	104	N/A	1
Local water utility	1	100	N/A	1

### 2.8.5.2.2 Water Supply Work and/or Use Approvals

Water supply work and/or water use approvals allow you to use water from a river, lake, or groundwater source, and to construct infrastructure to do this.

A water supply work approval allows construction and use of works to take water (e.g. pumps, bores, dams, dewatering, etc).

A water supply use approval allows use of water for a particular purpose (e.g. irrigation, power generation, mining, etc).

A water use approval allows you to use water on your land. Examples of water uses that require approval are irrigation, town water supply, power generation and mining.

A summary of all surface water supply work and use approvals applicable to the Project Area is included in Table 2.12. There are no WALs associated with the Project Area.

**TABLE 2.12: WATER SUPPLY WORK AND USE APPROVALS APPLICABLE TO THE PROJECT AREA**

Kind of Approval	Purpose / Work Type	Approval Number	Water Source	Lot / DP	Status
Basic Rights	Extraction Works GW - Bore	90WA815891	Peel Fractured Rock Water Source	Lot 16, 755341	Constructed
Basic Rights	Extraction Works GW - Bore	90WA816852	Peel Fractured Rock Water Source	Lot 14, 755341	Constructed
Basic Rights	Extraction Works GW - Bore	90WA815890	Peel Fractured Rock Water Source	Lot 2, 1108524	Constructed
Basic Rights	Extraction Works GW - Bore	90WA816516	Peel Fractured Rock Water Source	Lot 2, 1108524	Constructed
Basic Rights	Extraction Works GW - Bore	90WA815858	Peel Fractured Rock Water Source	Lot 6, 1108524	Constructed

### 2.8.5.3 Flood Works Approval

Flood work approvals allow you to construct and use a work that is situated in or near a river, estuary or lake, or within a floodplain, and is likely to have an effect on the flow of water to or from a river, estuary or lake, or the distribution or flow of floodwater.

WaterNSW issues flood work approvals for private rural landholders and rural industries, whereas NSW Government DPIE Water issues flood work approvals for government agencies, including Councils.

Major projects which are SSD or state significant infrastructure are exempt from flood work approvals.

### 2.8.5.4 Controlled Activity Approval

Controlled activities refer to work or action done on waterfront land, as defined by the *Water Management Act 2000*. These activities must be designed in a way to protect our waterways and ensure minimal harm as a result of the work carried out on the land, and include:

- Waterfront land includes the bed of rivers, lakes, or estuaries, as well as land on each side within 40 metres of a riverbank.
- That is within 40 m of the high bank of all watercourses with defined bed and banks as well as  $\geq 3^{\text{rd}}$  order NSW SS mapped hydrolines.

Controlled activities may include:

- Erecting a building.
- Carrying out works: including the construction of bridges, roads, control measures, sea walls, and more.
- Removing material from waterfront land: including plants, rocks, sand, gravel and more.
- Depositing material on waterfront land: including gravel or fill.
- Any activity which affects the quantity or flow of water in a water source.

Although SSD projects are exempt from requiring Controlled Activity Approvals, where the Project involves a controlled activity, assessment and design will be in accordance with:

- *DPI Guidelines for Controlled Activities on Waterfront Land (2018); and (if necessary).*
- *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Witheridge & Fairfull, 2003); and
- *Policy & Guidelines for Fish Habitat Conservation & Management* (DPI, 2013).

# 3. PROPOSED WATER MANAGEMENT

## 3.1 Water Balance

Water supply will be required during both construction and operation of the Project, including for:

- Dust Suppression.
- Concrete Works for construction of infrastructure hardstand areas (including batching and construction).
- Road Construction and Compaction.
- Vehicle Equipment Washdown.
- Potable Water for site amenities and temporary workforce accommodation camp.

### 3.1.1 Water Demands

Water demand will vary, depending on the stages of construction. The total water demand during construction, presented in Table 3.1, has been estimated based on the current Project layout, as described in Section 1.3. Post-construction water demands will be negligible, primarily consisting of occasional cleaning and potable water demands. A detailed breakdown of the assumption adopted in the water demand estimation is included in Appendix A.

**TABLE 3.1: SITE WATER DEMANDS SUMMARY**

Demand	Total Demand (ML)
Consumption – Day Work (Potable) <sup>1</sup>	5.8
Consumption – Accommodation Camp (Potable) <sup>1</sup>	19.5
Dust Suppression	6.6
Vehicle and Equipment Washdown	4.6
Road Construction / Compaction	14.3
Compound Hardstands	5.3
<b>Total Construction Demand</b>	<b>56.1</b>

<sup>1</sup> Conservatively based on the peak workforce for the full construction period.

The construction water demands are based on the workforce breakdown available at the time of this assessment, which includes a peak workforce of up to approximately 250 full time equivalent (FTE) employees during installation of the solar panels and BESS. During operation, it is assumed that approximately 10 FTE employees will be required.

The peak raw (non-potable) demand is expected to occur during site set up, due to road construction and compaction. The peak potable water demand is also expected to occur during installation when workforce is at approximately 250 FTE and the workforce accommodation camp is in place. This results in the following maximum demand rates:

- Maximum daily non-potable construction demand = 66.3 kL/day.
- Maximum daily potable construction demand (including worker accommodation camp) = 62.5 kL/d.
- Maximum daily operational demand = 0.5 kL/d (potable water for employees only).

The provided water demand volumes and rates are estimates based on the information available at the time this assessment and will be confirmed during detailed design.

### 3.1.2 Water Supply

It is understood that the Applicant does not own any of the land within the Project Area and therefore will be limited in their water harvesting options. The Applicant proposes to purchase water tanks and truck in water to support the minimal construction demands and does not anticipate the need to use existing water sources from within the Project Area.

Discussions with nearby Councils indicate that the maximum water demand (~130 kL/day) can be met through existing Council facilities, as described below:

- Liverpool Plains Shire Council can provide up to 80 kL/day through available supplies from the Quirindi Water Supply via the existing Bulk Fill facility. The Applicant would purchase and transport this water to the Project site as required, in consultation with Liverpool Plains Shire Council to ensure no disruption to residential supply.
- Tamworth Regional Council can provide up to 50 kL/day. This water would be sourced through registered water carters at one of Council's Bulk Water Filling Stations. It is noted that use of water from these filling stations is subject to the provisions of the Tamworth Regional Council's Drought and Demand Management Plan.

Although not anticipated, if the detailed design stage of the Project identifies that additional water may be required to fulfill construction and operation demands, this may be sourced from:

- Reuse water from sediment basins (which may be used during the construction phase to prevent contamination of downstream watercourses). It is important to note that the ability to make use of this water supply will be dependent on available infrastructure (dams) and rainfall.
- Land Agreements to source some of the non-potable construction and operation water demands from harvested runoff from farm dams (refer to Section 2.8.5.1). In accordance with basis landholder rights, the maximum capacity of harvestable rights dams within the Project area is 29.52 ML. This water could be captured from local runoff in dams placed on 1<sup>st</sup> and 2<sup>nd</sup> order watercourses, up to 29.52 ML/year for use during construction and operation. It is important to note that the ability to make use of this water supply will be dependent on available infrastructure (dams) and rainfall. The Project does not anticipate the need to use water from existing farm dams, however, dams will be retained to ensure continued water availability for stock.
- Land Agreements to access water via WALs held by the landholder. The Applicant may enter agreements with landholders that hold existing water access licences (WALs) to source surface or groundwater using the WAL. The following would need to be considered:
  - The type of WAL held by the landholder (e.g., WALs for stock and domestic purposes would not be able to be used).
  - The WAL entitlement (i.e. how much water can be accessed under the WAL).
  - Water security considerations associated with the different types of WALs (e.g., the availability of groundwater would be more consistent than surface water during periods of low rainfall).

It is understood that no WALs currently exist within the Project Area.

- Purchasing WALs and entering landholder agreements to register the associated Work Approvals. If there are WALs available in the water sources relevant to the Project Area, the Applicant could seek to purchase these WALs. The WALs would need to be associated with works approvals for the structures used to capture and/or extract the water (e.g. dams, weirs, bores, pumps etc.). The Applicant would enter into agreements with landholders to register these works approvals to the relevant lot owned by the landholder. A summary of total WALs currently issued under each relevant surface water source and existing works approvals are provided in Section 2.8.5.2.
- Purchasing and transporting water to site by water cart.
- Recycling and reuse of water.

It is understood that the Applicant is proposing to maintain water tanks on site which may capture rainwater for site amenities. If additional potable water is required, this would be imported to site. Similarly, it is understood that the solar panels will mostly rely on direct rainfall to remove any dirt build up. If cleaning is required in dry periods, water would be purchased and imported to site.

Where possible during construction, water should be recycled and reused. It is assumed that this will likely be possible for vehicle and equipment washdown demands.

The Project does not propose to extract groundwater to support construction or operation activities.

### 3.1.3 Wastewater Management

During construction, wastewater from the site office and temporary construction and accommodation facilities will be collected and managed through an on-site wastewater treatment system. To prevent interaction with natural surface and groundwater systems, the treated wastewater will be contained in tanks on site.

Waste solids generated by the treatment system will be handled by a licensed contractor, who will transport and dispose of at a nearby Council wastewater treatment plant or other appropriately licensed facility. The Applicant is in discussions with nearby Councils (e.g. Tamworth Shire Council) for the disposal of greywater at a suitable facility. An agreement must be obtained before Project construction commences.

The specifics of the on-site wastewater management system, including its design and capacity, will be determined in the detailed design phase, and should consider best practice guidelines and standards. Once construction is complete, all temporary wastewater management infrastructure will be decommissioned and removed from the Project Area for rehabilitation.

# 4. FLOOD MODELLING

## 4.1 Assessment Methodology

A flood model was developed to model flood behaviour in and around the Project Area. The methodology used to develop this model is summarised in subsequent sections of this report. Details on the model development and setup is provided in Section 4.1.

### 4.1.1 Study Area and Assessment Approach

There are two main creeks within the vicinity of Project Area that are made up of both minor and non-minor watercourses. The location of the site allows for the modelling of the entirety of the catchment upstream of the project area using a catchment wide 'Rain-on-Grid' (RoG) modelling approach. The RoG model was developed using the 2D hydraulic modelling software TUFLOW.

### 4.1.2 Key Assumptions

This assessment uses the following assumptions regarding the Project Area:

- Permanent ancillary infrastructure (BESS Stations / Substations) is located above the 1% AEP flood level and would be achieved by filling of the areas to raise the finished ground levels to at least the 1% AEP level and construction of diversion drains to minimise impacts to downstream flow regimes. Modelling of infrastructure conservatively assumes a minimum of 500 mm freeboard to identify potential changes to flood regimes in larger events (PMF).
- Drains would be designed, constructed and maintained to convey overland flows around hardstand areas and other ancillary infrastructure to maintain existing flow directions, as required.
- Access tracks that would cross ephemeral watercourses would be raised above the watercourse bed to provide a low-level crossing. Culverts or bridges may need to be provided at the crossings to convey flows through the crossing. Appropriate scour protection and design considerations will be provided at crossings and hydraulic structures to minimise the likelihood of erosion and scouring.

## 4.2 Model Development

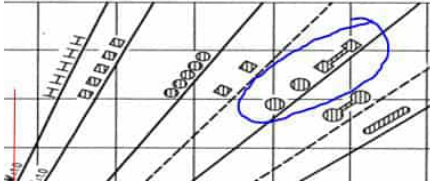
Details of key TUFLOW model parameters are tabulated in Table 4.1. The TUFLOW model extent and layout is shown in Figure 4.1.

**TABLE 4.1: HYDRAULIC MODEL DEVELOPMENT AND PARAMETERS**

Model Parameter	Details
Grid Size	A cells size of 5 m was adopted for the purpose of the assessment.
DEM	Digital Terrain Elevation Models (DEM) for the Project Area and upstream catchment used in the model in order of priority include: <ul style="list-style-type: none"> <li>• High resolution 1 m DEM, provided by the Applicant, flown January 2025.</li> <li>• 5 m DEM, derived from NSW Spatial Services LiDAR data, flown February 2016.</li> </ul>
Timestep & Model Build	The hydraulic models use TUFLOW's Heavily Parallelised Compute (HPC) computational method for calculations of the Shallow Water Equation. A part of this allows for the model to use a variable time step. The model build used for each assessment was the latest available at the time, 2023-03-AE.
Assessed Events	The 5%, 1%, and 0.2% annual exceedance probability (AEP) rainfall events were assessed, as well as a future climate change sensitivity scenario in accordance with ARR2019v4.2. The 0.2% AEP event is used as a proxy for climate change as specified in the Secretary's Environmental Assessment Requirements (SEARs) for the Project. This is further enhanced with modelling of a climate change scenario in accordance with ARR2019v4.2. Design rainfall data was sourced from the Australian Rainfall and Runoff (ARR) Data Hub (BoM, 2022)  The probable maximum flood (PMF) was modelled using rainfall volumes calculated using the Generalised Short Duration Method (GSDM).

Model Parameter	Details																		
ARR v4.2 - Climate Change Adjustment	<p>In accordance with latest updates to the Australian Rainfall and Runoff – A Guide to Flood Estimation (ARR v4.2 Guideline), unadjusted historical observations are no longer a suitable basis to define design rainfall information and must be adjusted to reflect the impacts of rising global temperatures. This is accounted for by adjusting the 2016 Intensity- Frequency- Duration (IFD) curves and ARR losses to represent conditions (i.e. the current climate). The change in design rainfall estimations under the latest ARRv4.2 guidance are sensitive to the climate scenario (i.e., year 2030 versus 2100) and the Shared Socioeconomic Pathways (SSP) adopted.</p> <p>The following climate scenarios and SSPs chosen for this assessment are as follows:</p> <ul style="list-style-type: none"> <li>• <i>Near Term</i> – 2030 Horizon at SSP 2-4.5, to reflect current climate conditions. This adjustment was applied to all modelled events.</li> <li>• <i>Long-Term</i> - 2090 Horizon at SSP 2-4.5, to reflect a long term climate change sensitivity scenario. Simulated for the 1% AEP baseline scenario to provide an understanding of the scale of change of flood behaviour relative to the 1% AEP event.</li> </ul> <p>The adjustment factors applied to the IFD are provided in Table 4.2.</p>																		
Assessed Durations and Temporal Patterns	For each of the modelled AEP events, durations ranging between 15 minutes and 9 hours were assessed. For each duration, ten temporal patterns were modelled to provide statistical variation to determine the median storm event. The peak of the median duration results was then adopted to be representative of peak flood behaviour.																		
Aerial Reduction Factors	ARFs were derived from the model boundary area of approximately 18.4 km <sup>2</sup> .																		
Rainfall Losses	Initial and continuing rainfall losses were sourced from the ARR Data Hub (BoM, 2022), and in accordance with the Floodplain Risk Management Guide and Review of ARR Design Inputs for NSW (OEH, 2019). This assessment has adopted the recommendations of ARR 2019 v4.2, including consideration of adjustment factors to align with latest methodologies. The applied adjustment factors are provided in Table 4.3.																		
Inflow Boundaries	Design rainfall was spatially distributed across the model terrain within the RoG model boundary. No routed inflow boundaries were applied.																		
Downstream Boundary	To allow flow to exit the model area through Tamarang and Sugarloaf Creeks, TUFLOW boundary conditions were represented as a normal depth (HQ) based on low flow channel grades at the downstream extent of the models. The grades were established from DEM data. A perimeter water level (HT) boundary was applied around the remainder of the model domain to enable controlled outflows from localised low points and minor drainage paths. The HT boundary was set to the lowest elevation along model perimeter (549.6 mAHD at the Garoo Road outflow location) to avoid backwater effects.																		
Manning’s ‘n’ Roughness	<p>Manning’s ‘n’ roughness classifications for the baseline and developed case modelling is shown on Figure 4.1 and Figure 4.2 respectively. Adopted roughness values are presented in Table 4.4. Land use delineation was based on aerial imagery sourced from Google Maps and NSW Six Maps.</p> <p>The Manning’s ‘n’ value adopted for the proposed solar panel arrays was determined using the Modified Cowan Method for Floodplain Roughness:</p> <p>Modified Manning’s ‘n’ = <math>(n_b + n_1 + n_2 + n_3 + n_4) m</math>, where:</p> <table border="1" data-bbox="448 1615 1469 1948"> <thead> <tr> <th rowspan="2">Floodplain Condition</th> <th colspan="2">Adopted n and m value</th> <th rowspan="2">Description</th> </tr> <tr> <th>Existing</th> <th>Solar Panels</th> </tr> </thead> <tbody> <tr> <td>Floodplain Material (<math>n_b</math>)</td> <td>0.04</td> <td>0.04</td> <td>Grassland with Low-Density Vegetation</td> </tr> <tr> <td>Degree of irregularity (<math>n_1</math>)</td> <td colspan="2">No change from pre-development</td> <td></td> </tr> <tr> <td>Variation in Floodplain Cross Section (<math>n_2</math>)</td> <td colspan="2">No change from pre-development</td> <td></td> </tr> </tbody> </table>	Floodplain Condition	Adopted n and m value		Description	Existing	Solar Panels	Floodplain Material ( $n_b$ )	0.04	0.04	Grassland with Low-Density Vegetation	Degree of irregularity ( $n_1$ )	No change from pre-development			Variation in Floodplain Cross Section ( $n_2$ )	No change from pre-development		
Floodplain Condition	Adopted n and m value		Description																
	Existing	Solar Panels																	
Floodplain Material ( $n_b$ )	0.04	0.04	Grassland with Low-Density Vegetation																
Degree of irregularity ( $n_1$ )	No change from pre-development																		
Variation in Floodplain Cross Section ( $n_2$ )	No change from pre-development																		

Model Parameter	Details			
	Effect of Obstructions ( $n_3$ )	0.000	0.004	Negligible (<5%) based on typical solar array modules of a frame supported by ~150 mm diameter piers at a typical grid spacing of ~5 m, resulting ~2.5% flow obstruction.
	Amount of vegetation ( $n_4$ )	No change from pre-development		
	Change in roughness	0.000	0.004	$n_b + n_1 + n_2 + n_3 + n_4$
	Adopted Manning's 'n'	0.040	0.044	
	Correlation Factor for meandering of the channel (m)	1	1	Minor
1D Network	<p>Hydraulic structures (culverts/bridges) located within the model extent have been identified based on a desktop review of aerial imagery, the DEM and survey provided by Transport for NSW (TfNSW). Hydraulic structures identified are shown in Figure 4.1.</p> <p>Culverts characteristics and dimensions along the New England Highway, west of the Project Area, were obtained from survey provided by TfNSW. Details of the smaller culverts within the Project Area were not available and therefore estimated through use of DEM, aerial imagery and google earth.</p> <p>A bridge is proposed across Tamarang Creek to facilitate construction and operation of the solar farm. A layered flow constriction structure was modelled in TUFLOW to assess the potential flooding impacts associated with the proposed bridge crossing, based on the flowing assumptions.</p>			

Model Parameter	Details		
	<b>Component</b>	<b>Assumption</b>	<b>Basis for Assumption</b>
	L3 (Bridge guard)	0.6 m high with 100% blockage	<ul style="list-style-type: none"> <li>100% blockage assumed as a conservative assumption for the proposed transmission line conduit to be attached to the bridge deck.</li> </ul>
	L2 (Bridge deck)	1 m high with 100% blockage	<ul style="list-style-type: none"> <li>100% blockage is always applied to bridge decks.</li> </ul>
	L1 (Under bridge area)	Height Variable.	<ul style="list-style-type: none"> <li>Based on LiDAR, to tie into the existing surface.</li> <li>Blockage to allow for placement of piers (see below)</li> </ul>
	Bridge width	6 m	<ul style="list-style-type: none"> <li>Based on cross-sectional area provided.</li> </ul>
	Bridge length	172 m across creek	<ul style="list-style-type: none"> <li>Based on cross-sectional area provided.</li> </ul>
	Pier Type	As below, using Figure 7 <i>Incremental Backwater Coefficient for Piers</i> (Bradly, 1960): 	<ul style="list-style-type: none"> <li>Represents a standard double pier configuration (with piers located both upstream and downstream of the deck) as per design.</li> </ul>
	Pier details	~2.2 % blockage	<ul style="list-style-type: none"> <li>Based on 4 x 2 m diameter piers.</li> </ul>
<p>It is noted that the adopted assumptions are based on what is thought to be reasonably practical given the proposed bridge location and cross-sectional area. It is understood that further design and assessment of the proposed bridge crossing will be undertaken during the post approval detailed design stage.</p>			

**TABLE 4.2: CLIMATE CHANGE FACTORS – HORIZON RAINFALL IFD ADJUSTMENT FACTORS**

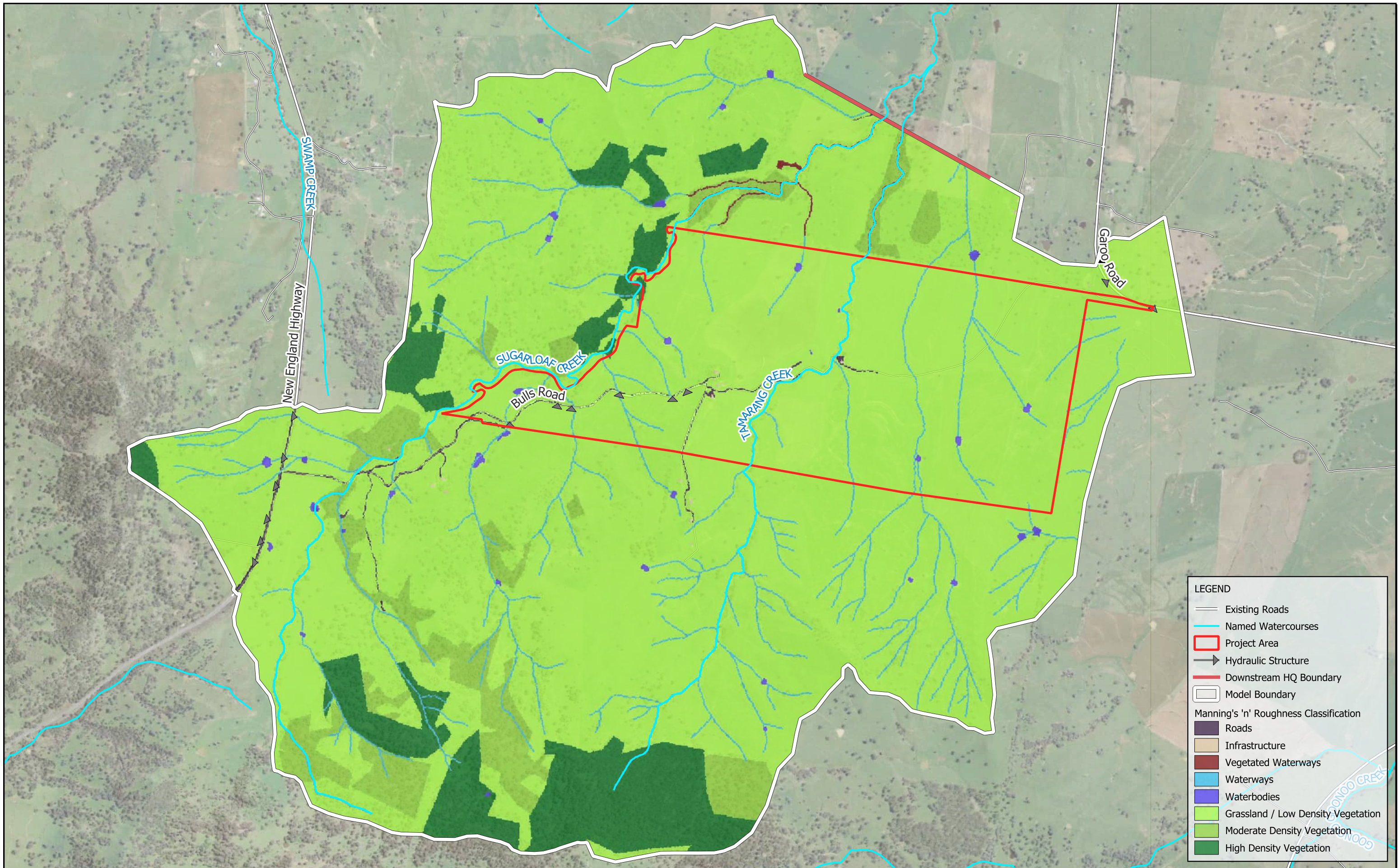
Climate Scenario	< 1 h	1.5 h	2 h	3 h	4.5 h	6 h	9 h	12 h	18 h	> 24 h
Near Term SSP2-4.5	1.18	1.17	1.16	1.14	1.13	1.12	1.12	1.11	1.10	1.10
Long Term SSP2-4.5	1.40	1.36	1.34	1.31	1.28	1.26	1.24	1.23	1.21	1.20

**TABLE 4.3: CLIMATE CHANGE FACTORS – RAINFALL LOSS ADJUSTMENT FACTORS**

Climate Scenario	Initial Loss	Continuing Loss
Near Term SSP2-4.5	1.01	1.02
Long Term SSP2-4.5	1.03	1.05

**TABLE 4.4: MANNING'S VALUES**

Land Use Type	Manning's 'n' Value
Roads and Other Hardstands	0.025
Infrastructure	0.500
Grassland with Low Density Vegetation	0.040
Moderate Density Vegetation	0.065
High Density Vegetation	0.075
Open Waterbodies	0.030
Waterways	0.040
Proposed Solar Arrays	0.044



**LEGEND**

- Existing Roads
- Named Watercourses
- ▭ Project Area
- ➔ Hydraulic Structure
- Downstream HQ Boundary
- ▭ Model Boundary

**Manning's 'n' Roughness Classification**

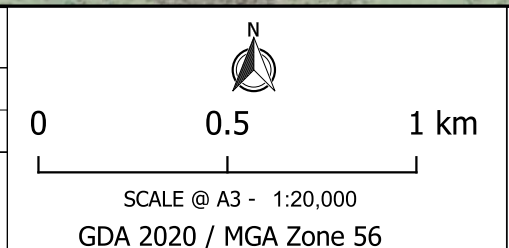
- ▭ Roads
- ▭ Infrastructure
- ▭ Vegetated Waterways
- ▭ Waterways
- ▭ Waterbodies
- ▭ Grassland / Low Density Vegetation
- ▭ Moderate Density Vegetation
- ▭ High Density Vegetation

R	DETAILS	DATE
0	Final Issue	10-06-2025

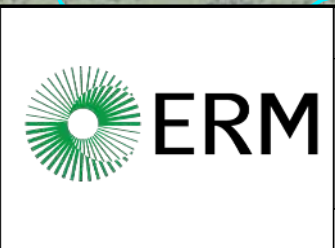
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DRAWN	LV	CHECKED	SES
APPROVED	SES	DATE	10/06/25

NOTES:



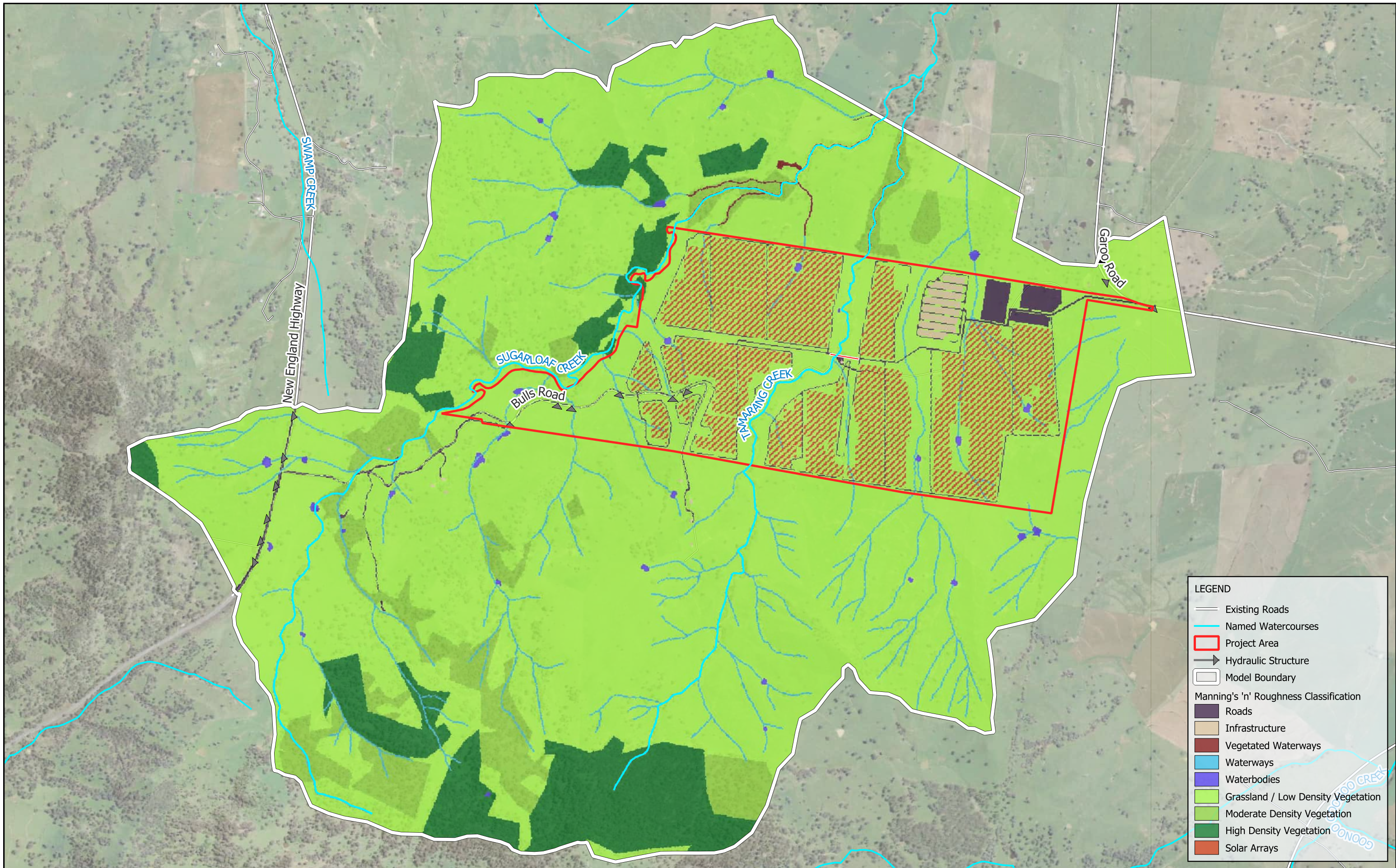
**DISCLAIMER**  
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**DATA SOURCE**  
Google Maps



Garoo Solar Farm & BESS

Figure 4.1: TUFLOW Model Layout

Drg Ref. BNTL00206\_0019-FIG-013



**LEGEND**

- Existing Roads
- Named Watercourses
- ▭ Project Area
- Hydraulic Structure
- ▭ Model Boundary

**Manning's 'n' Roughness Classification**

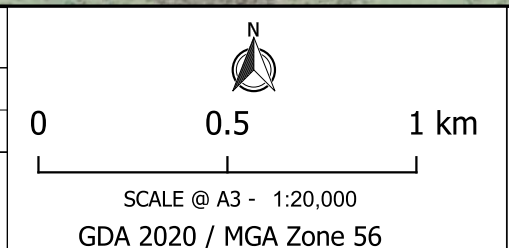
- ▭ Roads
- ▭ Infrastructure
- ▭ Vegetated Waterways
- ▭ Waterways
- ▭ Waterbodies
- ▭ Grassland / Low Density Vegetation
- ▭ Moderate Density Vegetation
- ▭ High Density Vegetation
- ▭ Solar Arrays

R	DETAILS	DATE
0	Final Issue	10-06-2025

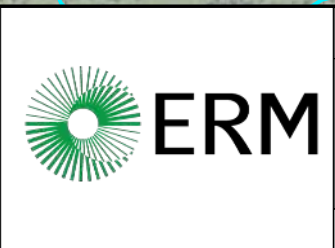
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APPROVED	SES	DATE	10/06/25

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DATA SOURCE  
Google Maps



Garoo Solar Farm & BESS

Figure 4.2: Manning's Roughness - Developed Case

Drg Ref. BNTL00206\_0019-FIG-014

## 4.3 Existing Flood Behaviour

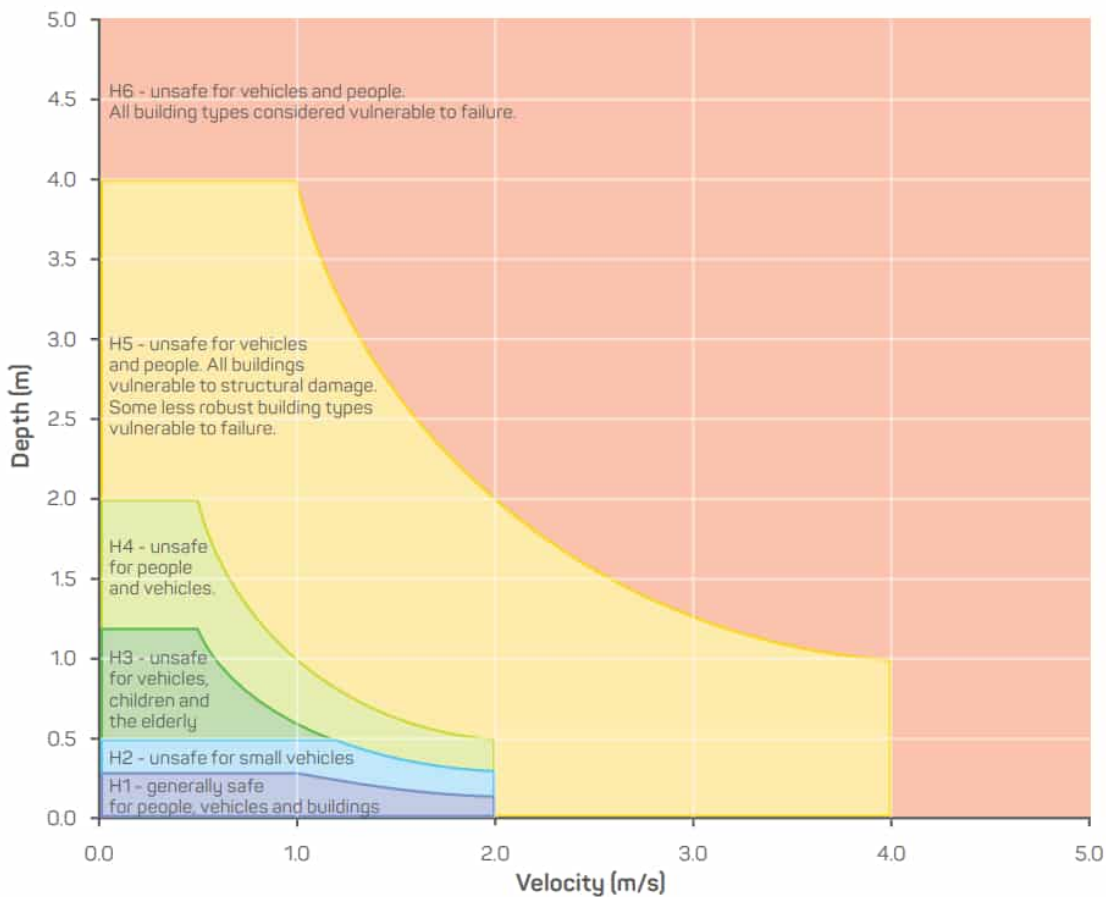
Appendix B contains mapping of flood depth, velocity, and hazard categories for the baseline flooding results (i.e. with the Project Area undeveloped) for the 5% AEP, 1% AEP, 1% AEP Climate Change Sensitivity, 0.2% AEP, and PMF events. The following is a summary of the baseline results within the Project Area.

- Flooding within the western portion of the Project Area is dominated by defined drainage channels, including contour drains, diverting catchment to the existing farm dams. Through the centre of the Project Area, flows are concentrated in Tamarang Creek, while the eastern Project Area is subject to areas of broader overland flow. External to the Project Area, flooding is dominated by the local creek systems.
- Flood depths across the Project Area are typically less than 0.5 m in events up to the 1% AEP, however peak flood depths can reach up to 3 m within Tamarang Creek. In the PMF event, flood depths exceed 0.5 m in several locations across the Project Area, with peak flood depths up to 1.5 m in the broad overland flow path and exceeding 4 m within the channel of Tamarang Creek.
- Flow velocities within the broad overland flow path through the Project Area typically exceed 1.5 m/s in all events modelled events, and exceed 4 m/s in the PMF. Velocities within Tamarang Creek exceed 4 m/s in all modelled events.
- The general flood hazard curves and categorisation presented in ARR (Ball, et al., 2019) have been adopted (refer to Figure 4.3) and the predominant hazard categories for the Project Area is low (H1) to moderate (H3), with higher hazards within defined watercourses and overland flow paths. Drainage paths through the Project Area record hazard categories up to H5 (unsafe for vehicles and people) in the 1% AEP event, while Tamarang Creek and Sugarloaf Creek indicate areas of H6.

### 4.3.1 Flood Hazard Classification

The general flood hazard curves and categorisation presented in ARR (Ball, et al., 2019) have been adopted (refer to Figure 4.3) to determine the flood hazard categorisation for the project Area. In accordance with the methodology in the *Australian Disaster Resilience Handbook 7 – Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia* (AIDR, 2017), the combined flood hazard curves set hazard thresholds that relate to the vulnerability of the community when interacting with floodwaters. The combined curves are divided into hazard classifications that relate to specific vulnerability thresholds as described in Table 4.5.

From the flood hazard mapping in Appendix B, hazard categories for the Project Area range between low (H1) to high (H5) outside of non-minor watercourses (Tamarang Creek and Sugarloaf Creek).



**FIGURE 4.3: FLOOD HAZARD CATEGORIES**

**TABLE 4.5: COMBINED HAZARD CATEGORIES – VULNERABILITY THRESHOLDS AND LIMITS**

Hazard Vulnerability Classification	Description	Classification Limit (D and V in combination) m <sup>2</sup> /s	Limiting still water depth (D) m	Limiting velocity (V) m/s
H1	Generally safe for vehicles, people and buildings.	$D \cdot V \leq 0.3$	0.3	2.0
H2	Unsafe for small vehicles	$D \cdot V \leq 0.6$	0.5	2.0
H3	Unsafe for vehicles, children and the elderly.	$D \cdot V \leq 0.6$	1.2	2.0
H4	Unsafe for vehicles and people.	$D \cdot V \leq 1.0$	2.0	2.0
H5	Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.	$D \cdot V \leq 4.0$	4.0	4.0
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.	$D \cdot V \leq 4.0$	-	-

### 4.3.2 Flood Planning Area

The flood planning area (FPA) for the Project Area has been considered by assessing the 1% AEP and adding 500 m freeboard to the flood levels, in accordance with the recommended methodology in the *Flood risk management manual* (DPE, 2023). As the assessment uses a RoG approach, depths less than 50 mm have not been included in the 1% AEP flood extent. Additionally, minor man-made contour drains have been excluded from the FPA, as their scale and limited hydraulic connectivity reduce their overall influence on broader overland flow

behaviour and would introduce unnecessary complexity and uncertainty in extrapolated flood planning levels. The FPA extent within the Project Area is provided in Figure 4.4.

### 4.3.3 Hydraulic Categorisation

Three hydraulic categories of flood prone land are identified, being the floodway, flood storage and flood fringe, and are a distinction used to aid in the process of developing a floodplain risk management plan. The DEP *Floodplain Risk Management Guideline* document definitions and the adopted criteria for each categorisation are summarised in Table 4.6.

**TABLE 4.6: HYDRAULIC CATEGORISATION**

Category	Definition	Adopted Criteria
<b>Floodway</b>	Areas which convey a significant portion of water during floods and are particularly sensitive to changes that impact flow conveyance. They often align with naturally defined channels.	1% AEP Hazard Category of $\geq 4$
<b>Flood Storage</b>	Areas outside of a floodway and generally store a significant proportion of the volume of water and where flood behaviour is sensitive to changes that impact the storage of water during a flood.	1% AEP Hazard Category of $< 4$
<b>Flood Fringe</b>	Areas within the extent of flooding for the event but which are outside floodways and flood storage areas. Flood fringe areas are not sensitive to changes in either flow conveyance or storage.	PMF extent

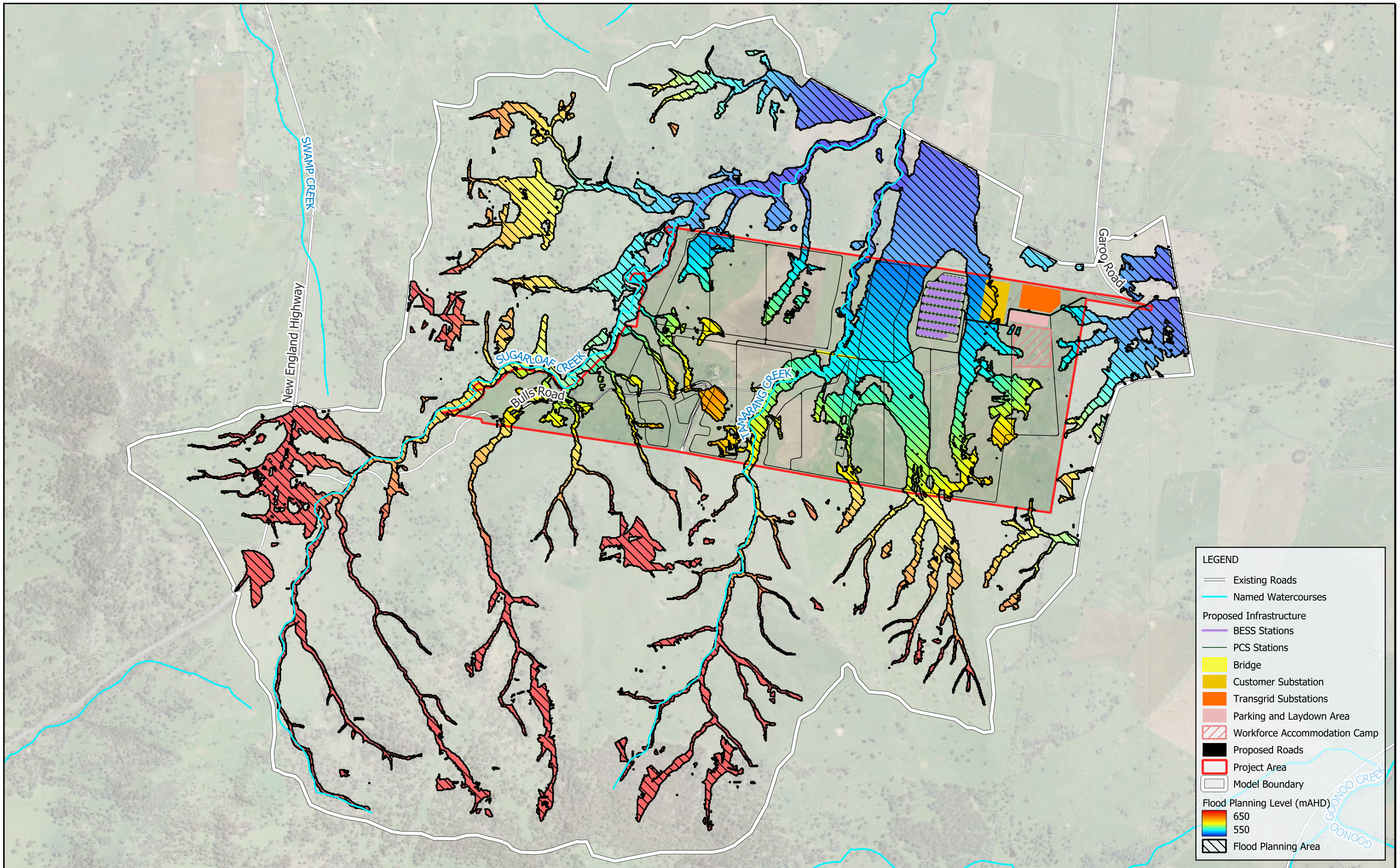
Figure 4.5 provides the hydraulic categorisation within the Project Area for each of these areas.

### 4.3.4 Climate Change Assessment

A climate change assessment was undertaken to understand the sensitivity of flooding and flood impacts to climate change. Two climate change scenarios were modelled to provide an understanding of the scale of change of flood behaviour relative to the current 1% AEP event, including the current (Near-Term) 0.2% AEP design event (typically used as proxies for climate change) and the Long-Term 1% AEP climate change event, in accordance with the ARR v4.2 Guideline (refer to Table 4.1). A comparison of the flood extents between these events is presented in Figure 4.6 while further detailed flood mapping for the full range of events is provided in Appendix B.

The climate change sensitivity modelling indicates that there is generally little difference in flood extent across the Project Area for the two climate change scenarios assessed, including through the major drainage channels. Additional outcomes from the climate change assessment are as follows:

- The difference in flood depth for climate change proxies relative to the 1% AEP is typically less than 0.1 m, which is below the 0.5 m freeboard adopted in setting flood planning levels. This indicates that a climate change scenario would result in the future flood planning reference event (1% AEP plus climate change) not exceeding the current flood planning level (existing 1% AEP plus 500 mm freeboard). This change in depth and extent does not result in inundation of additional buildings or potential ancillary infrastructure locations.
- The increase in inundation during flood events (refer to Figure 4.6) from the 1% AEP (blue) to the 1% AEP Climate Change Scenario (orange) and the 0.2% AEP (red) is shown on the figure with minimal areas that are only inundated by the 1% AEP Climate Change Scenario and the 0.2% AEP extents that are not already inundated by the 1% AEP extent.
- The small change in flood regime (i.e., flood level or extent) for the agricultural land (grazing and cropping) or crown land is not considered to have a resulting impact on the use of the land under a climate change scenario.



**LEGEND**

- Existing Roads
- Named Watercourses
- Proposed Infrastructure**
  - BESS Stations
  - PCS Stations
  - Bridge
  - Customer Substation
  - Transgrid Substations
  - Parking and Laydown Area
  - Workforce Accommodation Camp
  - Proposed Roads
  - Project Area
  - Model Boundary
- Flood Planning Level (mAHd)**
  - 650
  - 550
- Flood Planning Area

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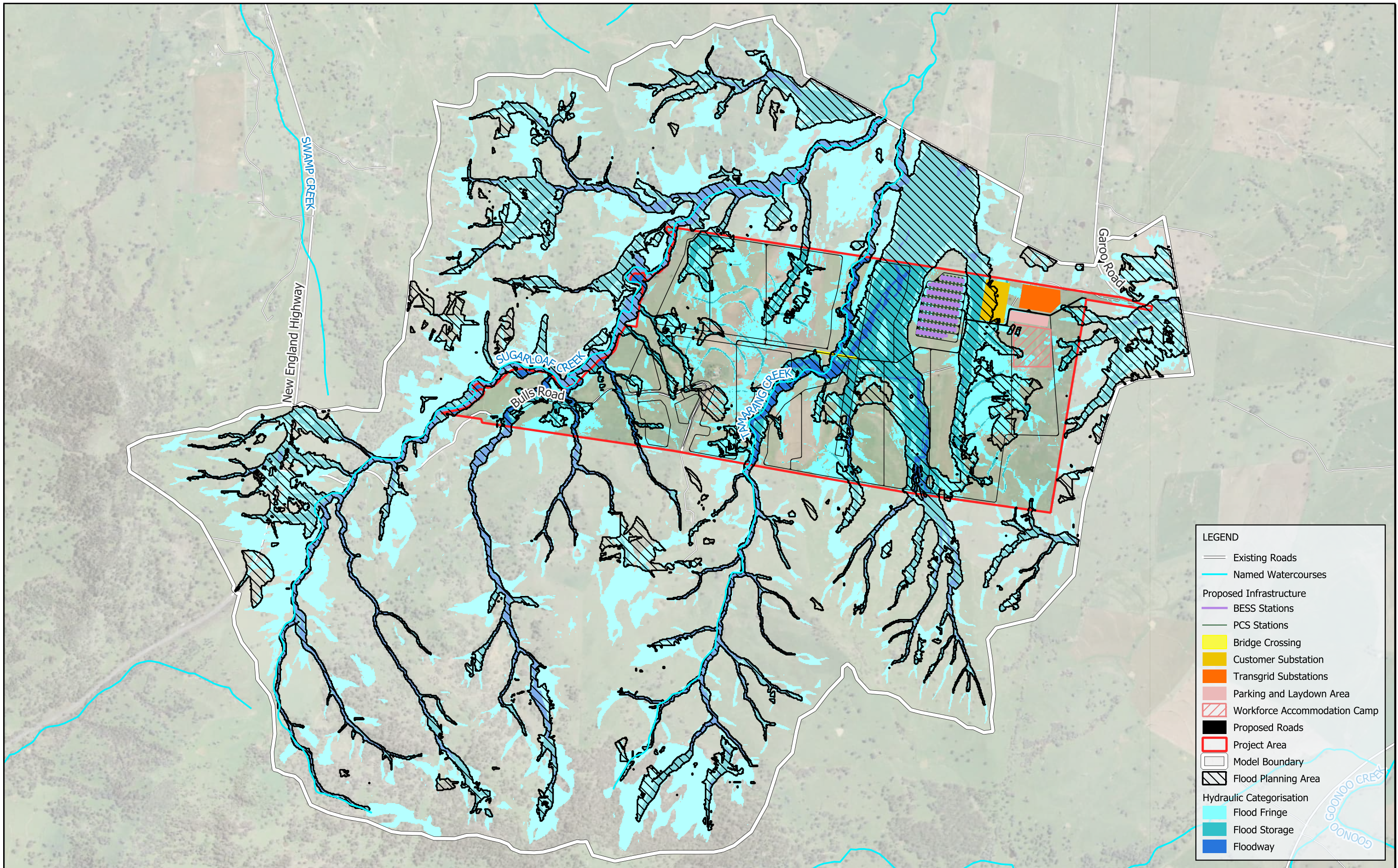
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Figure 4.4: Flood Planning Area

Drg Ref. BNTL00206\_0019-FIG-015



**LEGEND**

- Existing Roads
- Named Watercourses
- Proposed Infrastructure**
- BESS Stations
- PCS Stations
- Bridge Crossing
- Customer Substation
- Transgrid Substations
- Parking and Laydown Area
- Workforce Accommodation Camp
- Proposed Roads
- Project Area
- Model Boundary
- Flood Planning Area
- Hydraulic Categorisation**
- Flood Fringe
- Flood Storage
- Floodway

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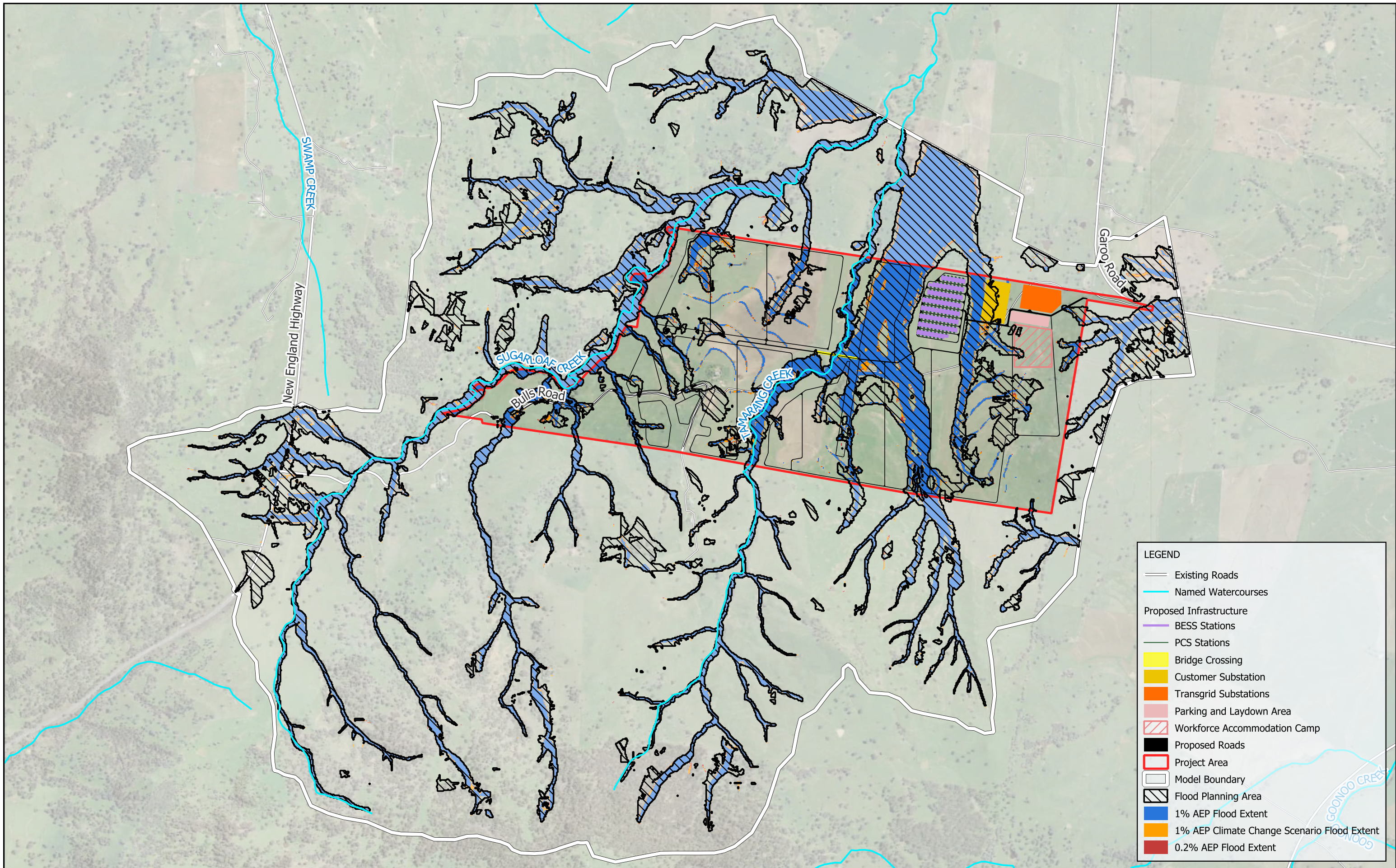
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Figure 4.5: Hydraulic Categorisation

Drg Ref. BNTL00206\_0019-FIG-016



**LEGEND**

- Existing Roads
- Named Watercourses
- Proposed Infrastructure**
- BESS Stations
- PCS Stations
- Bridge Crossing
- Customer Substation
- Transgrid Substations
- Parking and Laydown Area
- Workforce Accommodation Camp
- Proposed Roads
- Project Area
- Model Boundary
- Flood Planning Area
- 1% AEP Flood Extent
- 1% AEP Climate Change Scenario Flood Extent
- 0.2% AEP Flood Extent

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Figure 4.6: Climate Change Sensitivity

Drg Ref. BNTL00206\_0019-FIG-017

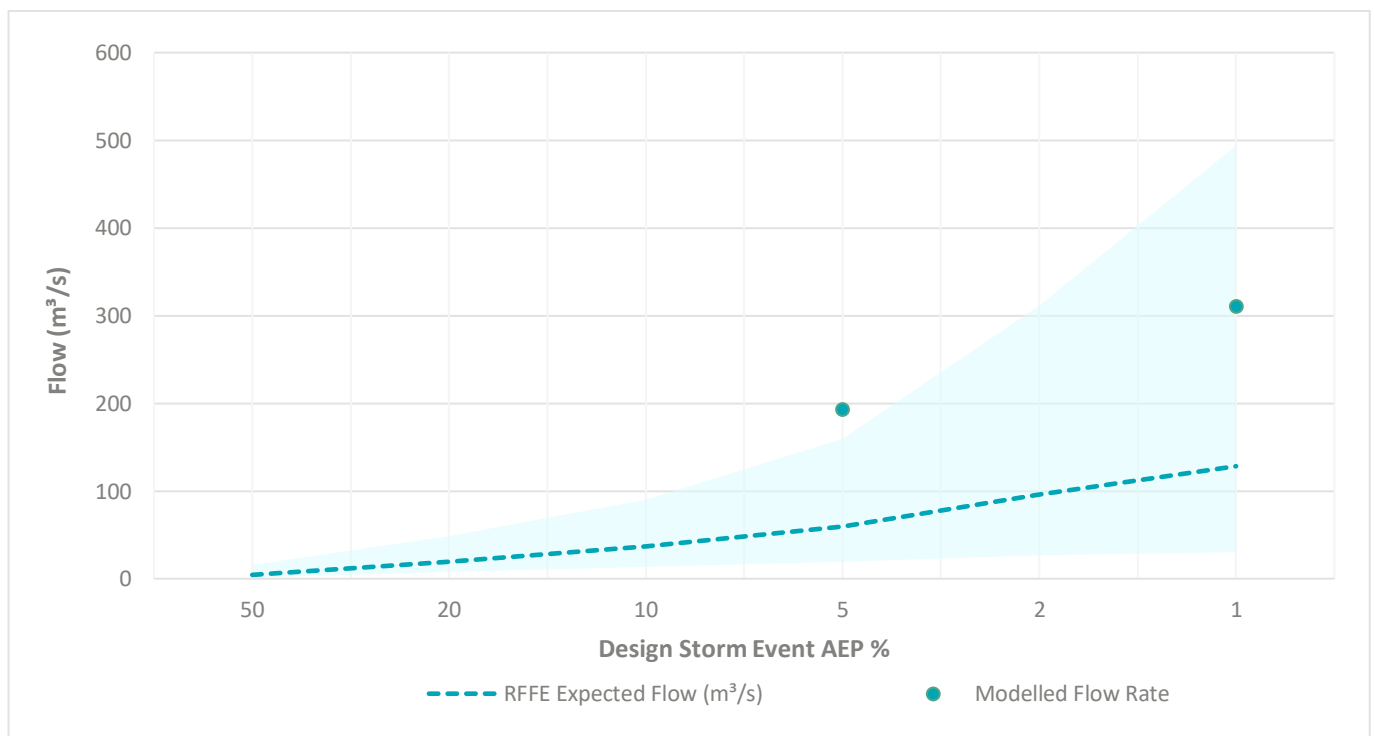
### 4.3.5 Design Flow Validation

The Regional Flood Frequency Estimation (RFFE) Model (ARR, 2024) was used to validate peak flows from the TUFLOW model. The validation was undertaken for the Sugarloaf Creek and Tamarang Creek catchments, which cover a majority of the Project Area.

The results of this RFFE comparison are presented in Table 4.7 and Figure 4.7 and indicate that the TUFLOW model may overestimate peak flows. However, the modelled values for the 1% AEP remain within the RFFE confidence limits, confirming that the model outputs are suitable for larger flow events and for the purposes of the assessment. Without additional validation data, further refinement or calibration of the model was not undertaken.

**TABLE 4.7: RFFE VALIDATION RESULTS**

Design Event AEP	Modelled Peak Flow (m <sup>3</sup> /s)	RFFE Expected Flow (m <sup>3</sup> /s)	RFFE Lower Confidence Limit (m <sup>3</sup> /s)	RFFE Upper Confidence Limit (m <sup>3</sup> /s)
5% AEP	192.4	59.5	19.5	159.7
1% AEP	310.7	128.3	31.4	493.9



**FIGURE 4.7: RFFE FLOW VALIDATION**

## 4.4 Developed Flood Behaviour

Appendix C contains mapping of flood depth, velocity and hazard categories for the developed case flood modelling for the 5% AEP, 1% AEP and PMF events.

The changes made to the baseline hydraulic model to represent the development of the Project Area are as follows:

- Change to Manning’s ‘n’ values for proposed infrastructure areas including solar panels, BESS and substation locations and proposed roads.
- Ancillary infrastructure (BESS, Customer Substation and Transgrid Substation) conservatively raised to above the Flood Planning Level (existing 1% AEP plus 500 mm freeboard).
- Inclusion of an indicative bridge structure across Tamarang Creek (refer to Table 4.1).

The following provides a summary of the developed results within and surrounding the Project Area:

- The BESS infrastructure structures are not flooded up to and including the PMF event, however, due to the RoG approach and adopted 5 m grid, they still show some flood flows on the figures in Appendix B. The inundation shown on the figures is related to local runoff. Allowance has been made in the model for local runoff to drain between the BESS blocks, adjacent to the internal roads. Stormwater management will be further refined during detailed design.
- Increases in flood depths of up to 0.1 m in the 5% AEP and 1% AEP within the Project Area, due to impeded flows and changed flow routes around the customer substation and the proposed bridge over Tamarang Creek, as well as modified runoff rates associated with the solar arrays. In the PMF, flood depths are increased around the customer substation by around 0.5 m and significant ponding is observed around the eastern abutment of the proposed bridge, due to the blockages associated with the bridge deck.
- Some locations of minor increases in flood depths (typically < 30 mm) outside of the Project Area in the 5% AEP and 1% AEP events. This is to the north of the Project Area, where flows are re-routed around the proposed customer substation.
- In addition to the above, minor increases in flood depth are observed within the downstream reach of Tamarang Creek due additional overland flow being routed into the creek from the proposed bridge/crossing location changing local drainage pathways.
- Typically, velocities within the solar array area remain below 1 m/s during the 5% AEP and 1% AEP events, except in key overland flow paths, and 2.0 m/s during the PMF, except through the key overland flow paths.
- Negligible changes in flood hazards are reported through the Project Area in the 5% AEP and 1% AEP, with no observable external impacts. Flood hazards remain between H1 to H5 in the 5% AEP and 1% ARP events within the Project Area, with the higher H4-H5 categories within key overland flow paths.
- During the PMF, increased flooding is expected around the eastern abutment of the proposed bridge, resulting in an increase of flood hazard by 1 category to H6, indicating these areas would be unsafe for people and vehicles in the PMF event. It is noted that much of this area is already classified as a H6 category under baseline conditions.

# 5. SURFACE WATER IMPACT ASSESSMENT

## 5.1 Watercourse Characteristics

### 5.1.1 Flow Regimes

The proposed works will not involve significant modification or realignment of any natural watercourses traversing the Project Area, resulting in no impacts to stream ordering.

The proposed disturbance associated with construction and operation infrastructure (e.g. solar arrays, BESS Stations, Substations and roads) may result in disturbance of minor overland flow paths. Where possible, the proposed roads in addition to existing access tracks will be used during construction and operation of the Project, limiting additional crossings of flow/drainage paths.

A new bridge crossing is proposed across Tamarang Creek, in the centre of the Project Area. It is understood that the bridge design will be optimised during detailed design to minimise disturbance within the watercourse and maintain natural flow conveyance in Tamarang Creek as much as possible. An indicative bridge structure was included in the developed case flood model, and the resulting potential impacts are discussed in Section 5.1.3.

Construction of some ancillary infrastructure is proposed within proximity of mapped watercourses, however, is not expected to change flow path regimes. These items mostly consist of existing and proposed access tracks and solar arrays, as the BESS Stations and Substations have been positioned outside of the 1% AEP flood extent where possible. While these items may impede overland and out of bank flows, erosion and sediment controls will be implemented to minimise scouring and erosion around the infrastructure. Additionally, it is understood the proposed installation methods of the solar array modules will not modify channel geometry. Earthworks will be minimised and where possible, the natural drainage channel will be maintained.

The potential impacts to waterfront land and riparian zones associated with the proposed infrastructure is discussed in Section 5.1.2 and potential flood impacts are discussed in Section 5.1.3.

It is understood that filling of existing farm dams is not proposed to allow installation of solar arrays and will therefore not induce impacts to flow regimes.

### 5.1.2 Waterfront Land

As described in Section 5.1.1, installation of some infrastructure are proposed within close proximity of waterways (refer to Figure 2.3). Detailed waterfront land mapping was undertaken for all 3<sup>rd</sup> order and above watercourses, as well as 1<sup>st</sup> and 2<sup>nd</sup> order watercourses, and waterbodies exhibiting defined bed and banks. The assessment indicates that infrastructure items proposed within the mapped waterfront lands are typically associated with access tracks. Where access tracks are required to cross watercourses with defined waterfront land, they will be designed, constructed and maintained to maintain flows and ensure negligible impacts the full bank flow. A bridge is proposed across Tamarang Creek to provide access and connection to the western portion of the Project Area, crossing the waterfront land of Tamarang Creek. Design and construction of the bridge will be completed during the post approval detailed design stage, in accordance with the DPI Guidelines for *Controlled Activities on Waterfront Land* (2018), *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (DPI 2003), and *Policy & Guidelines for Fish Habitat Conservation & Management* (DPE, 2013). Preliminary flood modelling (refer to Section 5.1.3) indicates that if the bridge crossing is designed with minimal in-channel infrastructure, impacts to flows through Tamarang Creek will be negligible in the 5% AEP and 1% AEP events. Design optimisation is recommended to minimise impacts during the PMF.

Additionally, some solar arrays are proposed within the waterfront land of waterbodies, which are understood to be man-made farm dams. The placement and installation method of the solar arrays would not impact the bank full water level of the dams.

### 5.1.3 Flooding

During construction, operation and decommissioning of the Project, careful consideration should be given to the impacts of flooding both on the Project itself and any potential changes to flooding downstream of the Project.

The flood assessment has considered impacts of all proposed infrastructure, including solar arrays, access tracks, BESS and Substation locations and the proposed bridge crossing. The Project layout has been developed to minimise interaction with the baseline 5% AEP and 1% AEP flood extents, with greater impacts associated with the PMF.

A summary of peak flood depths and velocities associated with key infrastructure locations (refer to Figure 5.1) is included in Table 5.1 and Table 5.2 respectively. These summaries also indicate where there has been a change compared to baseline flood conditions.

#### 5.1.3.1 Solar Arrays

Typically, changes in flood depth as a result of the proposed solar arrays is less than 0.01 m (10 mm) and considered negligible. The proposed solar arrays alone are not expected to have notable flood impacts within, or outside of the Project Area. Where changes in flood depths of greater than around 0.05 m are reported within the Solar Blocks in Table 5.1, this is due to proximity to other proposed infrastructure.

#### 5.1.3.2 Ancillary Infrastructure

The flood assessment has considered the impacts of both temporary and permanent ancillary infrastructure. The Project infrastructure has generally been developed to avoid interaction with defined flow paths. As such, the majority of the proposed infrastructure is located outside of the 5% AEP and 1% AEP flood extents. Due to the shallow flow paths through the Project Area, the PMF flood extent is however much broader, and encroaches on more infrastructure items. A summary of existing peak flood depths and velocities recorded at and around proposed infrastructure locations shown in Figure 5.1 are included in Table 5.1 and Table 5.3. The flood depths and velocities for the different infrastructure items can be interpreted as follows:

- **BESS Stations** – The Project includes eight ‘blocks’ of BESS stations, comprising approximately 426 individual BESS units and 142 PCS stations. All BESS blocks are located entirely outside of the 5% AEP and 1% AEP baseline flood extents but lie within the PMF flood extent. Developed case modelling indicates minor increases in inundation, of less than 0.1 m, around the BESS blocks. These increases are likely attributed to grid interpolation effects associated with artificial terrain modification around the BESS stations and altered upstream flows from the customer substation. The model accounts for upstream flows to drain between the BESS blocks, via the internal roads. Stormwater management measure will be further refined during detailed design to mitigate the impacts in the 5% AEP and 1% AEP events.
- **Customer Substation** – The customer substation is located partially within the existing flood extents for all modelled events. As a result, the developed case modelling artificially raised the customer substation to above the 1% AEP flood level plus a nominal freeboard amount. Flows in the developed case model are therefore diverted around the substation, resulting in flood level increases both upstream and downstream of the substation area. Downstream increases in flood depths are relatively minor both within the Project Area (up to 0.18 m in the 1% AEP) and outside the Project Area (up to 0.06 m in the 1% AEP). Upstream increases are greater, due to upstream flows ponding against the raised substation, with changes of up to 0.51 m in the 1% AEP and 0.99 mm in the PMF. These areas of inundation and increased flood depths will be mitigated during the detailed Project design stage through the implementation of diversion drains and scour protection measures to manage flows around the customer substation.

The highest flood velocities around the customer substation occur along the western edge due to a natural flow path. Peak velocities of up to 1.5 m/s, 1.7 m/s and 3.5 m/s are expected in the 5% AEP, 1% AEP and PMF events respectively. Suitable erosion controls and flow management around the customer substation will minimise impacts associated with have this infrastructure within the flood extents. Similarly, increases in flood velocities of up to 0.5 m/s in the 5% AEP and 1% AEP and approximate 1.1 m/s in the PMF are observed outside of the Project Area adjacent to the customer substation. Suitable erosion controls and flow management will ensure these are minimised.

- **Transgrid Substation** – The Transgrid substation is located outside of the 5% AEP and 1% AEP flood extents, and partially within the baseline PMF flood extent. Inundation in the area during the PMF is due to top of catchment flows. It is proposed to level out and raise the substation area, which with suitable erosion controls and flow management (e.g. diversion drains and bunds) will minimise exposure in the PMF. This is demonstrated in the developed case modelling which results in only minor downstream impacts, with flood depth increases less than approximately 0.03 m.
- **Parking and Laydown** – The proposed parking and laydown area is outside of the 5% AEP and 1% AEP flood extents. Flood depths of up to 0.10 m are recorded in the PMF under both existing and proposed conditions.

- **Access Roads** – Proposed access roads were accounted for in the developed case modelling by adjusting the Manning’s ‘n’ values to a more impervious material type. Generally, this has negligible impact on the flood depth afflux, however, may result in an increase in velocity along the proposed roads, compared to the existing grassy landscape. The changes in velocity are generally less than a 0.3 m/s increase in the 5% AEP and 1% AEP events, and less than 1.0 m/s in the PMF. Risk of scouring and erosion at these locations will be mitigated through selection appropriate scour protection during the detailed design phase of the Project.
- **Workers Accommodation Camp** – The proposed worker accommodation camp area is mostly outside of the 5% AEP and 1% AEP flood extents, with flood depths of less than 0.10 m recorded in localised areas (Figure 5.2). Flood depths of up to about 0.20 m are recorded in the PMF within the southwest corner of the camp (Figure 5.3). As the camp is a temporary feature, to be in place for construction only, it was not assessed as part of the developed case modelling.

**TABLE 5.1: PEAK FLOOD DEPTH FOR PROPOSED PROJECT INFRASTRUCTURE**

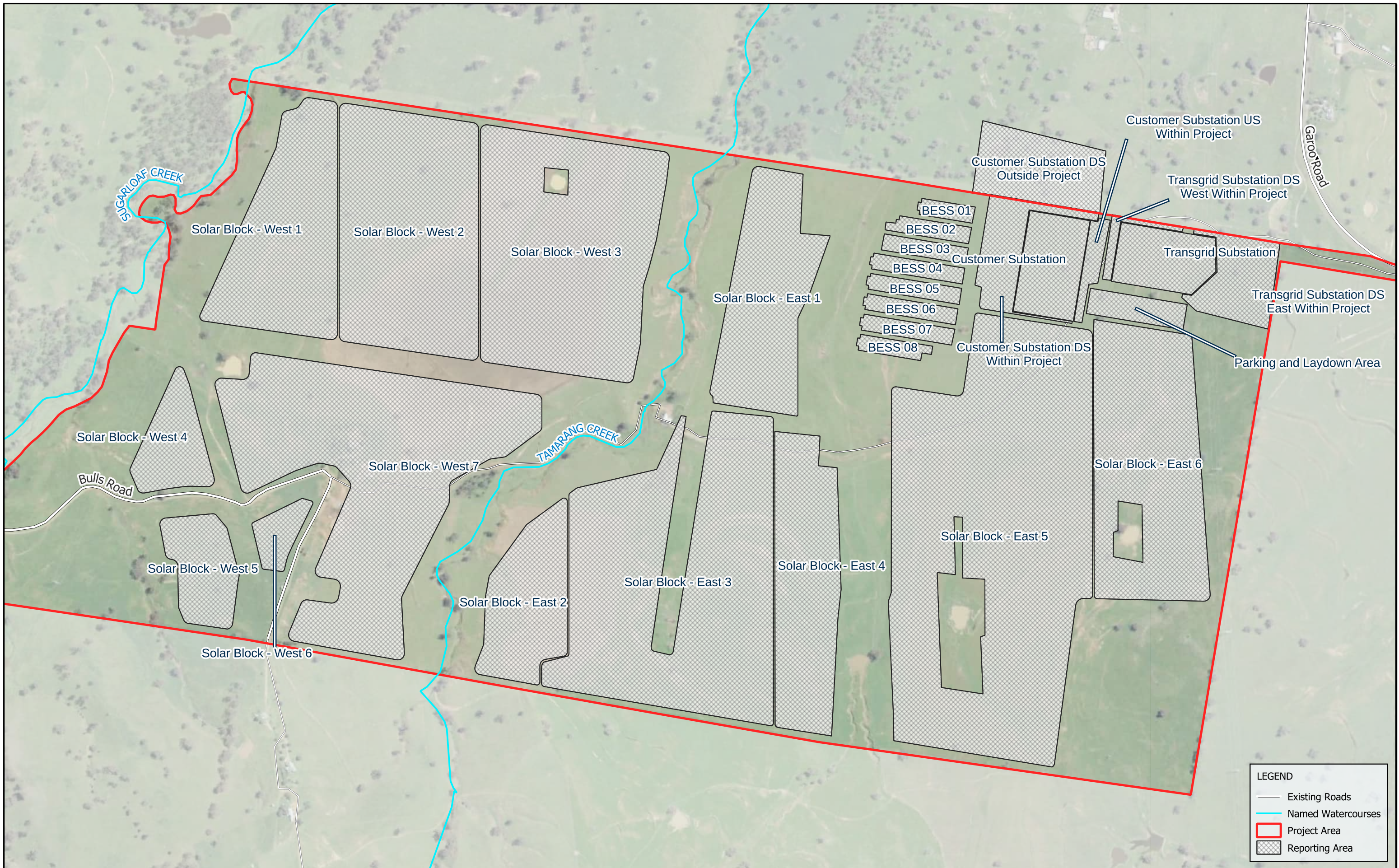
Location / Description	Peak Developed Flood Depth (m)			Change in Peak Flood Depth from Baseline (m)		
	5% AEP	1% AEP	PMF	5% AEP	1% AEP	PMF
BESS_01	Outside of Flood Extent	Outside of Flood Extent	0.08	Outside of Flood Extent	Outside of Flood Extent	0.03
BESS_02	Outside of Flood Extent	Outside of Flood Extent	0.11	Outside of Flood Extent	Outside of Flood Extent	0.05
BESS_03	Outside of Flood Extent	0.05	0.11	Outside of Flood Extent	0.05	0.05
BESS_04	0.06	0.07	0.11	0.06	0.07	0.03
BESS_05	Outside of Flood Extent	0.05	0.15	Outside of Flood Extent	0.05	0.09
BESS_06	Outside of Flood Extent	0.05	0.10	Outside of Flood Extent	0.05	0.03
BESS_07	0.08	0.08	0.15	0.08	0.08	0.07
BESS_08	Outside of Flood Extent	0.05	0.16	Outside of Flood Extent	0.05	0.03
Customer Substation	0.25	0.28	0.55	0.08	0.09	0.48
Customer Substation DS Outside Project	1.49	1.58	2.47	0.05	0.06	0.21
Customer Substation DS Within Project	0.37	0.43	1.07	0.11	0.18	0.57
Customer Substation US Within Project	0.45	0.51	1.07	0.45	0.51	0.99
Transgrid Substation	Outside of Flood Extent	Outside of Flood Extent	0.07	Outside of Flood Extent	Outside of Flood Extent	0.01
Transgrid Substation DS East Within Project	0.06	0.08	0.23	0.00	0.00	0.02
Transgrid Substation DS West Within Project	Outside of Flood Extent	Outside of Flood Extent	0.09	Outside of Flood Extent	Outside of Flood Extent	0.03

Location / Description	Peak Developed Flood Depth (m)			Change in Peak Flood Depth from Baseline (m)		
	5% AEP	1% AEP	PMF	5% AEP	1% AEP	PMF
Parking and Laydown Area	Outside of Flood Extent	Outside of Flood Extent	0.10	Outside of Flood Extent	Outside of Flood Extent	0.00
Solar Block East 1	0.44	0.56	1.69	0.06	0.08	0.24
Solar Block East 2	0.27	0.30	0.64	0.00	0.01	0.02
Solar Block East 3	0.76	0.94	2.21	0.02	0.05	0.52
Solar Block East 4	0.92	1.03	1.73	0.01	0.02	0.03
Solar Block East 5	0.47	0.56	1.23	0.05	0.05	0.35
Solar Block East 6	0.16	0.22	0.52	0.00	0.01	0.06
Solar Block West 1	0.25	0.30	0.64	0.01	0.01	0.10
Solar Block West 2	0.23	0.27	0.57	0.01	0.01	0.04
Solar Block West 3	0.24	0.26	0.62	0.02	0.02	0.08
Solar Block West 4	0.16	0.19	0.67	0.01	0.01	0.02
Solar Block West 5	0.06	0.07	0.29	0.00	0.00	0.04
Solar Block West 6	Outside of Flood Extent	Outside of Flood Extent	0.12	Outside of Flood Extent	Outside of Flood Extent	0.01
Solar Block West 7	0.36	0.48	1.44	0.02	0.02	0.06

**TABLE 5.2: PEAK FLOOD VELOCITY FOR PROPOSED PROJECT INFRASTRUCTURE**

Location / Description	Peak Developed Flood Velocity (m/s)			Change in Peak Flood Velocity from Baseline (m/s)		
	5% AEP	1% AEP	PMF	5% AEP	1% AEP	PMF
BESS_01	Outside of Flood Extent	Outside of Flood Extent	0.72	Outside of Flood Extent	Outside of Flood Extent	0.16
BESS_02	Outside of Flood Extent	Outside of Flood Extent	1.07	Outside of Flood Extent	Outside of Flood Extent	0.13
BESS_03	Outside of Flood Extent	0.38	0.84	Outside of Flood Extent	0.38	-0.05
BESS_04	0.32	0.19	0.68	0.32	0.19	-0.23
BESS_05	Outside of Flood Extent	0.50	1.34	Outside of Flood Extent	0.50	0.46
BESS_06	Outside of Flood Extent	0.54	0.83	Outside of Flood Extent	0.54	-0.60
BESS_07	0.29	0.31	0.95	0.29	0.31	-0.14

Location / Description	Peak Developed Flood Velocity (m/s)			Change in Peak Flood Velocity from Baseline (m/s)		
	5% AEP	1% AEP	PMF	5% AEP	1% AEP	PMF
BESS_08	Outside of Flood Extent	0.42	0.93	Outside of Flood Extent	0.42	-0.56
Customer Substation	1.37	1.59	3.23	0.45	0.46	0.92
Customer Substation DS Outside Project	1.98	2.20	4.07	0.49	0.46	1.12
Customer Substation DS Within Project	1.46	1.68	3.45	0.73	0.82	1.68
Customer Substation US Within Project	1.06	1.12	2.10	1.06	1.12	0.47
Transgrid Substation	Outside of Flood Extent	Outside of Flood Extent	2.06	Outside of Flood Extent	Outside of Flood Extent	0.80
Transgrid Substation DS East Within Project	0.89	1.03	2.18	0.02	0.19	0.56
Transgrid Substation DS West Within Project	Outside of Flood Extent	Outside of Flood Extent	1.14	Outside of Flood Extent	Outside of Flood Extent	0.17
Parking and Laydown Area	Outside of Flood Extent	Outside of Flood Extent	1.90	Outside of Flood Extent	Outside of Flood Extent	0.60
Solar Block East 1	2.06	2.48	4.62	0.31	0.41	0.98
Solar Block East 2	1.32	1.42	2.64	0.16	0.14	0.06
Solar Block East 3	2.36	2.65	6.54	0.52	0.56	1.50
Solar Block East 4	1.78	2.03	4.50	0.03	0.07	0.17
Solar Block East 5	1.91	2.19	3.70	0.24	0.25	0.35
Solar Block East 6	0.85	1.06	2.89	0.02	0.04	0.27
Solar Block West 1	1.73	1.99	4.50	0.22	0.25	0.52
Solar Block West 2	1.05	1.18	2.74	0.09	0.11	0.41
Solar Block West 3	1.47	1.69	3.33	0.13	0.11	0.25
Solar Block West 4	1.46	1.64	3.39	0.14	0.18	0.29
Solar Block West 5	1.33	1.51	2.94	0.08	0.08	0.35
Solar Block West 6	Outside of Flood Extent	Outside of Flood Extent	2.07	Outside of Flood Extent	Outside of Flood Extent	0.05
Solar Block West 7	2.11	2.47	4.84	0.18	0.24	0.48



**LEGEND**

- Existing Roads
- Named Watercourses
- Project Area
- Reporting Area

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NOTES:

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0      0.2      0.4 km

SCALE @ A3 - 1:8,000  
GDA 2020 / MGA Zone 56

**DISCLAIMER**  
Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.  
DATA SOURCE  
Google Maps



Garoo Solar Farm & BESS

Figure 5.1: Flood Depth and Velocity Reporting Areas

Drg Ref. BNTL00206\_0019-FIG-018



FIGURE 5.2: 1% AEP BASELINE FLOOD DEPTH AT WORKERS ACCOMMODATION CAMP

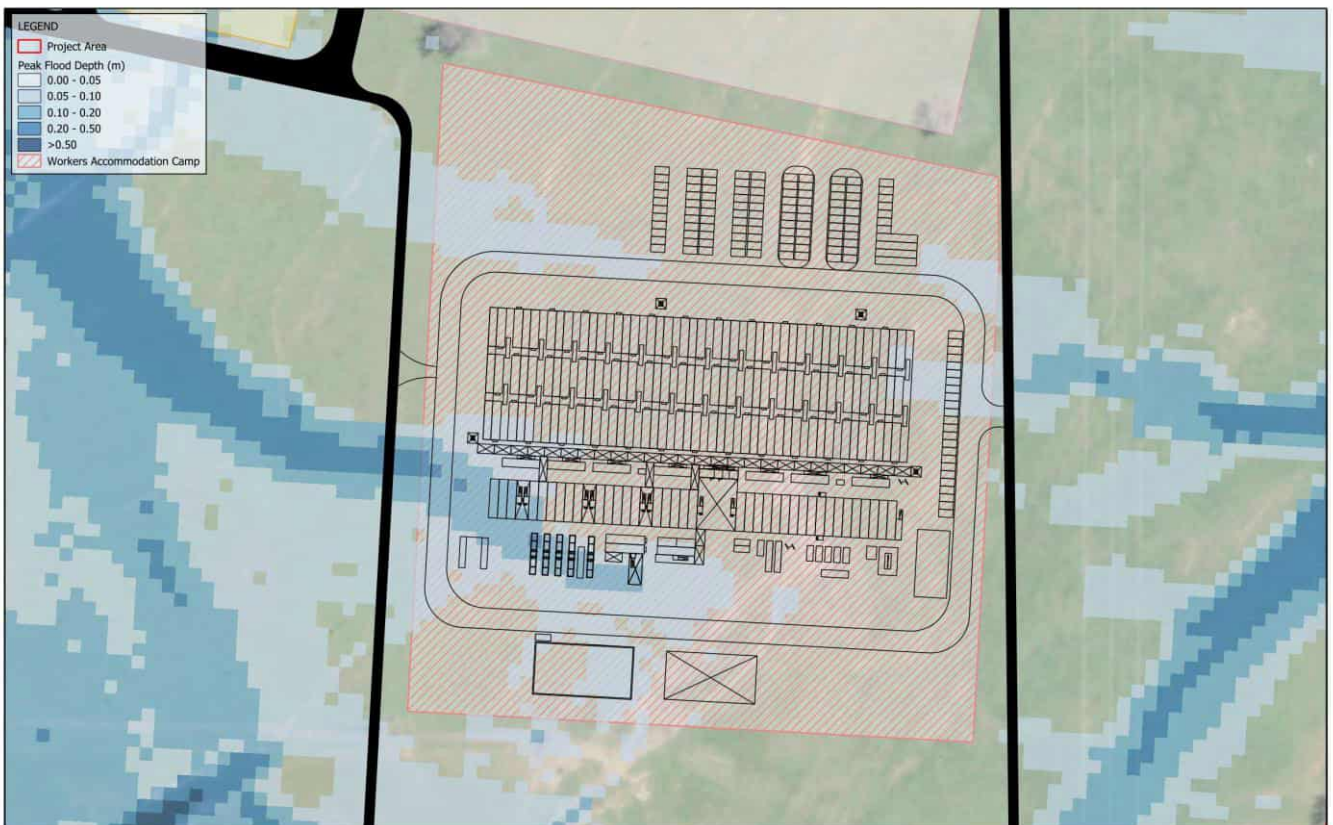


FIGURE 5.3: PMF BASELINE FLOOD DEPTH AT WORKERS ACCOMMODATION CAMP

### 5.1.3.3 Tamarang Creek

Tamarang Creek flows through the centre of the Project Area, with infrastructure proposed outside of the main channel area. In the 5% AEP and 1% AEP developed scenarios, impacts to flood depths and velocities within Tamarang Creek are minor, with only localised increases in flood depth and velocity (generally less than 0.05 m and 0.15 m/s respectively). Additionally, no significant changes flood extent is observed in these events.

During the PMF, however, modelling indicates more significant impacts, particularly to flood depth around the proposed bridge crossing, due to its placement within the PMF flood extent. The bridge and associated western abutment create localised blockage of both Tamarang Creek flows through the crossing and adjacent overland flows. This results in prolonged ponding of water against the upstream side of the bridge, resulting in increases in flood depth exceeding 1.0 m in the PMF.

Negligible downstream impacts are observed in the 5% AEP and 1% AEP flood events, however flood depths within the downstream Tamarang Creek channel are expected to increase during the PMF. These increases in flood depth are approximately 1.50 m directly downstream of the bridge and remain elevated by levels of ~0.02 m to the downstream model boundary. The increased flood depth is likely due to rerouting of overland flows captured behind the bridge crossing, into Tamarang Creek. It is noted that the blockage assumptions adopted for the bridge deck and railings are conservative (refer to Table 4.1), which may result in greater predicted afflux during the PMF than would be expected. The impacts surrounding during the PMF are expected to be mitigated during detailed bridge design to ensure it does not significantly obstruct the floodplain and maintain overall flow behaviour through Tamarang Creek.

Flows through Tamarang Creek, downstream of the Project Area, are not expected to change significantly with the proposed Project, as shown in Figure 5.4. As above, the greatest increase due to the Project is in the PMF where peak flows increase by approximately 5.2 m<sup>3</sup>/s (from 258.8 m<sup>3</sup>/s to 291.1 m<sup>3</sup>/s).

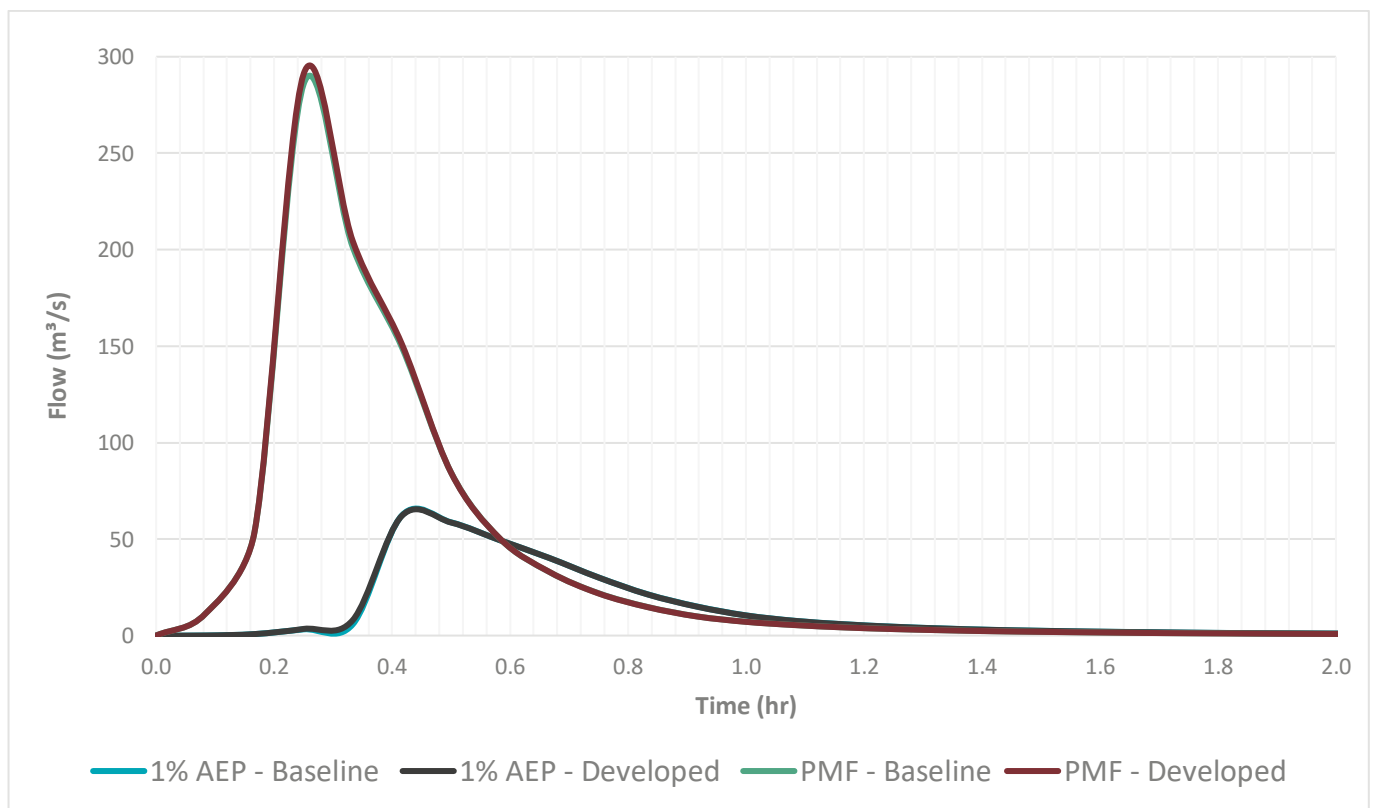


FIGURE 5.4: TAMARANG CREEK FLOWS DOWNSTREAM OF THE PROJECT

## 5.2 Water Quality

Several components of the Project introduce potential for impacts to the quality of surrounding surface water. The activities and potential impacts are summarised in Table 5.3 and discussed in further detail in subsequent sections. Potential mitigation measures are discussed in further detail in Section 8.

**TABLE 5.3: SURFACE WATER QUALITY IMPACTS**

Project Phase	Project Component	Activity	Risk / Impact	Mitigation Measure Overview
Construction	<ul style="list-style-type: none"> <li>Solar Panel Installation.</li> </ul>	<ul style="list-style-type: none"> <li>Ground disturbance.</li> <li>Vehicle movement.</li> </ul>	<ul style="list-style-type: none"> <li>Soil erosion and sedimentation of downstream watercourses and crops.</li> <li>Spill of hydrocarbons or other pollutants used to support transportation and installation activities.</li> </ul>	<ul style="list-style-type: none"> <li>Erosion and Sediment Control Plan (ESCP).</li> <li>Construction Environmental Management Plan (CEMP).</li> </ul>
	<ul style="list-style-type: none"> <li>Establishment of temporary parking and laydown area.</li> <li>Construction of permanent ancillary infrastructure (Substations, BESS).</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation clearing &amp; ground disturbance.</li> <li>Earthworks.</li> <li>Concrete works.</li> <li>Vehicle movement.</li> <li>Soil stockpiling.</li> </ul>	<ul style="list-style-type: none"> <li>Soil erosion and sedimentation of downstream watercourses and crops.</li> <li>Spill of hydrocarbons or other pollutants used to support transportation and construction activities.</li> <li>Release of stockpiled materials or concrete by-products (dust, slurry, water) into downstream watercourses and crops.</li> </ul>	<ul style="list-style-type: none"> <li>Erosion and Sediment Control Plan (ESCP).</li> <li>Construction Environmental Management Plan (CEMP).</li> </ul>
	<ul style="list-style-type: none"> <li>Construction / establishment of access tracks.</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation clearing &amp; ground disturbance.</li> <li>Earthworks.</li> <li>Vehicle movement.</li> </ul>	<ul style="list-style-type: none"> <li>Soil erosion and sedimentation of downstream watercourses and crops.</li> <li>Spill of hydrocarbons or other pollutants used to support transportation and construction activities.</li> </ul>	<ul style="list-style-type: none"> <li>Erosion and Sediment Control Plan (ESCP).</li> <li>Construction Environmental Management Plan (CEMP).</li> </ul>
	<ul style="list-style-type: none"> <li>Construction of access bridge.</li> </ul>	<ul style="list-style-type: none"> <li>Ground disturbance and earthworks within waterfront land.</li> <li>Concrete works.</li> <li>Vehicle Movement.</li> </ul>	<ul style="list-style-type: none"> <li>Soil erosion and sedimentation of downstream watercourse.</li> </ul>	<ul style="list-style-type: none"> <li>Erosion and Sediment Control Plan (ESCP).</li> <li>Construction Environmental Management Plan (CEMP).</li> </ul>

Project Phase	Project Component	Activity	Risk / Impact	Mitigation Measure Overview
	<ul style="list-style-type: none"> <li>Installation of electrical infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation clearing &amp; ground disturbance.</li> <li>Earthworks.</li> <li>Vehicle movement.</li> </ul>	<ul style="list-style-type: none"> <li>Soil erosion and sedimentation of downstream watercourses and crops.</li> <li>Spill of hydrocarbons or other pollutants used to support transportation and construction activities.</li> </ul>	<ul style="list-style-type: none"> <li>Erosion and Sediment Control Plan (ESCP).</li> <li>Construction Environmental Management Plan (CEMP).</li> </ul>
	<ul style="list-style-type: none"> <li>Site workers.</li> </ul>	<ul style="list-style-type: none"> <li>Wastewater from site amenities.</li> </ul>	<ul style="list-style-type: none"> <li>Discharge / spill of wastewater (treated or untreated) into downstream watercourses and crops.</li> </ul>	<ul style="list-style-type: none"> <li>Appropriately designed and maintained wastewater management system.</li> </ul>
Operation	<ul style="list-style-type: none"> <li>Site workers.</li> </ul>	<ul style="list-style-type: none"> <li>Wastewater from site amenities.</li> </ul>	<ul style="list-style-type: none"> <li>Discharge / spill of wastewater (treated or untreated) into downstream watercourses and crops.</li> </ul>	<ul style="list-style-type: none"> <li>Appropriately designed and maintained wastewater management system.</li> </ul>
	<ul style="list-style-type: none"> <li>Use of access tracks.</li> </ul>	<ul style="list-style-type: none"> <li>Vehicle movement.</li> </ul>	<ul style="list-style-type: none"> <li>Soil erosion and sedimentation of downstream watercourses and crops.</li> <li>Spill of hydrocarbons or other pollutants used to support transportation and operation activities.</li> </ul>	<ul style="list-style-type: none"> <li>Erosion and Sediment Control Plan (ESCP).</li> <li>Construction Environmental Management Plan (CEMP).</li> </ul>
Decommissioning	<ul style="list-style-type: none"> <li>Solar Panel Removal.</li> </ul>	<ul style="list-style-type: none"> <li>Ground disturbance.</li> <li>Vehicle movement.</li> </ul>	<ul style="list-style-type: none"> <li>Soil erosion and sedimentation of downstream watercourses and crops.</li> <li>Spill of hydrocarbons or other pollutants used to support transportation and decommissioning activities.</li> </ul>	<ul style="list-style-type: none"> <li>Erosion and Sediment Control Plan (ESCP).</li> <li>Construction Environmental Management Plan (CEMP).</li> </ul>
	<ul style="list-style-type: none"> <li>Removal of BESS and ancillary infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>Ground disturbance.</li> <li>Vehicle movement.</li> </ul>	<ul style="list-style-type: none"> <li>Soil erosion and sedimentation of downstream watercourses and crops.</li> <li>Spill of hydrocarbons or other pollutants used to support transportation and decommissioning activities.</li> </ul>	<ul style="list-style-type: none"> <li>Erosion and Sediment Control Plan (ESCP).</li> <li>Construction Environmental Management Plan (CEMP).</li> </ul>

There are several minor and non-minor watercourses within the Project Area with direct hydrological connections to downstream watercourses, ultimately discharging into the Namoi River. Sugarloaf Creek is a perennial creek flowing along the western boundary of the Project Area. The perennial nature of this watercourse (typically have water flowing all year round) increases the potential risk of downstream water quality impacts. However, interrogation of historical aerial imagery indicates that base flows through these watercourses are typically low, except during rainfall events.

With the mitigation measures tabulated in Table 5.3, it is therefore considered that the risk of significant downstream surface water quality impacts is low. However, the implementation of strict management and monitoring programs, detailed in the proposed ESCP and CEMP, will be critical to ensure downstream impacts are suitably mitigated and effectively managed.

### 5.2.1 Construction

During the Project construction phase, potential risks to surface water quality are higher due to greater amounts of ground disturbance and earthworks, vehicle movement, concrete works, and stockpiling, require management. As outlined in Table 5.3, the key risks include:

- Soil erosion and sedimentation of downstream watercourses and crops.
- Spill of hydrocarbons or other pollutants used to support transportation and installation activities.
- Release of concrete by-products (dust, slurry, water) into downstream watercourses and crops.
- Discharge/spill of wastewater (treated or untreated) into downstream watercourses and crops.

If sediments are exposed to the surrounding environment, they can degrade water quality, affect aquatic habitats, and harm crops through siltation. The impacts and mitigation strategies for the mobilisation and release of sediments during construction activities is further discussed in Section 5.3.

Surface water contamination resulting from a spill of hydrocarbons or other chemical pollutants, including concrete by-products, can be toxic to aquatic life, contaminate downstream watercourses and have long-term ecological impacts. Spills and contamination may also affect surrounding vegetation and soil, resulting in contamination of shallow groundwater pockets within and surrounding the Project Area, potentially harming crops that rely on water from affected sources. Best practice spill management controls can adequately minimise the potential contamination impacts.

Similarly, the discharge or spill of wastewater, whether treated or untreated, into downstream watercourses presents a risk to surface water quality. Untreated wastewater may contain pollutants harmful to aquatic life, while even treated effluent and residual solids can also contain residual chemicals that can impact the environment. These impacts can be significantly reduced through design, location and implementation of a suitable wastewater management system.

If unmanaged, the overall effect of the above risks could cause detrimental impacts on the ecological balance of watercourses. However, considering the limited connectivity of the Project to adjacent watercourses and through adopting best practice approaches and proposed mitigation measures (Section 8), these impacts are considered negligible. Such mitigation measures include the development of a construction erosion and sediment control plan (CESCP), suitable placement and controls for sediment stockpiles and hydrocarbon storage.

### 5.2.2 Operation

As outlined in Table 5.3, potential surface water quality impacts associated with the Project operation phase include:

- Soil erosion and sedimentation of downstream watercourses and crops, associated with vehicle movement, scouring and poor site stabilisation.
- Spill of hydrocarbons or other pollutants used to support transportation and operation of substations.
- Discharge / spill of wastewater (treated or untreated) into downstream watercourses and crops.

Operation activities, as well as poor site stabilisation following construction may result in sediments being exposed to the surrounding environment. As discussed in Section 5.2.1, this can degrade water quality, affect aquatic habitats, and harm crops through siltation. The impacts of the mobilisation and release of sediments during operation activities is further discussed in Section 5.3.

Surface water contamination resulting from a spill of hydrocarbons and wastewater would be managed through the same processes used during construction (refer to Section 8) and are considered negligible with these management measures in place.

### 5.2.3 Decommissioning

The equipment and process required for Project decommissioning would be similar to the construction phase and therefore result in similar risks to surface water quality due to ground disturbance, vehicle movement, and vegetation management. As outlined in Table 5.3, risks associated with decommissioning and rehabilitation are summarised below:

- Soil erosion and sedimentation of downstream watercourses and crops.
- Spill of hydrocarbons or other pollutants used to support transportation and decommissioning activities.
- Release of tannins to downstream watercourses and crops (considered a low risk in context of the vegetation types).

Water quality mitigation and management measures required during the construction phase would be informed by the practices used during construction and are further discussed in Section 8. With the proposed management measures in place, overall water quality impacts during decommissioning are expected to be negligible.

## 5.3 Erosion and Sedimentation

### 5.3.1 Construction

Project construction would require up to 306 ha of land disturbance for the installation of the solar arrays and establishment of site facilities and access tracks. Construction activities involving ground disturbance, earthworks and transporting and stockpiling soil introduce pathways for soils erosion and, in turn, potential movement of sedimentation into downstream water systems.

Impacts associated with the mobilisation of soil include:

- Degradation of the quality of downstream domestic and stock drinking water.
- Increased turbidity and reduced visual clarity of downstream watercourses, impacting aquatic ecosystem health (changes to natural reflectance of water, smothering aquatic life and clogging fish gills).
- Increased sediment build up in downstream watercourses and waterbodies, changing the geomorphology and disturbing natural flow regimes.
- Increased levels of dissolved metals and nutrients become mobilised with the soil, entering watercourses and waterbodies. This can be a threat if high concentrations of undesirable metals and nutrients reach water supplies for aquatic life or domestic, irrigation and livestock users.

Project construction would require area specific erosion and sediment control plans (ESCP) to be developed in accordance with *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004), *Volume 2A Installation of services* (DECC, 2008), *Volume 2C Unsealed roads* (DECC, 2008), *Volume 2D Main road construction* (DECC, 2008) and *Best Practice Erosion and Sediment Control* (IECA, 2008).

### 5.3.2 Operation and Decommissioning

Poor site stabilisation during and following construction will lead to impacts associated with the mobilisation of soil, as described in Section 5.3.1. This can be effectively managed through development of an ESCP and ongoing inspections and maintenance, in accordance with *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004), *Volume 2A, 2C and 2D* (DECC, 2008).

# 6. GROUNDWATER IMPACT ASSESSMENT

## 6.1 Groundwater Quality

Potential impacts to groundwater quality during construction and operation activities may result from spill of wastewater, hydrocarbons or other pollutants used to support transportation and site activities. The potential water quality impacts associated with these activities were summarised in Table 5.3. The risk of these spills impacting groundwater quality is considered relatively low due to the depth between the surface and groundwater table, and standard management practices that will be put in place (refer to Section 8).

## 6.2 Groundwater Levels and Flow Direction

As identified in Section 2.4, the existing groundwater table within the vicinity of the Project Area is around 3.6 m BGL to 20.4 m BGL which is well below the depth required for infrastructure footings and underground cables. Construction activities are therefore not anticipated to interact with the underlying groundwater table.

## 6.3 Groundwater Take and Users

The Project does not propose to extract groundwater via existing or new bores and no additional licences will be required. Additionally, the Project is not predicted to intercept the groundwater table. Therefore, no impacts to existing groundwater users are expected. Although unlikely, if use of existing groundwater bores is deemed necessary to support construction, the Applicant will obtain applicable WALs, works approvals and water use approvals prior to any water extraction taking place. The requirement for such activities will be determined during the detailed design stage of the Project.

## 6.4 Groundwater Dependent Ecosystems

As discussed in 2.6.2, the potential GDEs identified surrounding the Project Area are likely dependent on local groundwater pockets recharged by rainfall and runoff, as well as the regional groundwater table. As the Project does not propose to intercept the regional groundwater table, or extract groundwater, any impacts to shallow groundwater pockets would be localised to the Project Area and not impact surrounding GDEs.

# 7. CUMULATIVE IMPACTS

In accordance with the *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE, 2022), cumulative impacts are a result of incremental, sustained and combined effects of human action and natural variations over time and can be both positive and negative. The accumulation of effects from past, current and future activities can result in cumulative impacts on surface and groundwater resources. When considered in isolation, impacts from specific projects may be considered minor or negligible, however, when multiple projects influence common receivers, the cumulative impact may be more significant.

## 7.1 Relevant Projects

A total of seven known approved and proposed energy SSD projects were identified as being located within the vicinity of the Project Area (~50 km radius). These include the following solar, wind and energy storage and supply projects<sup>2</sup>:

- Middlebrook Wind Farm (Approved SSD-10455) – ~15 km north-east of the Project.
- Lambruk Solar Farm (Proposed SSD- 67436209) – ~20 km north of the Project.
- Nottingham Park Solar Farm (Proposed SSD-58886962) – ~45 km northwest of the Project.
- Hills of Gold Wind Farm (Approved SSD-9679) – ~25 km southeast of the Project.
- Kingswood BESS (Proposed SSD-63207219) – ~30 km north of the Project.
- Calala BESS (Approved SSD-52786213) – ~35 km north of the Project.
- Tamworth BESS (Proposed SSD-23830229) – ~30 km north of the Project.

## 7.2 Potential Cumulative Impacts

The potential for cumulative impacts from the Project and adjacent known projects has been considered as presented in Table 7.1.

The key common surface water receptor which was considered in the cumulative impact assessment includes the Peel River, which is connected to the Project Area by Goonoo Goonoo Creek. Goonoo Goonoo Creek is fed by Tamarang Creek and Sugarloaf Creek, which flow directly through and adjacent to the Project Area (Figure 2.2). No direct interactions with the Peel River and the Project are expected and adopting appropriate mitigation and management will prevent indirect impacts, such as erosion and sedimentation, to the other surface water receptors. Therefore, cumulative impacts to surface water quality and flow are considered negligible.

**TABLE 7.1: IDENTIFICATION OF CUMULATIVE IMPACTS**

Category of Impact	Potential Cumulative Impact
Flooding	<ul style="list-style-type: none"> <li>• Nearby projects may interact with the Peel River or its tributaries, however, none of which are directly connected to the Project Area via key watercourses and cumulative flooding impacts are considered negligible.</li> </ul>
Water Quality	<ul style="list-style-type: none"> <li>• The risk of pollution of common receiving waterways (the Peel River) from erosion and sedimentation or contaminant/wastewater spills during overlapping construction periods is considered negligible provided the recommended mitigation measures are implemented.</li> </ul>
Surface Water and Groundwater Supply	<ul style="list-style-type: none"> <li>• Construction water supply will be minimal and mostly trucked onto site. If additional supply is required, this will be in accordance with NSW licensing requirements and landholder rights, and therefore not contribute to cumulative impacts on surface water take.</li> <li>• Where rainwater is insufficient, potable water use will be supplemented with imported water. Overlapping project timelines may result in a cumulative impact to potable water supply, however, it is expected to be negligible in the context of the regional township water supply capacity.</li> <li>• Operational demands during operation will be limited to small amounts of potable water and expected to be negligible in the context of the regional township water supply capacity.</li> </ul>

<sup>2</sup> Proximity to the Project is estimated linear distance.

# 8. MITIGATION AND MANAGEMENT MEASURES

Detailed environmental studies have been undertaken to inform the Project design, including the surface water and groundwater assessments detailed in this WRIA. The consideration and outcomes of these studies in the design and integration with the approved operations minimise the potential for impacts on surface water resources.

The proposed mitigation measures for the Project are summarised in Table 8.1.

**TABLE 8.1: SUMMARY OF POTENTIAL IMPACTS AND MITIGATION AND MANAGEMENT MEASURES**

Potential Impacts	Mitigation Measure	Project Implementation Stage
<b>WATERCOURSE CHARACTERISTICS</b>		
Filling of streams for infrastructure / water crossings	Consider the following mitigation measures in the Project detailed design: <ul style="list-style-type: none"> <li>Limit water crossing to existing access tracks where possible.</li> <li>Arrange Project infrastructure such that stream disturbance and modifications (filling / diversions) are limited to minor watercourses.</li> </ul> In the event construction of waterway crossings is required, these will be designed, constructed and maintained to consider DPE <i>Guidelines for instream works on waterfront land</i> (DPE, 2022) and <i>Guidelines for riparian corridors on waterfront land</i> (DPE, 2022).	Detailed design
<b>FLOODING</b>		
Impacts to in-stream and overland flooding	Consider the following mitigation measures in the Project detailed design stage to minimise impacts to flooding possible: <ul style="list-style-type: none"> <li>Minimise filling of substation and BESS sites and on-site facilities.</li> <li>Minimise extent of Project infrastructure within the 1% AEP flood extent.</li> <li>Design to manage flood impacts and flow conveyance at watercourse crossings (if any).</li> <li>Underground transmission lines to minimise obstructions of flow paths.</li> </ul>	Detailed design
Impacts on the Project design due to predicted flooding	Optimisation of the Project design during detailed design to ensure: <ul style="list-style-type: none"> <li>A minimum of 300 mm freeboard is maintained between the 1% AEP flood level and proposed solar arrays.</li> <li>Permanent ancillary infrastructure (substations / BESS) raised above the 1% AEP flood level.</li> </ul>	Detailed design
Impacts to site personnel during a flood event	Floodplain management planning to determine site management protocols during flood events that could impact construction or access areas, including: <ul style="list-style-type: none"> <li>Suitable early warning and communication protocols.</li> <li>Triggers for closure, evacuation and recovery.</li> <li>Emergency response and support.</li> </ul>	Post Approval / Pre-construction

Potential Impacts	Mitigation Measure	Project Implementation Stage
Increased stormwater runoff from vegetation clearing and filling for infrastructure	<p>Increased stormwater runoff during operations (due to clearing of vegetation and filling for infrastructure) will be managed through development of erosion and sediment control plan (ESCP). The ESCP will consider:</p> <ul style="list-style-type: none"> <li>• Location of site infrastructure away from existing watercourses or areas subject to high levels of overland flow.</li> <li>• Diversion of upstream flows around site infrastructure as required, to minimise scouring and erosion.</li> <li>• Inspection and monitoring regimes to maintain stormwater and erosion and sediment control structures.</li> </ul>	Construction
<b>WATER QUALITY</b>		
Erosion and sedimentation of downstream watercourses	<p>Development of erosion and sediment control plans (ESCP) through all project phases, in accordance with <i>Managing Urban Stormwater: Soils and Construction – Volume 1</i> (Landcom, 2004), <i>Volume 2A Installation of services</i> (DECC, 2008), <i>Volume 2C Unsealed roads</i> (DECC, 2008), <i>Volume 2D Main road construction</i> (DECC, 2008) and <i>Best Practice Erosion and Sediment Control</i> (IECA, 2008).</p> <p>The ESCPs will detail area specific erosion and sediment control measures to be implemented and maintained during construction, as well as ongoing monitoring and maintenance through operation and decommissioning of additional controls if identified as required.</p> <p>The total area of disturbance at any time should be minimised where possible and ongoing rehabilitation and stabilisation strategies implemented throughout construction.</p>	Construction
Release of sediment or construction by-products	<p>During construction, the following management measures will be considered to minimise the potential for mobilisation of sediment or dust from topsoil stockpile:</p> <ul style="list-style-type: none"> <li>• Locate stockpiles away from drainage lines, or areas subject to high levels of overland sheet flow and minimise stockpile size.</li> <li>• Develop and implement area specific erosion and sediment control measures including bunding and diversion drains as required.</li> <li>• Use stockpile stabilisation techniques such as covering or dust suppression.</li> </ul>	Construction
Contaminant spills	<p>Prior to commencing construction activities, a Construction Environment Management Plan (CEMP) will be developed to identify site specific controls and procedures to minimise the potential for hydrocarbons and other contaminants being discharged into the environment. This CEMP should consider:</p> <ul style="list-style-type: none"> <li>• Storage of hydrocarbons and other liquid chemicals within an above ground, bunded areas away from watercourses or area subject to high levels of overland sheet flow.</li> <li>• Re-fuelling of construction vehicles and equipment to be limited to designated areas, with adequate spill management controls.</li> <li>• Maintain an emergency spill kit and relevant emergency spill response procedures.</li> <li>• Transport and dispose of any hydrocarbons captured during Project construction and operation of the substations and switchyards at a suitable off-site licenced facility.</li> </ul>	Construction, Operation

Potential Impacts	Mitigation Measure	Project Implementation Stage
Surface water and groundwater quality impacts	<p>The CEMP will consider the following management measures to minimise the potential impacts to surface water and groundwater quality within and surrounding the Project Area:</p> <ul style="list-style-type: none"> <li>• Develop and implement a suitable monitoring regime at sensitive downstream receivers, including visual inspections and routine monitoring of relevant physicochemical parameters.</li> <li>• Develop and implement a suitable monitoring regime of all stormwater and erosion and sediment control structures, particularly following large flow events.</li> </ul>	Construction, Decommissioning
<b>WATER SUPPLY</b>		
Water licences to meet demands	All required water licensing and approvals will be coordinated with associated landholders and/or regulators (e.g. Council, others) if that source is needed to support water supply arrangements for during construction and operation.	Post Approval (Construction, Operation)
<b>WASTEWATER MANAGEMENT</b>		
Discharge of wastewater or effluent from site	<p>Design and implement a wastewater treatment system that:</p> <ul style="list-style-type: none"> <li>• Is appropriately sized for the Project infrastructure and operations.</li> <li>• Collects and treats wastewater from site offices and temporary accommodation facilities for re-use on site to fulfill non-potable construction and operation demands.</li> <li>• Be designed and operated in accordance with best practices.</li> </ul>	Detailed design

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- (h) In preparing this document, including all relevant calculation and modelling, Engeny Australia Pty Ltd (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.
- (i) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.
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# APPENDIX A: WATER DEMAND ASSUMPTIONS



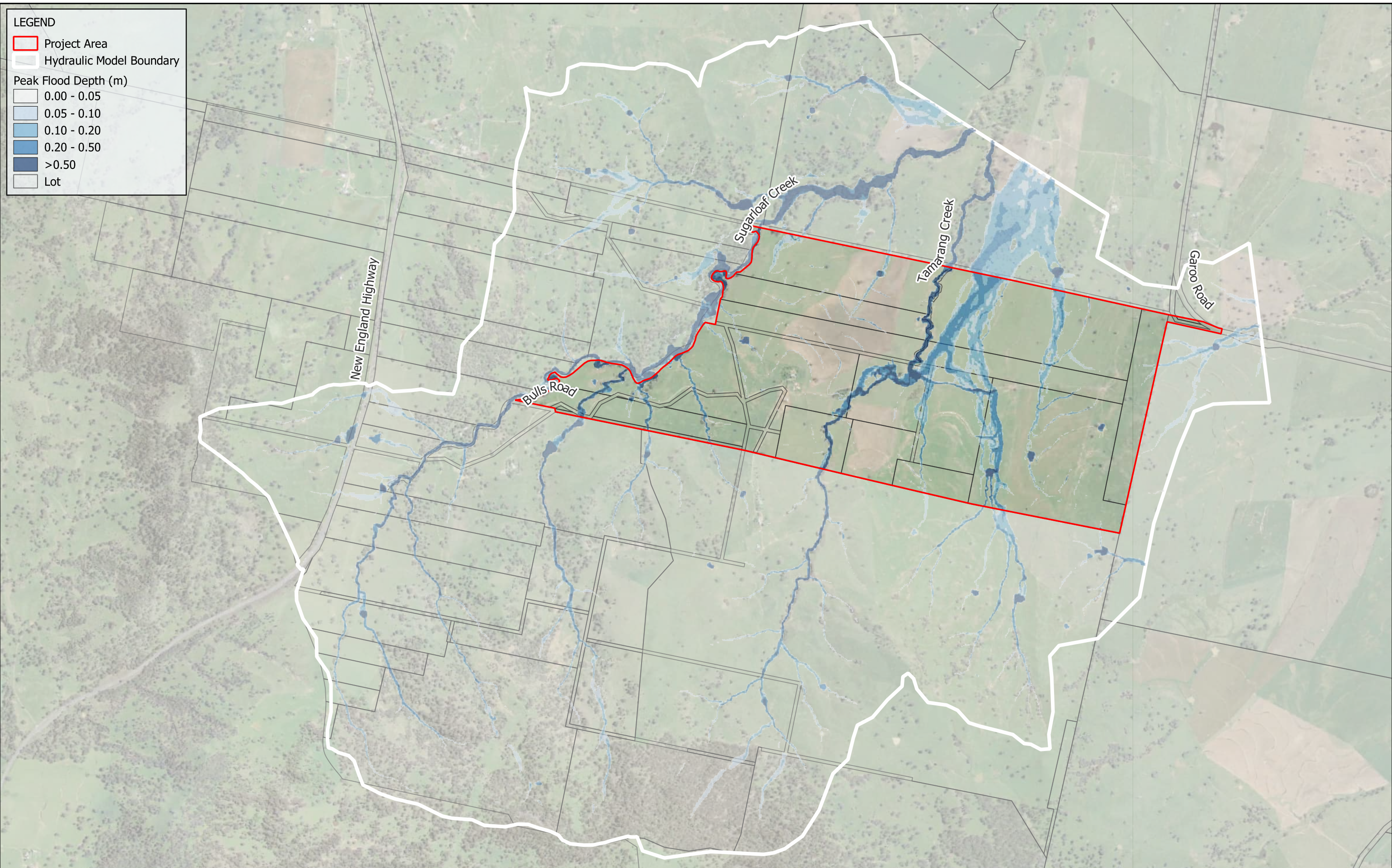
## Garoo Solar Farm and BESS Water Demand Calcs

 <b>ENGENY</b>					
Demand Type	Assumption Description	Assumption	Units	Total Demand (m3)	Total Demand (ML)
Dust Suppression - General	Spray depth per pass	0.3	mm		
Dust Suppression - Roadways	Total length of Proposed Roads	26.2	km	6,568	6.6
	Road width	4.5	m		
	Total road area	117,703	m <sup>2</sup>		
	Amount of roadway worked at any one time	10%	%		
	Active construction days (18 months, 6 days/week)	465	days		
	Number of passes per day on active work area	4	passes		
Road Construction / Compaction	Total length of road	26.2	km	14,313	14.3
	Road width	4.5	m		
	Total road area	117,703	m <sup>2</sup>		
	Water content added to condition initial rip	8%	%		
	Rip depth	500	mm		
	Dry Density	1,600	kg/m <sup>3</sup>		
	Total Weight for rip	94,162,598	kg		
	Water content added to condition fill	12%	%		
	Fill Depth	300	mm		
	Total Weight for fill	56,497,559	kg		
Compound Hardstands - Battery Energy Storage (BESS), PCS Station, Substations	Hardstand Area	91,620	m <sup>2</sup>	5,277	5.3
	Water content added to condition fill	12%	%		
	Fill Depth	300	mm		
	Dry Density	1,600	kg/m <sup>3</sup>		
	Total Weight for fill	43,977,700	kg		
Vehicle and Equipment Washdown	Active construction days (18 months, 6 days/week)	465	days	4,650	4.7
	Washdown demand	10,000	L/day		
Potable Water (Construction) - Peak Rate	Potable Demand - Day work	50	L/d/site worker	5,813	5.8
	Active construction days	465	days		
	Active workers	250	FTE		
Potable Water (Accommodation Camp) - Peak Rate	Potable Demand - Accommodation Camp	200	L/d/site worker	19,500	19.5
	Active construction days (15 months, 6 days/week)	390	days		
	Active workers	250	FTE		
<b>Total Construction Demand - Peak</b>				<b>56,120</b>	<b>56.1</b>
Potable Water - Operation	Potable Demand	50	L/d/site worker	130	0.1
	Days (1 year, 5 days/week)	261	days		
	Active workers	10	FTE		
<b>Annual Operational Demand</b>				<b>130</b>	<b>0.1 ML/yr</b>
					<b>0.5 kL/d</b>
Demand Type	Maximum Daily Rate (kL/d)				
Non-Potable (Road Construction & Dust Suppression)	66.3				
Potable	62.5				

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# APPENDIX B: EXISTING CONDITION FLOOD MODEL RESULTS





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0      0.4      0.8 km

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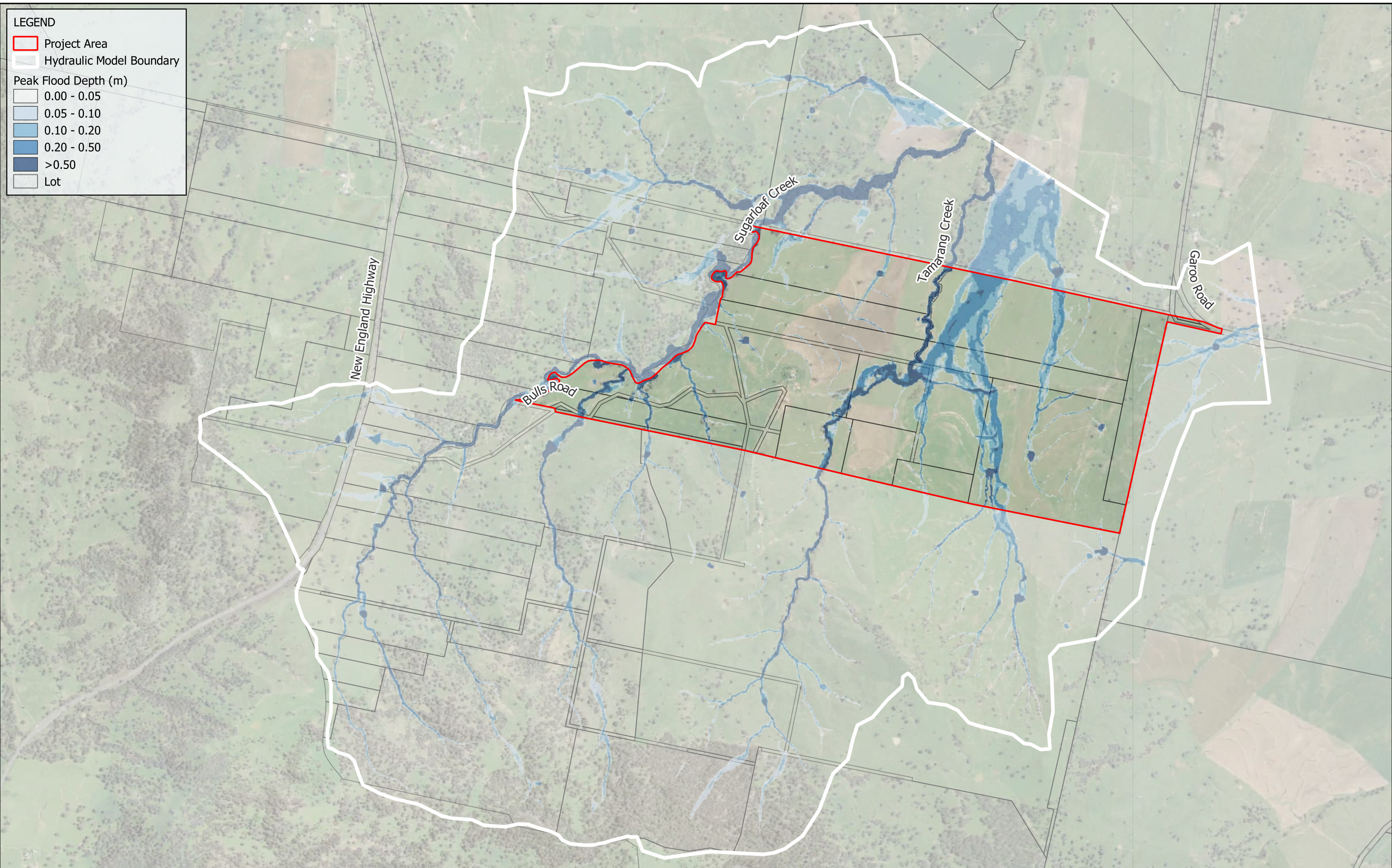
**DATA SOURCE**  
Google Maps



Garoo Solar Farm & BESS

Figure B1: Existing Conditions - 5% AEP Peak Flood Depth

Drg Ref. NTL00206\_0019-FIG-B1

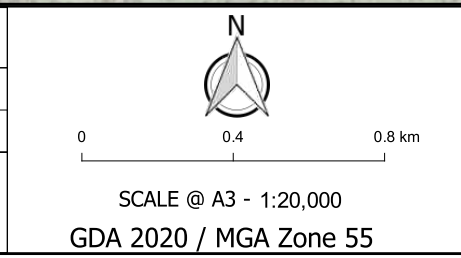


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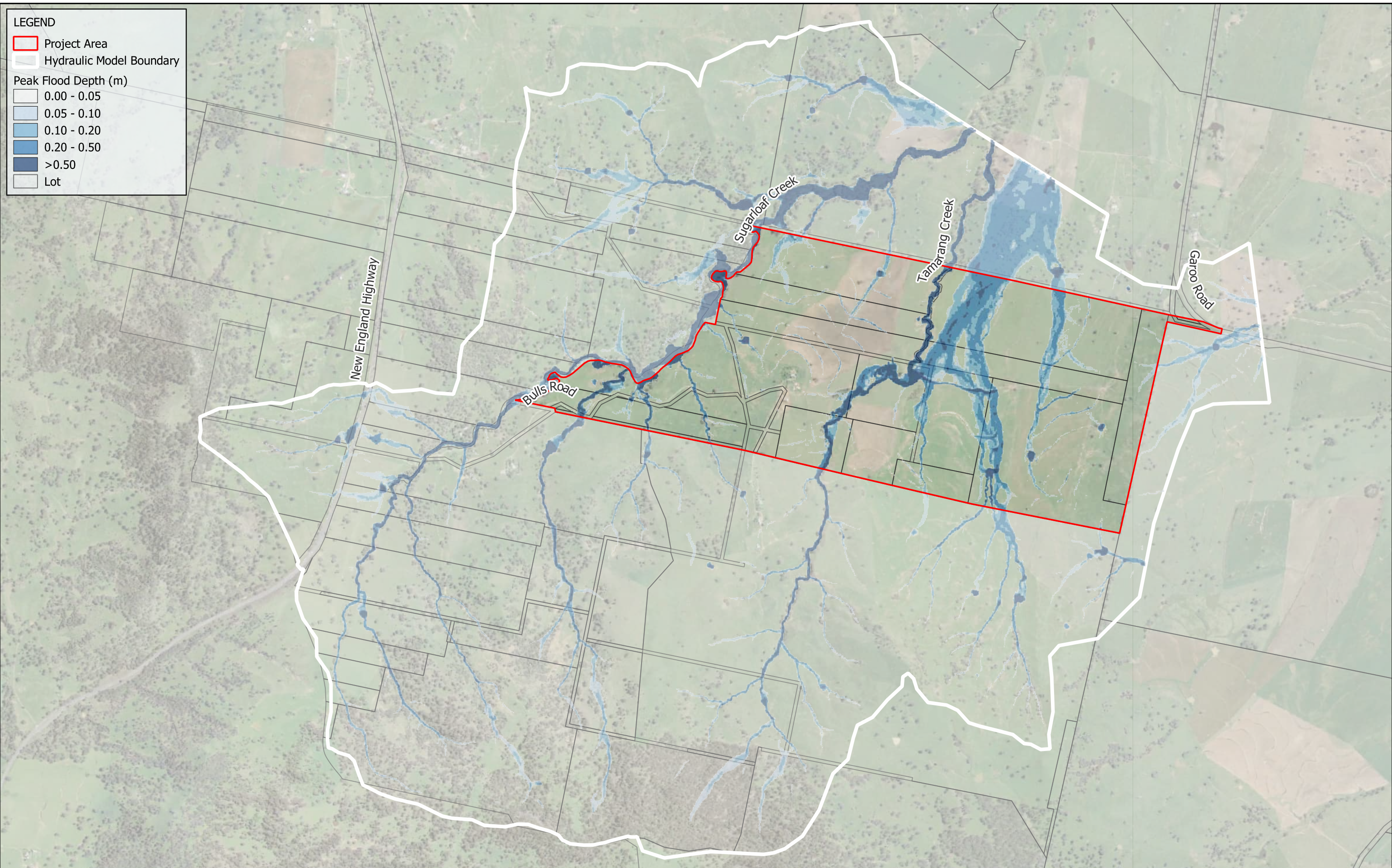
**DATA SOURCE**  
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Figure B2: Existing Conditions - 1% AEP Peak Flood Depth

Drg Ref. NTL00206\_0019-FIG-B2

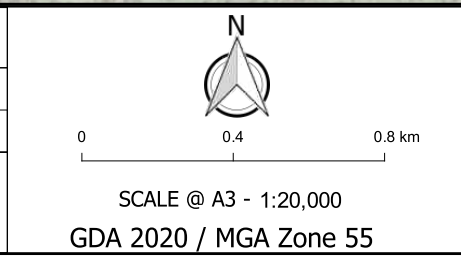


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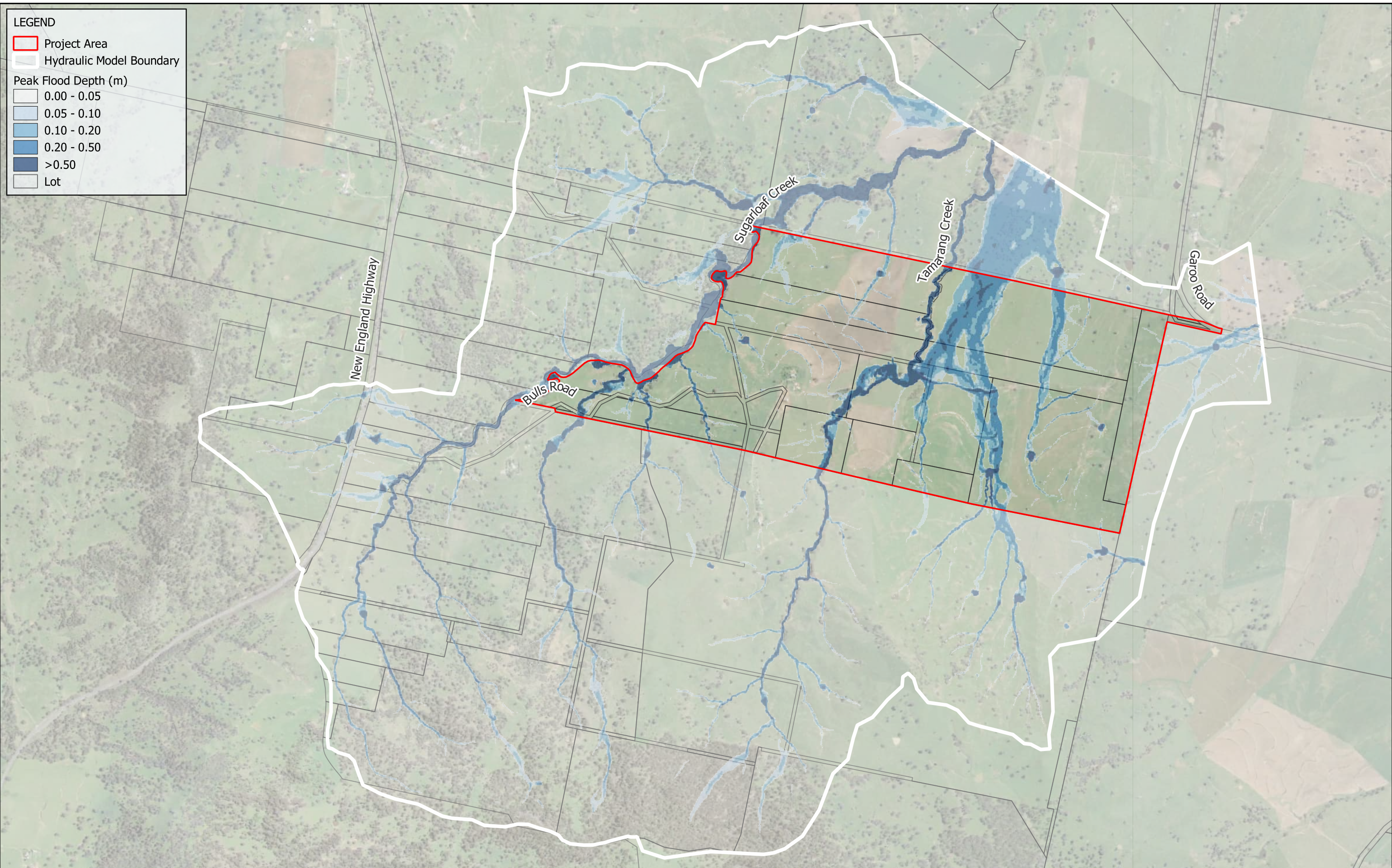
**DATA SOURCE**  
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Figure B3: Existing Conditions - 1% AEP Climate Change Sensitivity Peak Flood Depth

Drg Ref. NTL00206\_0019-FIG-B3

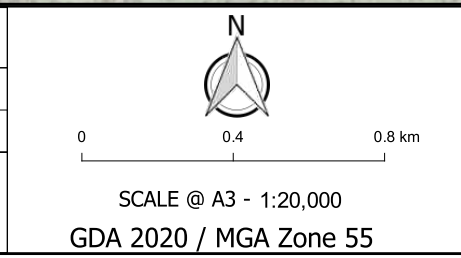


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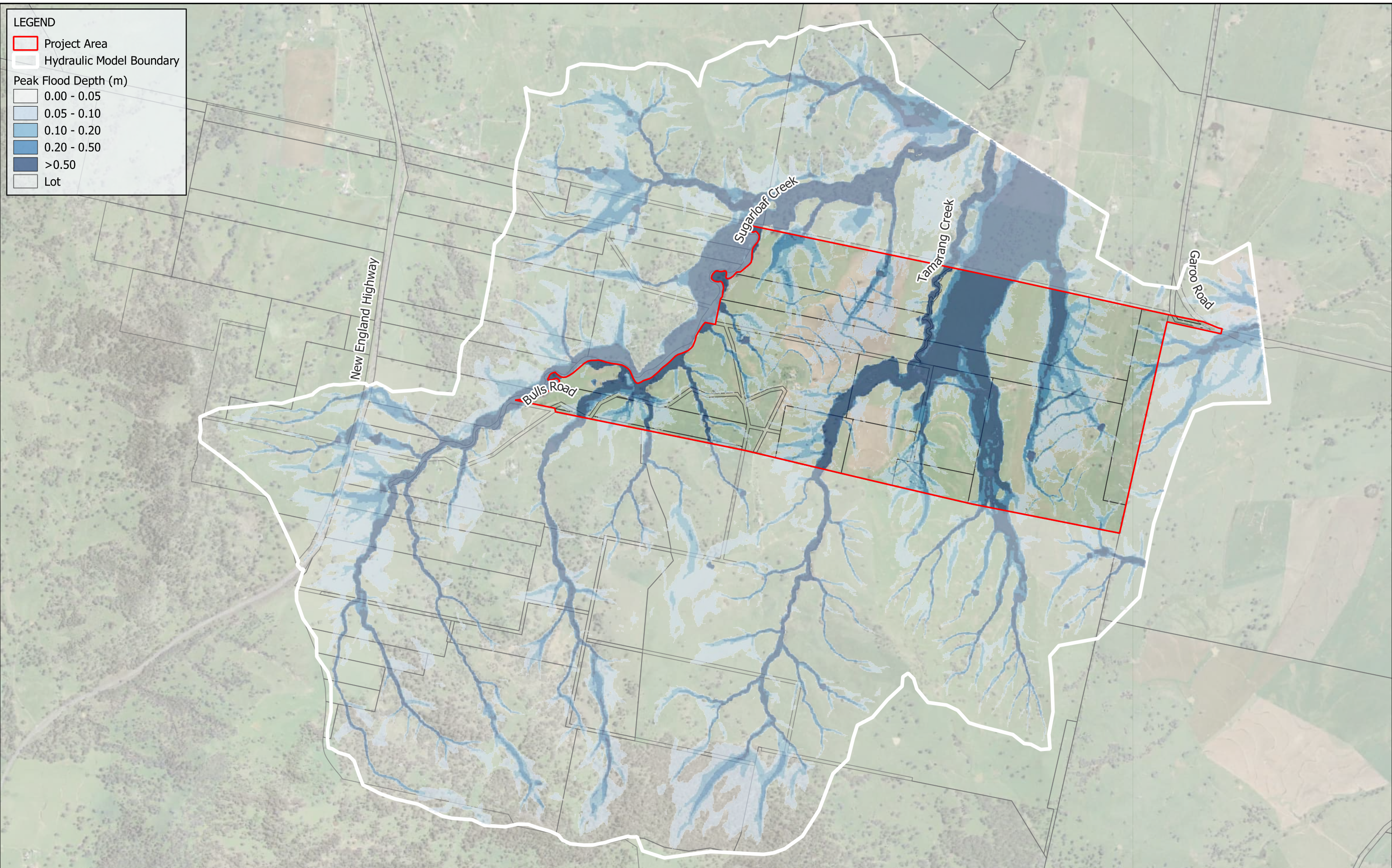
**DATA SOURCE**  
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Figure B4: Existing Conditions - 0.2% AEP Peak Flood Depth

Drg Ref. NTL00206\_0019-FIG-B4



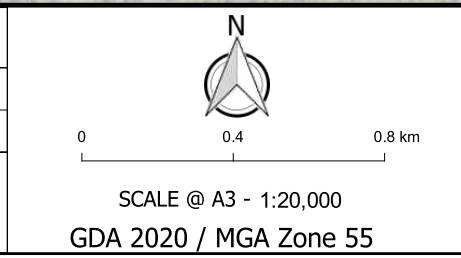
**LEGEND**

	Project Area
	Hydraulic Model Boundary
<b>Peak Flood Depth (m)</b>	
	0.00 - 0.05
	0.05 - 0.10
	0.10 - 0.20
	0.20 - 0.50
	>0.50
	Lot

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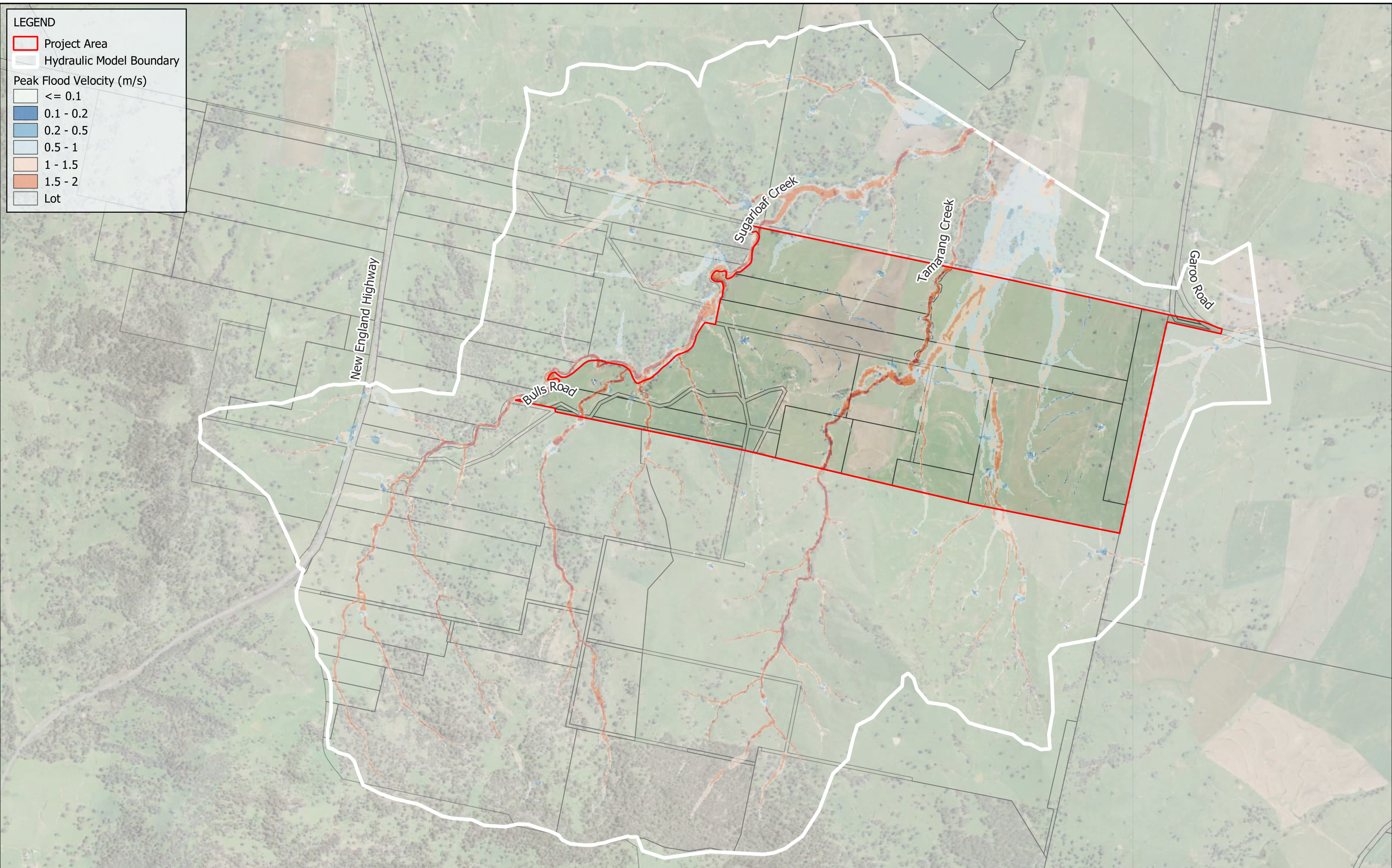
**DATA SOURCE**  
Google Maps



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Figure B5: Existing Conditions - PMF Peak Flood Depth

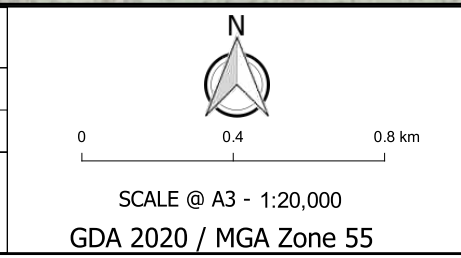
Drg Ref. NTL00206\_0019-FIG-B5



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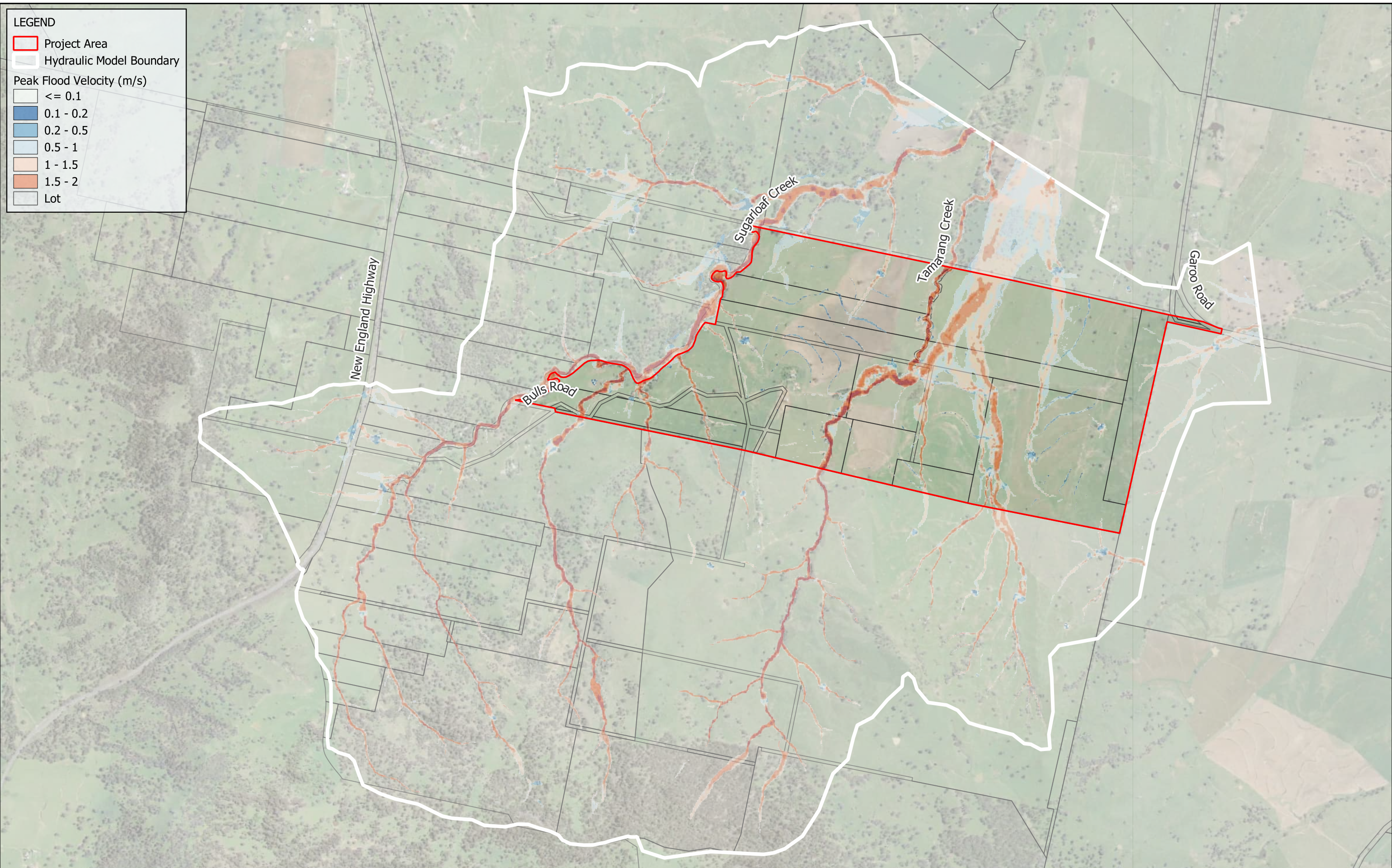
**DATA SOURCE**  
Google Maps



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Figure B6: Existing Conditions - 5% AEP Peak Flood Velocity

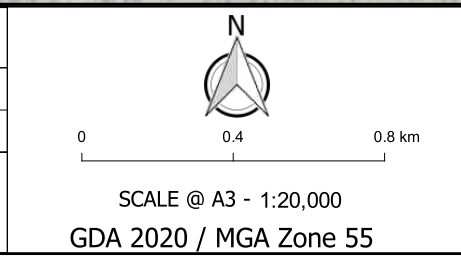
Drg Ref. NTL00206\_0019-FIG-B6



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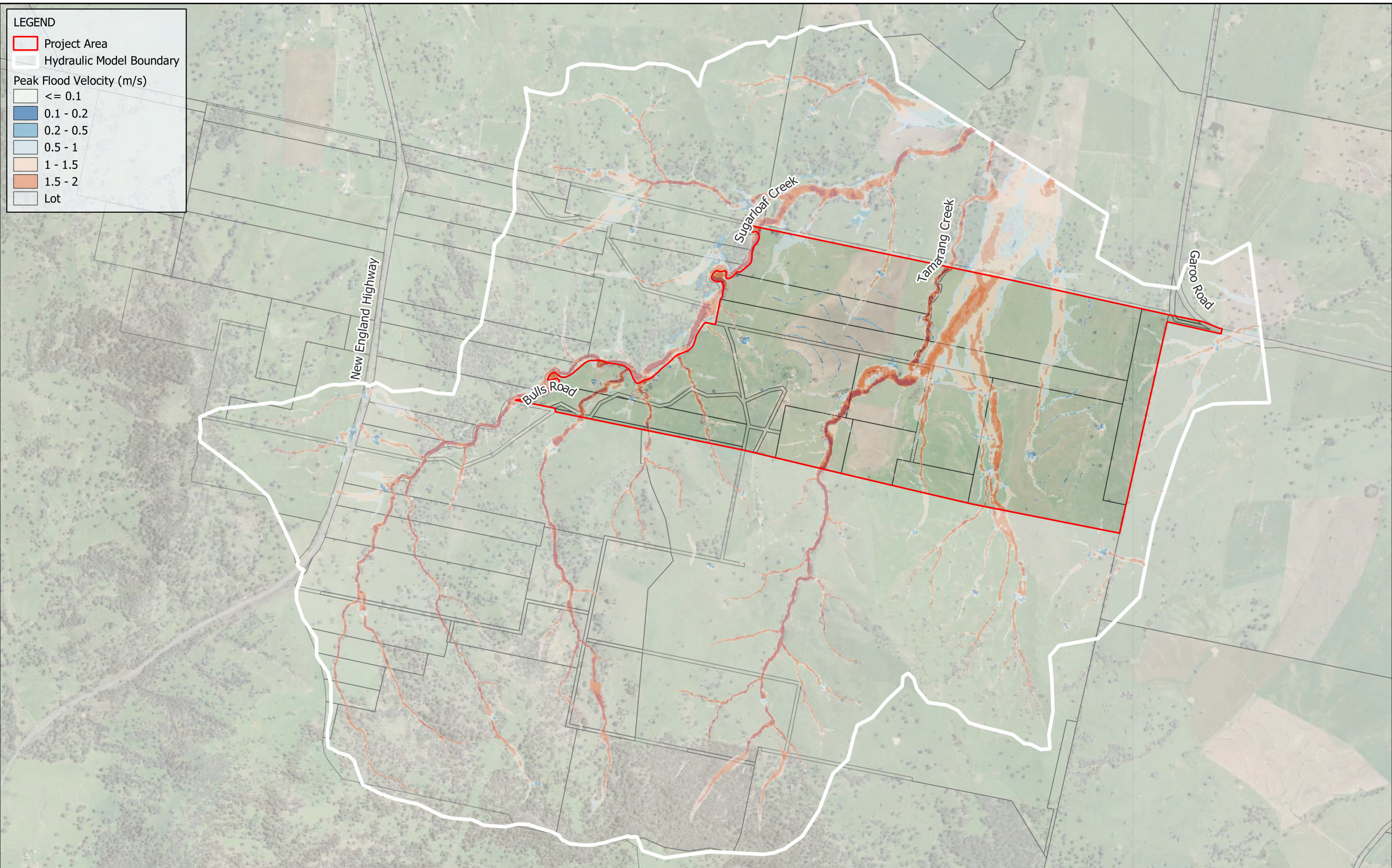
**DATA SOURCE**  
Google Maps



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Figure B7: Existing Conditions - 1% AEP Peak Flood Velocity

Drg Ref. NTL00206\_0019-FIG-B7



**LEGEND**

Project Area

Hydraulic Model Boundary

Peak Flood Velocity (m/s)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- Lot


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0      0.4      0.8 km

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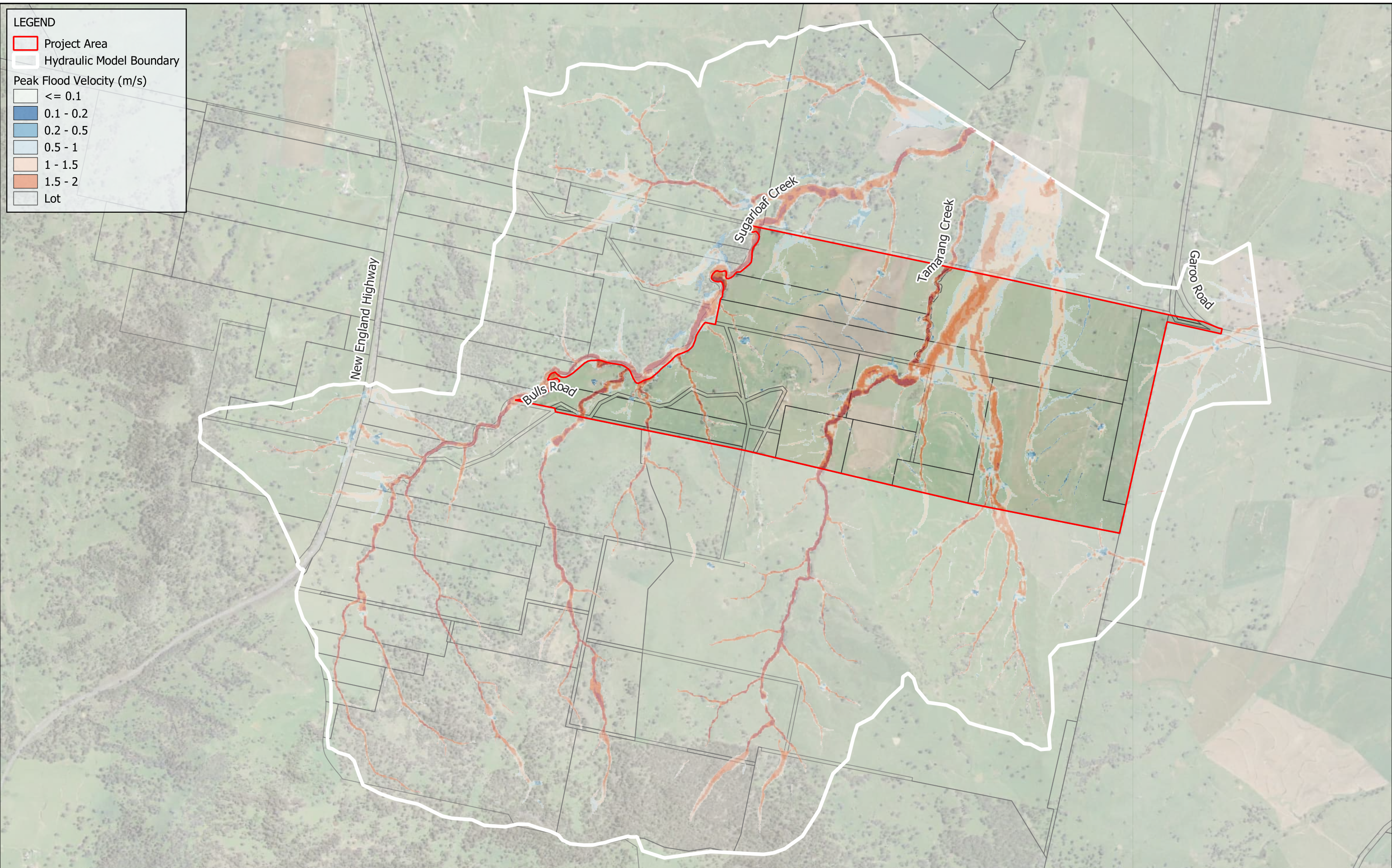
**DATA SOURCE**  
Google Maps



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Figure B8: Existing Conditions - 1% AEP Climate Change Sensitivity Peak Flood Velocity

Drg Ref. NTL00206\_0019-FIG-B8

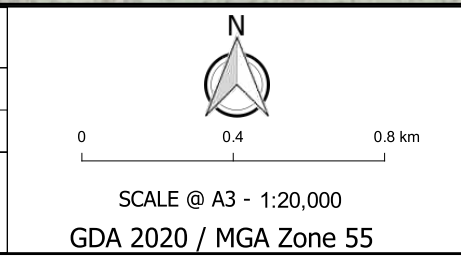


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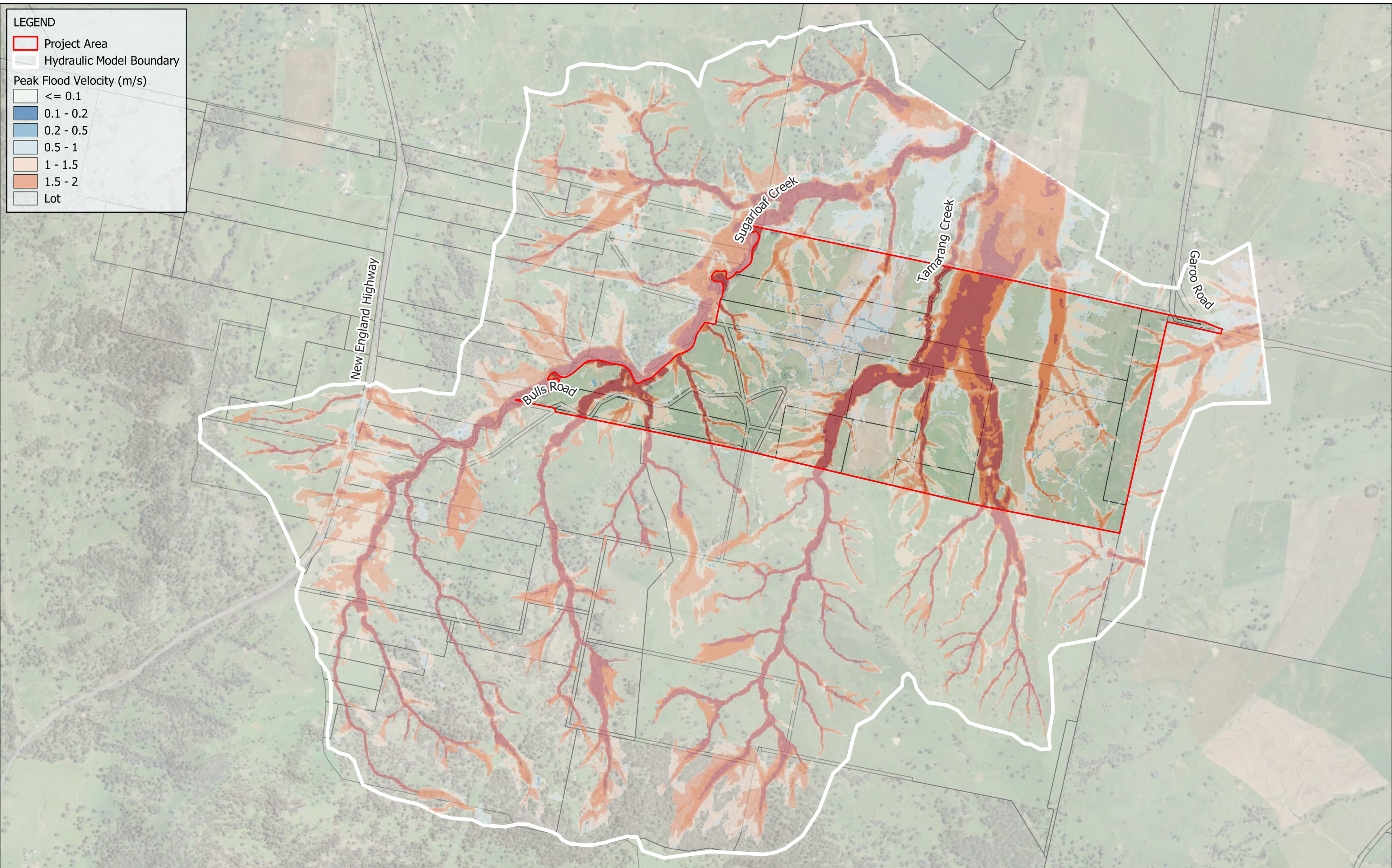
**DATA SOURCE**  
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Figure B9: Existing Conditions - 0.2% AEP Peak Flood Velocity

Drg Ref. NTL00206\_0019-FIG-B9

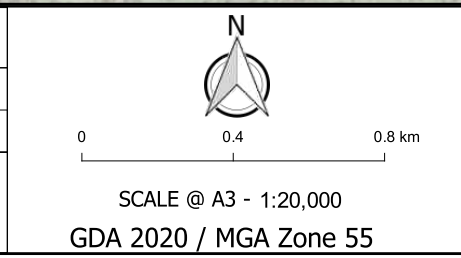


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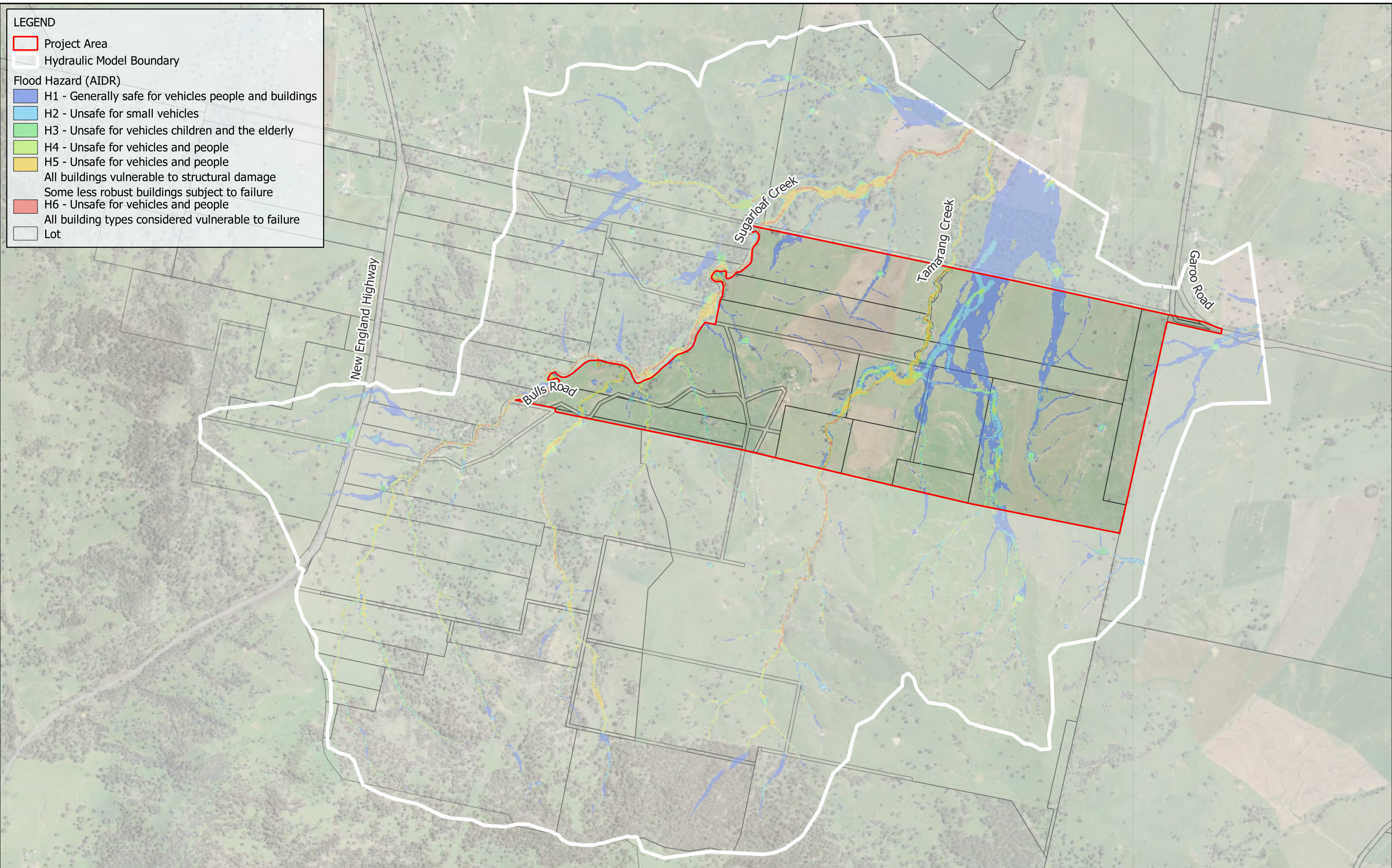
**DATA SOURCE**  
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Figure B10: Existing Conditions - PMF Peak Flood Velocity

Drg Ref. NTL00206\_0019-FIG-B10

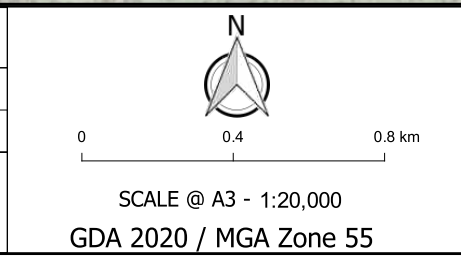


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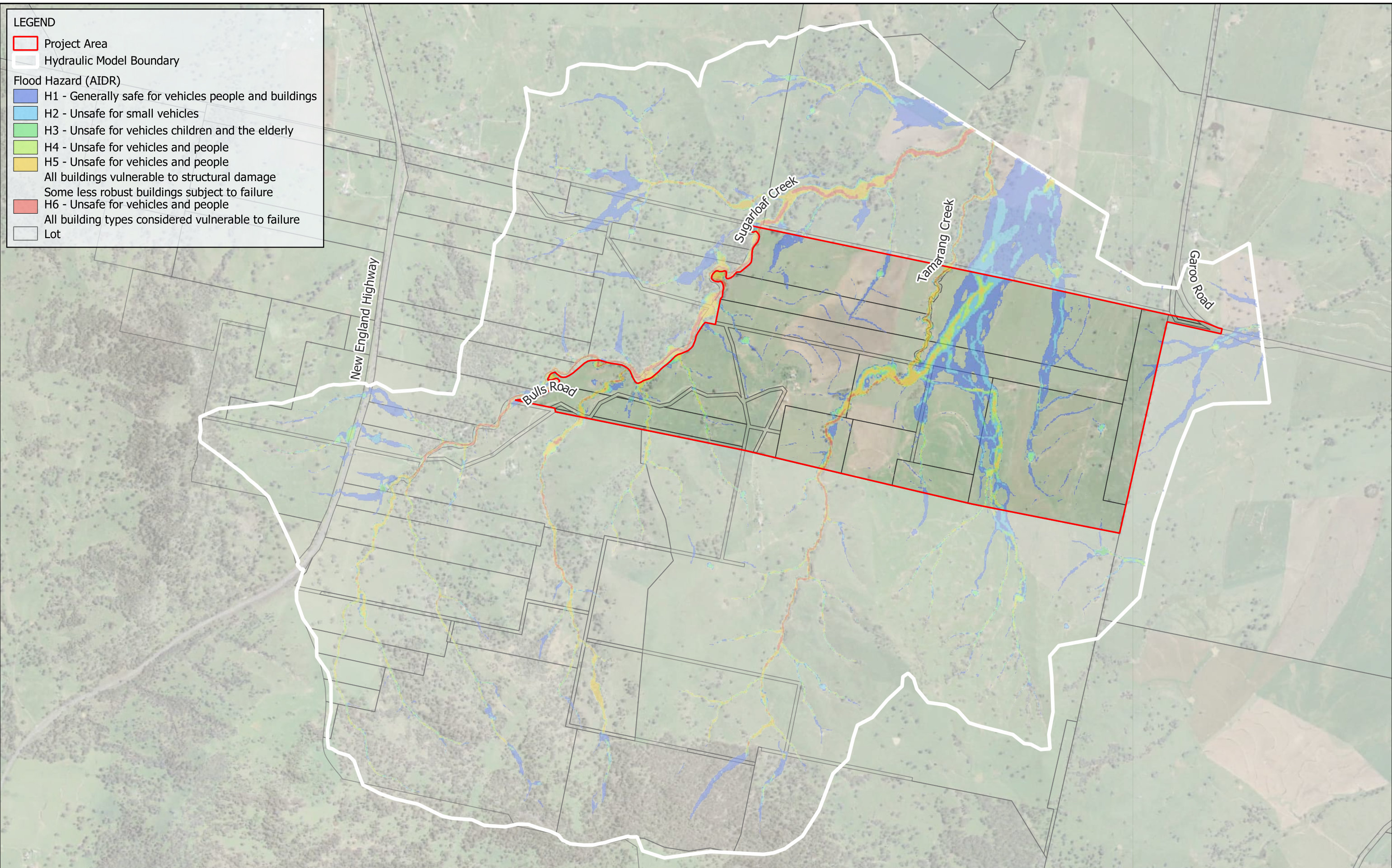
**DATA SOURCE**  
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Figure B11: Existing Conditions - 5% AEP Flood Hazard Categorisation

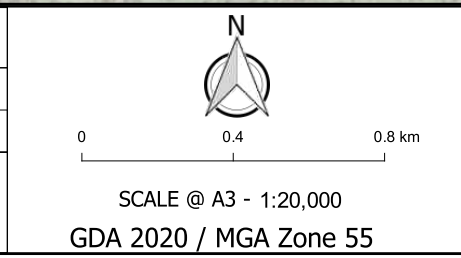
Drg Ref. NTL00206\_0019-FIG-B11



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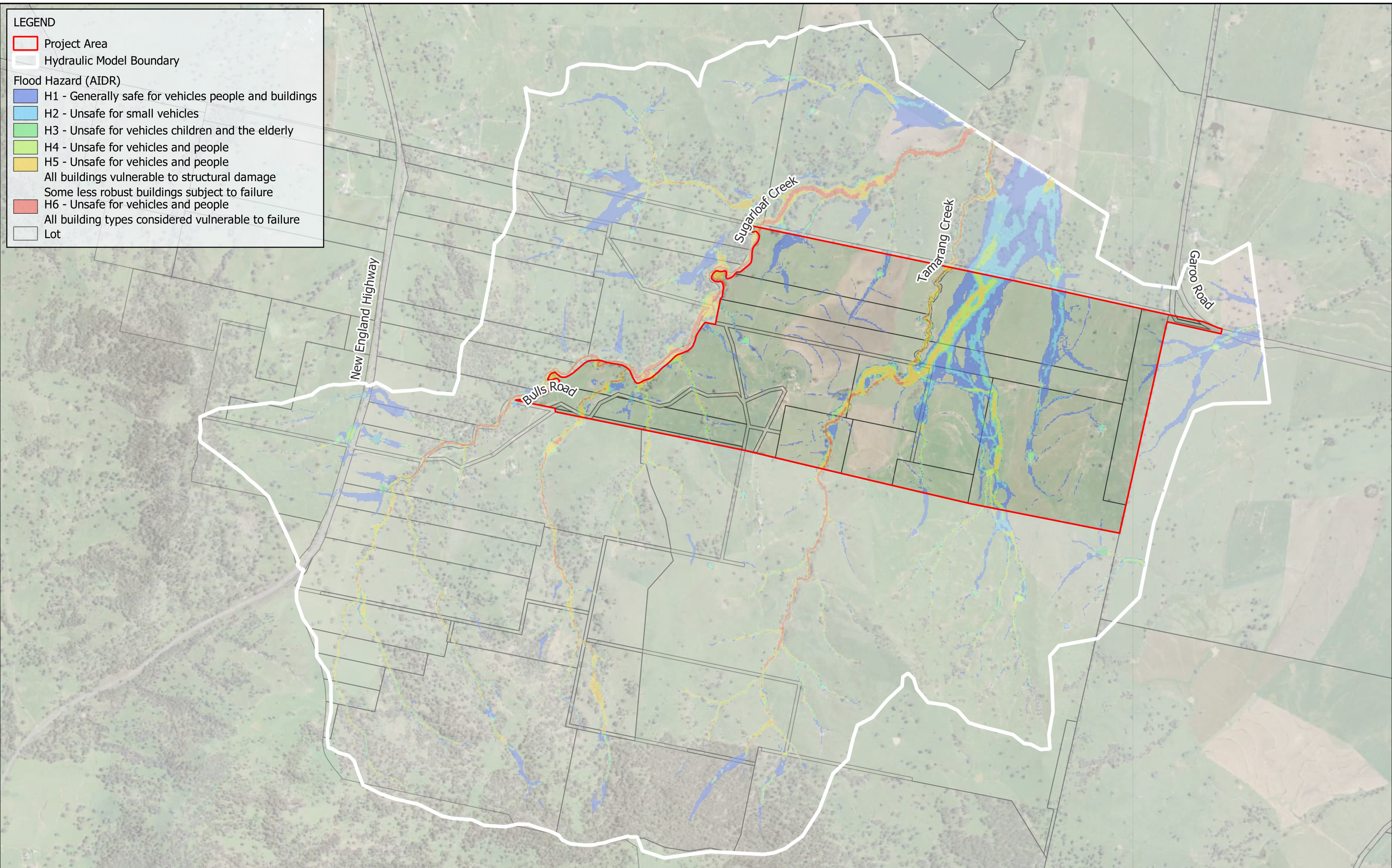
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Figure B12: Existing Conditions - 1% AEP Flood Hazard Categorisation

Drg Ref. NTL00206\_0019-FIG-B12

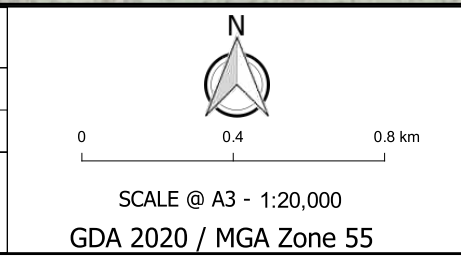


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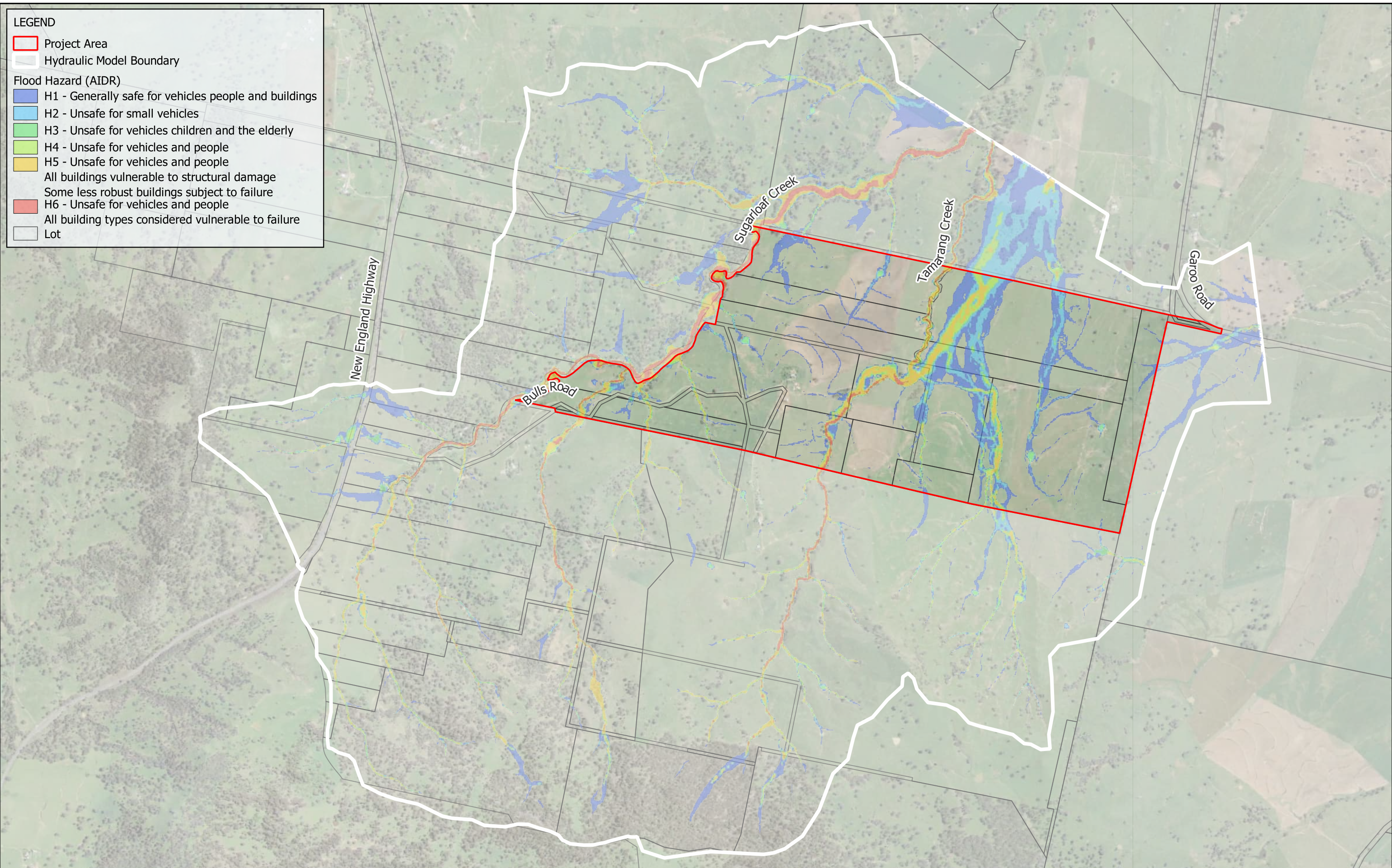
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Figure B13: Existing Conditions - 1% AEP Climate Change Sensitivity Flood Hazard Categorisation

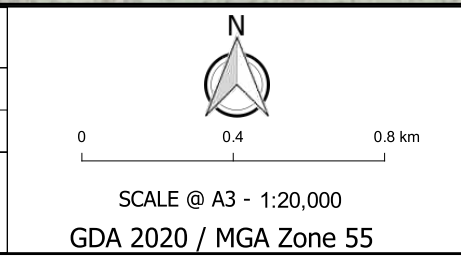
Drg Ref. NTL00206\_0019-FIG-B13



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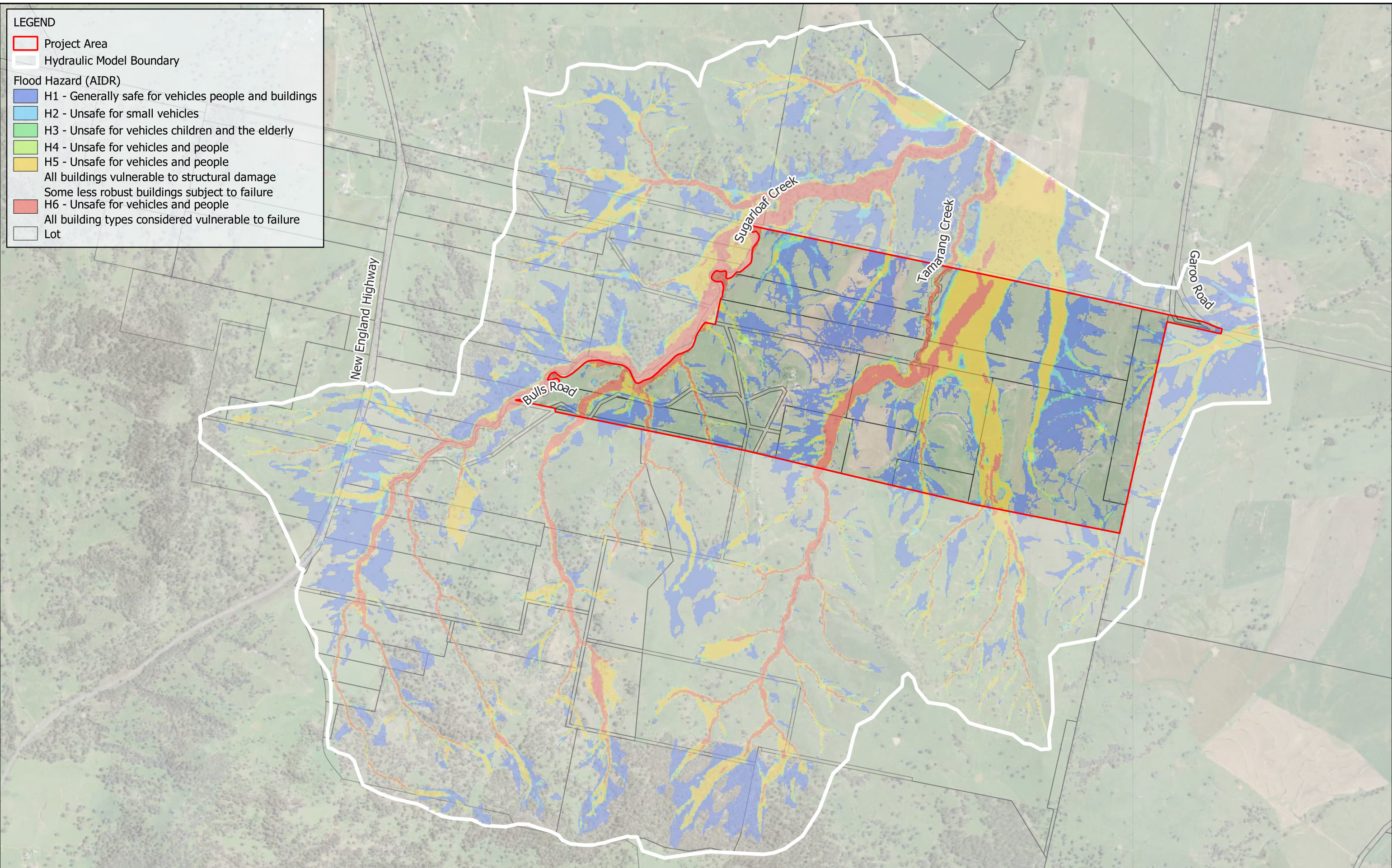
**DATA SOURCE**  
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Figure B14: Existing Conditions - 0.2% AEP Flood Hazard Categorisation

Drg Ref. NTL00206\_0019-FIG-B14

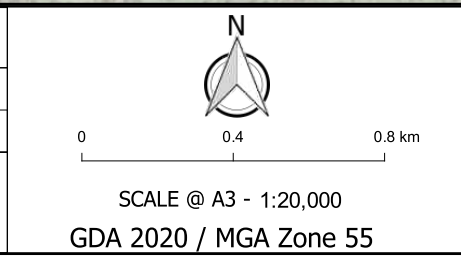


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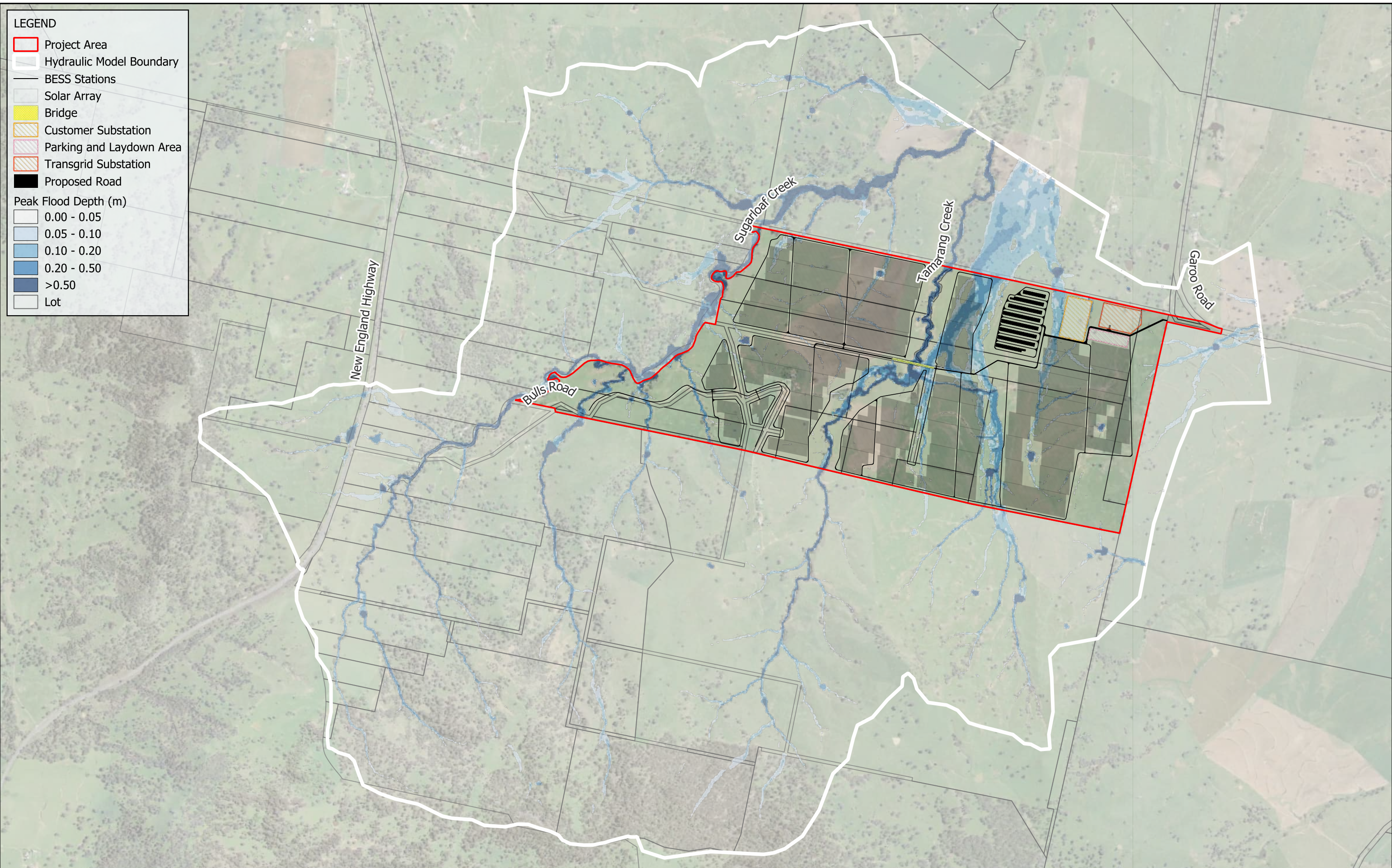
Figure B15: Existing Conditions - PMF Flood Hazard Categorisation

Drg Ref. NTL00206\_0019-FIG-B15

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# APPENDIX C: DEVELOPED CONDITIONS FLOOD MODEL RESULTS





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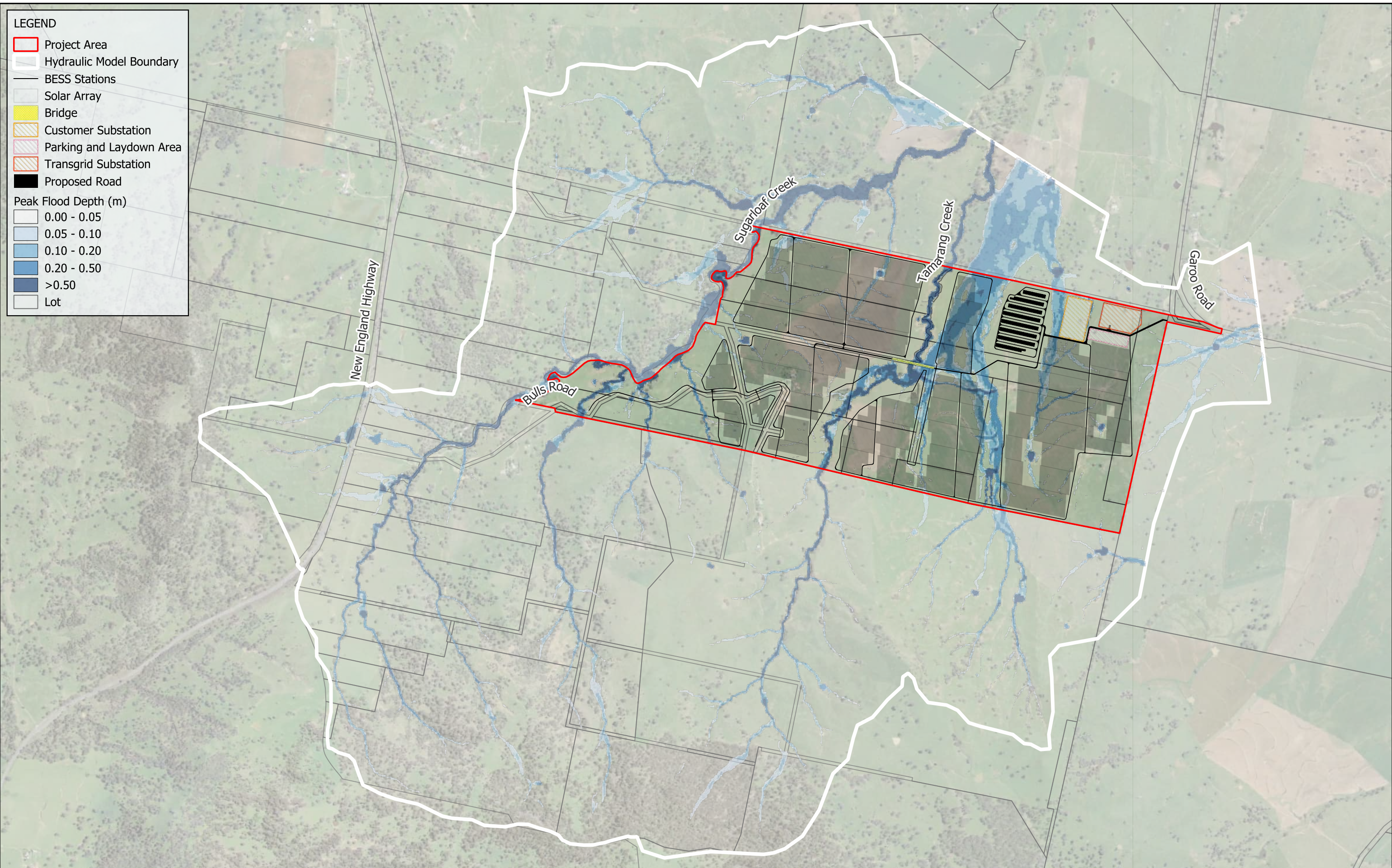
**DATA SOURCE**  
Google Maps



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Figure C1: Developed Conditions - 5% AEP Peak Flood Depth

Drg Ref. NTL00206\_0019-FIG-B1

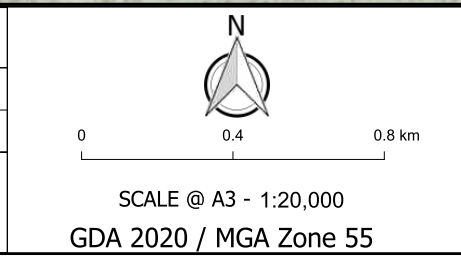


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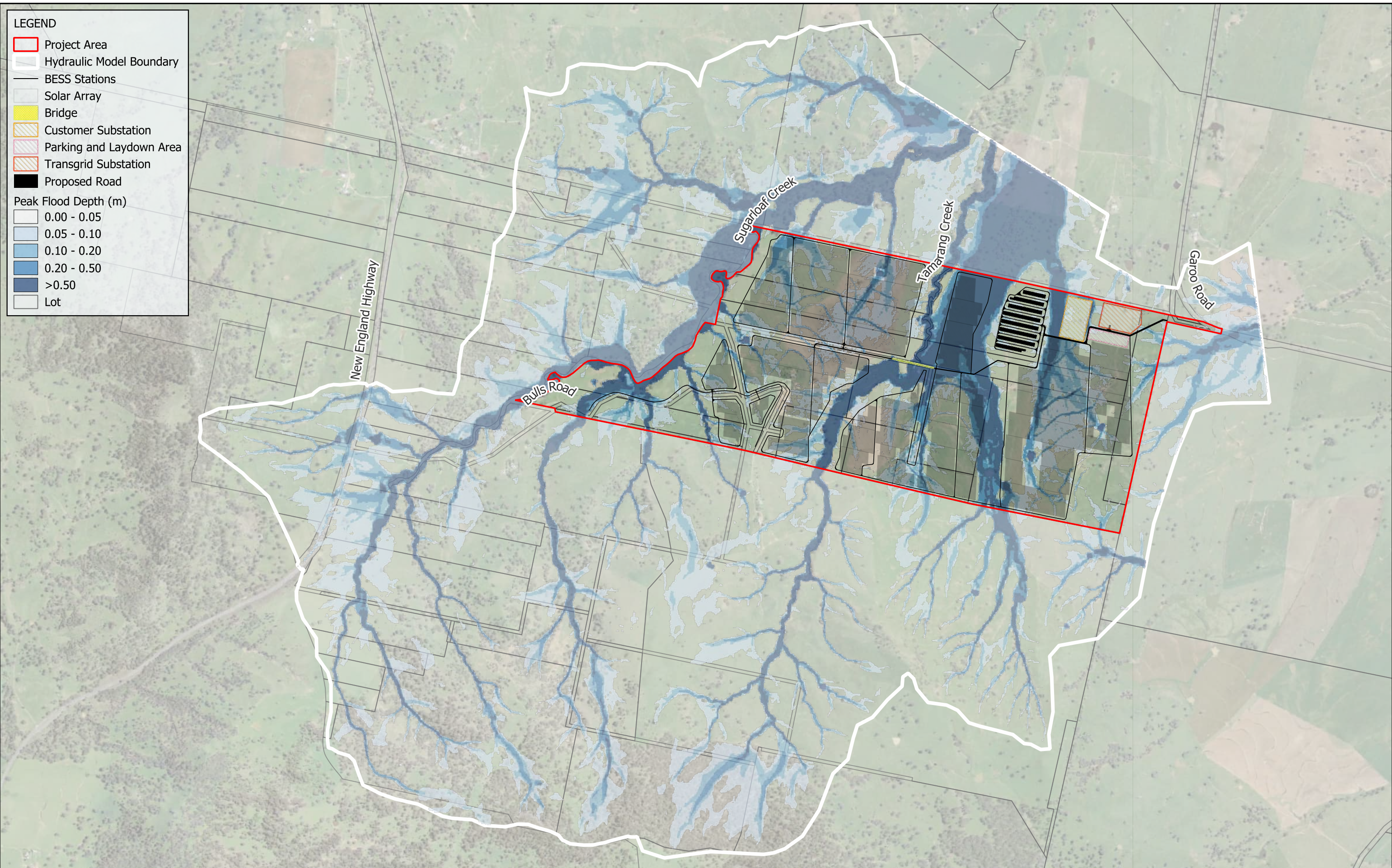
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Figure C2: Developed Conditions - 1% AEP Peak Flood Depth

Drg Ref. NTL00206\_0019-FIG-B2

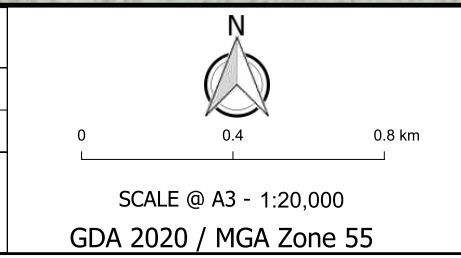


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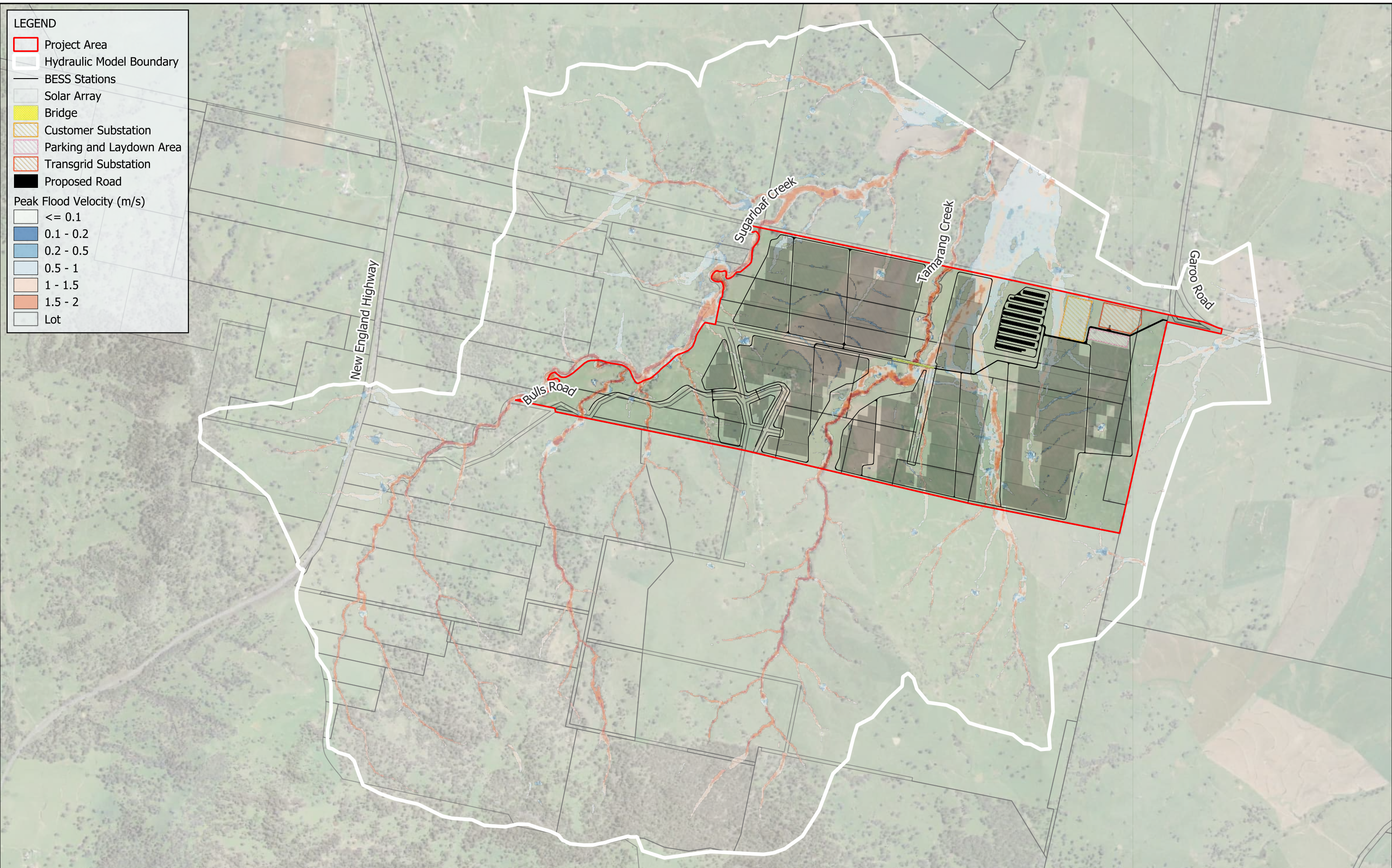
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Figure C3: Developed Conditions - PMF Peak Flood Depth

Drg Ref. NTL00206\_0019-FIG-B3

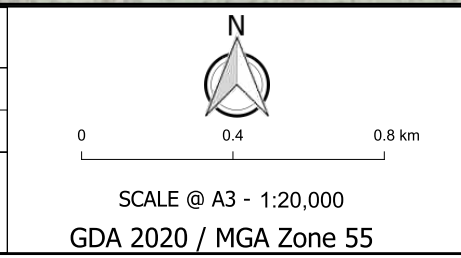


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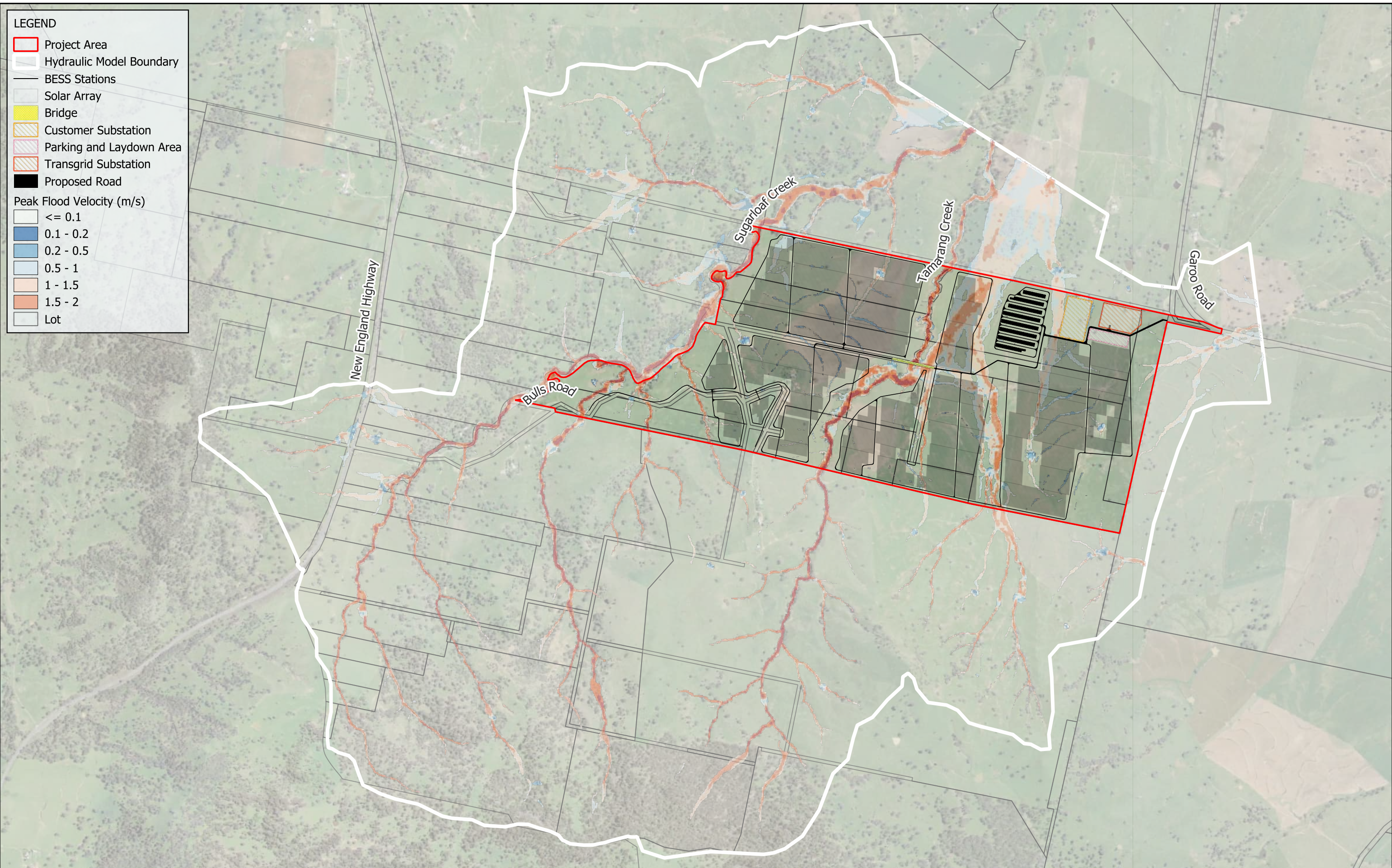
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Figure C4: Developed Conditions - 5% AEP Peak Flood Velocity

Drg Ref. NTL00206\_0019-FIG-B4

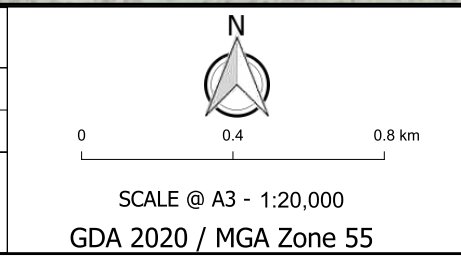


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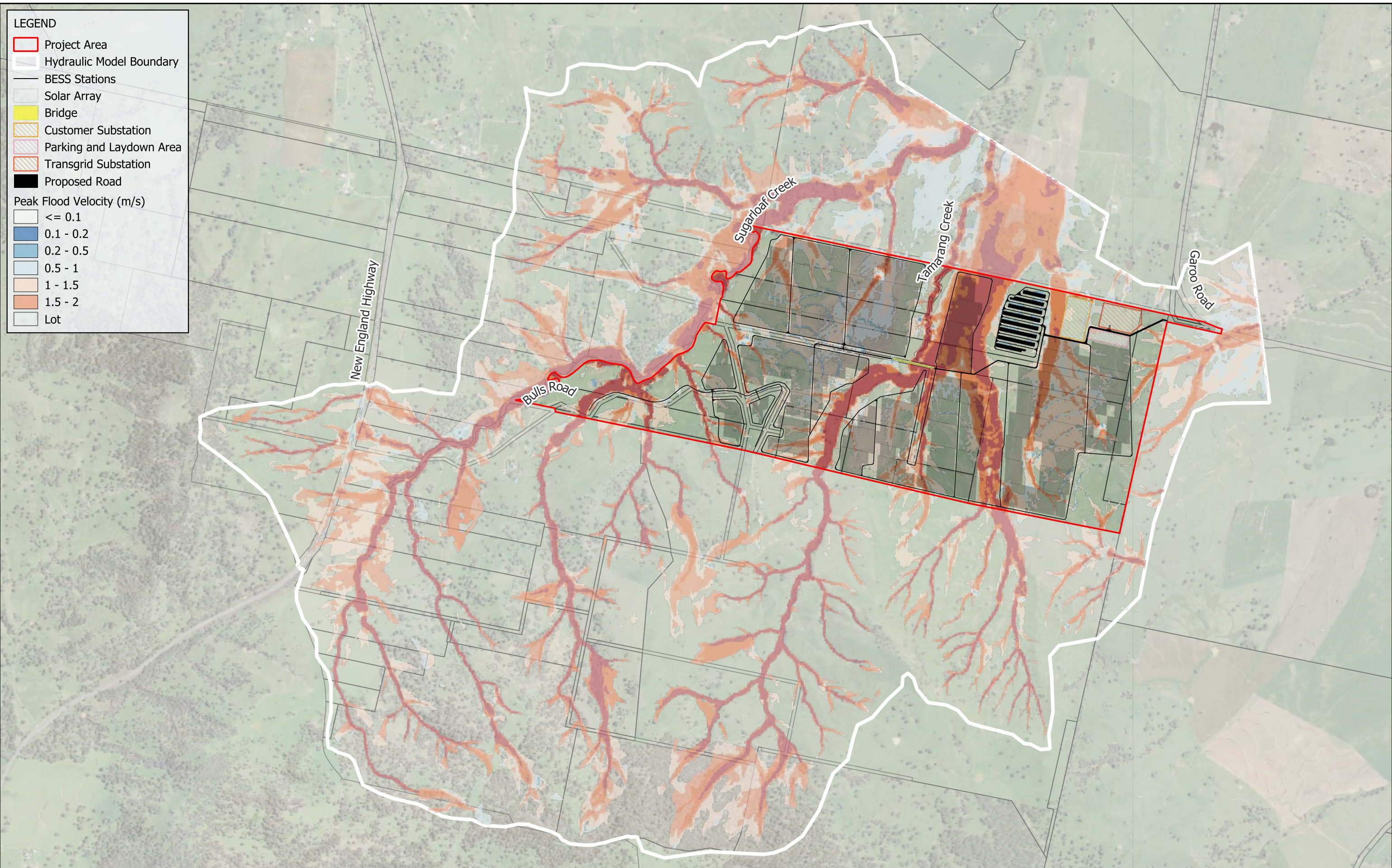
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Figure C5: Developed Conditions - 1% AEP Peak Flood Velocity

Drg Ref. NTL00206\_0019-FIG-B5




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0      0.4      0.8 km

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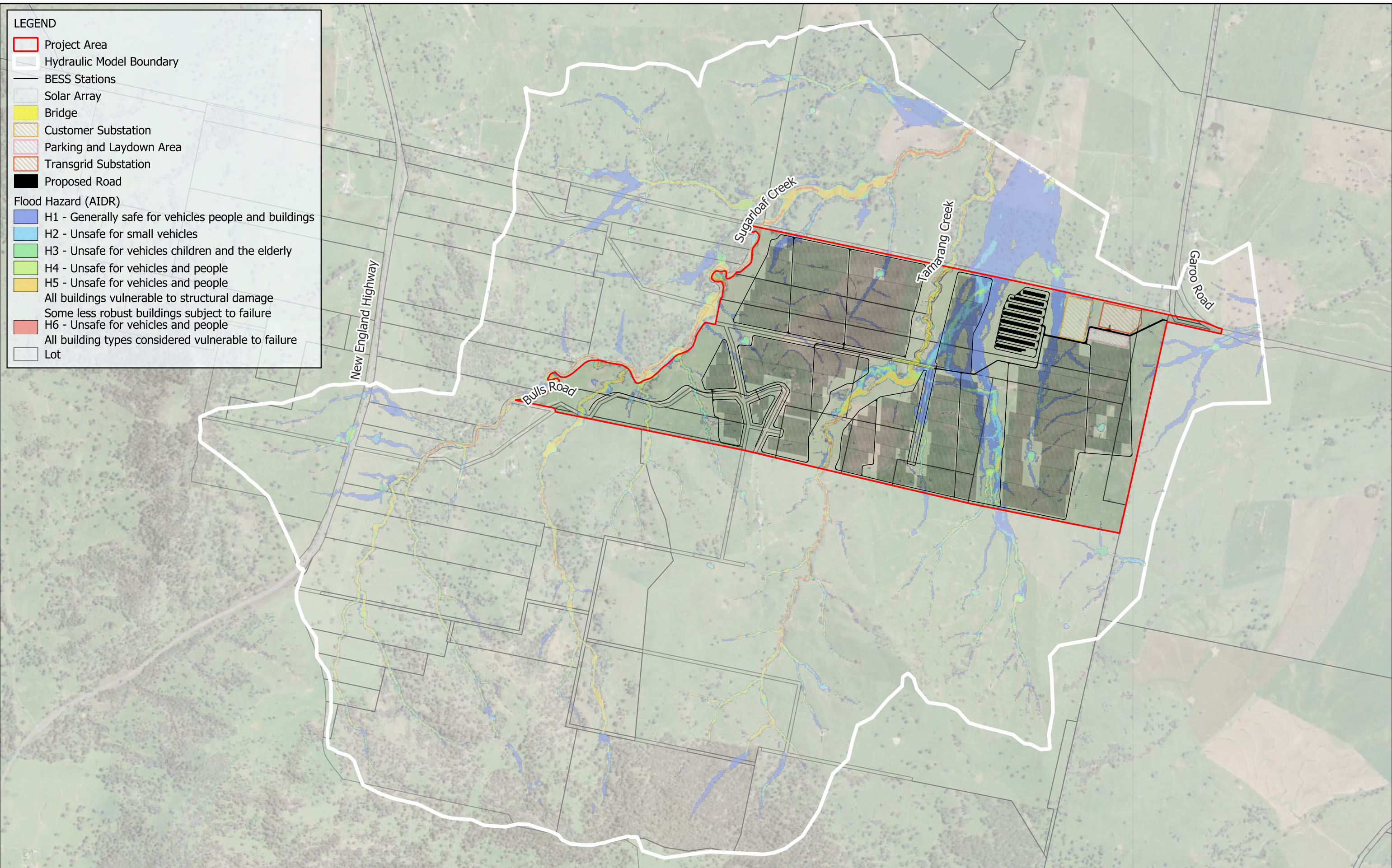
**DATA SOURCE**  
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Figure C6: Developed Conditions - PMF Peak Flood Velocity

Drg Ref. NTL00206\_0019-FIG-B6

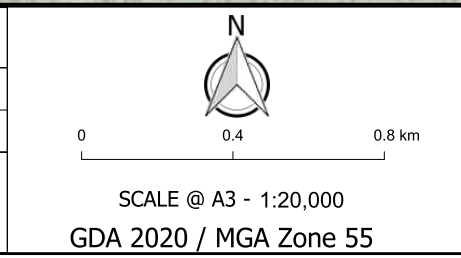


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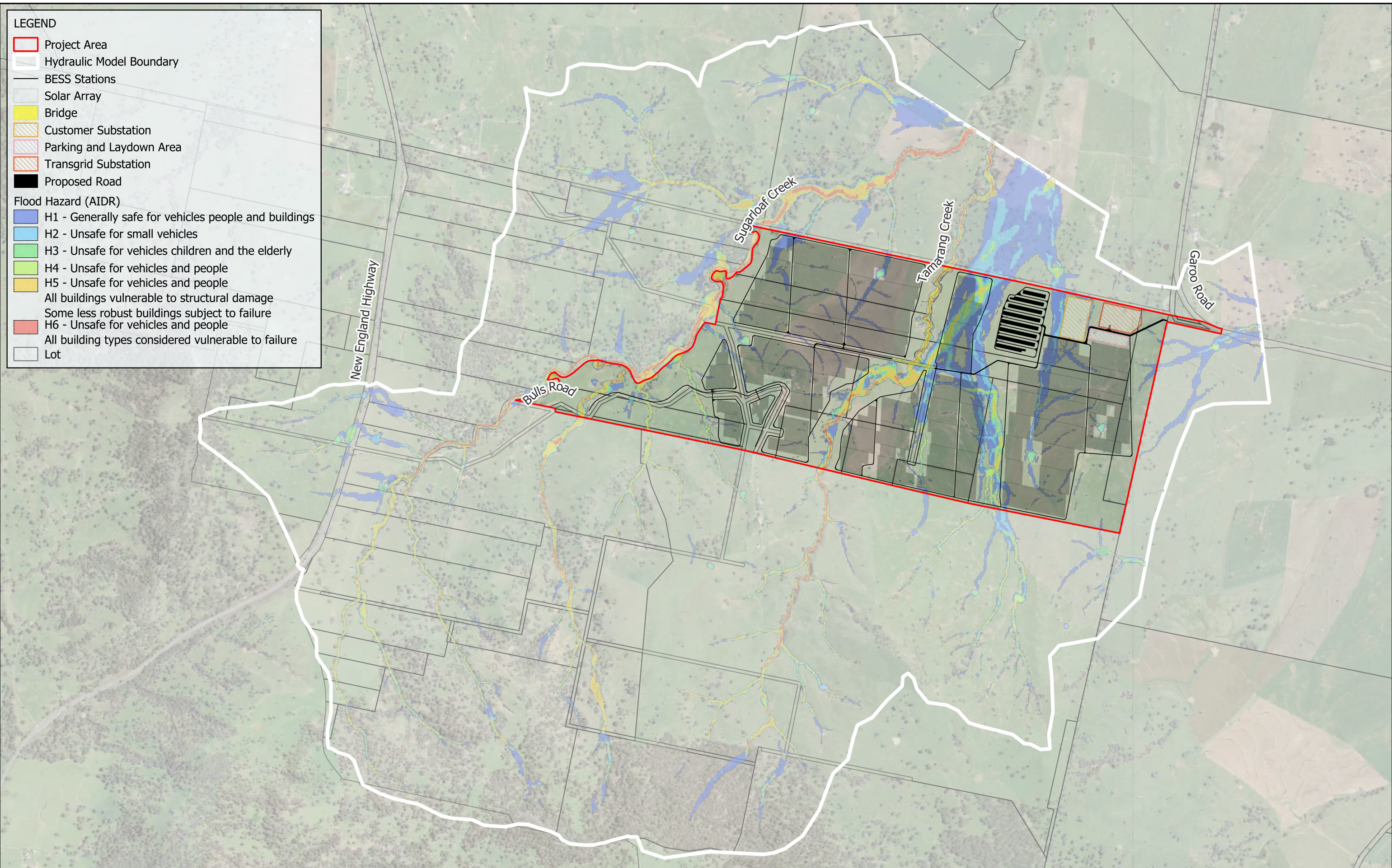
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Figure C7: Developed Conditions - 5% AEP Flood Hazard Categorisation

Drg Ref. NTL00206\_0019-FIG-B7

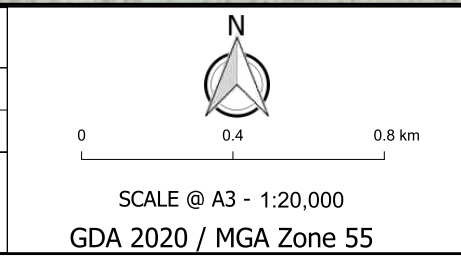


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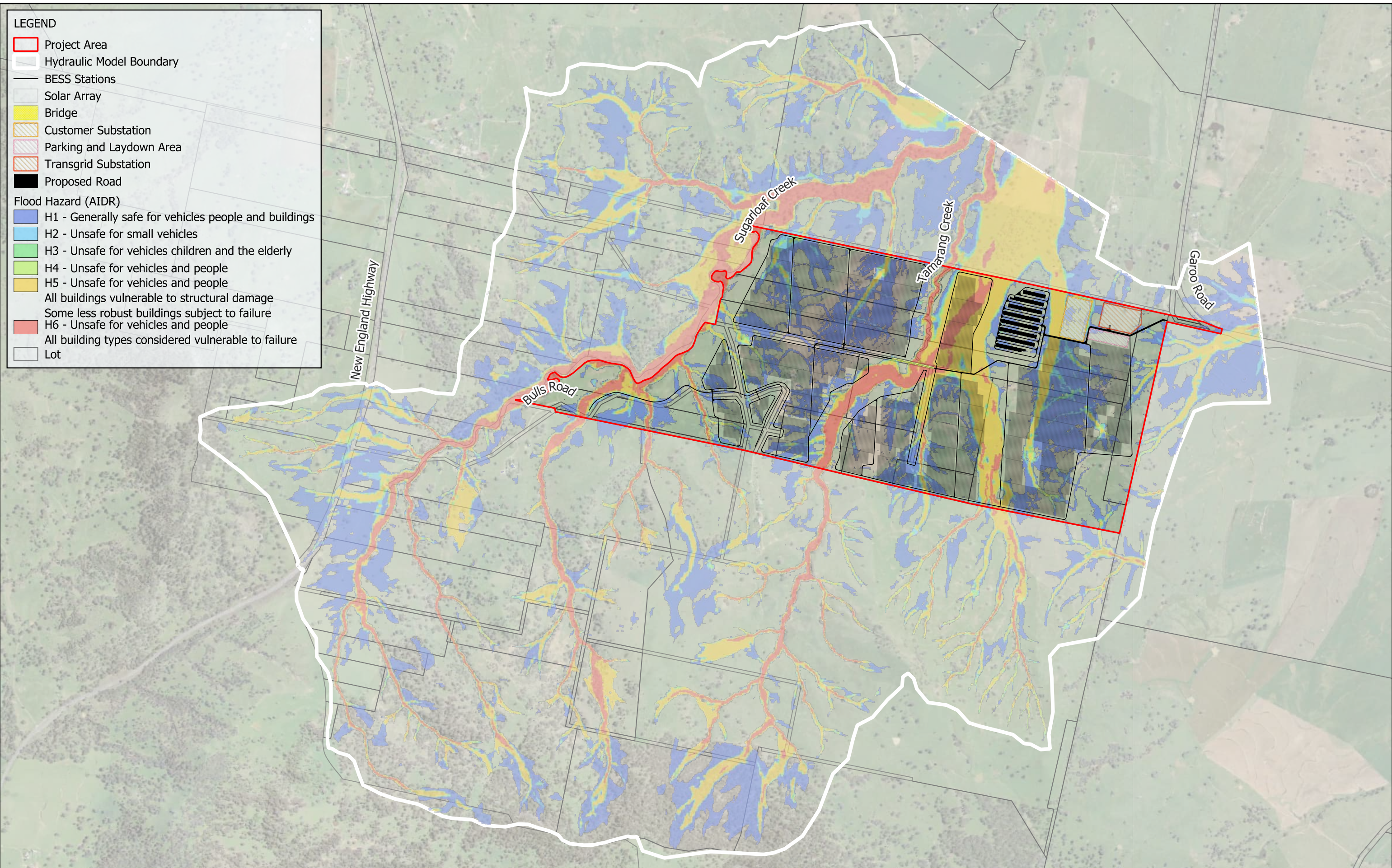
**DATA SOURCE**  
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Figure C8: Developed Conditions - 1% AEP Flood Hazard Categorisation

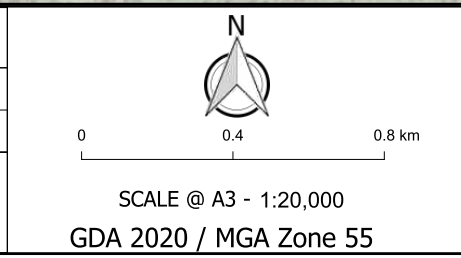
Drg Ref. NTL00206\_0019-FIG-B8



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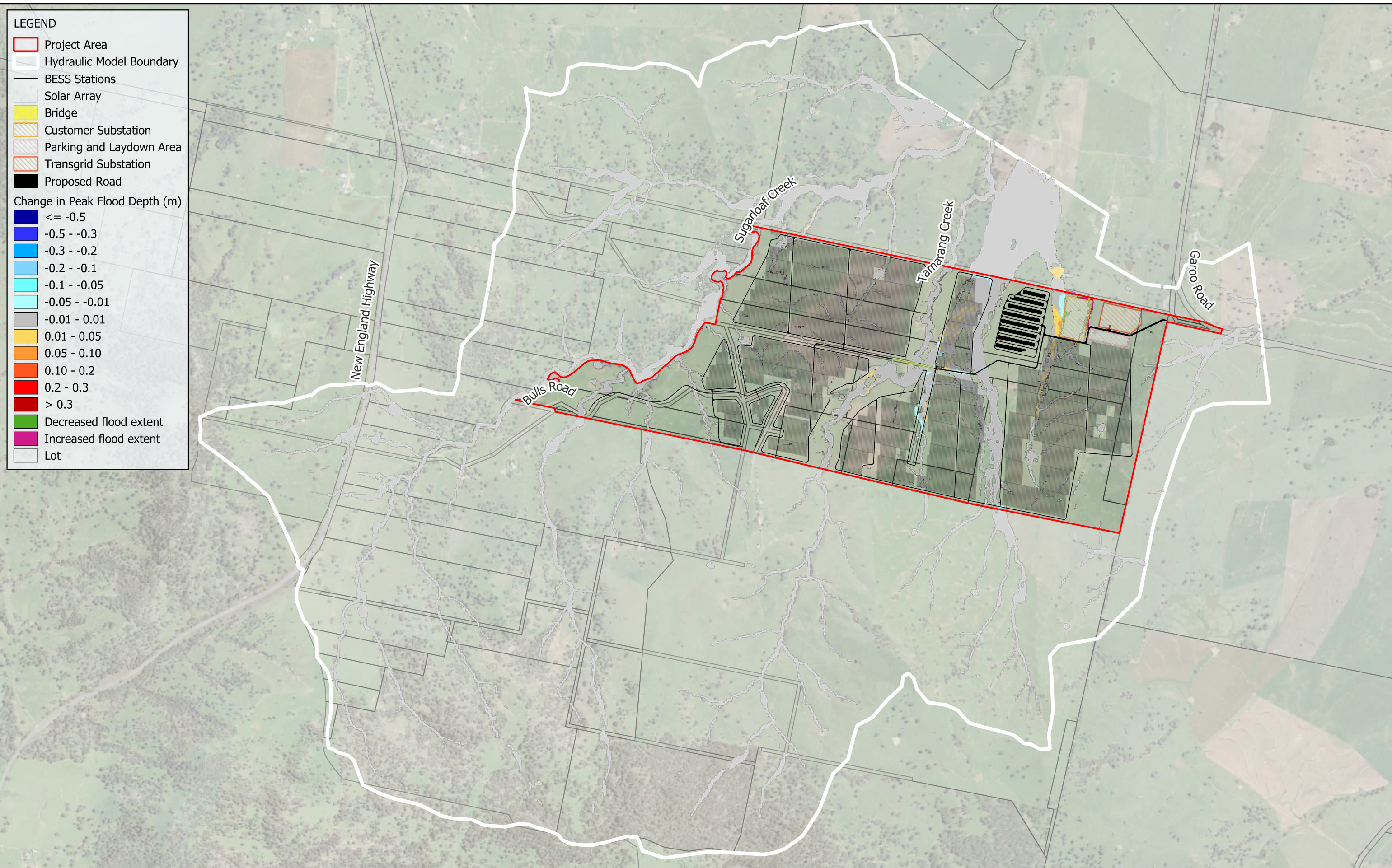
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Figure C9: Developed Conditions - PMF Flood Hazard Categorisation

Drg Ref. NTL00206\_0019-FIG-B9




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N



0      0.4      0.8 km

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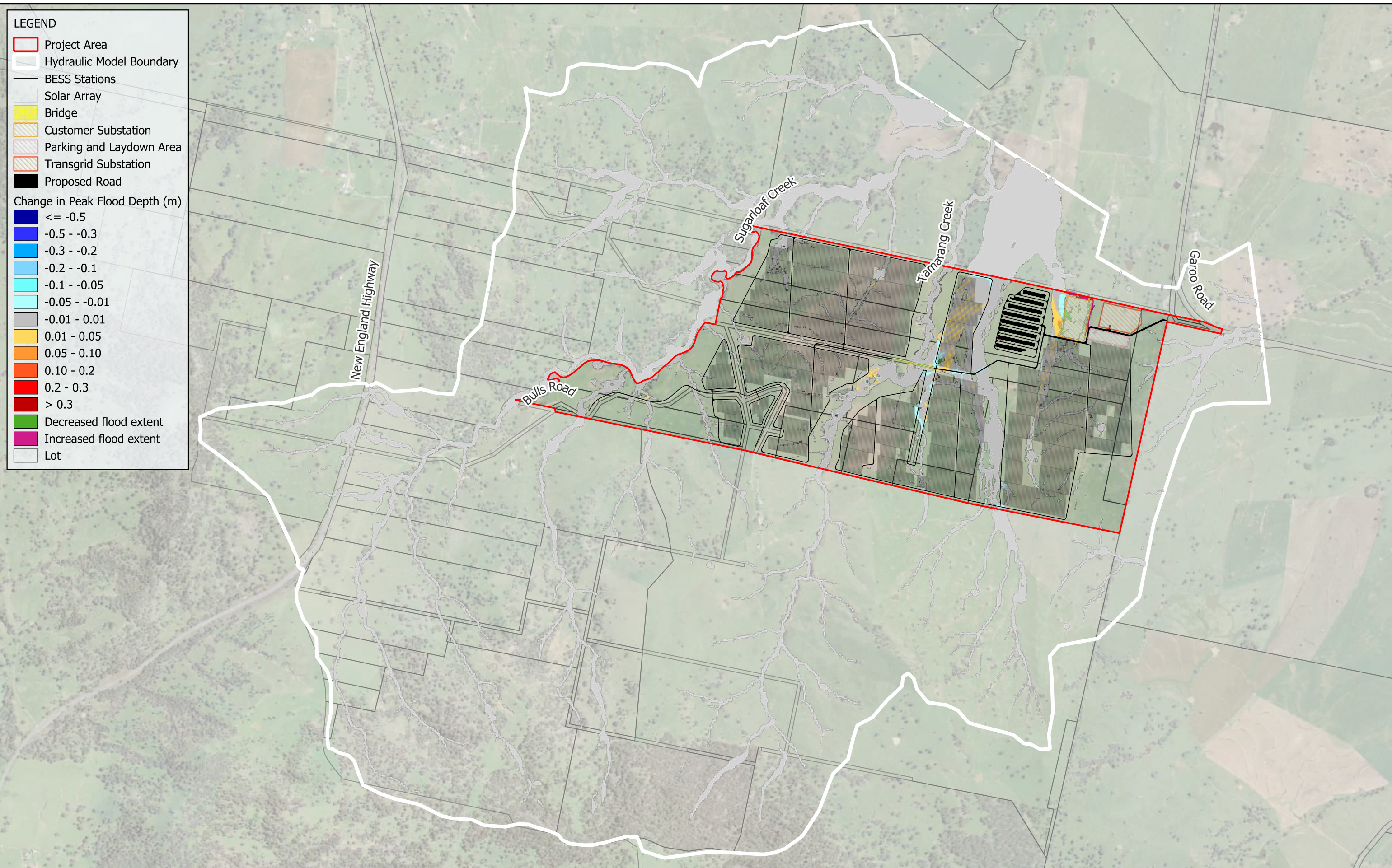
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Figure C10: Flood Afflux - 5% AEP Change in Peak Flood Depth

Drg Ref. NTL00206\_0019-FIG-B10




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0      0.4      0.8 km

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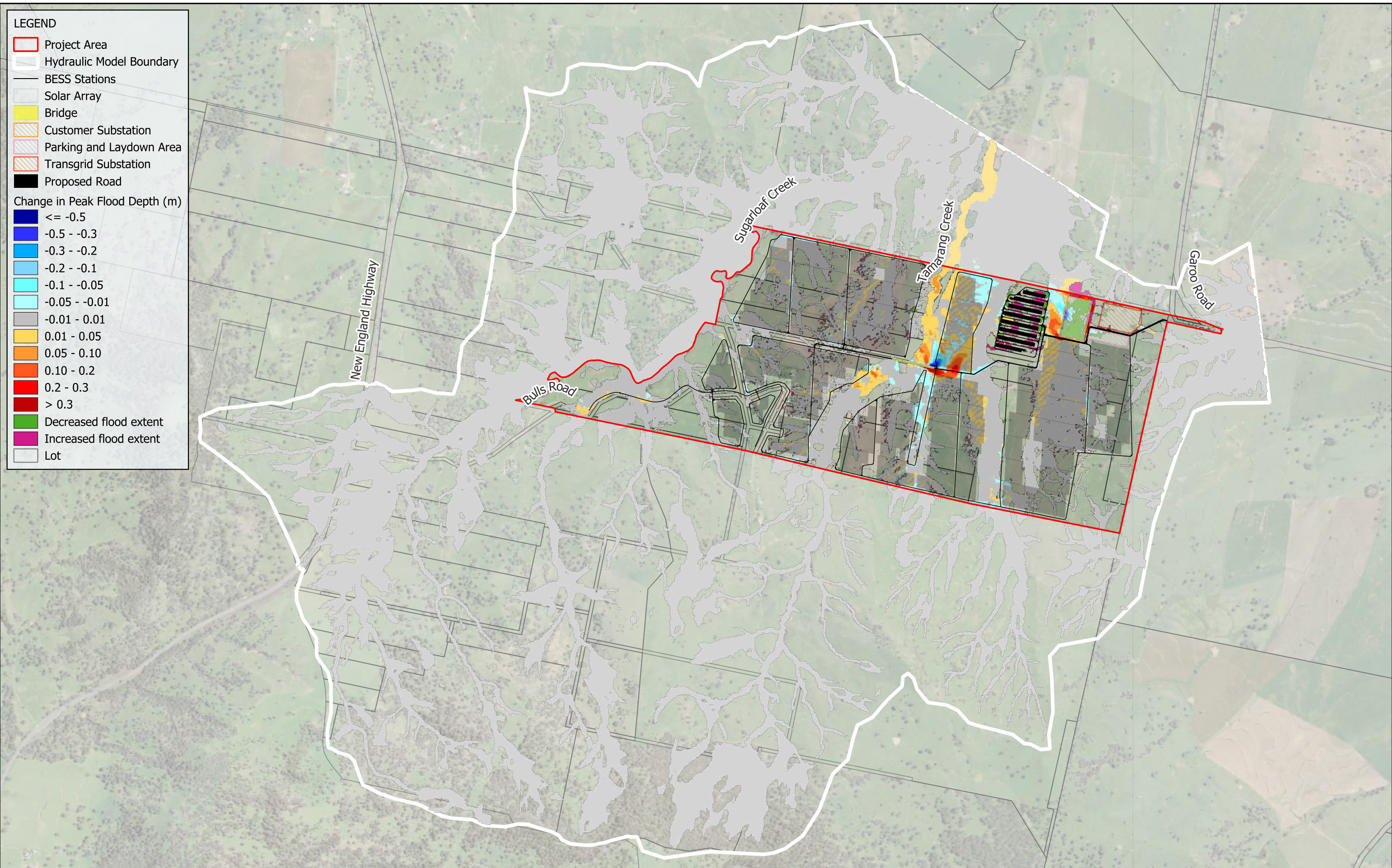
**DATA SOURCE**  
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Figure C11: Flood Afflux - 1% AEP Change in Peak Flood Depth

Drg Ref. NTL00206\_0019-FIG-B11

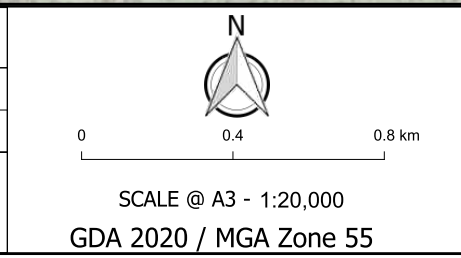


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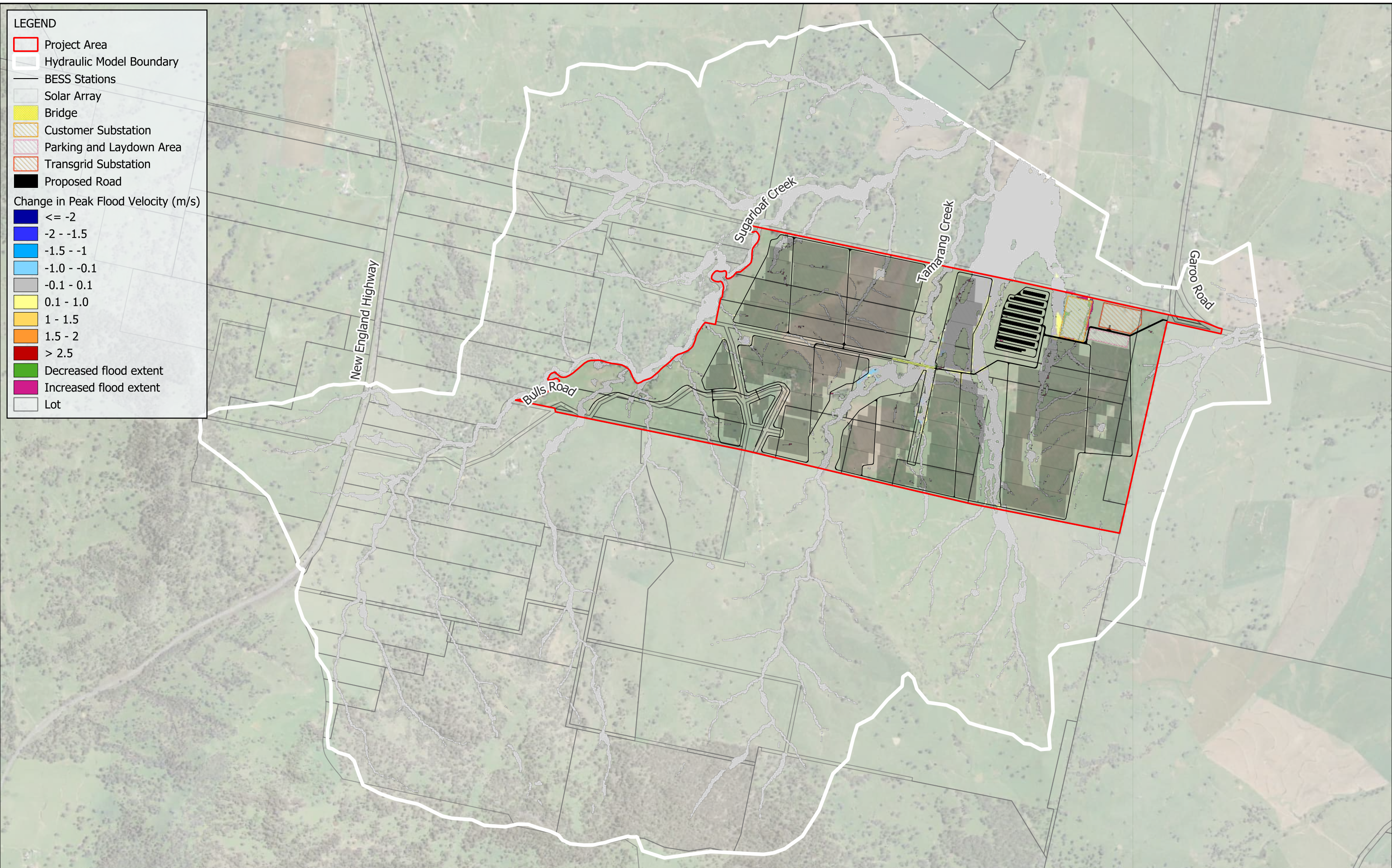
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Figure C12: Flood Afflux - PMF Change in Peak Flood Depth

Drg Ref. NTL00206\_0019-FIG-B12

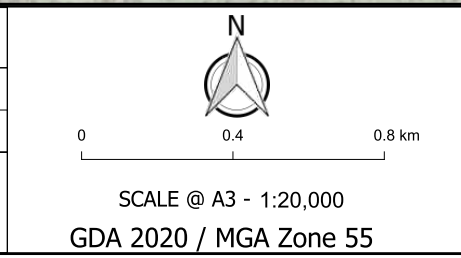


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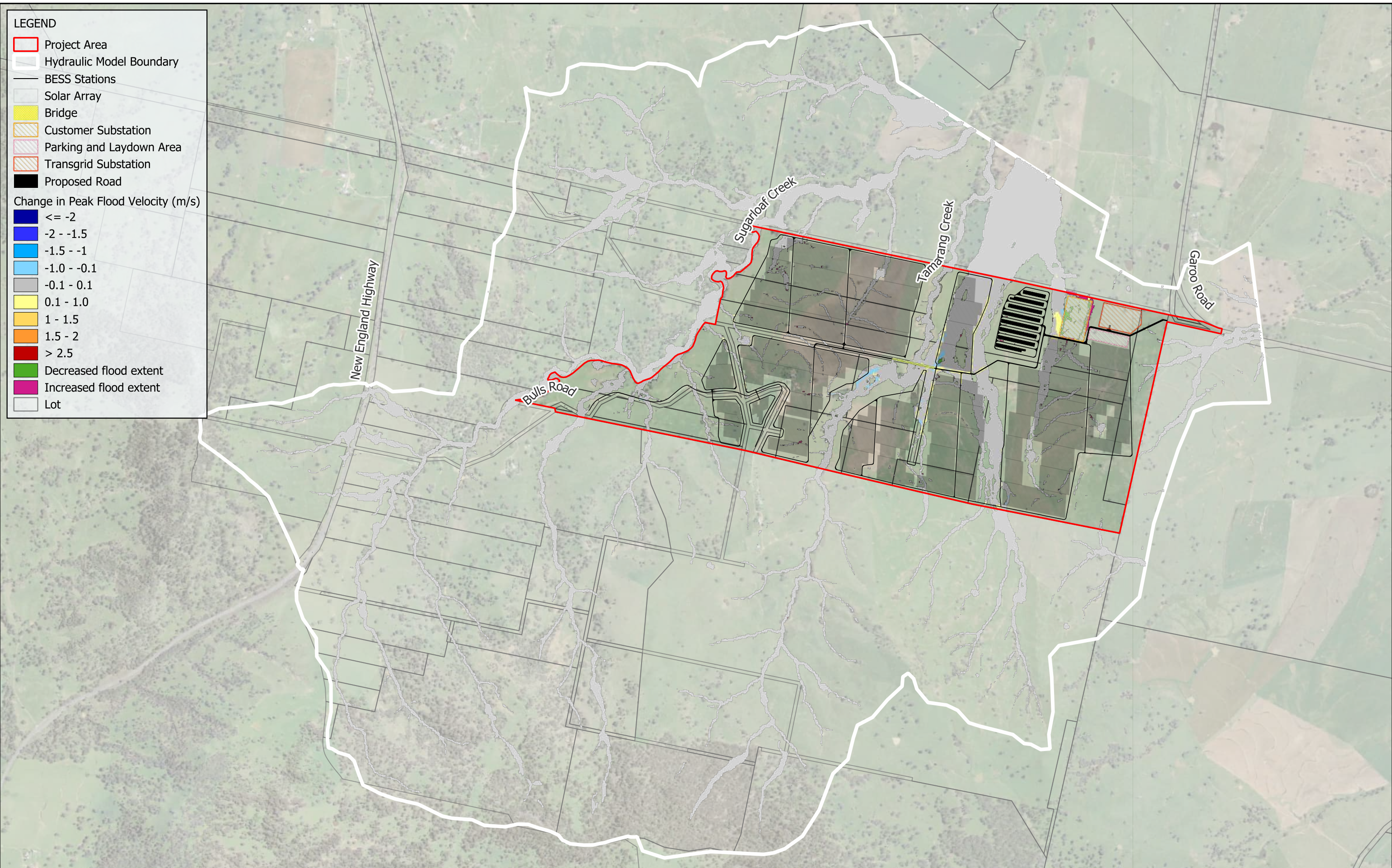
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Figure C13: Flood Afflux - 5% AEP Change in Peak Flood Velocity

Drg Ref. NTL00206\_0019-FIG-B13

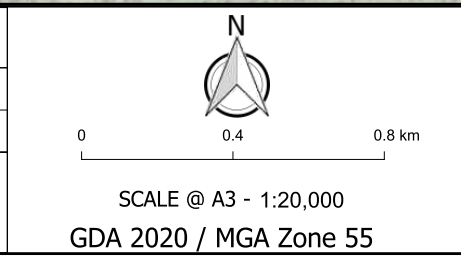


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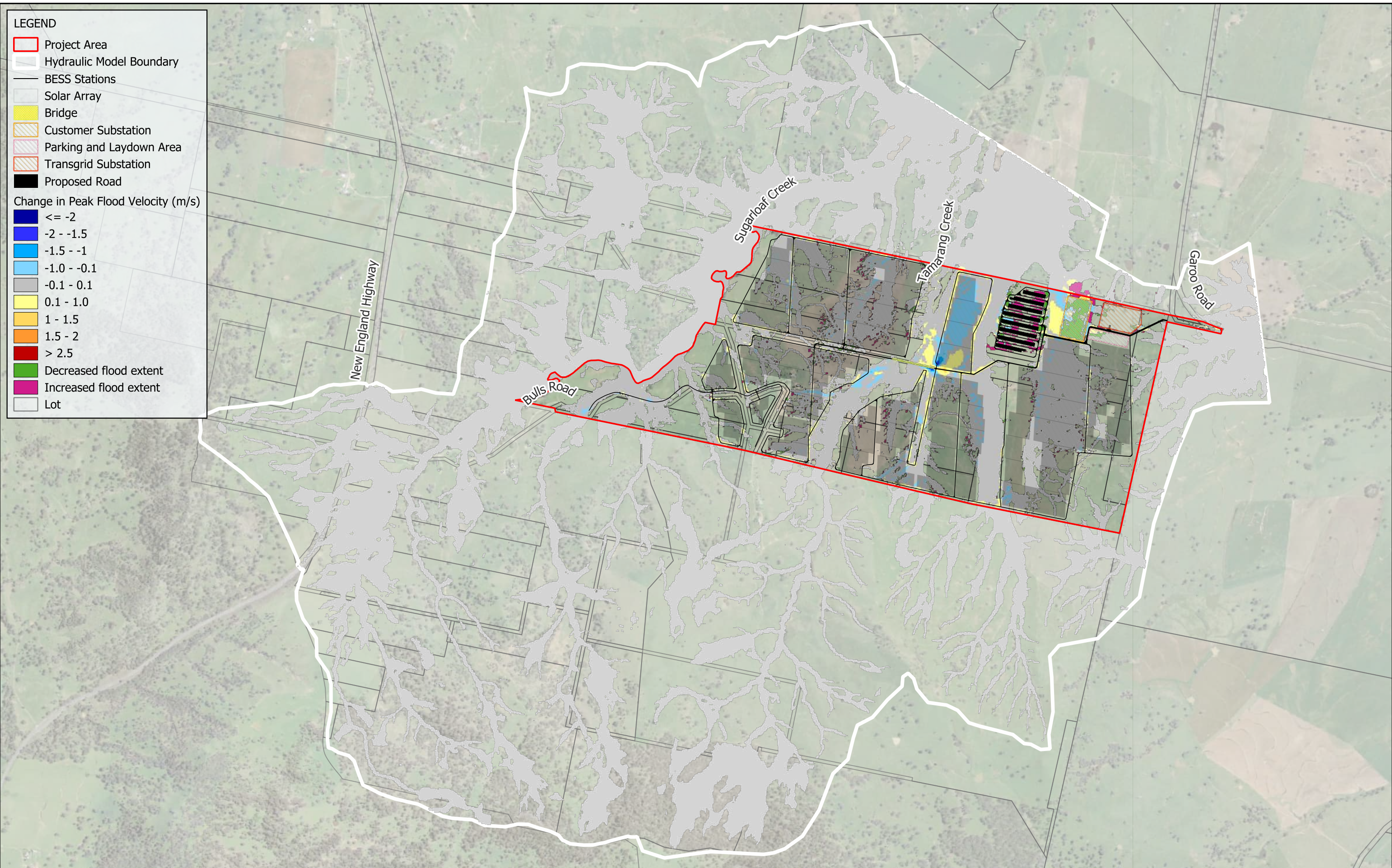
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Figure C14: Flood Afflux - 1% AEP Change in Peak Flood Velocity

Drg Ref. NTL00206\_0019-FIG-B14

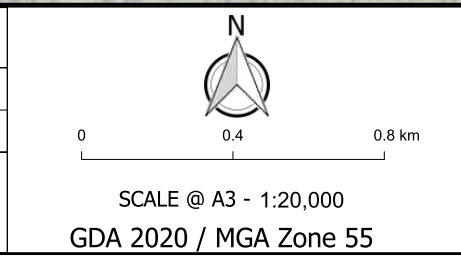


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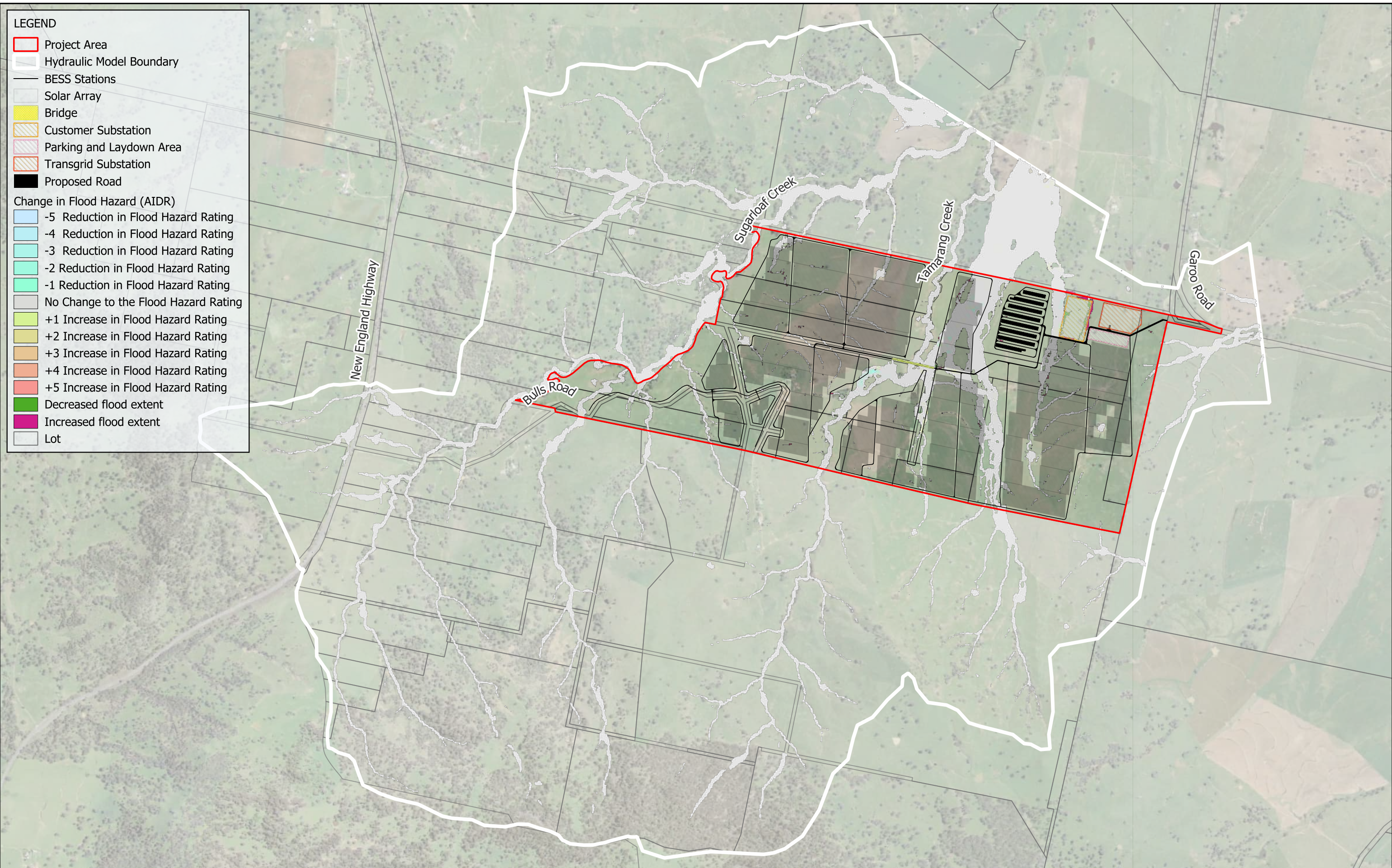
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Figure C15: Flood Afflux - PMF Change in Peak Flood Velocity

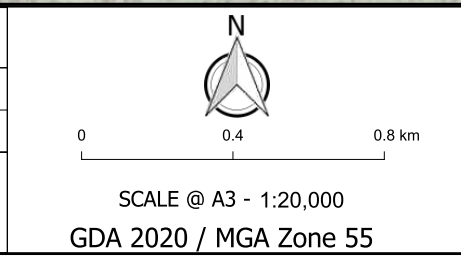
Drg Ref. NTL00206\_0019-FIG-B15



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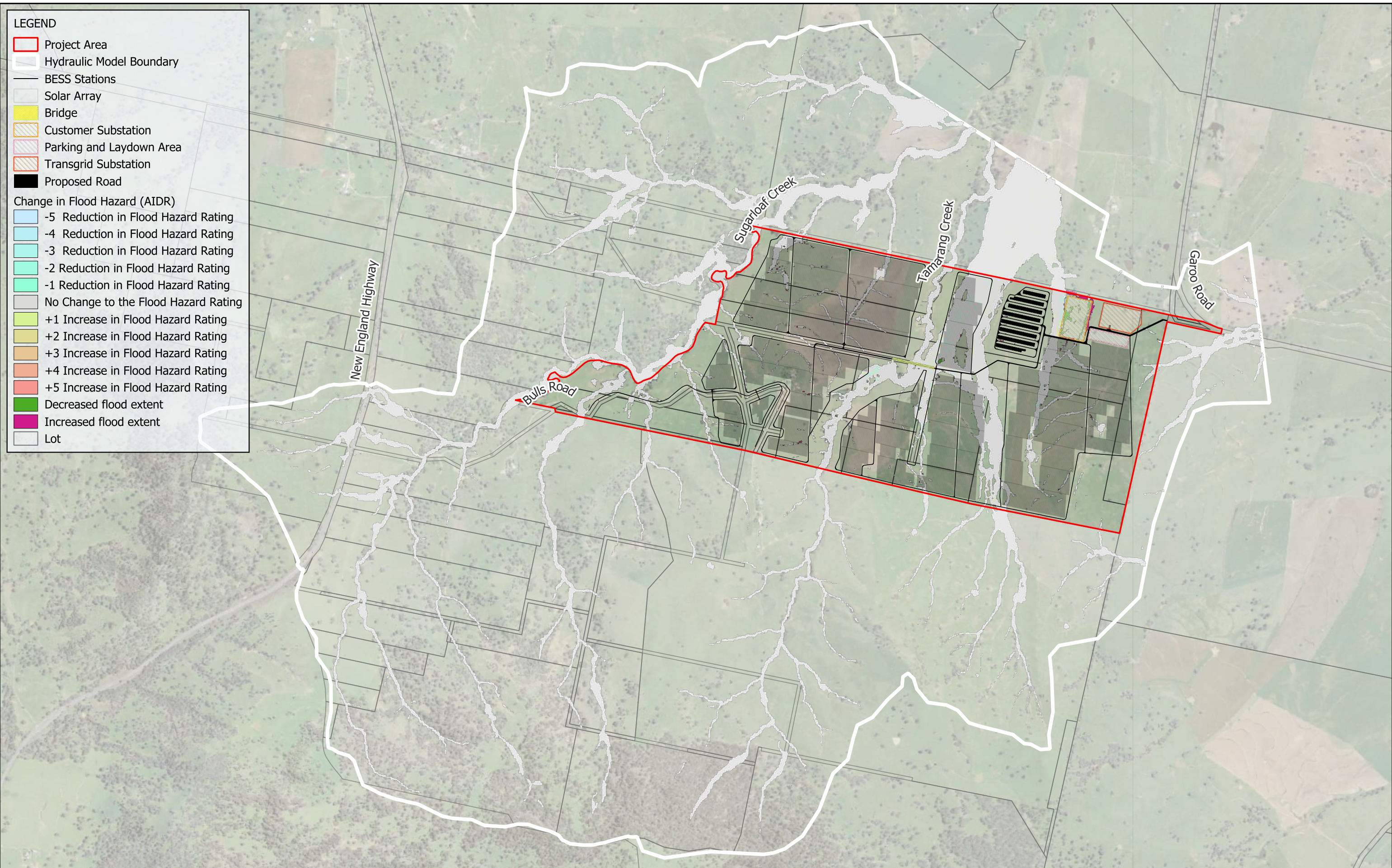
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Figure C16: Flood Afflux - 5% AEP Change in Flood Hazard Categorisation

Drg Ref. NTL00206\_0019-FIG-B16

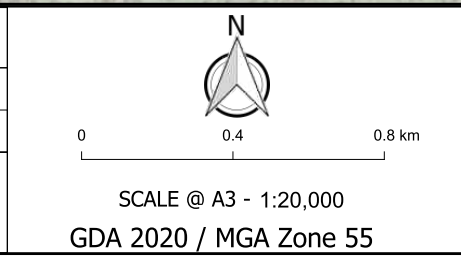


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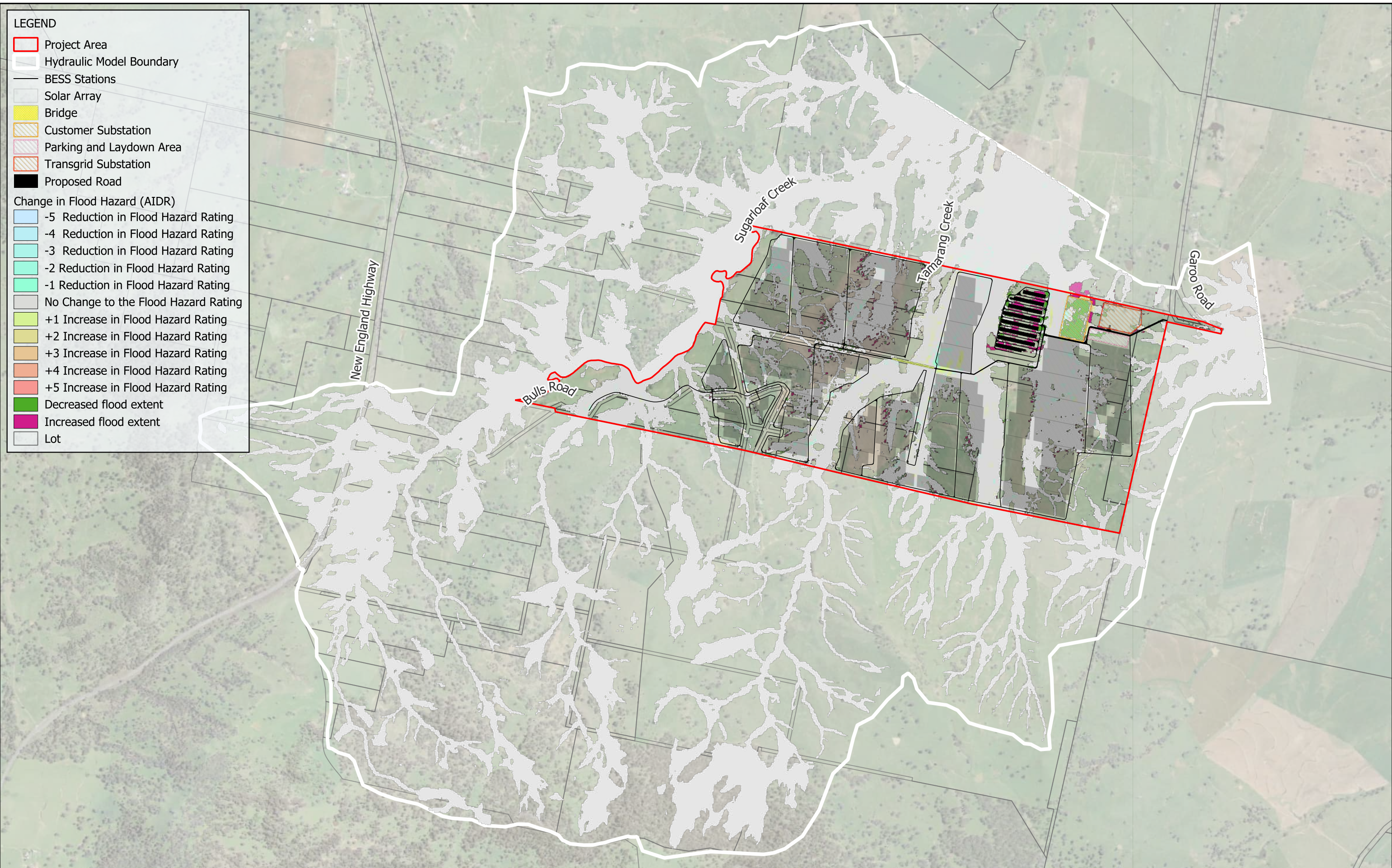
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Figure C17: Flood Afflux - 1% AEP Change in Flood Hazard Categorisation

Drg Ref. NTL00206\_0019-FIG-B17

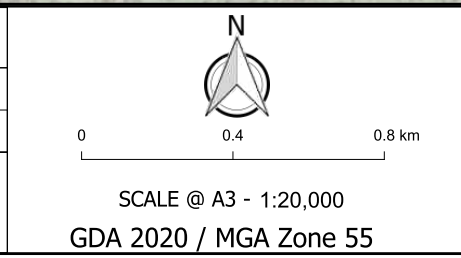


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Figure C18: Flood Afflux - PMF Change in Peak Flood Hazard Categorisation

Drg Ref. NTL00206\_0019-FIG-B18