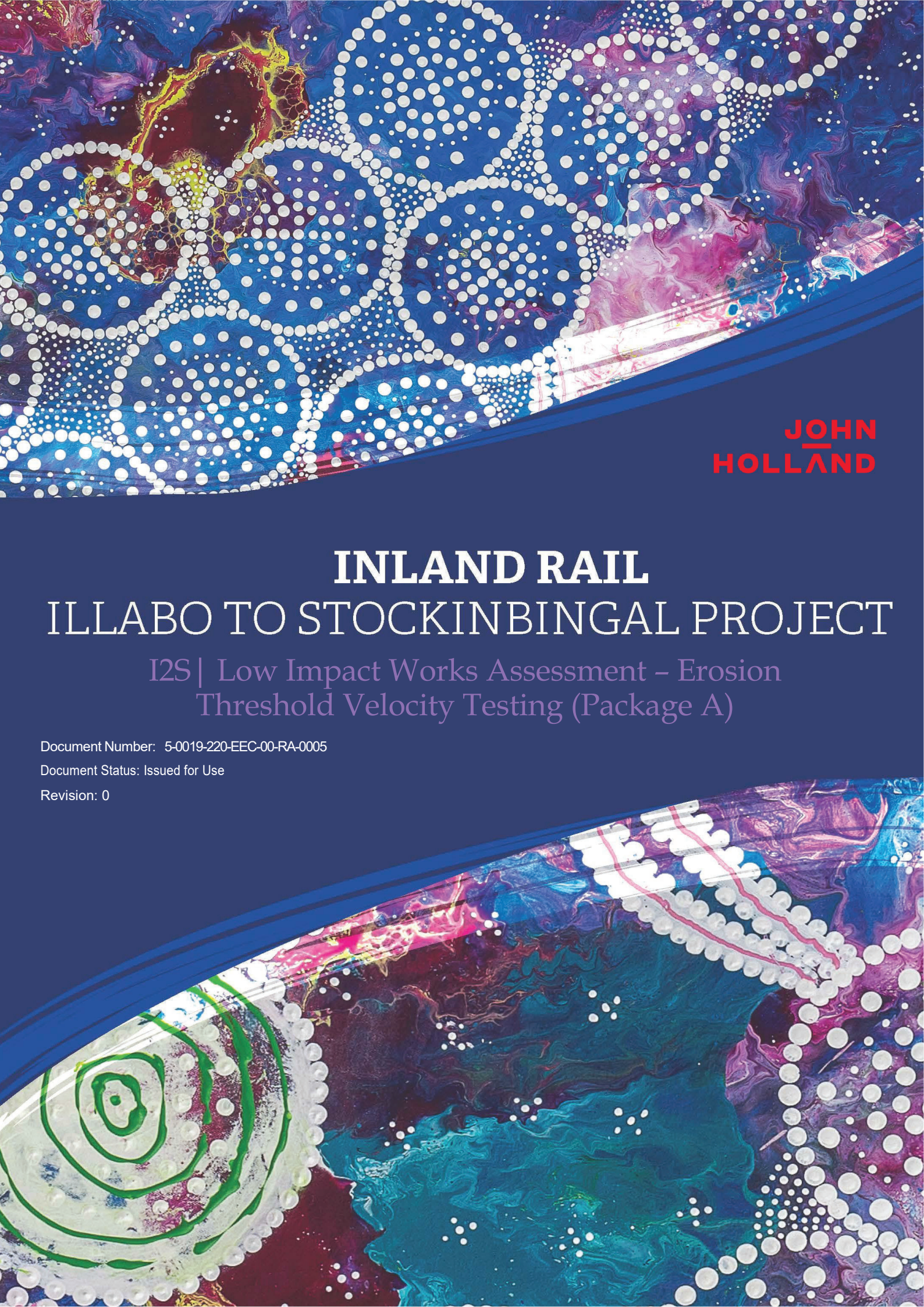




**JOHN
HOLLAND**

INLAND RAIL ILLABO TO STOCKINBINGAL PROJECT

I2S | Low Impact Works Assessment – Erosion
Threshold Velocity Testing (Package A)

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Inputs provided (i.e. review, specialist advice)	Heritage advice for low impact works.



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1 Revisions and Distribution

1.1 Revisions

Draft issues of this document are identified as Revision A, B, C etc. Following acceptance by the document approver, the first finalised revision will be Revision 0. Subsequent revisions will have an increase of “1” in the revision number (1, 2, 3 etc.).

1.2 Distribution

The controlled master version of this document is available for distribution as appropriate and maintained on the document management system being used on the project. All circulated hard copies of this document are deemed to be uncontrolled.

Client's Representative	Conrad Strachan (IRPL)
Project Director	Rob Pitt (JHG)
Rail Systems Manager	Andy Buchanan (JHG)
Quality & Completions Manager (Project Quality Representative)	Shane Aberdeen (JHG)
Environmental and Sustainability Manager	Dave Carberry (JHG)
Environmental Representative	Ricardo Prieto-Curiel (Wolfpeak)
Environmental Representative	Derek Low (Wolfpeak)
Environmental Representative	Tim Elder (Wolfpeak)

1.3 Certification

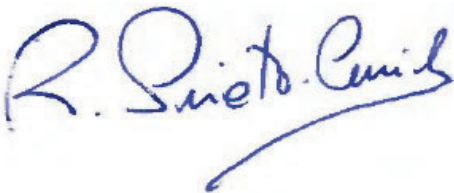
This assessment applies to the Low Impact Work definitions checked in Table 4-4.. Further to the details provided above, the proposed works are considered (tick one):

☒	Consistent with the Minister's Conditions of Approval (CoA) SSI-9406 and the definition of 'Low Impact Work' and are not defined as 'Construction'.
☐	Not consistent with the Minister's Conditions of Approval (CoA) SSI-9406 and/or defined as 'Construction'.

Environmental Representative

Note: The Environmental Representative (ER) has reviewed the Unexpected and Incidental Finds Protocol (Aconex Ref: 5-0019-220-PES-00-PR-0001) in accordance with CoA A17 and determined it to be compliant with the relevant approvals.

ER Reviewed ☒	ER Endorsed ☒	ER Approved ☐
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Signed	
Name	Ricardo Prieto-Curiel
Name	Derek Low
Name	Tim Elder
Position	Environmental Representative
Date	27 May 2025

Comments	This endorsement verifies taht the ER is satisfied that the works meet the definition of low impact works under the terms of the Approval. This endorsement does not verify that all pre-work requirements have been fulfilled
Name	

2 Definitions and Abbreviations

Definitions and abbreviations to be applied to this assessment are listed below.

2.1 Definitions and Abbreviations

Table 2-1: Definitions and Abbreviations

Term/Abbreviation	Definition
ACT	John Holland's Accountable Culture Tool
ARTC	Australian Rail Track Corporation
AMS	Activity Method Statement
Ancillary Facility	A temporary facility for construction of the CSSI including office and amenities compound, construction compound, material crushing and screening plant, batching plant, materials storage compound, maintenance workshop, testing laboratory, car parking facilities, a site used for assembly of infrastructure and a fixed material stockpile area.
A2P	Albury to Parkes
BC Act	<i>Biodiversity Conservation Act 2016</i>
BCS	Biodiversity, Conservation and Science Division of the Environment and Heritage Group of the NSW Department of Climate Change, Energy, the Environment and Water
BMSP	Biosecurity Management Sub-plan required under CoA Condition C25
CBMP	Construction Biodiversity Management Sub-Plan required under CoA Condition C20
CCS	Community Communication Strategy
CEMP	Construction Environmental Management Plan as defined in Conditions C12 and C13.
CH	Chainage
CMP	Construction monitoring Program
CNVMP	Construction Noise and Vibration Management Sub-plan required under CoA Condition C19
CoA	The Minister's Conditions of Approval for the CSSI
Construction	Includes work required to construct the CSSI as defined in the documents listed in Condition A1, including commissioning trials of equipment and temporary use of any part of the CSSI, but excluding low impact work which is carried out or completed prior to approval of the CEMP
Consultation	To provide information and actively engage with and obtain and consider feedback from stakeholders during development of post approval documents. How the feedback has been considered and whether any changes have been made in response to this feedback is then documented and communicated back to stakeholders. Consultation should not be limited to one-way notification about the project.
CSWMP	Construction Soil and Water Management Sub-plan required under CoA Condition C22
CNVMP	Construction Noise and Vibration Management Sub-Plan required under CoA Condition C19
CSSI	Critical State Significant Infrastructure, as generally described in Schedule 1 (of the Conditions of Approval), the carrying out of which is approved under the terms of the Conditions of Approval.
CTTAMP	Traffic, Transport and Access Management Sub Plan required under Condition CoA C21

Term/Abbreviation	Definition
D&C	Design and Construct
DEECCW	NSW Department of Climate Change, Energy, the Environment and Water
DPHI	Department of Planning, Housing and Infrastructure
DPI Agriculture	NSW Department of Primary Industry – Agriculture
Environmental Assessment Documentation	- Inland Rail – Illabo to Stockinbingal Environmental Impact Statement (ARTC 2022) - Illabo to Stockinbingal Project Response to Submissions (ARTC 2023) - Response to Submissions – Appendix E - Biodiversity Development Assessment Report version 12 (IRDJV, June 2024) - I2S – Mitigation Measures (Inland Rail, April 2024) - Illabo to Stockinbingal (SSI-9604) Additional and Appropriate Measures for Box Gum Woodland Impacts (Inland Rail, June 2024) - Technical and Approvals Consultancy Services: Illabo to Stockinbingal – Box Gum Woodland Gum Flat Rehabilitation Opportunity (IRDJV, June 2024)
EID	Environment in Design
EIS	The Environmental Impact Statement referred to in Condition A1 submitted to the Planning Secretary seeking approval to carry out the CSSI described in it, as revised if required by the Planning Secretary under the EP&A Act, and including any additional information provided by the Proponent in support of the application for approval of the CSSI
EMS	Environmental Management System
EMIS	Environmental Management Information System
Environment	Includes all aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings.
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPA	NSW Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
EPL	<i>Environment Protection Licence under the Protection of the Environment Operations Act 1997 (NSW)</i>
ER	Environmental Representative for the CSSI as approved by the Planning Secretary
ESCPs	Erosion and Sediment Control Plans
ESD	Ecologically Sustainable Development
ETV	Erosion Threshold Velocity
FEMP	Flood Emergency Management Sub-plan required under CoA Condition C24
GMRs	Global Mandatory Requirements
HMP	Heritage Management Sub-plan required under CoA Condition C23
Heritage NSW	Heritage NSW, Department of Climate Change, Energy, the Environment and Water
HSE	Health, Safety and Environment
IBC	Intermediate Bulk Container
Incident	An occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a non-compliance.
IMS	John Holland Integrated Management System
ISCA	Infrastructure Sustainability Council of Australia

Term/Abbreviation	Definition
ISC	Infrastructure Sustainability Council
IS	Infrastructure Sustainability
IRPL	Inland Rail Pty Ltd
I2S	Illabo to Stockinbingal
JHG	John Holland Group
km	kilometres
LAA	Land Access Agreement
LALC	Local Aboriginal Land Council
LGA	Local Government Area
LIW	Low Impact Work as defined by Table 1 of the CoA (CSSI-9406).
LIWA	Low Impact Work Assessment (i.e. this Risk Assessment document)
LLS	Local Land Services
MAF	Minor Ancillary Facility
Material Harm	is harm that: (a) involves actual or potential harm to the health or safety of human beings or to the environment that is not trivial; or - results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding \$10,000, (such loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment).
Non-compliance	An occurrence, set of circumstances or development that is a breach of this approval.
NSW	New South Wales
OEMP	Operational Environmental Management Plan
OSR	Old Sydney Road
OOHW	Out-of-Hours Work
OOHWP	Out-of-Hours Work Protocol
Planning Secretary	Planning Secretary of the Department (or nominee, whether nominated before or after the date on which this approval was granted).
PIRMP	Pollution Incident Response Management Plan
PDCA	Plan-Do-Check-Act
POEO Act	<i>Protection of the Environment Operations Act 1997 (NSW)</i>
RMAR	rail maintenance access road
RAPs	Registered Aboriginal Parties
Relevant Councils	Cootamundra Gundagai Reginal Council; Junee Council
RTS	The Proponent's response to issues raised in submissions received during the public exhibition of the CSSI application.
ROL	Road Occupancy Licence
SEARs	Secretary's Environmental Assessment Requirements
SEMP	Site Establishment Management Plan
SAP	Site Access Point
SEP	Site Environmental Plan

Term/Abbreviation	Definition
SES	NSW State Emergency Services
SIMP	Social impact Management Plan
SMART	Specific, Measurable, Achievable, Realistic and Timely
SME	Subject Matter Expert
SQE	Safety, Quality and Environment
SuMP	Construction Sustainability Management Plan
TRA	Task Risk Assessment
Total Station	Surveying tool that measures distance and angles, and is made up of a theodolite, an electronic distance metre, and a control panel.
TfNSW	Transport for NSW
The 'Blue Book'	<i>Managing Urban Stormwater – Guidelines published by Landcom, 2004</i> and used for industry best practice erosion and sediment control planning and management
UMMs	Updated Mitigation Measures
Work	Any physical work for the purpose of the CSSI including construction and low impact work but not including operational maintenance work
WRA	Workplace Risk Assessment

3 Introduction

3.1 Background

Inland Rail is an approximate 1,600 kilometres (km) freight rail network that will connect Melbourne and Brisbane via regional Victoria, New South Wales (NSW) and Queensland. Comprising 12 sections, a staged approach is being undertaken to deliver Inland Rail.

The Australian Rail Track Corporation (ARTC), with Inland Rail Pty Ltd (IRPL) as its subsidiary for the Inland Rail project, received infrastructure approval for the Illabo to Stockinbingal (I2S) section of Inland Rail in September 2024. The approval for I2S (the Project) was granted by the Minister for Planning and Public Spaces under section 5.19 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act).

The Project is located in south-western New South Wales (NSW) in the Riverina region (Figure 1-1). Illabo is a small town of approximately 132 people (Australian Bureau of Statistics, 2021) located at the southern end of the alignment, 16 kilometres (km) north-east of Junee in the Junee Local Government Area (LGA). Stockinbingal is a town of approximately 347 people (Australian Bureau of Statistics, 2021) is situated at the northern end of the project, approximately 20 km north-west of Cootamundra in the Cootamundra–Gundagai Regional LGA. The major towns surrounding the project are Wagga Wagga, about 50 km to the south, Young to the north-east and Cootamundra to the east.

The Project comprises a new rail corridor that would connect Illabo to Stockinbingal. The alignment branches out from the existing rail line north-east of Illabo and travels north to join the Stockinbingal–Parkes Line west of Stockinbingal. The route will travel primarily through undeveloped land predominantly used for agriculture. The project includes modifications to the tie-in points at Illabo and Stockinbingal to allow for trains to safely enter and exit the Illabo to Stockinbingal section of Inland Rail. The alignment also crosses several local and private roads, watercourses and privately owned properties. Additionally, no major towns are located within the project site between Illabo and Stockinbingal.

The Project will include a total extent of approximately 42.5 km, including 39 km of new, greenfield railway which will incorporate the following key features:

- Connection to other rail lines, including Stockinbingal to Parkes line, Lake Cargelligo line, and Main Southern Railway
- One crossing loop and maintenance siding
- Level crossings and stock crossings
- Bridges over rivers and other watercourses, floodplains, and roads
- Upgrades of around 3.5km of existing track for the tie-in works to the existing Main South Line at Illabo
- New track to maintain Lake Cargelligo line connection either side of the proposal
- Realignment and road-over rail bridge for a section of the Burley Griffin Way at Stockinbingal
- Realignment of Ironbong Road to allow for safe sight lines at the new active level crossing
- Ancillary infrastructure to support the proposal, inclusive of signalling and communications, drainage, drainage control areas, signage and fencing, and services and utilities
- Construction infrastructure, including ancillary facilities, and a temporary workforce accommodation facility

The Project will also include upgrades to approximately 3 km of existing track associated with tie-in works and construction of an additional 1.7 km of new track to maintain the existing rail network connections. Road upgrade works will also be undertaken to re-align approximately 1.4 km of Burley Griffin Way to provide a road-over-rail bridge at Stockinbingal. Re-alignment of Ironbong Road will also be completed to allow for safe sight lines. A temporary workforce accommodation camp will also be constructed to house the workforce for the duration of works.

3.2 Purpose of this Report

The purpose of this Low Impact Work Assessment (LIWA) is to provide an assessment of environmental impacts for the low impact works associated with Erosion Threshold Velocity (ETV) testing on I2S, and to determine if the proposed activities meet the LIW definition as provided in the Conditions of Approval (CoA) (CSSI-9406) (refer to Table 4-4).

The LIWA provides an overview of the activities and approach that John Holland Group (JHG) will take to undertake Low Impact Works (LIW). It also includes the mitigation measures to be applied throughout the LIW.

This report is applicable to only the activities and the locations listed in Table 4-2 of this report. This assessment includes:

- a list of proposed activities and their locations to be completed
- Site Environmental Plans (Appendix A—Site Environmental Plans (SEPs))
- outlines how John Holland (JHG) propose to manage LIW, related to the following aspects, during LIW works associated with the I2S Project:
 - Heritage (both Aboriginal Heritage and non-Aboriginal Heritage)
 - Biodiversity and Biosecurity
 - Noise and Vibration
 - Soils
 - Erosion and Sediment Control
 - Contamination
 - Waste
 - Traffic and Transport
 - Access
 - Specialist mitigation and advice where required (i.e. in areas where specialist advice would be needed to address potential impacts).

The relevant CoA, Revised Mitigation Measures (RMMs) and ARTC Construction Environmental Framework – A2P (Document Ref No: 0-0000-900-EEC-00-SP-0002_2) will be implemented to minimise potential environmental impacts and to inform JHG staff and subcontractors of the environmental requirements associated with LIW activities. Additionally, the Unexpected and Incidental Finds Protocol has been developed in accordance with CoA Condition A17 and will be implemented during all LIW activities for the Project. A copy of the Unexpected and Incidental Finds Protocol is available via Aconex (reference: **5-0019-220-PES-00-PR-0001**). Table 3-1 provides an overview of the conditions that need to be met prior to the commencement of LIW and how these have been complied with.

Table 3-1: Conditions required to be complied with prior to the commencement of Low Impact Work

Condition (CoA SSI-9406)	How the condition has been satisfied
A17 Prior to the commencement of low impact work, an Unexpected and Incidental Finds Protocol must be developed for: a) threatened species and threatened ecological communities; b) contamination, hazards and contaminated land; c) Aboriginal Cultural Heritage; and d) non-Aboriginal Heritage. The Unexpected and Incidental Finds Protocol must include procedures for: i) all Work in the associated location to stop to prevent further impact; and ii) notifying the Planning Secretary and relevant state agencies in writing. Work must not recommence until the relevant state agencies have been consulted and any required approvals have been obtained. The Unexpected and Incidental Finds Protocol must be made publicly available prior to low impact work commencing and must be implemented during low impact work.	An Unexpected and Incidental Finds Protocol has been developed for the project in accordance with CoA A17. The Protocol has been made publicly available. Aconex reference: 5-0019-220-PES-00-PR-0001
E143 An Unexpected Heritage Finds and Human Remains Procedure must be prepared to manage unexpected heritage finds in accordance with any guidelines and standards	An Unexpected and Incidental Finds Protocol has been developed for the project in accordance with

Condition (CoA SSI-9406)	How the condition has been satisfied
prepared by Heritage NSW and submitted to the Planning Secretary for information before the commencement of Work.	CoA E143. The Protocol has been made publicly available. Aconex reference: 5-0019-220-PES-00-PR-0001
E144 The Unexpected Heritage Finds and Human Remains Procedure, as submitted to the Planning Secretary, must be implemented for the duration of Work. <i>Note: Human remains that are found unexpectedly during the carrying out of Work may be under the jurisdiction of the NSW State Coroner and must be reported to the NSW Police immediately</i>	An Unexpected and Incidental Finds Protocol has been developed for the project in accordance with CoA E144. The Protocol has been made publicly available. Aconex reference: 5-0019-220-PES-00-PR-0001
E117 The Proponent must prepare and implement a Workforce Code of Conduct for employees and contractors involved in the construction of the CSSI. The Code of Conduct must be prepared by a suitably qualified and experienced person(s) in the human resources sector and made publicly available prior to work commencing. The Code of Conduct sets out the ethical standards that employees are expected to adhere to in the construction site and interaction with the local community.	The Workforce Code of Conduct has been made publicly available. The approved Workforce Code of Conduct is available via Aconex reference: 5-0019-220-PHR-00-SM-0001
B3 The Community Communication Strategy must be submitted to the Planning Secretary for approval no later than one (1) month before the commencement of any Work.	The Community Communication Strategy was approved by the Planning Secretary on the 13/11/24. Aconex reference: 6-0001-220-EEC-00-LT-0003
B12 A Community Complaints Mediator that is: a) independent of the design and construction personnel; and b) accredited under the National Mediator Accreditation System, administered by the Mediator Standards Board must be nominated by the Proponent, approved by the Planning Secretary and engaged while the Complaints Management System required by Condition B6 is in operation. The nomination of the Community Complaints Mediator must be submitted to the Planning Secretary for approval within one month before the commencement of Work.	A Community Complaints Mediator (Jack Ellis) was appointed to the project by the DPHI on 1/10/2024. Aconex reference: IR2200-DCACT-000879
A7 The Department must be notified in writing of the dates of commencement of Work (in relation to low impact works), construction and operation at least one (1) month before those dates.	Notification of commencement of LIW was issued to the Department on 4/10/24. Aconex reference: 6-0000-220-EEC-00-LT-0007
B18 A website or webpage providing information in relation to the CSSI must be established before commencement of Work and maintained for the duration of construction, and for a minimum of 24 months following the completion of construction, or unless otherwise agreed with the Planning Secretary. Up-to-date information (excluding	A website has been established for the Inland Rail program, available at: https://inlandrail.com.au

Condition (CoA SSI-9406)	How the condition has been satisfied
confidential commercial information) must be published before the relevant work commencing and maintained on the website or dedicated pages including: - information on the current implementation status of the CSSI; - a copy of the documents listed in Condition A1 of this approval, and any documentation relating to any modifications made to the CSSI or the terms of this approval; - a copy of this approval in its original form, a current consolidated copy of this approval (that is, including any approved modifications to its terms), and copies of any approval granted by the Minister to a modification of the terms of this approval; - a copy of each statutory approval, licence or permit required and obtained in relation to the CSSI; - a current copy of each document required under the terms of this approval must be published before the commencement of any work to which they relate or before their implementation, as the case may be; and - a copy of the compliance and audit reports required under this approval. A copy of each document required to be made publicly available under this approval must be published within 14 days of the finalisation or approval of the relevant document unless an alternate timeframe is prescribed by another condition of this approval. Where the information / document relates to a particular work or is required to be implemented, it must be published before the commencement of the relevant work to which they / it relates or before its implementation. All information required in this condition is to be provided on the Proponent's website, ordered in a logical sequence and be easy to navigate. Notes: <i>The intention of this condition is to increase transparency and for information/documents required as part of the approval to be provided proactively and publicly in an easily accessible manner. Where information is excepted by this condition, it is intended that these documents are provided in their redacted form.</i> <i>The Planning Secretary may instruct the Proponent to finalise and upload any report or documents to the Project's website in accordance with Condition A4.</i> <i>The publishing of documents should occur a minimum of a week before the relevant Work / activity is going to commence.</i> <i>In determining what information should be published under this condition, the proponent should have regard to the principles in Division 2 of Part 2 of the Government Information (Public Access) Act, 2009.</i>	

Condition (CoA SSI-9406)	How the condition has been satisfied
5. Documents should be named to be consistent with the conditions of approval where possible. The name should also give an overall impression of what the document is about. The names should be simple and concise (no more than 50 characters) without any unnecessary punctuation or under scoring in the title.	
B7 The Complaints Management System must make the following information publicly available to facilitate community enquiries and manage complaints, from one (1) month before the commencement of Work and for 12 months following the completion of construction of the CSSI: - a 24- hour telephone number for the registration of complaints and enquiries about the CSSI; - a postal address to which written complaints and enquires may be sent; - an email address to which electronic complaints and enquiries may be transmitted; and - a mediation system for complaints unable to be resolved. This information must be accessible to all in the community regardless of age, ethnicity, disability or literacy level.	Complaints Management System prepared and information under the Complaints Management System made public available in the following website: https://inlandrail.com.au/
E3 Despite Conditions E1 and E2 work may be undertaken outside the hours specified in the following circumstances: (a) Safety and emergencies, including: (i) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or (ii) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or (b) Low impact noise activities, including: (i) construction that causes LAeq(15 minute) noise levels: • no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, and • no more than the 'noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land uses; and ii) construction that causes LAFmax noise levels no more than 15 dB(A) above the rating background level at any residence during the night period as defined in the Noise Policy for Industry (EPA, 2017); and (iii) construction that	LIW must comply with the parameters set in CoA E3 (b) where Out of Hours Works are proposed to be undertaken outside the rail corridor (as described in the definition of 'Low impact work' in SSI-9406). All ETV is proposed outside of the existing ARTC rail corridor.

Condition (CoA SSI-9406)	How the condition has been satisfied
causes: • continuous or impulsive vibration values, measured at the most affected residence, are no more than the preferred values for human exposure to vibration specified in Table 2.2 of Assessing vibration: A technical guideline (DEC, 2006), or • intermittent vibration values, measured at the most affected residence, are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing vibration: A technical guideline (DEC, 2006); or (c) By approval or agreement, including: (i) where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or (ii) works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol as required by Condition E5; or (iii) negotiated agreements with directly affected residents and sensitive land uses. On becoming aware of the need for emergency work in accordance with Condition E3(a)(ii) above, the ER, the Planning Secretary and the EPA must be notified of the reasons for such work. The Proponent must use best endeavours to notify as soon as practicable all noise and/or vibration affected sensitive land uses of the likely impact and duration of those work. All negotiated agreements with owners and occupiers of sensitive land uses to carry out work in accordance with Condition E3(c)(iii) must be in writing, and include the hours, duration and likely noise levels compared to the NML defined in the ICNG. The negotiated agreement must be agreed and finalised before the commencement of work affecting the sensitive land uses.	
E62 The methodology/ies used to determine the ETVs must be submitted to and approved by the Planning Secretary in advance of submitting the Erosion Threshold Velocities Report required by Condition E60 for the Planning Secretary's approval.	The methodology for the ETV testing included in this assessment is provided in Appendix F – Landloch ETV Methodology The methodology was submitted to DPHI on the 07/05/2025.
The following conditions must be met prior to Works, however, are not applicable to this assessment:	
E135 Prior to the commencement of any ground disturbance work within areas identified as requiring archaeological investigation or salvage identified in documents listed in Condition A1, the Proponent must prepare and implement an Additional Aboriginal Archaeological Survey Methodology and an Aboriginal Archaeological Test Excavation Methodology.	No ground disturbing LIW included in this assessment is proposed within areas identified as requiring archaeological investigations or salvage.

Condition (CoA SSI-9406)	How the condition has been satisfied
The methodology must include procedures for additional archaeological survey of Zones 5, 6, 9 and 10, and management protocols including consultation with the Registered Aboriginal Parties, for any Aboriginal objects and sites identified during the survey.	
E140 Ground disturbance works and construction work may not commence in those areas where archaeological excavation and surface collection of Aboriginal objects is required (including areas identified as requiring further assessment) until the archaeological works described in the Aboriginal Cultural Heritage Assessment reports listed in Condition A1 have been completed.	No ground disturbing LIW included in this assessment is proposed within areas identified as requiring archaeological investigations or surface collection.
E145 Before commencement of any work, a structural engineer must undertake condition surveys of all buildings, structures, utilities and the like identified in the documents listed in Condition A1 as being at risk of damage. The results of the surveys must be documented in a Condition Survey Report for each item surveyed. Copies of Condition Survey Reports must be provided to the owners of the items surveyed, and no later than one month before the commencement of construction.	No buildings or structures identified in the Environmental Assessment Documentation as being at risk of damage are affected by the LIW included in this assessment. For DPHI correspondence on the interpretation of this condition, please see Aconex reference: IR2200-CA-000017

4 Description of the Proposed LIW Activities

Table 4-1 Details of proposed works

Details of Proposed Works	
Purpose of the proposed low-impact works	The proposed works are Erosion Threshold Velocity (ETV) testing. ETV testing is used to determine the critical shear stress for initiation of erosion scour and the associated ETV for a range of slope gradients. ETV testing must be conducted to inform the ETV Report required under CoA E61.
Description of the proposed low-impact works	Scope: The scope of works covered in this assessment is ETV Testing. The ETV testing will be undertaken at varying locations along the alignment, where JH have determined that a replacement of the default ETV of 0.5m/s is required. The locations chosen for ETV testing are a result of flood modelling undertaken on the Project. Flood mapping and associated ETV testing is provided in Appendix G – Flood Mapping, showing ETV compliances and non-compliance with Quantitative Design Limits. Access: • Via existing farm tracks, gates and public road corridors. Site Location / Description: • Between the townships of Illabo and Stockinbingal, within the Cootamundra-Gundagai LGA and Junee Shire LGA • ETV testing will be conducted at a number of locations along the alignment. These locations are provided in Appendix A—Site Environmental Plans (SEPs). • All testing is to be undertaken within the CIZ. Methodology: The methodology for the work to be completed by the ETV subcontractor (Landloch) is provided in Appendix F – Landloch ETV Methodology. The methodology was submitted to DPHI on the 07/05/2025, and must be approved by the Planning Secretary in advance of submitting the Erosion Threshold Velocities Report required by CoA E60 for the Planning Secretary's approval. Approval of the Methodology by the Planning Secretary is not required prior to the commencement of ETV testing.
Proposed plant and equipment	• 1x 6t excavator • 2x hand tools • 3x Light vehicles • 3x Trailers attached to light vehicles • 2x Guide sleepers • 2x Sampling frames
Proposed dates of works:	The works proposed as part of this assessment are for a period commencing following the approval of this LIWA (est. late May, 2025) to the commencement of Construction, subject to all relevant approvals being obtained.
Will works outside of the standard hours of construction be required? <i>Standard hours as specified by the relevant SSI approval.</i>	If 'Yes', justification is to be provided, and an activity specific noise assessment is required to predict potential noise impacts and identify impacted sensitive receivers: Not anticipated. The approved working hours for the LIW activities included in this on the Project are (CoA E1) assessment are: • Monday to Friday: 7am to 6pm • Saturday: 7am to 6pm • Sunday and public holidays: no work Where OOHW are required, works will be subject to CoA E3 (b), as per the definition of 'Low impact work' in SSI-9406. Any relevant OOHW must be obtained prior to the

Details of Proposed Works

commencement of OOHW activities. Any relevant OOHW approvals must be obtained prior to the OOHWs. All OOHWs must be justified with an assessment prior to the commencement of OOHW activities.

Despite Conditions E1 and E2 work may be undertaken outside the hours specified in the following circumstances:

(a) Safety and emergencies, including:

(i) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or

(ii) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or

(b) Low impact noise activities, including:

(i) construction that causes LAeq(15 minute) noise levels:

- no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, and

- no more than the 'noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land uses; and

(ii) construction that causes LAFmax noise levels no more than 15 dB(A) above the rating background level at any residence during the night period as defined in the *Noise Policy for Industry* (EPA, 2017); and

(iii) construction that causes:

- continuous or impulsive vibration values, measured at the most affected residence, are no more than the preferred values for human exposure to vibration specified in Table 2.2 of *Assessing vibration: A technical guideline* (DEC, 2006), or

- intermittent vibration values, measured at the most affected residence, are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of *Assessing vibration: A technical guideline* (DEC, 2006); or

(c) By approval or agreement, including:

(i) where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or

(ii) works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol as required by Condition E5; or

(iii) negotiated agreements with directly affected residents and sensitive land uses.

On becoming aware of the need for emergency work in accordance with Condition E3(a)(ii) above, the ER, the Planning Secretary and the EPA must be notified of the reasons for such work. The Proponent must use best endeavours to notify as soon as practicable all noise and/or vibration affected sensitive land uses of the likely impact and duration of those work.

All negotiated agreements with owners and occupiers of sensitive land uses to carry out work in accordance with Condition E3(c)(iii) must be in writing, and include the hours, duration and likely noise levels compared to the NML defined in the ICNG. The negotiated agreement must be agreed and finalised before the commencement of work affecting the sensitive land uses.

A noise assessment has been conducted for the works included in this application, provided in Appendix B—Noise Assessment.

Details of Proposed Works	
Other relevant licenses and approvals	No works in this assessment are required to be undertaken under a possession arrangement, or within an existing rail corridor.

A list of the access gates that will be utilised to access the works location has also been included below in Table 4-3. Any Minor Ancillary Facilities (MAFs) required for these works will be applied for in a separate application and will be subject to approval by the ER in accordance with CSSI CoA C9. A 10–20 meter buffer has been applied for the ETV testing to allow for contingency and flexibility in response to on-site conditions varying from the time of their initial constructability assessment. The buffer on the ETV sites is visible in Appendix A—Site Environmental Plans (SEPs)

Table 4-2: LIW ETV testing locations

Testing Location (ID#)	Relevant Landholder(s)	Chainage	Relevant SEP (Appendix A—Site Environmental Plans (SEPs))
1	Property #1 - Pam McInerney and Peter Curran	433	ETV_1
105	Property # 2 - David and Jenny Thompson	1515	ETV_2
2	Property #4 – John Green	5640	ETV_3
3	Property #4 – John Green	6060	ETV_4
4	Property #6 – Tony Lloyd-Jones	8340	ETV_5
5	Property #5 – Mal and Maria Lloyd-Jones	9964	ETV_6
6	Property #5 – Mal and Maria Lloyd-Jones	10175	ETV_6
7	Property ARTC Deakin & Gumflat	12600	ETV_7
8	Property ARTC Deakin & Gumflat	13000	ETV_8
9	Property ARTC Deakin & Gumflat	13635	ETV_9
12	Property ARTC Deakin	18200	ETV_10
14	Property ARTC Deakin	21700	ETV_11
106	Property #11 - Charlie Ryals	25100	ETV_12
16	Property #12 – Nigel Emery	28100	ETV_13
102	Property #13 – Peter McClintock	29780	ETV_14
103	Property #18 Peter Kepreotes (Tony Hill)	35890	ETV_15
17	Property ARTC – Harold Park	37680	ETV_16
18	Property #21 – Craig Morton	39950	ETV_17

Table 4-3: Existing access gates to be used for the works

SAP ID	Location	Gate Location (CH)	Property Boundary
i	Existing Olympic Hwy LX	-700	01 - Pam McInerney & Peter Curran
XLVIII	Warrens Lane	400	01 - Pam McInerney & Peter Curran
XLIX	Old Sydney Rd	1300	2 – Davis & Jenny Thompson
2	Olympic Highway	2793	2 – Davis & Jenny Thompson 3 – Helen Dunstan
3 South	Old Sydney Rd	5600	3 – Helen Dunstan
3 North	Old Sydney Rd	5600	04 - John Green
xxxix	Ironbong Rd	8000	05 - Mal & Maria Lloyd-Jones
4	Ironbong Rd	8200	06 - Tony Lloyd-Jones
li	Eulomo Settlement Rd	8750	05 - Mal & Maria Lloyd-Jones
lii	Ironbong Rd	8750	06 - Tony Lloyd-Jones
xxxv	Ironbong Rd	8800	05 - Mal & Maria Lloyd-Jones, 06 - Tony Lloyd-Jones
xxxvi	Ironbong Rd	9700	05 - Mal & Maria Lloyd-Jones
4A	Ironbong Rd	11400	05 - Mal & Maria Lloyd-Jones ARTC (Deakin), ARTC (Gumflat)
iv	Ironbong Rd	11950	ARTC (Deakin), ARTC (Gumflat)
vii	Ironbong Rd	16000	7 – Eric & Diane McKenzie; Yvette McKenzie
xii South Access	Dirnaseer Rd	18450	7 – Eric & Diane McKenzie; Yvette McKenzie
xiii	Private Road of Dudauman Road South	19800	08 / 09 – Chris Friend 10 – David Carr (CC)
xix	Private Road of Old Cootamunda Road	24580	11 – Charlie Ryals 12 – Nigel Emery
xxi	Private Road of Old Cootamundra Road	27470	12 – Nigel Emery
6	Old Cootamundra Rd	28250	12 - Nigel Emery, 13 - Peter McClintock
LIII	Dudauman Rd North	29950	13 - Peter McClintock
7	Private Rd of Dudauman Rd North	30850	15 - Tony & Diana Hill
LI	Dudauman Rd North	31000	15 - Tony & Diana Hill
xxii	Dudauman Rd North	32150	14 - Tony & Diana Hill; Alex Hill
xxiii	Dudauman Rd North	32150	14 - Tony & Diana Hill; Alex Hill
xxx	Corbys Lane	33780	16 – Tony & Diana Hill; Alex Hill, 17 – Tim Berryman
7A	Dudauman Rd North	34950	18 – Peter Kepreotes (Tony Hill)
LII	Temora St	37200	17 – Tim Berryman
8	Burley Griffin Way (East)	37250	17 – Tim Berryman
xxvi	Burley Griffin Way (West)	37300	ARTC – Harold Park
XLV	Burley Griffin Way (East)	37500	19 – Linx Haulage
XLIV	Hibernia St	37550	Stockinbingal Yard
10	Hibernia St	37550	Stockinbingal Yard
XLIII	West St	37700	20 – Little & Gray

xxxi	West St	38200	21 – Craig Morton
11	Grogan Road	40250	21 – Craig Morton
xxix	McLaughlins Ln	40700	21 – Craig Morton
xxvii	McLaughlins Ln	40700	21 – Craig Morton
XLI	Grogan Road	40950	ARTC Corridor
XLII	Freeman's Lane	41665	ARTC Corridor

4.1 Conditions of Approval and Classification of LIW

This assessment has been developed in accordance with the Condition of Approval (CoA) definitions of Low Impact Work, which is provided in Table 4-3. The checked boxes indicate the applicable clauses of LIW definition that is included in this assessment.

Table 4-4: LIW as defined in the CoA

Ref	Description The work subject to this submission meets the definition of Low Impact Work under SSI 9406 by being (where a green shaded check box is ticked, the ER shall endorse this form):	Applicable
(a)	survey works including carrying out general alignment surveys, installing survey controls (including installation of global positioning system (GPS)), installing repeater stations, carrying out surveys of existing and future utilities and building and road dilapidation surveys;	☐
(b)	Investigations including investigative drilling, contamination investigations and excavation	☒
(c)	installation of mitigation measures including erosion and sediment controls, temporary exclusion fencing for sensitive areas and acoustic treatments;	☒
(d)	property acquisition adjustment work including installation of property fencing;	☐
(e)	archaeological testing under the Code of practice for archaeological investigation of Aboriginal objects in NSW (Department of Environment Climate Change and Water, 2010) or archaeological monitoring undertaken in association with Low Impact work to ensure that there is no impact on heritage items;	☐
(f)	archaeological and cultural salvage undertaken in accordance with a strategy or salvage operation required by the conditions of this approval;	☐
(g)	maintenance work to existing buildings and structures as required to facilitate the carrying out of the CSSI; and	☐
(h)	other activities determined by the ER to have minimal environmental impact which may include relocation and connection of utilities, establishment of minor ancillary facilities in accordance with Condition C9 construction of minor access roads (other than access roads' connection to the road network), temporary relocation of pedestrian paths and the provision of property access.	☐
(i)	Site establishment work approved under a Site Establishment Management Plan in accordance with Condition C5.	☐
Despite the above, the following works are not Low Impact Work:		
(i)	where heritage items, or threatened species or their habitat, or threatened ecological communities (within the meaning of the Biodiversity Conservation Act 2016), are adversely affected or potentially adversely affected by any low impact work as defined in (a) to (i) above, that work is construction, unless otherwise determined by the Planning Secretary in consultation with Heritage NSW, BCS or DPI Fisheries (in the case of impact upon fish, aquatic invertebrates or marine vegetation); and	☐

Ref	Description The work subject to this submission meets the definition of Low Impact Work under SSI 9406 by being (where a green shaded check box is ticked, the ER shall endorse this form):	Applicable
(ii)	any Work undertaken outside the hours specified in Condition E1 that exceeds noise management and vibration levels as identified in Condition E3(b)	☐
Will Low Impact Work?		
Adversely affect or potentially adversely affect Heritage Items		YES ☐ NO ☒
Adversely affect or potentially adversely affect Threatened Species (or their habitat)		YES ☐ NO ☒
Adversely affect or potentially adversely affect Threatened Ecological Communities (within the meaning of the <i>Biodiversity Conservation Act 2016</i>)		YES ☐ NO ☒
Adversely affect or potentially adversely affect matters of national significance (within the meaning of the <i>Environmental Protection and Biodiversity Conservation Act 1999</i>)		YES ☐ NO ☒
If the answer is "YES" to any of the above, then the work is Construction (unless otherwise agreed or determined by the Planning Secretary in consultation with Heritage NSW, EHG or DPI Fisheries.		

JHG has determined that the proposed LIW activities meet clause (b) investigations including investigative drilling, contamination investigations and excavation. The determination of these proposed works being LIW is provided in Section 8 of this document.

4.2 Change Management

In accordance with Condition A27(b) of the Environmental Impact Statement (EIS) and the Conditions of Approval (CoAs), the Project team has initially identified locations for each Low Impact Work (LIW) activity for the ER's consideration by evaluating:

- Proximity to a sensitive receiver or environment
- Environmental constraints identified within existing GIS layers of the EIS
- Subject matter expert (SME) advice
- General requirements of the EIS, CoA and associated IRPL and JHG IRPL guidelines and documents.

To comply with the CoAs and to ensure the ER is involved in the change management process, the process for managing changes for access or any other scope associated with works in this LIW will be the following:

1. If the scope of work or access is found that it will deviate from the detail or maps included in the LIWA document, The Project team will contact the JHG Environmental Representative to advise of the change.
2. Details of the change including relevant evidence documentation will be provided to the ER and IRPL over Aconex, which will require review by IRPL and endorsement or approval by the ER. The documentation provided must show that the new location or activity has been assessed, and confirmation that the changes are of low impact and remain consistent with the definition of Low Impact Work under SSI-9406.

5 Workforce Notification

5.1 Induction

All personnel (including sub-contractors) will attend a compulsory site induction that includes an environmental component prior to commencement on-site. This is done to ensure all personnel involved in the Project are aware of the requirements of LIW and to ensure the implementation of mitigation measures as indicated in this assessment. The Project induction includes a summary of the following environmental factors:

- Obligations on I2S, including individual obligations under the *Protection of the Environment Operations Act 1997 (NSW)* and approvals (SSI-9406) and EPBC (2018-8233).
- Noise and vibration
- Waste management

- Biodiversity and biosecurity
- How to use and follow a Site Environmental Plan (SEP)
- Water
- Soil, erosion and sediment control
- Heritage (including Aboriginal and non-Aboriginal Heritage)
- Contamination
- Complaints management procedure.

5.2 Pre-Start Briefing

The details included in this application will be communicated to all staff at the daily pre-start meeting.

The Construction Superintendent (or delegate) will conduct a daily pre-start meeting with the site workforce before the commencement of work each day (or shift) or where changes occur during a shift. Daily pre-start meetings are generally succinct in nature and take approximately 10-15 minutes.

Specific environmental components relevant to the location of works to be undertaken will be communicated by the relevant foreman (or delegate) and environmental personnel and will include any environmental issues that could potentially be impacted by, or impact on, the day's activities (as defined in the relevant Site Environment Plan).

All attendees will be required to sign on to the pre-start and acknowledge their understanding of the issues explained.

5.3 In-field Reference Materials

A copy of this application and permit will be required to be retained in the field by the Site Supervisor for reference as required.

Site Environmental Plans (SEPs) are visual figures that outline the location of protection measures, monitoring requirements, sensitive receivers and environmentally sensitive areas. SEPs are to be used in project inductions, during site set-up and as part of general work management.

SEPs identify control measures and mitigation strategies outlined in the operational control documentation such as this assessment. As more information relating to land access becomes available to JHG, SEPs may be updated to reflect the correct work method (as per the change management process in Section 4.2) and will be developed specifically for each work area

5.4 Training

Targeted environmental awareness training will be provided to individuals or groups of workers with a specific authority or responsibility for environmental management or those undertaking an activity with a high risk of environmental impact. John Holland will establish and maintain a register of environmental training carried out, including dates, names of persons trained and trainer details. JHG are required to complete relevant safety inductions for works within the rail corridor.

6 Consultation

Consultation with relevant land holders is required at least 7 days prior to the commencement of works relating to that landholder. Landholders relating to this application will be notified of works to be undertaken on their property.

The project team will adhere to the specific access points specified/outlined by existing Land Access Agreements or Individual Property Management Plans and in accordance with the Landowners Agreements and Plans.

Complaints and enquiries will be managed in accordance with the I2S Community Communication Strategy (4-0000-220-PCS-00-ST-0001), which was endorsed by the ER on the 15th October, 2024.

Complaints may include any interaction with a stakeholder who expresses dissatisfaction with the project, policies, contractor's services, staff members, actions or proposed actions during the project.

All communications with stakeholders including consultation, engagement and management of complaints are captured by JH in Consultation Manager as detailed in the Community Communication Strategy (available via Aconex transmittal reference: **IR2200-CA-000024**).

John Holland will attend to enquiries and complaints in a responsive and consistent manner to ensure feedback is considered and addressed in a timely and productive way. This will help ensure that the Project benefits from local input and impacts on the community are minimised wherever possible.

Community enquiries and complaints will generally be received via:

- Inland Rail's 24-hour telephone number: 1800 732 761
- Inland Rail's email: inlandrailnsw@inlandrail.com.au

The 24-hour telephone number and email address will be answered by John Holland, during business hours and Possessions, any Out of Hours phones calls not associated with possessions will be directed to a call Centre who will notify John Holland the following day. All complaints will be managed in accordance with the Community Communication Strategy. John Holland will notify Inland Rail of all content specific to the Project for investigation and response in accordance with required response time frames. The phone number and email are included on all written project communications.

All calls to 1800 732 761 are answered and responded to 24 hours a day, seven days a week

In accordance with CoA E96, JHG will also consult with all landowners where the works proposed under this LIWA will either temporarily or permanently impact farm operations, access to the property from public roads and/or to other parts of the property owned by the landowner to ensure that impacts to the use of properties are minimised and mitigated. The consultation will include the following.

- a. safe and convenient stock and machinery movement across the rail corridor, including provision and maintenance of livestock holding pens;
- b. the safe and efficient operation of agricultural aerial activities;
- c. provision and maintenance of fencing of a type suited to stock and livestock husbandry operations conducted on the property (including barrier fencing where appropriate); and
- d. relocation of farm infrastructure necessitated by the CSSI.

Details of consultation and agreed management measures will be included in the Individual Property Management Plans required by CoA E95.

7 Roles and Responsibilities

An outline of responsibilities for site personnel throughout the duration of LIW is included in Table 7-1.

Table 7-1: Roles and responsibilities during LIW

Role	Responsibility
Environmental and Sustainability Manager	- Implementation of procedures - Liaise with specialist consultants and IRPL. - Notify regulators and relevant stakeholders as required - Complete incident investigation and reporting (where required) - Updates to scheduled activities and management plans as a result of varying on-site conditions and any changes are communicated to the Project Team - Ensures compliance on site with the project approvals, including this assessment.
Site Supervisors	- Ensure that this Assessment Report and relevant documentation are communicated to all site personnel under their management and are being fully implemented on site - Stop work as required - Ensure that any scope changes are approved by ER/IRPL prior to undertaking works. - Delineate the area - Contact Environmental Manager and Project Manager - Manage access into and out of the site
Specialist consultants – Ecologist, Archaeologist, Contaminated Land Expert, Site Auditor (Contamination)	- Indicate the required exclusion area or “no-go” zone for any nearby works - Advise on any controls that should be put in place to due to changing on-site conditions - Develop any required management plan (or equivalent) for the management of LIW - Call on other technical specialists as required to assist in any identification and management of LIW - Assist in the completion of any required notifications in consultation with the Project Environment Team - Assist in implementation of the unexpected and incidental finds procedure
ARTC / Inland Rail	- Liaise between relevant government agencies and relevant stakeholders in relation to any incidents - Provide written approval for works - Liaise between relevant government agencies for any ARTC approvals and/or with other stakeholders as required in relation to incidents/events.
Community and Stakeholder Engagement Team	- Develop and maintain open lines with the community, stakeholders, and landowners to ensure their concerns and feedback are effectively captured and addressed - Provide notifications to the community for LIWA and manage the complaints management process associated with LIWA. - Facilitate engagement activities, such as public meetings, information sessions, and consultations - Coordinate with the Project Team to integrate community feedback into project planning and decision-making processes

Role	Responsibility
	- Prepare and disseminate clear, accurate, and timely information about activities and changes to ensure transparency - Conduct consultation for written approval to use private access roads, provide notification to landowners and sensitive receivers ahead of the works and for noise consultation
Environmental Representative(s) (ER)	- Consider and recommend improvements to work practices to reduce environmental impact and enhance community well-being - Review and validate project documentation to ensure consistency with planning approvals and environmental regulations - Conduct regular site inspections to monitor compliance with environmental standards and provide on-site environmental advice to support the project team

7.1 Emergency Contacts

A list of key emergency services contacts is provided in Table 7-2. Specific contacts from ARTC/IRPL and JHG will be included in each SEP for staff in the field to be able to contact the relevant parties in the event of an incident or unexpected find.

Table 7-2: Emergency Services Contacts

Emergency Contact	Contact Details	When to contact
Environment Protection Authority (EPA)	131 555	In the event of a pollution incident in accordance with Part 5.7 of the POEO Act.
SafeWork NSW	131 050	In the event of safety incidents
RSPCA / WIRES	1300 094 737	To report injury to wildlife
Heritage NSW	(02) 9873 8500	In the event of confirmed heritage item or suspected human remains
NSW Police	(02) 6922 2599 (Wagga Wagga District Command) 000 (emergency only)	In the event of suspected human remains
DPHI Unit (Compliance)	1300 305 695	In the event of an incident
Cootamundra – Gundagai Council	1300 459 689	As required
Junee Council	(02) 6924 8100	As required

7.2 Review

This assessment will be reviewed as needed in response to circumstances where on-site conditions vary from the time of desktop assessment.

7.3 Hold Points

The following hold points have been identified in the ARTC Construction Environmental Management Framework and are to be included in planning to manage risks associated with these activities. Hold points are anticipated to be triggered by this LIW associated with general approvals are confirmed to be in place prior to commencement.

Table 7-3: Environment Hold Points

Hold Point	Release Authority	Milestone
All Approvals required for commencement of early works or other works (as the case may be) have been obtained prior to commencing those works.	ARTC Environmental Manager or delegate	Submission of evidence to ARTC 5 days before commencing works, including a list of applicable approval requirements (including under any CoA) and a statement of how those requirements have been satisfied
Outside Hours Work Permit for proposed out of hours works	ARTC Environmental Manager or delegate	Submission of evidence to ARTC 5 days before commencing works
Relaxation of impact to sensitive receivers	ARTC Environmental Manager or delegate	Submission of evidence to ARTC 5 days before commencing works
Flora and Fauna No Go Zones assessed and protected/delineated prior to commencing any relevant works	ARTC Environmental Manager or delegate	Submission of evidence to ARTC 5 days before commencing works.
Cultural Heritage No Go Zones have been assessed, protected/delineated and (where relevant) salvaged prior to commencing any works	ARTC Environmental Manager or delegate	Submission of evidence to ARTC 5 days before commencing works.
Disturbance footprint/Construction Impact Zone to be delineated by a surveyor before works commence.	ARTC Environmental Manager or delegate	Submission of evidence to ARTC 5 days before commencing works.

7.4 Incident Reporting

If an environmental incident occurs whilst conducting LIW activities, the ARTC Environmental Event Management Process is to be followed. In addition, the JH Incident Management Procedure (JH-MPR-SQE-010) will be used to manage incidents. All events are to be entered into the Horizon360 software for reporting and close-out.

Soteria is John Holland's Health, Safety, Environment, & Sustainability platform. Soteria is a web-based application for entry and review of events, incident Management, NCRs, infringements, investigations and action data. Incidents must also be lodged through Aconex. The Project Environment Advisor and/or appropriate delegates will immediately notify (verbally) IRPL of any incidents or non-compliances.

This includes any environmental or heritage incidents or the Unexpected Finds Protocol and associated procedures. Soteria will be regularly updated with identified corrective actions, non-compliances, proposed actions, close-out dates, and the owner of specific actions. Upon completion of proposed actions, the Project Environment Advisor will update the register to review and ensure close out as appropriate and has been addressed in a timely manner.

7.5 Inspections

Inspections of the works will include monitoring for the implementation of environmental controls in accordance with this assessment, and performance of the controls. Environmental inspections throughout LIW are conducted approximately fortnightly. The Project Environment Team will undertake inspections during LIW approximately fortnightly or as required evaluate the effectiveness of environmental controls. The inspection checklist will be used and documented using John Holland's reporting system, Soteria. Additional inspections may be undertaken by other appropriate delegates.

If any maintenance and/or deficiencies in environmental controls or in the standard of environmental performance are observed, they will be recorded in Soteria. Records will also include details of any maintenance required, the nature of the deficiency, any actions required and an implementation priority.

All inspections will be uploaded/recorded in Soteria along with any corresponding corrective action items or non-conformances.



8 Environmental Risk and Impact Assessment

This environmental impact and risk assessment considers whether the LIW for the works proposed meets the relevant conditions of approval and Revised Mitigation Measures (RMMs) from the EIS. This assessment also considers whether these CoA's and RMMs can be implemented in a compliant manner (where relevant) as part of the proposed works. Mitigation measures to be implemented on-site have been included in Table 8-1.

For the purposes of determining whether the proposed activities meet the description of LIW, a summary for each environmental aspect has been considered below.

8.1 Risk and Impact Assessment

The following table (Table 8-1) provides a description of the risks identified based on the outcomes of the assessment. The table below provides a summary of the risks identified per aspect. Maps show constraints across the areas included in this assessment and mitigation measures to be applied on-site, and are included in Appendix A—Site Environmental Plans (SEPs).

Table 8-1 Summary of impacts

Discipline	Risk Summary Based On The Outcomes Of The Risk Assessment	Consistency with CoA & EIS
Aboriginal Heritage	Specialist heritage advice provided in Appendix E—LIW Heritage Advice provides a framework for the management of Aboriginal Heritage throughout LIW. The activities proposed in this LIWA are not at risk of damaging items of Aboriginal Heritage where the mitigation measures provided in Appendix E—LIW Heritage Advice (derived from the recommendations of the Aboriginal Cultural Heritage Assessment Report prepared by GML for the I2S EIS) are implemented. The works included in this assessment are not within Indigenous Survey Zones 1-11 East. Some ETV locations in this assessment are located within 25m of the borders of Indigenous Survey Zones 1-11 East. These locations are listed below. • ETV ID #1 to Indigenous Survey Zone 1 • ETV ID #9 to Indigenous Survey Zone 4 • ETV #12 to Indigenous Survey Zone 5 Although they are located within 25 meters of these zones, they are located at least 200m from known heritage items, objects or places (visible in Appendix E—LIW Heritage Advice and Appendix A—Site Environmental Plans (SEPs),) and located outside heritage zones. The closest known artefact to an ETV test location included in this assessment is ARTC1 to ETV ID#1, which is 230m from the works. No ETV sites are located within known areas of Aboriginal Heritage sensitivity, including items, objects or places. Items, objects or places identified as part of the GML ACHAR (Chapter 15 and Tech Paper 7 of the EIS) are shown in Appendix E—LIW Heritage Advice. Furthermore, none of the ETV testing locations included in this package are within Indigenous Survey Zones 1-11 East. Prior to works occurring in Indigenous Survey Zones, the items, objects and places identified in Appendix E—LIW Heritage Advice will be delineated with the appropriate buffers.	YES Works will be undertaken in accordance with the following conditions and RMMs. - Conditions A17 - Condition E127 & E128 - Condition E143 & E144 - AH1 - AH7 - AH8 - AH11 - Condition E130 - Condition E135 - Condition E140 - Condition E142

I2S| Low Impact Works Assessment – Erosion Threshold Velocity Testing (Package A)

Discipline	Risk Summary Based On The Outcomes Of The Risk Assessment	Consistency with CoA & EIS
	An Aboriginal Cultural Heritage Assessment Report (ACHAR) was produced as part of the EIS process. The extent of the original study area was wider than the final EIS boundary. As such and as part of the EIS process, the area of the Temporary Workforce Accommodation Facility (TWAF) was assessed for archaeological potential as part of the early investigation works in a separate Due Diligence Assessment. The area was not considered to be in an area of archaeological sensitivity due to landform features and prior disturbance. The area assessed at the TWAF includes the location for ETV ID #18, and as such, is unlikely to result in impacts to Aboriginal Heritage and can proceed as LIW. ETV ID#12 is within an area not assessed for archaeological potential under the ACHAR, however, as stated in the EIS, a wider search was conducted on the study area or 'Focused Area of Investigation (FAI)', a corridor generally 250m in width across the proposal site. The FAI was used in the EIS to assess the potential for cultural heritage significance across the site. This search included an AHIMS database search. The closest Aboriginal object identified in this search to ETV ID #12 is AHIMS Side ID 50-5-003, located approximately 2.8km from the activity and outside of the Project boundary. ETV works at this location are therefore unlikely to result in impacts to Aboriginal Heritage and can proceed as LIW. The activities described in this assessment are not vibration intensive works that are liable to create ground borne vibration. The works identified in this assessment can proceed under the definition of LIW. <u>Additional mitigation measures:</u> • Zones identified as sensitive with respect to Aboriginal Heritage are indicated on SEPs, where in proximity to the works. • The border of Indigenous Survey Zones 5, 6, 9, and 10 will be delineated with star pickets/bollards and signage, with a 25-meter buffer. The delineation will act as the beginning of the no-ground disturbance zone. • On-site personnel will be regularly briefed on the exact locations of Indigenous Survey Zones 1-11 East, and any items, places or objects identified as sensitive with respect to Aboriginal Heritage • All site personnel will be inducted to the Project before the commencement of work activities. The project induction includes a visual depiction of sensitive Aboriginal Heritage areas (including Indigenous Survey Zones 1-11 East and other Aboriginal Heritage items) along the alignment, and their restrictions. • Indigenous Survey Zones 1-11 East and items, objects or places sensitive with respect to Aboriginal Heritage are indicated on SEPs. Hard copies are available on site and provided to all JHG site personnel via email. • The Unexpected and Incidental Finds Procedures Unexpected Heritage Finds and Human Remains Procedure (E143 and E144) for heritage is available on site and provided to all JHG site personnel via email.	

I2S| Low Impact Works Assessment – Erosion Threshold Velocity Testing (Package A)

Discipline	Risk Summary Based On The Outcomes Of The Risk Assessment	Consistency with CoA & EIS
Non-Aboriginal Heritage	- Regular checks and documentation procedures will be established to monitor the integrity and adherence to no-ground disturbance zone restrictions. - Consultation with Heritage NSW and relevant local council will occur as required to ensure impact to Aboriginal Heritage items are avoided and mitigated. No consultation is expected to be required for this portion of LIW. Consultation requirements would be undertaken in line with the conditions of approval and the Unexpected and Incidental Finds Protocol and Procedure(s). - Site personnel will have access to geospatial data indicating areas of Aboriginal Heritage (Indigenous Survey Zones 1-11 East, plus a 25m buffer zone on each border) and all items, places and objects of Aboriginal Heritage significance available whilst moving across the alignment. <u>Heritage listed items:</u> Two non-Aboriginal heritage listed items have been identified within the proposal site: - the Stockinbingal Railway Station - Stockinbingal Heritage Conservation Area (heritage conservation area). Both are listed with 'local' significance under the Cootamundra LEP. Two non-Aboriginal heritage items have been identified during the EIS phase as holding potential heritage significance: - Billabong Creek Rail Underbridge - Historic sawmill site No impact is expected to occur to non-Aboriginal heritage listed items during this portion of LIW. The closest work in this assessment to non-Aboriginal Heritage is ETV ID #17, which is located approximately 900m from the Stockinbingal Heritage Conservation Area. The TfNSW Construction Noise and Vibration Guideline states that; "Attended vibration measurements shall be undertaken at all buildings within 25 m of vibration generating activities when these activities commence to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage." Vibration monitoring is therefore not deemed to be required during LIW. Potential impacts to non-Aboriginal heritage items may include: - potential for vibration impacts close the proposal site as a result of construction works and the movement of plant, vehicles and machinery - accidental damage because of the movement of machinery and equipment. - changes to the visual landscape, noise and vibration	YES Works will be undertaken in accordance with the following conditions and RMMs. - NAH1 - NAH2 - NAH4 - Conditions A17 - Condition E127 & E128 - Conditions E143 and E144

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I2S| Low Impact Works Assessment – Erosion Threshold Velocity Testing (Package A)

Discipline	Risk Summary Based On The Outcomes Of The Risk Assessment	Consistency with CoA & EIS
Biodiversity and Biosecurity	Impacts to non-Aboriginal Heritage are not expected to occur as a result of the works included in this application, as the works do not require vibration generating equipment. Items of non-Aboriginal Heritage are indicated as no-go zones in the LIW induction, and as such, are unlikely to face accidental damage due to plant movements. The works will not cause significant impacts to visual impact or the existing landscape. <u>Additional mitigation measures:</u> - Non-Aboriginal heritage sites will be clearly defined as exclusion zones in SEPs, with appropriate barriers such as bollards and hazard tape where required to ensure their preservation and to mitigate the risk of inadvertent damage. - The project teams will be updated on the exact locations of these heritage-sensitive areas and the importance of complying with restrictions via toolboxes, pre-starts, SEPs, and the LIW induction. - Regular checks and documentation procedures will be established to monitor the integrity and adherence to No-Go zone restrictions. - Consultation with Heritage NSW and relevant local council will occur as required to ensure impact to non-Aboriginal heritage assets are avoided and mitigated. No consultation is expected to be required for this portion of LIW due to the low-risk nature of the works. Consultation requirements would be undertaken in line with the conditions of approval and the Unexpected and Incidental Finds Protocol and Procedure(s). The Project site is predominantly Category 1 Land (exempt land where native vegetation can be cleared without approval from Local Land Services, low conservation grasslands or land containing only low conservation groundcover (not being grasslands)) and has been heavily fragmented and disturbed due to ongoing agricultural practices, with existing habitat connectivity to remnant vegetation to the east and west limited to creek lines and road reserves. LIW will be undertaken in a manner to avoid areas with known biodiversity values or their accompanying habitat. This measure has been precursor to the assessment of other environmental factors to eliminate avoidable direct and indirect impacts to biodiversity. Works within TEC or their habitat will be conducted in accordance with the approved <i>Inland Rail, Illabo to Stockinbinal - Biodiversity Advice, Low Impact Works</i> (Appendix D—LIW Biodiversity Advice) letter. Ecological pre-clearance will be undertaken at sites within TEC or their habitat (including areas not ecologically surveyed) and provided to the ER prior to the commencement of works in this assessment. Any additional mitigation measures imposed by Land Access Agreements (LAA) and Farm Management Plans (FMP) for LIW will be included as mitigation measures as they become available to JHG. Crossing property boundaries within the alignment and to access the alignment have been avoided to the maximum extent practicable.	YES Works will be undertaken in accordance with the following conditions and RMMs. - Condition C9 - Condition E27 - BD-4 - BD-5 - BD-6

I2S| Low Impact Works Assessment – Erosion Threshold Velocity Testing (Package A)

Discipline	Risk Summary Based On The Outcomes Of The Risk Assessment	Consistency with CoA & EIS
	<u>Additional mitigation measures:</u> - Bollards and bunting will be used where required to delineate the approved works area from no-ground disturbance zones. - On-site personnel will receive an induction on biodiversity and biosecurity which includes; - A list of TEC's and their habitat; - Instructions for no-go and no-ground disturbance areas, - What to do in the case of an unexpected find. - TEC zones are indicated on SEPs. Hard copies are available on site and provided to all JHG site personnel via email. SEPs are provided in Appendix A—Site Environmental Plans (SEPs). - Lands not surveyed are also included in SEPs. Ecological pre-clearance of lands that have not been ecologically surveyed is required, which is indicated in Appendix D—LIW Biodiversity Advice. - The Unexpected and Incidental Finds Procedures for biodiversity are available on site and provided to all JHG site personnel via email. - A biosecurity fact sheet is available on site. - Biosecurity risk will be mitigated through the implementation of a Cleanliness Declaration Checklist. The checklist will be completed when making between-property movements as part of conducting the activities included in this assessment. This checklist ensures that prior to making between-property movements, vehicles and personnel footwear are visually inspected and free of organic material. Vehicles will be required to be brush down if required to remove any organic material. - Personnel footwear and vehicles will then be disinfected with bleach before moving to the next property. The checklist remains valid as long as the vehicle/equipment/personnel stay within the designated work area (the CIZ footprint) and have not crossed a property boundary or other designated boundary. - Site personnel will have access to geospatial data indicating areas containing TECs or their habitat available whilst moving across the alignment.	
Noise and Vibration	Due to the nature of the proposed LIW in this assessment daily noise and vibration impacts are expected to be negligible. No OOHW are anticipated for the activities outlined in this assessment.	YES Works will be undertaken in accordance with the following conditions and RMMs

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Discipline	Risk Summary Based On The Outcomes Of The Risk Assessment	Consistency with CoA & EIS																										
	Where out of hours works are required, they must be conducted in accordance with CoA E3 as per the definition of 'Low impact work'. A noise assessment has been prepared for all activities included in this assessment (Appendix B—Noise Assessment). Noise modelling was undertaken using a 'worst case scenario' approach to determine noise impacts at the closest receiver to the works during standard hours. The table below provides a summary of the dBA exceedances (if any) of the RBL for ETV testing at the closest residential receiver. More detail is presented in Appendix B—Noise Assessment. Any out of hours works will be applied for separately via permit. <table><tr><th>ETV Test ID</th><th>dBA exceedance of NML</th><th>Number of properties affected</th></tr><tr><td>ETV #105</td><td>0</td><td>1</td></tr></table> RMMs and CoAs will be applied to the LIW for these works, including project notification and verification monitoring in response to complaints (where monitoring will assist in resolving the complaint). No LIW access routes included in this package were identified as being in the highly affected dBA range at the closest sensitive receiver. Noise impacts from access routes will be temporary in nature, due to the intermittent nature of TABLE 16-1: NOISE MANAGEMENT LEVELS FOR RESIDENTIAL RECEIVERS <table><tr><th>Timing</th><th>RBL (dBA)¹</th><th>NML (dBA)</th><th>Highly noise affected level (dBA)</th></tr><tr><td>Standard hours</td><td>35</td><td>45</td><td>75</td></tr><tr><td>Out of hours—Day</td><td>35</td><td>40</td><td>N/A</td></tr><tr><td>Out of hours—Evening</td><td>30</td><td>35</td><td>N/A</td></tr><tr><td>Out of hours—Night</td><td>30</td><td>35</td><td>N/A</td></tr></table> 1. Background levels are below the minimum assumed rating background noise levels at all measurement locations along the proposal site; as such, they have been adjusted to 35dBA during the day period, and 30dBA during the evening and night periods. access/egress.	ETV Test ID	dBA exceedance of NML	Number of properties affected	ETV #105	0	1	Timing	RBL (dBA) ¹	NML (dBA)	Highly noise affected level (dBA)	Standard hours	35	45	75	Out of hours—Day	35	40	N/A	Out of hours—Evening	30	35	N/A	Out of hours—Night	30	35	N/A	- Condition C9 - Condition E3 - Condition E6 and E7 - NV8 - E1 - E2
ETV Test ID	dBA exceedance of NML	Number of properties affected																										
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Timing	RBL (dBA) ¹	NML (dBA)	Highly noise affected level (dBA)																									
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Out of hours—Evening	30	35	N/A																									
Out of hours—Night	30	35	N/A																									

Discipline	Risk Summary Based On The Outcomes Of The Risk Assessment	Consistency with CoA & EIS						
	<u>Additional mitigation measures:</u> As a minimum, all affected landowners will be notified of the works to be undertaken in or around their properties at least 7 days prior to the commencement of works in accordance with the Community Communication Strategy (CCS). Generally, affected residences will be notified of; • A diagram that identifies the location of the proposed works in relation to nearby cross streets and local landmarks • The nature, scope and duration of the works, including start and finish times • The expected noise impacts on receivers • Information on how to obtain further information or make a complaint, including an after-hours number and Inland Rail Program website. As these works are planned to be undertaken within standard hours, the recommended mitigation as per the ARTC IRPL NSW Construction Noise and Vibration Framework will be the implementation of standard environmental mitigation measures. These are provided below and will be implemented where reasonable and feasible. <table><tr><th>Mitigation measures</th></tr><tr><td>Using portable temporary acoustic screens where effective to screen the noise emissions.</td></tr><tr><td>Avoid the simultaneous operation of noisy plant within discernible range of noise sensitive receivers where possible.</td></tr><tr><td>Where available, equipment selection will favour the use of quieter and less vibration emitting construction methods.</td></tr><tr><td>Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks</td></tr><tr><td>Static plant should be located as far as possible from sensitive receivers, be located to take advantage of natural acoustic screening such as terrain, site buildings, etc and where necessary for reduction of noise impacts, provided with an acoustic enclosure.</td></tr></table>	Mitigation measures	Using portable temporary acoustic screens where effective to screen the noise emissions.	Avoid the simultaneous operation of noisy plant within discernible range of noise sensitive receivers where possible.	Where available, equipment selection will favour the use of quieter and less vibration emitting construction methods.	Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks	Static plant should be located as far as possible from sensitive receivers, be located to take advantage of natural acoustic screening such as terrain, site buildings, etc and where necessary for reduction of noise impacts, provided with an acoustic enclosure.	
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Discipline	Risk Summary Based On The Outcomes Of The Risk Assessment	Consistency with CoA & EIS
	A telephone, email and web-based community information service shall be established to allow the community to obtain additional information on construction activities, provide feedback or make a complaint. Regular communications on the activities and progress of the proposal shall be provided to the community (e.g. via newsletter, email and/or website). Noise or vibration monitoring in response to complaints shall be undertaken where the results or the process assist in resolving or understanding the receiver's issue. Where vibration levels are predicted to approach the criteria for cosmetic building damage or limits for critical or sensitive areas, attended vibration measurements shall be undertaken at the commencement of vibration generating activities to confirm that vibration limits are within the acceptable range. A respite period shall be provided for receivers impacted by weekend work. The respite period will ensure that no single receiver is impacted for two consecutive periods of weekend work. Respite will be provided every second weekend commencing at 1pm on Saturday and concluding at 7am on Monday. Additionally, Project inductions and pre-starts will include that; • Non-tonal reversing alarms must be fitted and used on all construction vehicles and mobile plant. • Quieter and less noise emitting construction methods should be used whenever possible. • Avoid shouting and slamming doors to minimise unnecessary noise. • All vehicles accessing the project site must comply with local speed restrictions. • Plant equipment engines should be turned off when not in use to reduce potential noise impacts on surrounding stakeholders. Based on the assessment of noise impacts, these works can be undertaken as low impact works. Noise monitoring equipment will be kept on site for monitoring in response to complaints (where the results or the process assist in resolving or understanding the receiver's issue).	
Soils (ERSED)	Temporary stockpiling of spoil from excavations will be required throughout ETV testing. All excavations will be backfilled. The risk of soil erosion is deemed low. Mitigation measures included in this LIW Assessment will be sufficient in mitigating the potential impacts associated with soil and ERSED management. <u>Additional mitigation measures:</u>	YES Works will be undertaken in accordance with the following conditions and RMMs - Condition C9 - Condition E150 - SC9

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I2S| Low Impact Works Assessment – Erosion Threshold Velocity Testing (Package A)

Discipline	Risk Summary Based On The Outcomes Of The Risk Assessment	Consistency with CoA & EIS
	• Appropriate sediment and erosion control devices are to be installed on site to minimise transport of sediment for geotechnical works. Indicative control measures to be used as appropriate are outlined the SEPs. In addition, sediment/erosion controls such as the installation of coir logs, sediment fencing and the application of geofabric will be installed where required (near drains, waterways and high slope angles). • Erosion and sediment control measures would be maintained and left in place until the works are complete and areas are stabilised. • Reinstatement of voids will be completed to ensure stable landform consistent with the surrounding environment. • Any drilling mud and fluid as a result of the excavations will be stored in an Intermediate Bulk Container (IBC) until its offsite disposal at a facility licensed to accept the waste. IBC tanks will be either bunded or underlaid with geofabric (or other protective material) and surrounded with sandbags where immediate disposal offsite is not available. • All temporary stockpiles will be covered with geofabric or plastic sheeting to prevent wind and water erosion (where wind and water erosion is anticipated). Stockpiles will be removed from site as soon as possible to reduce potential erosion and sediment control risks. • The volume of excavated material to be removed from site will be minimised by maximising reuse of excavated material where possible and practical. • All erosion and sediment control measures are to be inspected, and any damage would be rectified. Control measures are required to be inspected regularly during and after rainfall events to ensure their effectiveness over the duration of the works. • Sediment would be cleared from behind barriers/sand bags/filtration devices on a regular basis and all controls would be managed to ensure they always work effectively.	
Contamination	Site investigations undertaken as part of the Environmental Assessment for I2S identified a number of areas requiring further investigation and potential remediation (i.e. AECs). Works included in this LIWA are at low risk of mobilising contaminants, as no activities are located within identified within AECs. In the event contaminated land or material is encountered, it will be managed in accordance with the Unexpected and Incidental Finds Protocol and mitigation measures specific for working in and around each AEC. Mitigation measures have been included in SEPs where relevant.	YES Works will be undertaken in accordance with the following conditions and RMMs - Condition A17

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I2S| Low Impact Works Assessment – Erosion Threshold Velocity Testing (Package A)

Discipline	Risk Summary Based On The Outcomes Of The Risk Assessment	Consistency with CoA & EIS
	Soil contamination could occur as a result of any accidental spills or leaks of fuels, oils and other chemicals from equipment and vehicles during construction. The RMMs relevant to this LIW assessment are sufficient in managing potential contamination risks associated with the works. <u>Additional mitigation measures:</u> • Vehicles are to drive on established pathways and farm tracks as much as reasonably practicable. • Works in proximity to AECs must be undertaken in accordance with the appropriate mitigation measures determined by a contamination specialist and endorsed by the Site Auditor. The proximity around each AEC that is required will also be agreed with the Site Auditor to confirm the extent of locations where mitigation measures are required (above and beyond the current measure of undertaking works under the Unexpected and Incidental Finds Protocol). • Driving over AECs are of low risk at mobilising contaminants as no contamination is expected to be present at the surface. • Contamination encountered will be managed in accordance with the Unexpected and Incidental Finds Protocol for Contamination. • Spill kits will be stored in site vehicles and available at MAFs and their indicative locations indicated on SEPs. • Site personnel will be made aware of AECs via SEPs. • Any contaminated material will be removed off site in accordance with the requirements of the contamination consultant and the Site Auditor • All refuelling operations (if any are required) will occur >50m from a waterway, ephemeral watercourse or wetland. All refuelling activities will be undertaken in either a bunded area or with a drip tray.	- Condition E159 - Condition E161
Waste	Waste streams in high volumes are not expected to be generated from the LIW activities in this assessment. All excavations will be backfilled into the hole. All excess materials will be removed offsite. Waste generated may include: • Hard plastic • Soft plastic • Organic/food waste • Paper/cardboard • Vegetative waste (as a result of vehicle wheel cleaning and boot brush) • General Solid Waste (GSW) and spoil (excavated material)	YES Works will be undertaken in accordance with the following conditions and RMMs - WM3 - Condition C9 - Condition E165 - Condition E163

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Discipline	Risk Summary Based On The Outcomes Of The Risk Assessment	Consistency with CoA & EIS
	<u>Additional mitigation measures:</u> - All spoil generated as a result of the excavations will be backfilled into the excavations. Any excess spoil will be disposed of offsite. - All waste being disposed of offsite must be classified in accordance with the <i>NSW Waste Classification Guidelines</i>. Waste will be disposed of at a facility licensed to accept the waste type. - Plastic bags will be in place in site vehicles to ensure that any waste produced by the team remains in the site vehicles and is contained. - All waste will be recycled where possible. - Waste generation will be avoided where possible, and where avoidance is not reasonably practicable, waste generation will be reduced. - All waste will be disposed of at facilities licensed to accept the respective waste types. - Where disposal at waste facilities is undertaken, waste transport and disposal dockets will be maintained.	
Water	No LIW activities submitted in this package are within a waterbody. Water bodies in this case include farm dams, streams, creeks, and rivers, or other depressions in the landscape carrying water. Construction teams will use routes indicated on the SEPs and JHG risk management documentation (AMs and TRAs). Based on the assessment of impacts to water, these works can be undertaken as low impact works. <u>Additional mitigation measures:</u> Prior to crossing a dry creek, stream or drainage line with a vehicle, onsite personnel are to assess whether site conditions will not cause adverse environmental impacts to the receiving environment. These include large slope angles (erosion potential), weather forecasts, potential biosecurity concerns, the presence of overly dry or wet soil, and the presence of vegetation. Personnel are to contact the JHG environmental manager or delegate prior to crossing a dry creek where there is a significant risk of generating sediment runoff, impacting vegetation or altering the existing landform to a state that would require rehabilitation or alter existing flow paths.	YES Works will be undertaken in accordance with the following conditions and RMMs - Condition C9 - Condition E150 - SC9 - E42
Traffic and transport	The proposal is located between sections of existing rail line near the townships of Illabo in the south and Stockinbinal in the north. These townships are predominantly surrounded by large rural properties connected by minor local roads. There are no major towns located along the proposal site between Illabo and Stockinbinal.	YES Works will be undertaken in accordance with the following conditions and RMMs

I2S| Low Impact Works Assessment – Erosion Threshold Velocity Testing (Package A)

Discipline	Risk Summary Based On The Outcomes Of The Risk Assessment	Consistency with CoA & EIS
	The LIW may generate some additional traffic as a result of light and heavy vehicles accessing sites. The volume of extra vehicles and traffic is expected to be minimal. No closure or diversion of roads, level crossings or other ancillary transport items will occur as part of the activities in this assessment. Based on the assessment of traffic and transport, the works can be classified as low impact. Road occupancy licenses (ROLs) from the relevant approval authorities (TNSW or otherwise) will be obtained prior to works occurring within the road seal or verge, where required. ROLs obtained for the Project to date are available on request. <u>Additional mitigation measures:</u> • Right of way will be given to the public (road users and pedestrians) at access points into work areas. • Traffic control will be implemented where required to manage the flow of traffic at access gates. • Appropriate land access approvals will be obtained prior to the commencement of LIW. • The construction workforce and project staff will be encouraged to ride-share to reduce the number of light vehicles travelling to and from site and within the project alignment.	- T6 - Condition C9 - Condition E100 - Condition E107
Access	Access routes are visually presented in Appendix A—Site Environmental Plans (SEPs). Proposed access points for activities in this assessment are provided in Table 4-3. Existing approved access points (SAP 2-11, Chapter 11 p. 15 of the EIS) will be preferentially used, however, many of these locations are limited due to constructability constraints (i.e. the size of gates, landscape limitations, the requirement to cross creeks to access the worksite, etc.). All access routes proposed for these works are either public roads or existing farm tracks, no construction of new access roads will be required. Access locations will be subject to IRPL and landowner approval in accordance with the Inland Rail Community Communication Strategy (CCS). Agreements are to be reached with landholders and communications to be undertaken in accordance with the CCS. Based on the assessment of access gates and routes to the LIW activities included, the works have been classified as low impact. These works can be carried out as LIW using the mitigation measures included in this LIWA.	YES Works will be undertaken in accordance with the following conditions and RMMs - LP1 - LP4 - LP5 - LP7 - LP8 - LP10 - Condition C9 - Condition E94 - Condition E95 - Condition E97
Air quality	LIW could result in minor air quality impacts associated with: • Dust emissions: the use of light vehicles during investigations. • Gaseous emissions: inclusive of vehicle emissions and fugitive emissions from equipment and plant. Based on the assessment of impacts to air quality, the works can be undertaken as low impact works.	YES Works will be undertaken in accordance with the following conditions and RMMs

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	<u>Additional mitigation measures:</u> Site vehicles are to go the speed limits enforced on NSW roads and within private properties to avoid excessive dust and disturbance of dirt roads.	- AQ2
Sustainability	Sustainable practices would be implemented from the outset of the LIW. Efficient plant use and effective waste management processes would be undertaken. This includes the reporting of energy, waste and water in Project Pack Web (PPW) - John Holland's compliance reporting program. Procurement would be undertaken in accordance with the <i>Inland Rail Sustainable Procurement Policy</i> (ARTC, 2018c), the <i>Sustainable Procurement Guide</i> (Commonwealth of Australia, 2021) and the <i>NSW Government Resource Efficiency Policy</i> (OEI, 2014b).	YES Works will be undertaken in accordance with the following conditions and RMMs - SU1
Landscape & Visual Impacts	Landscape and visual impacts are not anticipated during LIW. LIW included in this assessment will be mobile and minor in terms of vehicles, plant and equipment with all materials and staff moving offsite at the end of each day and moving throughout the CIZ footprint.	YES Works will be undertaken in accordance with the following conditions and RMMs - LV4 - LV6 - Condition C9



9 Mitigation Measures

Based on the level of impacts described above, the LIW activities associated with this package will be managed under the RMMs and relevant conditions of approval.

Communication of specific RMMs associated with activities will be described and communicated through the planning and implementation documents prepared by John Holland (the AMS, TRA and SEP) as well as this document communicated as part of the sign off process for staff prior to undertaking any work.

In addition to the RMMs and CoA's, the following General Mitigation Measures have been included for works associated with this assessment:

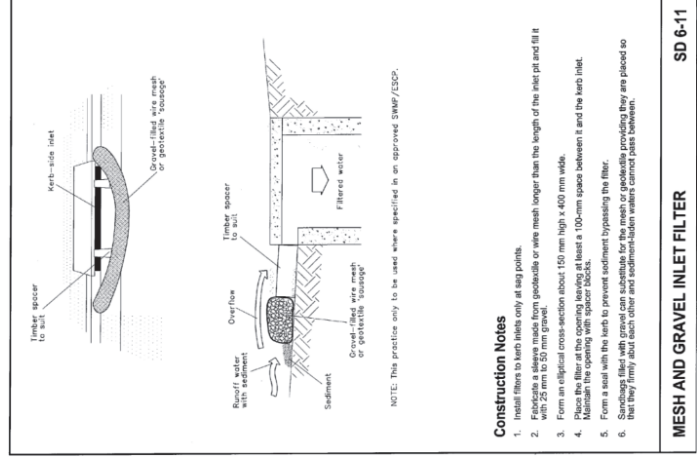
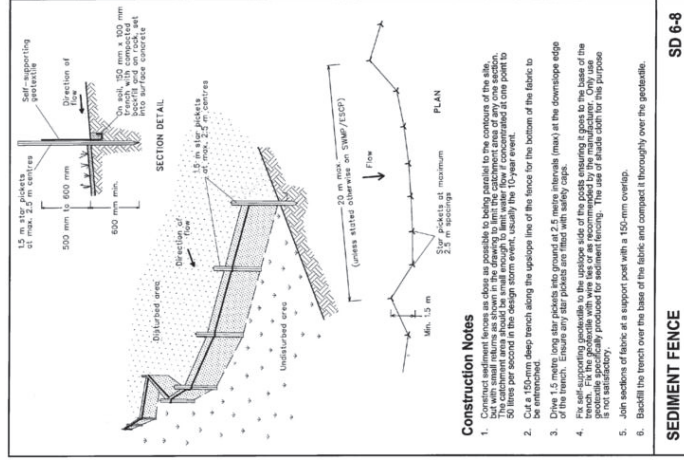
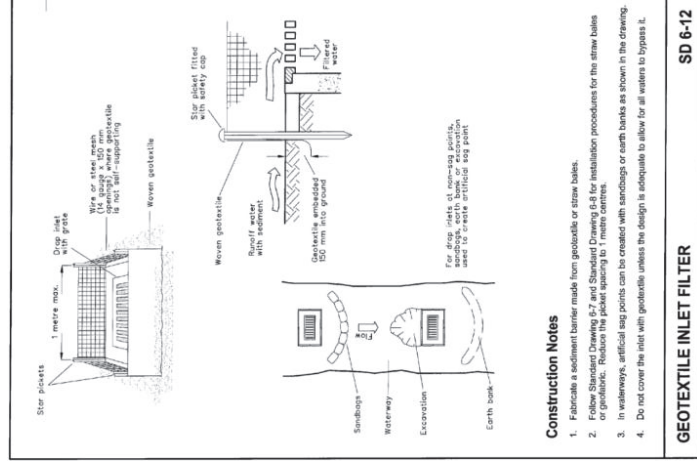
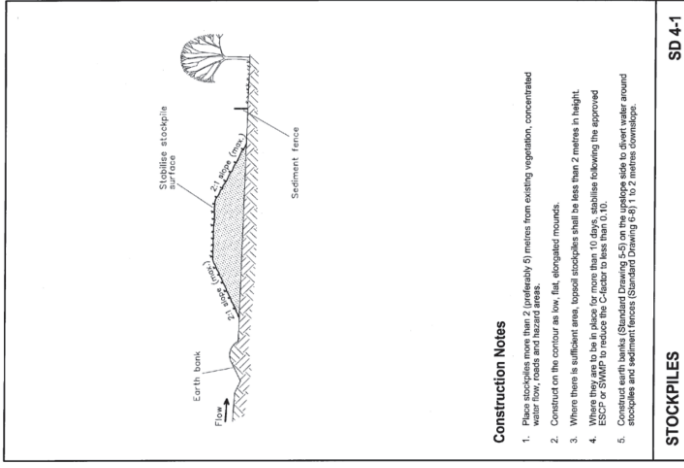
- All vehicles entering the site will be equipped with portable spill kits and all personnel will have access to these kits, to rapidly address any incidental leaks, ensuring immediate containment and cleanup.
- All spoil generated as a result of the excavations will be backfilled into the excavations. Any excess spoil will be disposed of offsite.
 - All waste being disposed of offsite must be classified in accordance with the NSW Waste Classification Guidelines. Waste will be disposed of at a facility licensed to accept the waste type. All waste dockets are to be tracked and retained.
- Vehicles transitioning from dirt roads onto public asphalted roads will undergo a visual inspection to prevent debris from being transported off-site and to maintain cleanliness on public roadways.
- Farm gates encountered during LIW will be left in the condition specified by the landowner, whether that be open or closed. If no contact with relevant landowner is achieved, the specific gate will be left in the condition it was found in.
- TEC's and TEC habitat locations will be available electronically and via hard copies of the SEPs to all site personnel. Vegetation within the CIZ will be delineated as required with appropriate barriers such as bollards and bunting.
- Ecological pre-clearance of work sites will be undertaken by the Project ecologist in accordance with the advice in Appendix D—LIW Biodiversity Advice, including sites not ecologically surveyed.
- All site personnel are to be inducted to the Project. The project induction includes the controls and mitigation measures within this assessment, along with visual depictions of no-go zones.
- Biosecurity measures will be established. Prior to making between-property movements, all personnel's boots and vehicles will undergo a cleanliness inspection to ensure they are clean and free of organic material.
- Prior to the initiation of any work, access routes crossing private property will be established in consensus with the respective landowners.
- The utilisation of existing farm tracks will be adhered to as much as reasonably practicable for the proposed activities, thereby reducing the environmental impact of the works.
- Non-tonal reversing alarms must be fitted and used on all construction vehicles and mobile plant.
- Quieter and less noise emitting construction methods will be used whenever possible.
- Shouting and slamming doors to minimise unnecessary noise will be avoided.
- All vehicles accessing the project site must comply with local speed restrictions.
- Plant equipment engines should be turned off when not in use to reduce potential noise impacts on surrounding stakeholders.



10 Appendices

Appendix A—Site Environmental Plans (SEPs)

Legend



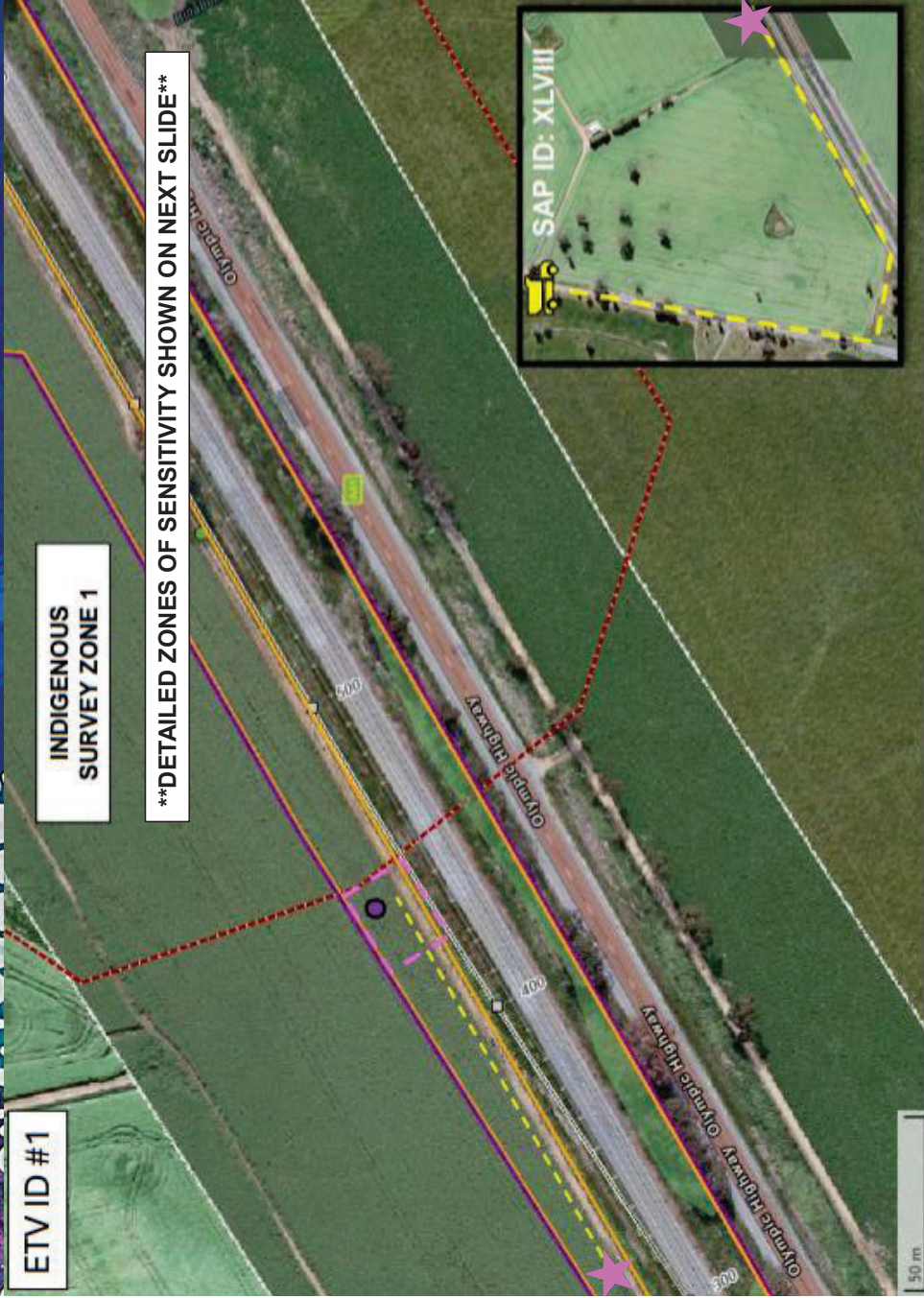
Symbol	Feature	Access track	Access track continued	Other
	Sensitive area			
	Native vegetation			
	CIZ boundary			
	Aboriginal Heritage artefact			
	Black Falcon			
	Brown Treecreeper			
	Diamond Firetail			
	Dusk Woodswallow			
	Flame Robin			
	Grey-crowned Babbler			
	Little Eagle			
	Little Eagle – Nest (Confirmed)			
	Spotted Harrier			
	Spotted Harrier – Nest (Confirmed)			
	Squirrel Glider			
	Superb Parrot			
	Superb Parrot - Nesting			
	White-fronted Chat			
	Spill kit			
	Chainage			
	PAD High Density			
	PAD Low Density			
	Indigenous Survey Zones			

Aboriginal Heritage Artefacts

AHIMS ID	Site ID	Artefact type
50-5-0280	Site Zone 1, Zone 1 – Low density scatter	Zone of archaeological potential
50-05-0266, 50-5-0267, 50-5-0274, 50-5-0276	ARTC 1-4	Low density artefact scatter / isolated artefacts
50-5-0277	ARTC6	Scarred tree
50-5-0287	Site Zone 2	Zone of archaeological potential
50-5-0286	ARTC18	Scarred tree
AHIMS # pending	ARTC20	Scarred tree
50-5-0285	ARTC7	Isolated artefact
50-5-0284	ARTC8	Artefact scatter and zone of archaeological potential
50-5-0283	ARTC9	Isolated artefact
50-5-0268	ARTC12	Isolated artefact
50-5-0269	ARTC13	Isolated artefact
50-5-0270	ARTC14	Isolated artefact
50-5-0271	ARTC15	Isolated artefact
50-5-0272	ARTC16	Isolated artefact
50-5-0273	ARTC17	Isolated artefact
50-2-0054	ARTC10	Isolated artefact
50-2-0055	ARTC11	Isolated artefact
50-2-0058	ARTC19	Scarred tree

Legend

	AEC		Access track continued
	Sensitive area		
	Native vegetation		
	CIZ boundary		
	Aboriginal Heritage artefact		
	Black Falcon		
	Brown Treecreeper		
	Diamond Firetail		
	Dusk Woodswallow		
	Flame Robin		
	Grey-crowned Babbler		
	Little Eagle		
	Little Eagle – Nest (Confirmed)		
	Spotted Harrier		
	Spotted Harrier – Nest (Confirmed)		
	Square-tailed Kite		
	Squirrel Glider		
	Superb Parrot		
	Superb Parrot - Nesting		
	White-fronted Chat		
	Spill kit		
	Chainage		
	PAD High Density		
	PAD Low Density		
	Indigenous Survey Zones		
	<i>Euphrasia arguta</i> , <i>Grevillea wilkinsonii</i> , <i>Fraxophyllum sp.</i> , <i>Wybona</i>		
	<i>Diuris Tricolor</i>		
	<i>Cullen Parvum</i>		
	<i>Caladenia arenaria</i> , <i>Eleocharis obliqua</i> , <i>Indigofera efoliata</i> , <i>Swainsona sericea</i>		
	<i>Austrostipa Wakoolica</i> and <i>Swainsona murrayana</i>		
	<i>Ammobium craspedioides</i>		
	<i>Acacia ausfeldii</i>		
	Habitat connectivity		
	Stream (incl. ephemeral)		
	Grey Box (<i>E. macrocarpa</i>)		
	White-Box-Yellow Box-Blakely's Red Gum		
	Receivers		
	<i>Swainsona recta</i>		
	Local Heritage		
	State Heritage		
	Scattered Paddock Tree		
	Land not surveyed (ecologically)		
	Access/egress point		
	Public level crossing		
	Private level crossing		
	Bridge point		
	Stock crossing		
	Culvert point		
	ETV Test Locations		
	ETV buffer area		



DETAILED ZONES OF SENSITIVITY SHOWN ON NEXT SLIDE

INDIGENOUS SURVEY ZONE 1

Erosion and Sediment Controls (ESC):

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 - Water will be used for dust suppression as required.
- **Monitoring of ESC:**
 - Periodic monitoring of the effectiveness of the ESC to be undertaken as part of environmental inspections, prior to unfavourable weather conditions and after heavy rainfall events (>20mm in 24-hour period).

INDIGENOUS SURVEY ZONES:

All relevant heritage advice must be adhered to prior to ground disturbance within Indigenous Survey Zones 1-11 East.

UNSURVEYED LANDS:

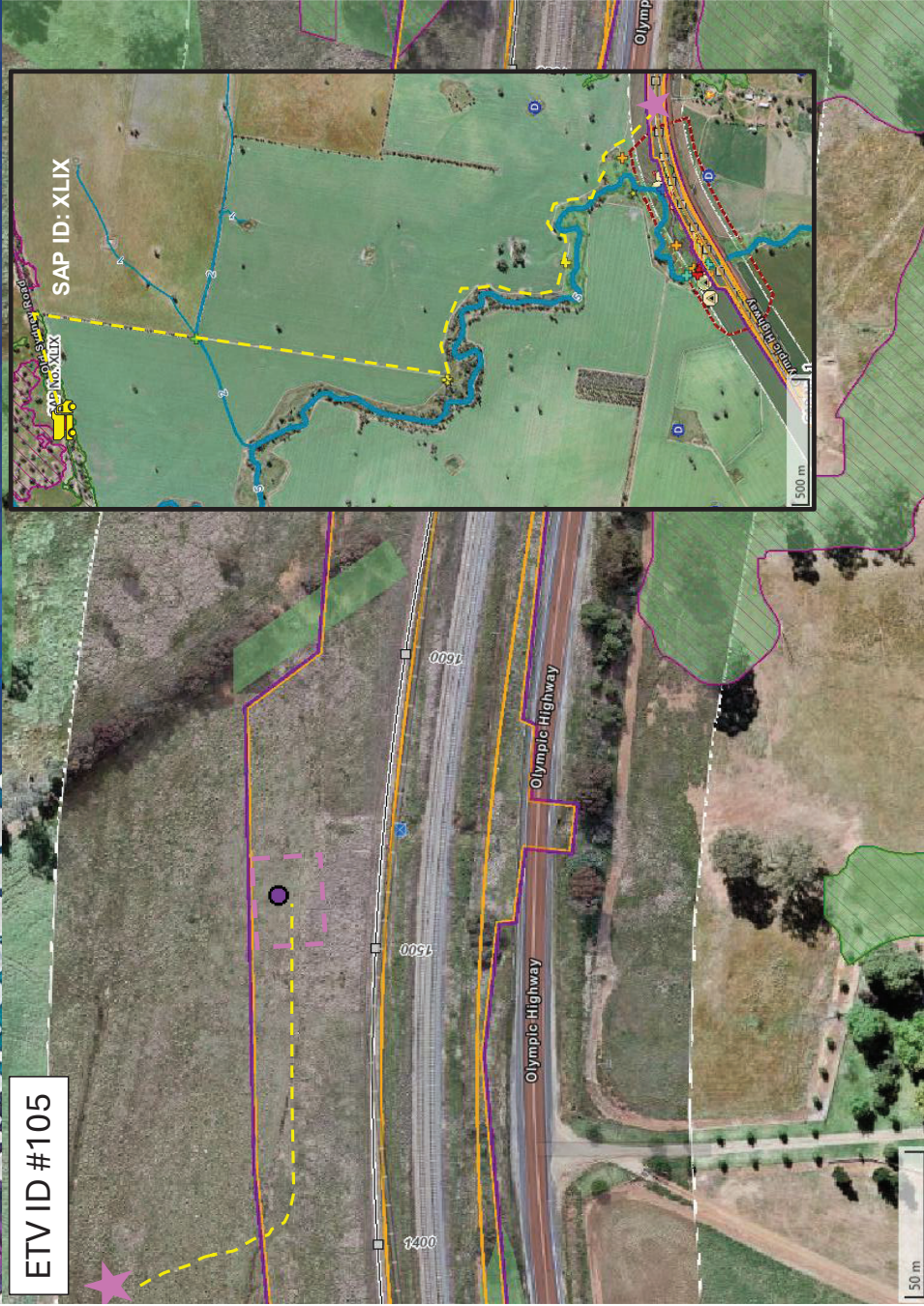
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TEC ZONES OR TEC HABITAT:

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WATERWAYS (OR POTENTIAL WATERWAYS):

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Legend

	AEC		Access track continued
	Sensitive area		
	Native vegetation		
	CIZ boundary		
	Aboriginal Heritage artefact		
	Black Falcon		
	Brown Treecreeper		
	Diamond Firetail		
	Dusk Woodswallow		
	Flame Robin		
	Grey-crowned Babbler		
	Little Eagle		
	Little Eagle – Nest (Confirmed)		
	Spotted Harrier		
	Spotted Harrier – Nest (Confirmed)		
	Square-tailed Kite		
	Squirrel Glider		
	Superb Parrot		
	Superb Parrot - Nesting		
	White-fronted Chat		
	Spill kit		
	Chainage		
	PAD High Density		
	PAD Low Density		
	Indigenous Survey Zones		
	Euphrasia arguta, Grevillea wilkinsonii, Prasophyllum sp.		
	Diuris Tricolor		
	Cullen Parvum		
	Caladenia arenaria, Eleocharis obolis, Indolifera efoliata, Swainsona sericea		
	Austrostipa Wakoolica and Swainsona Murrayana		
	Ammobium craspedioides		
	Acacia ausfeldii		
	Habitat connectivity		
	Stream (incl. ephemeral)		
	Grey Box (E. macrocarpa)		
	White-Box-Yellow Box-Blakely's Red Gum		
	Receivers		
	Swainsona recta		
	Local Heritage		
	State Heritage		
	Scattered Paddock Tree		
	Land not surveyed (ecologically)		
	Access/egress point		
	Public level crossing		
	Private level crossing		
	Bridge point		
	Stock crossing		
	Culvert point		
	ETV Test Locations		
	ETV buffer area		

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- Monitoring of ESC:**
 - Periodic monitoring of the effectiveness of the ESC to be undertaken as part of environmental inspections, prior to unfavourable weather conditions and after heavy rainfall events (>20mm in 24-hour period).

INDIGENOUS SURVEY ZONES:

All relevant heritage advice must be adhered to prior to ground disturbance within Indigenous Survey Zones 1-11 East.

UNSURVEYED LANDS:

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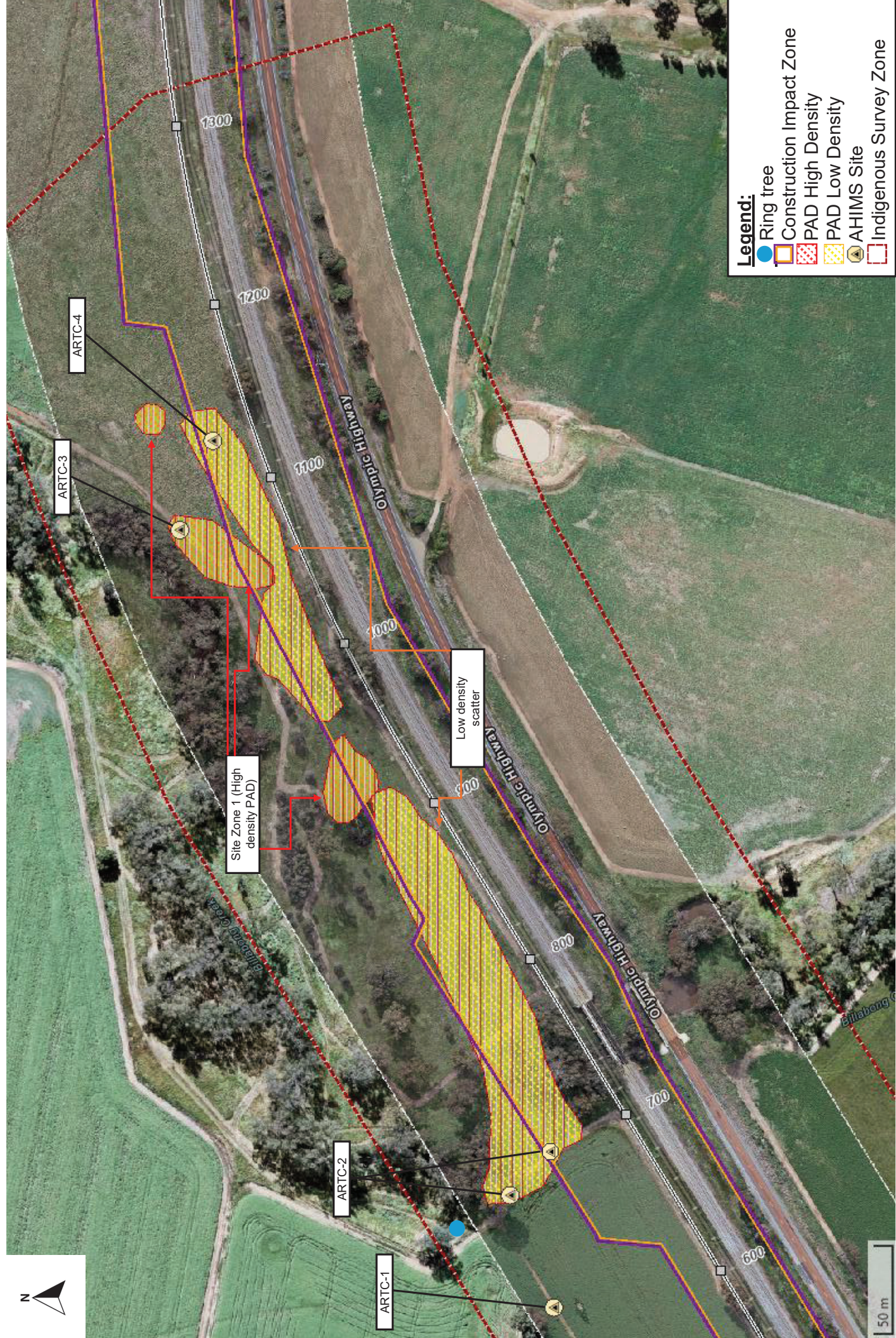
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WATERWAYS (OR POTENTIAL WATERWAYS):

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Indigenous Survey Zone 1
Artefact sites: ARTC1-4, Site Zone 1 – Low density
scatter



50 m

ETVID #2



Legend

Symbol	Feature	Symbol	Feature	Symbol	Feature
	AEC		Access track continued		<i>Euphrasia arguta</i> , <i>Grevillea wilkinsonii</i> , <i>Psoraleum</i> sp., <i>Wybona</i>
					<i>Diuris</i> <i>Tricolor</i>
					<i>Cullen</i> <i>Parvum</i>
	Sensitive area				<i>Caladenia arenaria</i> , <i>Eleocharis obliqua</i> , <i>Indigifera effoliata</i> , <i>Swainsona sericea</i>
					<i>Austrostipa Wakoolica</i> and <i>Swainsona murrayana</i>
	CIZ boundary				<i>Ammobium craspedioides</i>
					<i>Acacia austfeldii</i>
	Aboriginal Heritage artefact				Habitat connectivity
	Black Falcon				Stream (incl. ephemeral)
	Brown Treecreeper				Grey Box (<i>E. macrocarpa</i>)
	Diamond Firetail				White-Box-Yellow Box-Blakely's Red Gum
	Dusk Woodswallow				Receivers
	Flame Robin				<i>Swainsona recta</i>
	Grey-crowned Babbler				Local Heritage
	Little Eagle				State Heritage
	Little Eagle – Nest (Confirmed)				Scattered Paddock Tree
	Spotted Harrier				Land not surveyed (ecologically)
	Spotted Harrier – Nest (Confirmed)				Access/egress point
	Square-tailed Kite				Public level crossing
	Squirrel Glider				Private level crossing
	Superb Parrot				Bridge point
	Superb Parrot – Nesting				Stock crossing
	White-fronted Chat				Culvert point
	Spill kit				ETV Test Locations
	Chainage				ETV buffer area
	PAD High Density				
	PAD Low Density				
	Indigenous Survey Zones				

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Monitoring of ESC:

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INDIGENOUS SURVEY ZONES

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UNSURVEYED LANDS:

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Legend

	AEC		Access track continued
	Sensitive area		
	Native vegetation		
	CIZ boundary		
	Aboriginal Heritage artefact		
	Black Falcon		
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	Diamond Firetail		
	Dusk Woodswallow		
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	Grey-crowned Babbler		
	Little Eagle		
	Little Eagle – Nest (Confirmed)		
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	Square-tailed Kite		
	Squirrel Glider		
	Superb Parrot		
	White-fronted Chat		
	Spill kit		
	Chainage		
	PAD High Density		
	PAD Low Density		
	Indigenous Survey Zones		
	Euphrasia arguta		
	Grevillea wilkinsonii		
	Fraserophyllum sp.		
	Wybona		
	Diuris Tricolor		
	Cullen Parvum		
	Caladenia arenaria		
	Eleocharis obliqua		
	Indrofera efoliata		
	Swainsona sericea		
	Austrostipa Wakoolica		
	Murrayana		
	Ammobium craspedioides		
	Acacia ausfeldii		
	Habitat connectivity		
	Stream (incl. ephemeral)		
	Grey Box (E. macrocarpa)		
	White-Box-Yellow Box-Blakely's Red Gum		
	Receivers		
	Swainsona recta		
	Local Heritage		
	State Heritage		
	Scattered Paddock Tree		
	Land not surveyed (ecologically)		
	Access/egress point		
	Public level crossing		
	Private level crossing		
	Bridge point		
	Stock crossing		
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	ETV Test Locations		
	ETV buffer area		

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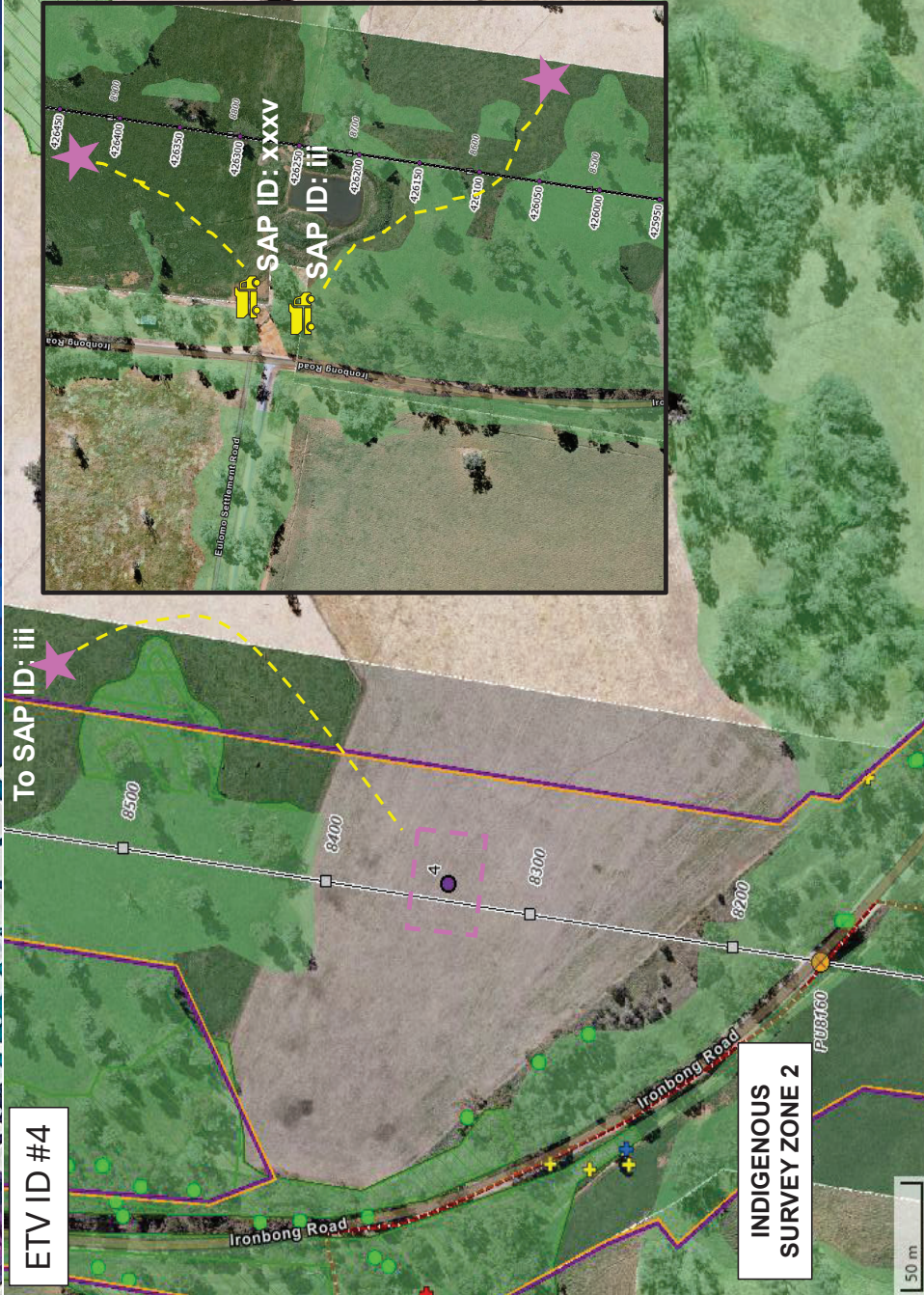
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Property #5 – Mal and Maria Lloyd-Jones



Legend

Symbol	Legend	Map Feature
	AEC	Access track continued
	Sensitive area	
	Native vegetation	
	CIZ boundary	
	Aboriginal Heritage artefact	
	Black Falcon	
	Brown Treecreeper	
	Diamond Firetail	
	Dusk Woodswallow	
	Flame Robin	
	Grey-crowned Babbler	
	Little Eagle	
	Little Eagle – Nest (Confirmed)	
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	Superb Parrot	
	Superb Parrot - Nesting	
	White-fronted Chat	
	Spill kit	
	Chainage	
	PAD High Density	
	PAD Low Density	
	Indigenous Survey Zones	
	<i>Euphrasia arguta</i> , <i>Grevillea wilkinsonii</i> , <i>Prasophyllum</i> sp. <i>Wybona</i>	
	<i>Diuris tricolor</i>	
	<i>Gullen Parvum</i>	
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	<i>Austrostipa Wakoolica</i> and <i>Swainsona Murrayana</i>	
	<i>Arimobolium craspedioides</i>	
	<i>Acacia austreidili</i>	
	Habitat connectivity	
	Stream (incl. ephemeral)	
	Grey Box (<i>E. macrocarpa</i>)	
	White-Box-Yellow Box-Blackely's Red Gum	
	Receivers	
	<i>Swainsona recta</i>	
	Local Heritage	
	State Heritage	
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INDIGENOUS SURVEY ZONES

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Legend	
	AEC
	Access track continued
	Sensitive area
	Native vegetation
	CIZ boundary
	Aboriginal Heritage artefact
	Black Falcon
	Brown Treecreeper
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	Dusk Woodswallow
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	PAD Low Density
	Indigenous Survey Zones
	<i>Euphrasia arguta</i> , <i>Grevillea wilkinsonii</i> , <i>Prosochylum</i> sp., <i>Wyboona</i>
	<i>Diuris</i> <i>Tricolor</i>
	<i>Cullen</i> <i>Parvum</i>
	<i>Caladenia arenaria</i> , <i>Eleocharis oblica</i> , <i>Indigofera effoliata</i> , <i>Swainsona sericea</i>
	<i>Austrostipa Wakoolica</i> and <i>Swainsona</i>
	<i>Murrawana</i>
	<i>Ammobium craspedioides</i>
	<i>Acacia ausfeldii</i>
	Habitat connectivity
	Stream (incl. ephemeral)
	Grey Box (<i>E. macrocarpa</i>)
	White-Box-Yellow Box-Blakely's Red Gum
	Receivers
	<i>Swainsona recta</i>
	Local Heritage
	State Heritage
	Scattered Paddock Tree
	Land not surveyed (ecologically)
	Access/egress point
	Public level crossing
	Private level crossing
	Bridge point
	Stock crossing
	Culvert point
	ETV Test Locations
	ETV buffer area

- All erosion and sediment controls are to follow the requirements of the Blue Book Managing Urban Stormwater, Volume 1, 4th Edition, March 2004.
- EROD controls have been included on the SEPs in areas where potential EROD risks are anticipated. Additional EROD control equipment will be positioned at EROD controls indicated in maps must be determined appropriately on site (i.e. downslope of work activity, covering a drain, etc.).

- Appropriate ESC (e.g. geofabric) to be placed over stormwater/rail corridor drains (as required – if works have potential to impact).

- All temporary stockpiling of materials will take place away from drainage lines and creeks.
- Geotechnical excavation will be backfilled by excess soil.
- Water will not be discharged or pumped off-site or to drains. For any water discharge, the use on site).

- Sediment control to be implemented in all laydown areas, specifically drains and gutters for stormwater control.
- ESC to be in place on the downward side of stockpiles. All temporary stockpiles to be covered and weighted down with plastic sheeting to prevent wind and water erosion.
- All spoil generated as a result of hydraulic excavation will be contained within a sucker truck and liquid waste bins and will be disposed of as liquid waste at an appropriate waste-on site).
- Stockpiles not to exceed 2 metres in height.

- Any material delivered to site or excavated material to bins (cover is essential for preventing ingress of rainwater).

- Where stockpiles are to be established overnight, they would be covered with impermeable material such as builder's plastic and a sandbag bund will be created to prevent erosion and sedimentation.
- Where appropriate, geolabrics would underlay the stockpile to facilitate easier site clean-up upon removal of the stockpile.
- Groundwater will be managed in accordance with the requirements of the Waste Classification Guidelines (EPA, 2014).

- Periodic monitoring of the effectiveness of the ESC to be undertaken as part of environmental inspections, prior to unfavourable weather conditions and after heavy rainfall events (>20mm in 24-hour period).

All relevant heritage advice must be adhered to prior to ground disturbance within Indigenous Survey Zones 1-11 East.

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Legend

	AEC		Access track continued		<i>Euphrasia arguta</i> , <i>Grevillea wilkinsonii</i> , <i>Fraxophyllum</i> sp.	<i>Wybona</i>
	Sensitive area		Native vegetation		<i>Diuris Tricolor</i>	
	Ciz boundary		Aboriginal Heritage artefact		<i>Cullen Parvum</i>	
	Black Falcon		Brown Treecreeper		<i>Caladenia arenaria</i> , <i>Eleocharis obolis</i> , <i>Indiofera efoliata</i> , <i>Swainsona sericea</i>	
	Diamond Firetail		Dusk Woodswallow		<i>Austrostipa Wakoolica</i> and <i>Swainsona murrayana</i>	
	Flame Robin		Grey-crowned Babbler		<i>Ammodium craspedioides</i>	
	Little Eagle		Spotted Harrier		<i>Acacia ausfeldii</i>	
	Spotted Harrier		Spotted Harrier – Nest (Confirmed)		Habitat connectivity	
	Spotted Harrier		Square-tailed Kite		Stream (incl. ephemeral)	
	Spotted Harrier		Squirrel Glider		Grey Box (E. macrocarpa)	
	Spotted Harrier		Superb Parrot		White-Box-Yellow Box-Blakely's Red Gum	
	Spotted Harrier		White-fronted Chat		Receivers	
	Spotted Harrier		Spill kit		<i>Swainsona recta</i>	
	Spotted Harrier		Chainage		Local Heritage	
	Spotted Harrier		PAD High Density		State Heritage	
	Spotted Harrier		PAD Low Density		Scattered Paddock Tree	
	Spotted Harrier		Indigenous Survey Zones		Land not surveyed (ecologically)	
	Spotted Harrier				Access/egress point	
	Spotted Harrier				Public level crossing	
	Spotted Harrier				Private level crossing	
	Spotted Harrier				Bridge point	
	Spotted Harrier				Stock crossing	
	Spotted Harrier				Culvert point	
	Spotted Harrier				ETV Test Locations	
	Spotted Harrier				ETV buffer area	

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 - Stockpiles not to exceed 2 metres in height.
 - Any material delivered to site or excavated material to be reused as fill would be neatly stockpiled only in the designated stockpile location until required. Materials may be stored in 'Bulka Bags' or covered skip bins (cover is essential for preventing ingress of rainwater).
 - Where stockpiles are to be established overnight, they would be covered with impermeable material such as builder's plastic and a sandbag bund will be created to prevent erosion and sedimentation.
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 - Groundwater will be managed in accordance with the requirements of the Waste Classification Guidelines (EPA, 2014).
 - Water will be used for dust suppression as required.
- Monitoring of ESC:
 - Periodic monitoring of the effectiveness of the ESC to be undertaken as part of environmental inspections, prior to unfavourable weather conditions and after heavy rainfall events (>20mm in 24-hour period).

INDIGENOUS SURVEY ZONES

All relevant heritage advice must be adhered to prior to ground disturbance within Indigenous Survey Zones 1-11 East.

UNSURVEYED LANDS:

No activities to commence prior to endorsement of works by an ecologist.

TEC ZONES OR TEC HABITAT:

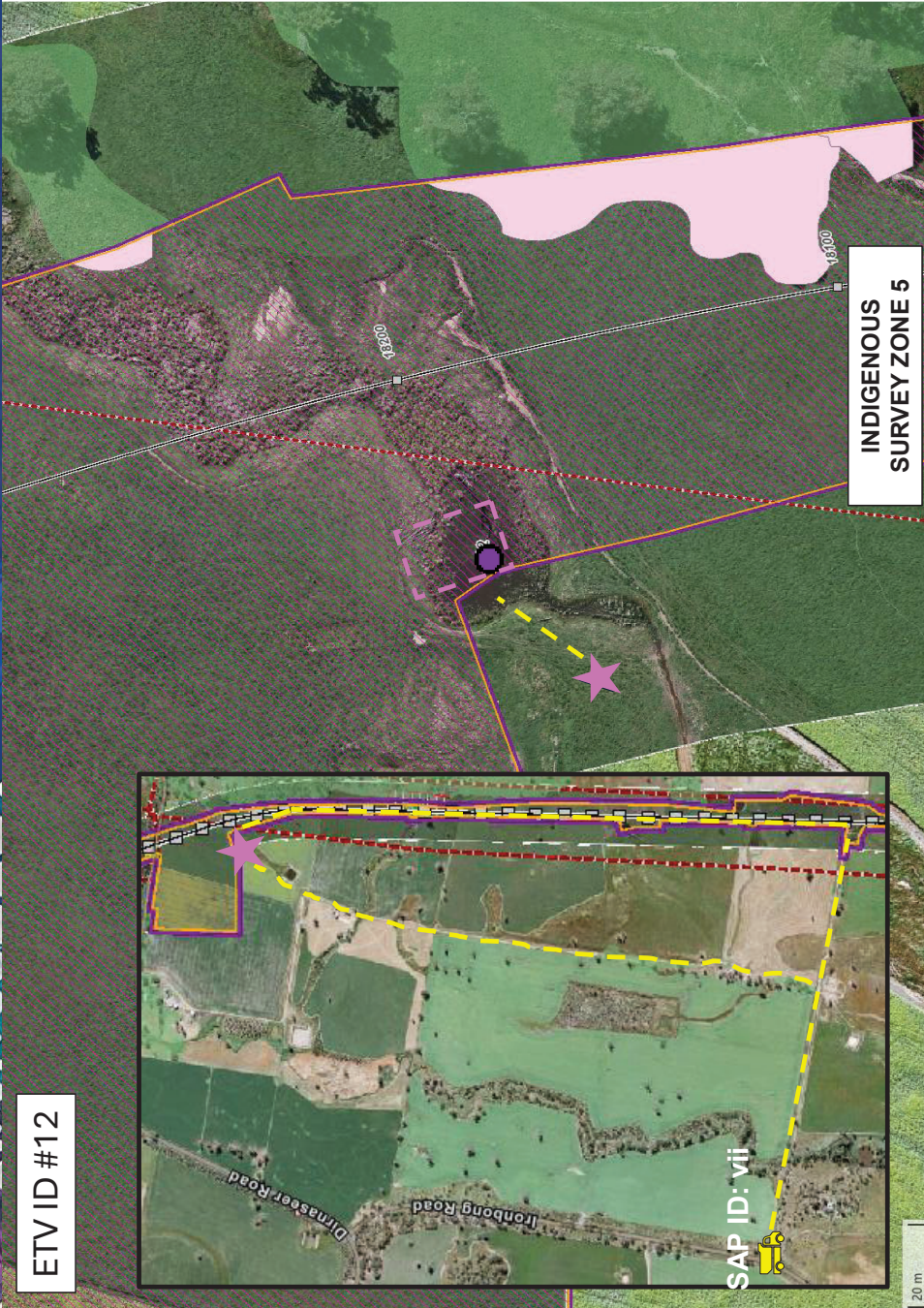
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WATERWAYS (OR POTENTIAL WATERWAYS):

- Vehicles may only proceed following an assessment of on-site conditions (i.e. high risk of erosion, >20mm of rainfall in 24h, change to existing flow path)

Legend

	AEC		Access track continued		<i>Euphrasia arguta</i> , <i>Grevillea wilkinsonii</i> , <i>Fraxophyllum</i> sp.	<i>Wybona</i>
	Sensitive area		Native vegetation		<i>Diuris Tricolor</i>	
	CIZ boundary		Aboriginal Heritage artefact		<i>Cullen Parvum</i>	
	Black Falcon		Brown Treecreeper		<i>Caladenia arenaria</i> , <i>Eleocharis obliqua</i> , <i>Indiofera efoliata</i> , <i>Swainsona sericea</i>	
	Diamond Firetail		Dusk Woodswallow		<i>Austroslipa Wakoolica</i> and <i>Swainsona murrayana</i>	
	Flame Robin		Grey-crowned Babbler		<i>Ammobium craspedioides</i>	
	Little Eagle		Spotted Harrier		<i>Acacia ausfeldii</i>	
	Spotted Harrier		Spotted Harrier – Nest (Confirmed)		Habitat connectivity	
	Square-tailed Kite		Squirrel Glider		Stream (incl. ephemeral)	
	Superb Parrot		White-fronted Chat		Grey Box (E. macrocarpa)	
	Spill kit		Chainage		White-Box-Yellow Box-Blakely's Red Gum	
	PAD High Density		PAD Low Density		Receivers	
	Indigenous Survey Zones				<i>Swainsona recta</i>	



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Monitoring of ESC:

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INDIGENOUS SURVEY ZONES

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Legend

Legend	
	AEC
	Access track continued
	Sensitive area
	Native vegetation
	CIZ boundary
	Aboriginal Heritage artefact
	Black Falcon
	Brown Treecreeper
	Diamond Firetail
	Dusk Woodswallow
	Flame Robin
	Grey-crowned Babbler
	Little Eagle
	Little Eagle – Nest (Confirmed)
	Spotted Harrier
	Spotted Harrier – Nest (Confirmed)
	Square-tailed Kite
	Squirrel Glider
	Superb Parrot
	Superb Parrot - Nesting
	White-fronted Chat
	Spill kit
	Chainage
	PAD High Density
	PAD Low Density
	Indigenous Survey Zones
	<i>Euphrasia arguta</i> , <i>Grevillea wilkinsonii</i> , <i>Psoralea sp.</i> , <i>Wybonia</i>
	<i>Diuris Tricolor</i>
	<i>Cullen Parvum</i>
	<i>Caladenia arenaria</i> , <i>Eleocharis obicis</i> , <i>Indigofera efoliata</i> , <i>Swainsona sericea</i>
	<i>Austrostipa Wakoolica</i> and <i>Swainsona Murrayana</i>
	<i>Ammobium craspedioides</i>
	<i>Acacia ausfeldii</i>
	Habitat connectivity
	Stream (incl. ephemeral)
	Grey Box (<i>E. macrocarpa</i>)
	White-Box-Yellow Box-Blakely's Red Gum
	Receivers
	<i>Swainsona recta</i>
	Local Heritage
	State Heritage
	Scattered Paddock Tree
	Land not surveyed (ecologically)
	Access/egress point
	Public level crossing
	Private level crossing
	Bridge point
	Stock crossing
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INDIGENOUS SURVEY ZONES

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UNSURVEYED LANDS:

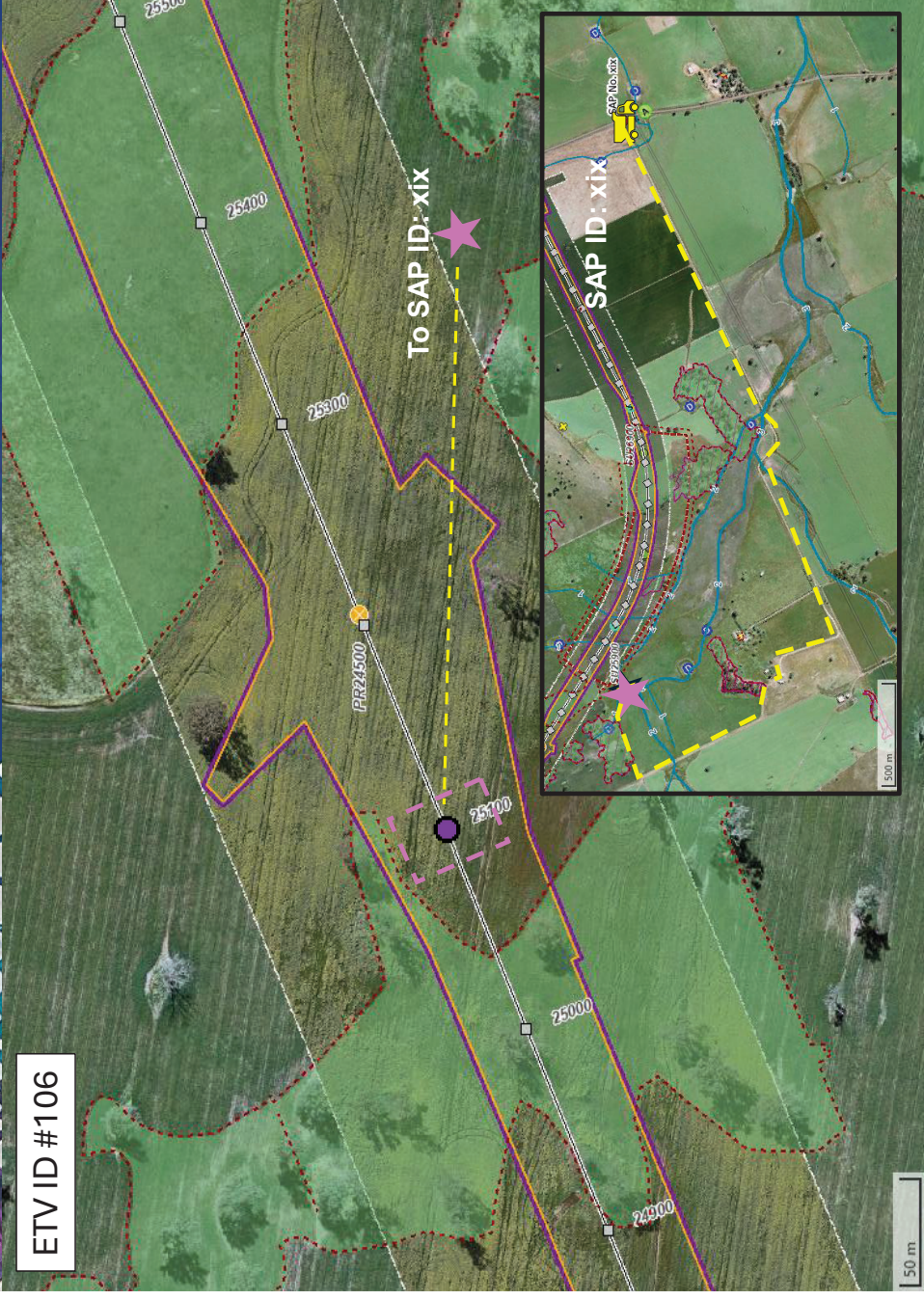
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Legend

	AEC		Access track continued		<i>Euphrasia arguta</i> , <i>Grevillea wilkinsonii</i> , <i>Fraxophyllum</i> sp.	<i>Wybona</i>
	Sensitive area		Native vegetation		<i>Diuris Tricolor</i>	
	CIZ boundary		Aboriginal Heritage artefact		<i>Cullen Parvum</i>	
	Black Falcon		Brown Treecreeper		<i>Caladenia arenaria</i> , <i>Eleocharis obliqua</i> , <i>Indiofera efoliata</i> , <i>Swainsona sericea</i>	
	Diamond Firetail		Dusk Woodswallow		<i>Austrostipa Wakoolica</i> and <i>Swainsona murrayana</i>	
	Flame Robin		Grey Box (E. macrocarpa)		<i>Ammobium craspedioides</i>	
	Grey-crowned Babbler		Little Eagle – Nest (Confirmed)		<i>Acacia ausfeldii</i>	
	Little Eagle		Spotted Harrier		Habitat connectivity	
	Spotted Harrier – Nest (Confirmed)		Square-tailed Kite		Stream (incl. ephemeral)	
	Squirrel Glider		Superb Parrot		Grey Box (E. macrocarpa)	
	Superb Parrot - Nesting		White-fronted Chat		White-Box-Yellow Box-Blakely's Red Gum	
	Spill kit		Chainage		Receivers	
	PAD High Density		PAD Low Density		<i>Swainsona recta</i>	
	Indigenous Survey Zones				Local Heritage	
					State Heritage	
					Scattered Paddock Tree	
					Land not surveyed (ecologically)	
					Access/egress point	
					Public level crossing	
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	Sensitive area		Native vegetation		<i>Diuris Tricolor</i>	
	Ciz boundary		Aboriginal Heritage artefact		<i>Cullen Parvum</i>	
	Black Falcon		Brown Treecreeper		<i>Caladenia arenaria</i> , <i>Eleocharis obliqua</i> , <i>Indiofera efoliata</i> , <i>Swainsona sericea</i>	
	Diamond Firetail		Dusk Woodswallow		<i>Murrawana</i>	
	Flame Robin		Grey Box (E. macrocarpa)		<i>Austroslipa Wakoolica</i> and <i>Swainsona</i>	
	Grey-crowned Babbler		Little Eagle		<i>Ammobium craspedioides</i>	
	Little Eagle – Nest (Confirmed)		Spotted Harrier		<i>Acacia ausfeldii</i>	
	Spotted Harrier		Spotted Harrier – Nest (Confirmed)		Habitat connectivity	
	Square-tailed Kite		Squirrel Glider		Stream (incl. ephemeral)	
	Superb Parrot		White-fronted Chat		Grey Box (E. macrocarpa)	
	Spill kit		Chainage		White-Box-Yellow Box-Blakely's Red Gum	
	PAD High Density		PAD Low Density		Receivers	
	Indigenous Survey Zones				<i>Swainsona recta</i>	

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Legend

- | Legend | |
|--------|--|
| | AEC |
| | Access track continued |
| | Sensitive area |
| | Native vegetation |
| | CIZ boundary |
| | Aboriginal Heritage artefact |
| | Black Falcon |
| | Brown Treecreeper |
| | Diamond Firetail |
| | Dusk Woodswallow |
| | Flame Robin |
| | Grey-crowned Babbler |
| | Little Eagle |
| | Little Eagle – Nest (Confirmed) |
| | Spotted Harrier |
| | Spotted Harrier – Nest (Confirmed) |
| | Square-tailed Kite |
| | Squirrel Glider |
| | Superb Parrot |
| | Superb Parrot - Nesting |
| | White-fronted Chat |
| | Spill kit |
| | Chainage |
| | PAD High Density |
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| | White-Box-Yellow Box-Blakely's Red Gum |
| | Receivers |
| | <i>Swainsona recta</i> |
| | Local Heritage |
| | State Heritage |
| | Scattered Paddock Tree |
| | Land not surveyed (ecologically) |
| | Access/egress point |
| | Public level crossing |
| | Private level crossing |
| | Bridge point |
| | Stock crossing |
| | Culvert point |
| | ETV Test Locations |
| | ETV buffer area |

Erosion and Sediment Controls (ESC):

- All erosion and sediment controls are to follow the requirements of the Blue Book Managing Urban Stormwater, Volume 1, 4th Edition, March 2004.
 - ERSed controls have been included on the SEPs in areas where potential ERSed risks are anticipated. Additional ERSed control equipment will be available to site teams if required. The orientation and position of ERSed controls indicated in maps must be determined appropriately on site (i.e. downslope of work activity, covering a drain, etc.).
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 - Geotechnical excavation will be backfilled by excess soil.
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 - Sediment control to be implemented in all laydown areas, specifically drains and gutters for stormwater control.
 - ESC to be in place on the downward side of stockpiles. All temporary stockpiles to be covered and weighted down with plastic sheeting to prevent wind and water erosion.
 - All spoil generated as a result of hydraulic excavation will be contained within a sucker truck and liquid waste bins and will be disposed of as liquid waste at an appropriately licenced facility.
 - Stockpiles not to exceed 2 metres in height.
 - Any material delivered to site or excavated material to be reused as fill would be neatly stockpiled only in the designated stockpile location until required. Materials may be stored in 'Bulk Bags' or covered skip bins (cover is essential for preventing ingress of rainwater).
 - Where stockpiles are to be established overnight, they would be covered with impermeable material such as builder's plastic and a sandbag bund will be created to prevent erosion and sedimentation.
 - Where appropriate, geofabric would underlay the stockpile to facilitate easier site clean-up upon removal of the stockpile.
 - Groundwater will be managed in accordance with the requirements of the Waste Classification Guidelines (EPA, 2014).
 - Water will be used for dust suppression as required.

Monitoring of ESC:

- Periodic monitoring of the effectiveness of the ESC to be undertaken as part of environmental inspections, prior to unfavourable weather conditions and after heavy rainfall events (>20mm in 24-hour period).

INDIGENOUS SURVEY ZONES

- All relevant heritage advice must be adhered to prior to ground disturbance within Indigenous Survey Zones 1-11 East.

UNSURVEYED LANDS:

- No activities to commence prior to endorsement of works by an ecologist.**

TEC ZONES OR TEC HABITAT:

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Legend	
	AEC
	Access track continued
	Sensitive area
	Native vegetation
	Ciz boundary
	Aboriginal Heritage artefact
	Black Falcon
	Brown Treecreeper
	Diamond Firetail
	Dusk Woodswallow
	Flame Robin
	Grey-crowned Babbler
	Little Eagle
	Little Eagle – Nest (Confirmed)
	Spotted Harrier
	Spotted Harrier – Nest (Confirmed)
	Square-tailed Kite
	Squirrel Glider
	Superb Parrot
	Superb Parrot - Nesting
	White-fronted Chat
	Spill kit
	Chainage
	PAD High Density
	PAD Low Density
	Indigenous Survey Zones
	Euphrasia arguta, Grevillea wilkinsonii, Prasophyllum sp.
	Wybona Diuris Tricolor
	Cullen Parvum
	Caladenia arenaria, Eleocharis obliqua, Indolifera efoliata, Swainsona sericea
	Austrostipa Wakoolica and Swainsona Murravanua
	Ammobium craspedioides
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	Habitat connectivity
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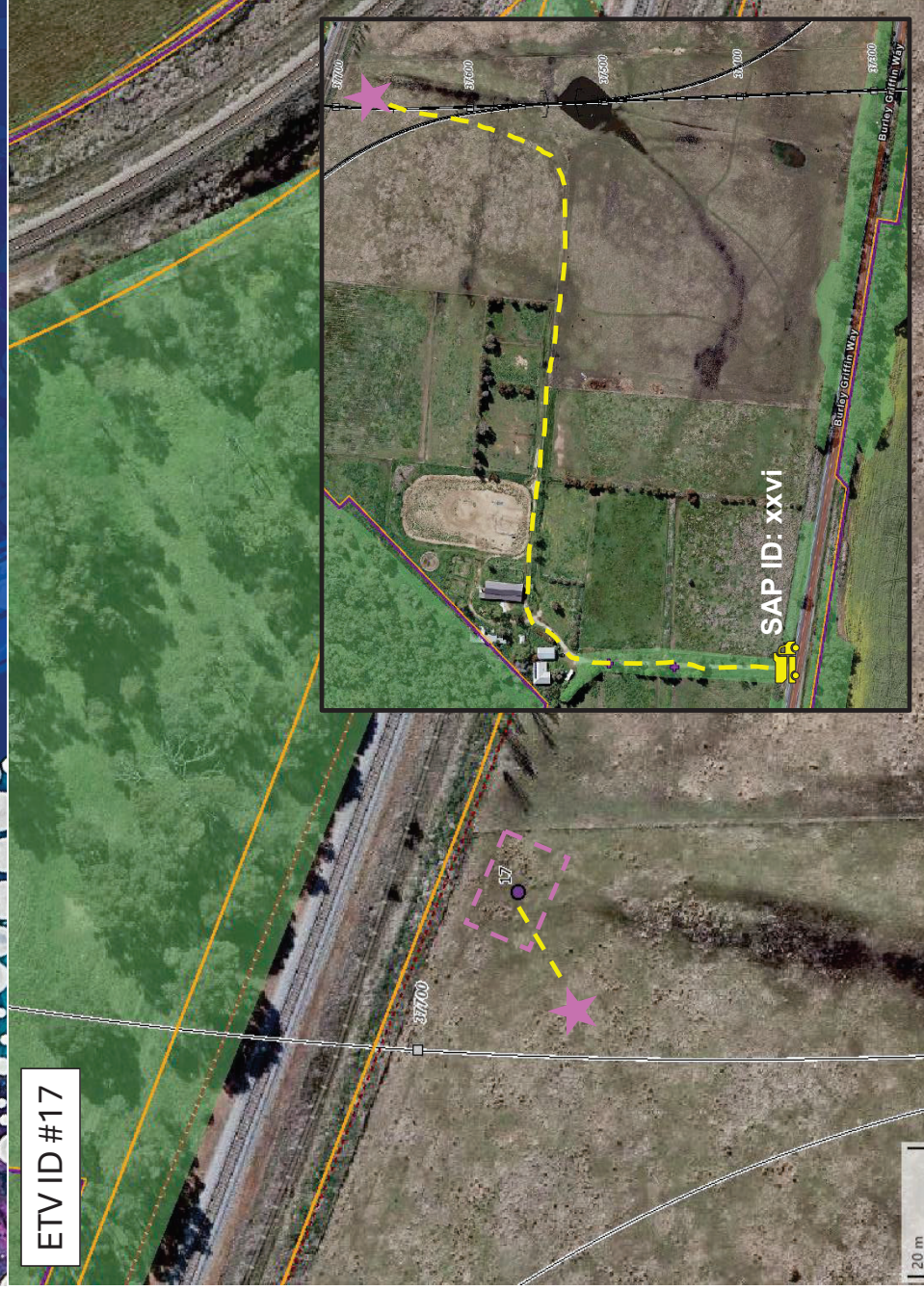
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ETVID #17



Legend

Legend	
	AEC
	Access track continued
	Sensitive area
	Native vegetation
	CIZ boundary
	Aboriginal Heritage artefact
	Black Falcon
	Brown Treecreeper
	Diamond Firetail
	Dusk Woodswallow
	Flame Robin
	Grey-crowned Babbler
	Little Eagle
	Little Eagle – Nest (Confirmed)
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	Spill kit
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	<i>Diuris</i> <i>Tricolor</i>
	<i>Cullen</i> <i>Parvum</i>
	<i>Caladenia arenaria</i> , <i>Eleocharis obicis</i> , <i>Indigofera effoliata</i> , <i>Swainsona sericea</i>
	<i>Austrostipa Wakoolica</i> and <i>Swainsona Murrayana</i>
	<i>Ammobium craspedioides</i>
	<i>Acacia ausfeldii</i>
	Habitat connectivity
	Stream (incl. ephemeral)
	Grey Box (<i>E. macrocarpa</i>)
	White-Box-Yellow Box-Blakely's Red Gum
	Receivers
	<i>Swainsona recta</i>
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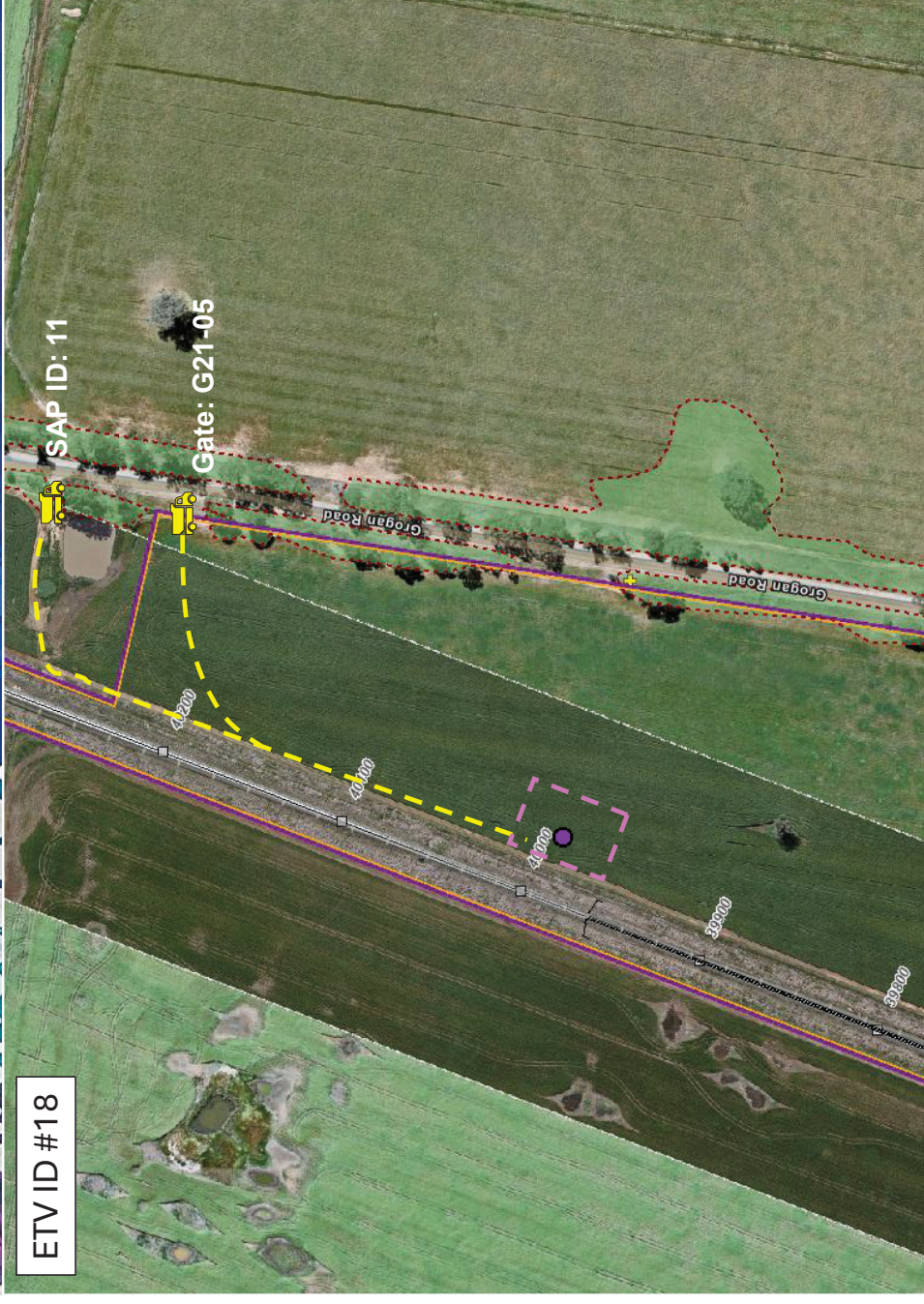
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Legend

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Appendix B—Noise Assessment



Appendix B – Noise Assessment

Noise model summary:

A scenario-based approach has been applied to the low impact works assessment to assess potential noise impacts associated with Low Impact Works (LIW).

Standard construction hours on I2S are;

- 7:00am to 6:00pm Monday to Friday
- 7:00am to 6:00pm Saturday
- At no time on Sunday or public holidays.

Where out of hours works are required, they must comply with CoA E3 (b) as per the definition of ‘Low impact work’ as per SSI-9406. Any relevant OOHW approvals must be obtained prior to the commencement of OOHW activities. This approval will be sought via separate application/permit as OOHW are required.

Site Characteristics:

The existing noise environment is characteristic of a rural landscape. Most of the proposal site has little or no road traffic noise, sparse settlement patterns, and generally being characterised by low background noise levels. Burley Griffin Way, Olympic Highway and the existing rail lines are the main noise sources within the proposal site; however, traffic along these roads is typically sparse and does not significantly impact the background noise levels of the surrounding environment.

The most significant existing sources of vibration along the proposal site include those generated by traffic on the local road network and existing rail operations at Illabo and Stockinbingal. Although not measured directly, vibration due to existing road and rail sources is considered to be below the structural damage and human comfort criteria for all vibration sensitive receivers.

Most residential receivers are in Stockinbingal, east of the proposal site, including low-density residential dwellings. Residential receivers located within the study area outside of Stockinbingal are typically present as isolated rural residential dwellings within open farmland. Residential dwellings located near the proposal are predominantly single storey.

Rationale:

The following noise model is for the activities to be undertaken during Low Impact Works for the Illabo to Stockinbingal Project.

The works planned for 2025, which are included in this assessment, are mostly set to occur at expansive distances from sensitive and residential receivers, as established by an initial assessment of access and on-site investigations. The closest receiver for these works would be on the Dudauman Rd (386 DUDAUMAN RD, DIRNASEER NSW 2666, EIS Receiver ID 226828). This receiver is approximately 1km from the proposed work area. The impacts (as per the ICNG) are not within the highly noise affected dBA range (75dB(A)).



INLAND RAIL ILLABO TO STOCKINBINGAL

Modelling has been conducted via a 'worst case scenario' approach for the activity to be conducted throughout LIW. Activities included in this noise assessment are not proposed to be undertaken concurrently. If any activities overlap, this would be subject to additional noise modelling to assess the potential cumulative impacts of multiple work activities at the same location. This would be subject to approval by the ER.

A model for each activity is provided in the below sections, which includes;

- A map, showing the work activities and their proximity to receivers (if any);
- The noise model inputs (showing equipment usage percentages and quantity);
- The noise model outputs (showing the results of the modelling).

Noise Management Levels

TABLE 16-1: NOISE MANAGEMENT LEVELS FOR RESIDENTIAL RECEIVERS

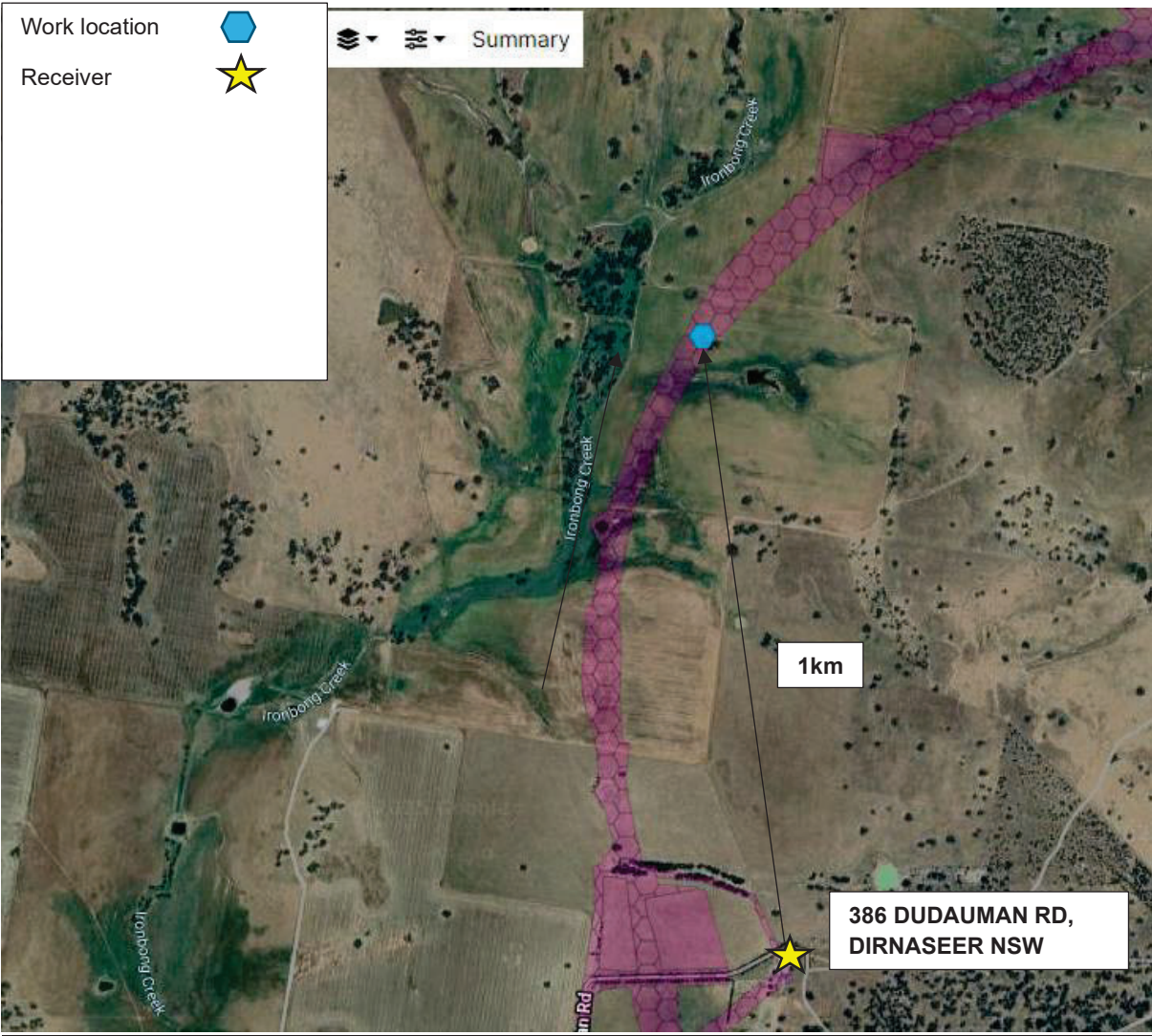
Timing	RBL (dBA) ¹	NML (dBA)	Highly noise affected level (dBA)
Standard hours	35	45	75
Out of hours—Day	35	40	N/A
Out of hours—Evening	30	35	N/A
Out of hours—Night	30	35	N/A

1. Background levels are below the minimum assumed rating background noise levels at all measurement locations along the proposal site; as such, they have been adjusted to 35dBA during the day period, and 30dBA during the evening and night periods.

Modelling was conducted using standard hours Noise Management Level (NML) of 45dBA. The NMLs used are source from the EIS and Construction Noise and Vibration Impact Assessment prepared for the Project (*Environmental Impact Statement: Inland Rail: Illabo to Stockinbingal, 2022*), please refer below. Noise modelling has been conducted using Hutchinson Weller's KNOWNoise software.



Map:



Noise Model Inputs:

The following inputs (equipment type, quantity and usage) were entered into the noise model. Note that the dates of the noise model inputs are not reflective of the actual work date.

Equipment type	Qty	Usage	Reduction	Sound power level			
				LAeq	LAmix		
Excavator (06 tonne)	1	70%	0	92	101	✎	✖
Hand Tools (electric)	1	20%	0	87	99	✎	✖
Light vehicle	3	5%	0	77	90	✎	✖

Impact to Receivers:

A detailed noise output profile for the closest residential receiver to the work activity is provided in the figure below.



386 DUDAUMAN RD, DIRNASEER NSW 2666

NCA

NCA02

Address

386 DUDAUMAN RD, DIRNASEER NSW 2666

Land Use

Residential

Heritage Listing

☐

Visible

☒

	Floor	Land Use	NML	Predicted level (dBA)	NML Exceedance	Sound Impact	Highly Affected	Sleep Disturbed
👁	1	Residential	45	22	0	None	No	No

Ok

Noise model summary:

A scenario-based approach has been applied to the low impact works assessment to assess potential noise impacts associated with Low Impact Works (LIW). A summary of the noise impacts associated with the works are included in the table below.

Activity ID	dBA exceedance of NML	Number of properties affected
ETV #10	0	1

The impacts (as per the ICNG) are deemed to be not within the highly noise affect dBA range (75dB(A)) during standard hours.

Conclusion and Mitigation:

Although noise impacts are expected to be minor based on the nature of the low impact works and their planned hours (standard hours), mitigation measures will be implemented to manage noise and vibration impacts. The following measures will be implemented where reasonable and practicable in accordance with the ARTC NSW Noise and Vibration Framework Specification.

Mitigation measures
Using portable temporary acoustic screens where effective to screen the noise emissions.
Avoid the simultaneous operation of noisy plant within discernible range of noise sensitive receivers where possible.
Where available, equipment selection will favour the use of quieter and less vibration emitting construction methods.
Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks
Static plant should be located as far as possible from sensitive receivers, be located to take advantage of natural acoustic screening such as terrain, site buildings, etc and where necessary for reduction of noise impacts, provided with an acoustic enclosure.
A telephone, email and web-based community information service shall be established to allow the community to obtain additional information on construction activities, provide feedback or make a complaint.
Regular communications on the activities and progress of the proposal shall be provided to the community (e.g. via newsletter, email and/or website).
Noise or vibration monitoring in response to complaints shall be undertaken where the results or the process assist in resolving or understanding the receiver's issue.
Where possible, construction compounds should be located a minimum of 1km from the nearest resident or noise sensitive receiver.



Where vibration levels are predicted to approach the criteria for cosmetic building damage or limits for critical or sensitive areas, attended vibration measurements shall be undertaken at the commencement of vibration generating activities to confirm that vibration limits are within the acceptable range.

Early morning works between 6am-7am will be low impact noise activities¹

A respite period shall be provided for receivers impacted by weekend work (see Definitions). The respite period will ensure that no single receiver is impacted for two consecutive periods of weekend work. Respite will be provided every second weekend commencing at 1pm on Saturday and concluding at 7am on Monday.

Note 1: Work is limited to low impact works which generate low levels of noise and vibration at the nearest receivers (e.g. light vehicle movements, deliveries, site shed set up, toolbox talks, generators, hand-tools) and where the relevant NML or vibration criteria are not predicted to be exceeded or as defined by the relevant Conditions of Approval.

As a minimum, all affected landowners will be notified of the works to be undertaken in or around their properties at least 7 days prior to works commencement in accordance with the Community Communication Strategy (CCS).

Additionally, pre-starts and inductions will detail noise mitigation measures for all personnel, which includes that;

- Non-tonal reversing alarms must be fitted and used on all construction vehicles and mobile plant.
- Quieter and less noise emitting construction methods should be used whenever possible.
- Avoid shouting and slamming doors to minimise unnecessary noise.
- All vehicles accessing the project site must comply with local speed restrictions.
- Plant equipment engines should be turned off when not in use to reduce potential noise impacts on surrounding stakeholders.

Based on the assessment of noise impacts, these works can be undertaken as low impact works.



Appendix C—Community Notification

Low Impact Works Illabo to Stockinbingal 1 – 30 June 2025

**JOHN
HOLLAND**

Throughout **June 2025**, John Holland will continue with their low impact works, including site investigations, as part of the Illabo to Stockinbingal (I2S) section of Inland Rail in New South Wales.

Description of works

Ahead of construction, site investigations are required to provide essential information to assist with design. Inland Rail's contractor, John Holland, will undertake low impact work as part of these investigations.

Proposed activities include (subject to approval):

- Surveying the project/property boundaries, road and pavement levels at multiple locations
- Underground and overhead utility locating and mapping using non-destructive digging (NDD)
- Geotechnical and archaeological investigation works including drilling, soil sampling and drone operation
- Environmental including cultural heritage investigations through inspection and monitoring activities including out-of-hours fauna spotting
- Installation of fencing and gates in consultation with landowners
- Dilapidation survey and testing of existing roads, bridges, culverts, leased land and buildings and road traffic counts on Burley Griffin Way
- Establishment of temporary workers' accommodation facilities on Grogan Road, north of Stockinbingal. (More information will be provided in a separate notification)
- Inspections of existing railway infrastructure and assets.

What can I expect?

- Light vehicles entering and exiting the temporary site facilities between 6.30am – 6.30pm Monday to Saturday
- Works occurring between 7am – 6pm, Monday to Saturday

- Affected property owners will be contacted regarding access, prior to works commencing
- Traffic management including reduced speed limits may be required in some locations where works are occurring in proximity/adjacent to roads or for safe access. Please observe all traffic management instructions and signage
- Workers operating machinery, equipment, hand tools and service vehicles
- Residents in the vicinity may notice a slight increase in noise levels during these works, along with the presence of additional workers and vehicles in the area.

Expected plant and machinery used

Excavators, drill rigs, small truck mounted drill rig, NDD (Non-destructive digging) truck, water carts and support vehicles, workers using hand tools, survey equipment (including drones), traffic management equipment and associated signage.

How we're managing impacts

- Traffic management and reduced road speeds, where applicable
- Environmental controls in place
- Access to private properties will be maintained
- Temporary fencing around excavations and sensitive areas.

Cancellation of works

Works can sometimes be cancelled at short notice depending on weather and other factors. Should this occur, works will be rescheduled.

For any concerns or enquiries phone 1800 732 761 or email inlandrailnsw@inlandrail.com.au

Thank you for your patience and cooperation while we carry out these works.

Scan QR code for latest information.



☎ 1800 732 761 @ inlandrailnsw@inlandrail.com.au

✉ GPO Box 14, Sydney NSW 2000

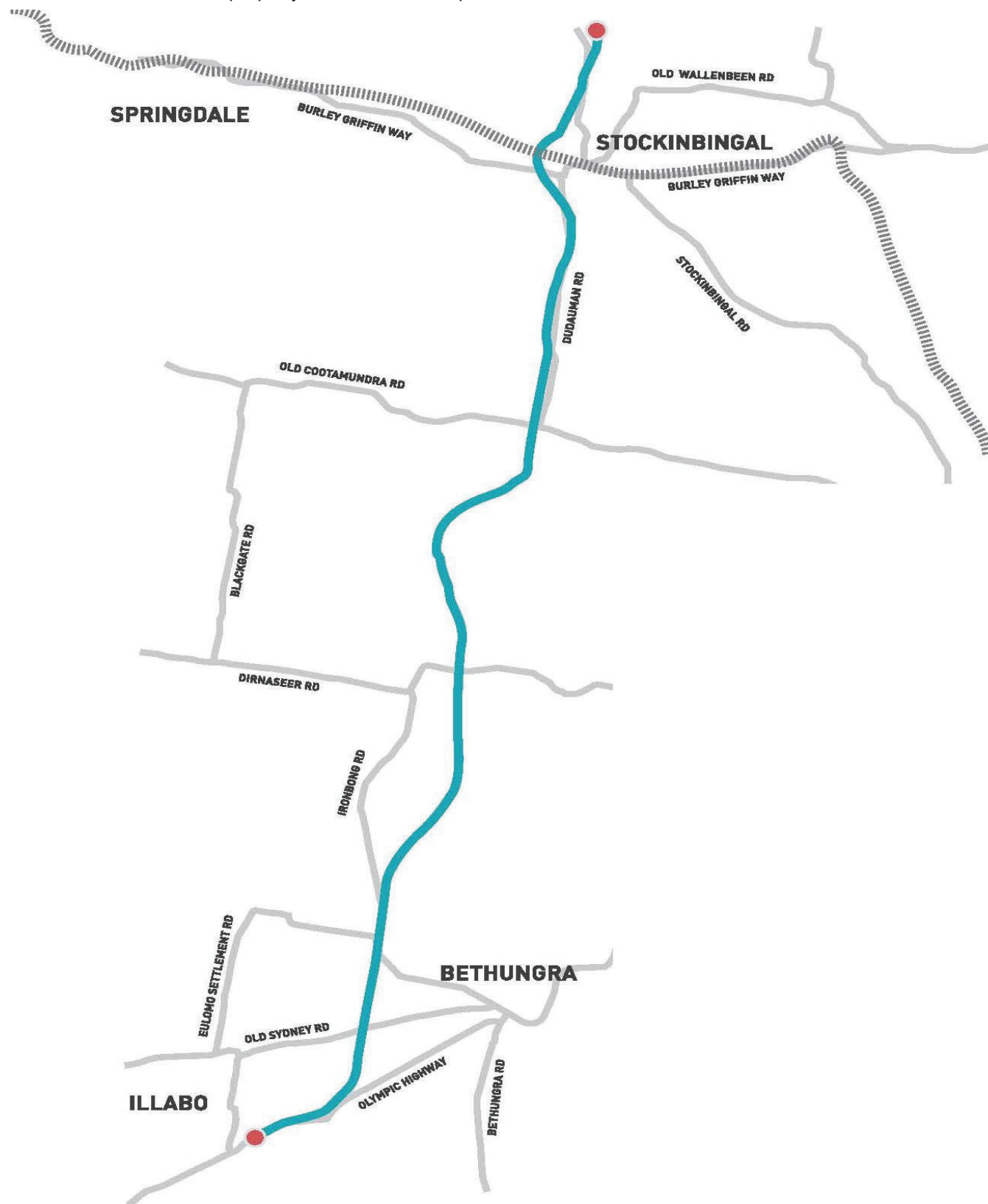


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**INLAND
RAIL**

Work locations

Work will occur at various locations within the project boundaries (shown in blue on the map below) and will be discussed with individual property owners / lessees prior to commencement.



☎ 1800 732 761 @ inlandrailnsw@inlandrail.com.au

✉ GPO Box 14, Sydney NSW 2000



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**INLAND
RAIL**



Appendix D—LIW Biodiversity Advice

14 March 2025



Daniel Lidbetter
Environmental Approvals Manager
Inland Rail Illabo to Stockinbingal
John Holland Pty Ltd
Level 5, 15 Bourke Road
Mascot NSW 2020

daniel.lidbetter3@jhgc.com.au
cc: tess.anastakis@jhgc.com.au

Dear Daniel

Re: 240107 – Inland Rail, Illabo to Stockinbingal - Biodiversity Advice, Low Impact Works

Introduction

Thank you for requesting biodiversity advice on approved Low Impact Work (LIW) within the Inland Rail Illabo to Stockinbingal Project area prior to construction. John Holland needs to conduct LIW (Table 2) activities within the Project area under the definition of LIW and Construction as described in the conditions of consent (Table 4). LIW activities must not impact biodiversity values of the CSSI # SSI-9406 to be compliant with Conditions of Approval (CoA) including (but not limited to) E26, E28 and E29. In addition, LIW must not trigger the requirement to retire offset credits.

Low Impact Works are unlikely to result in significant ground or native vegetation disturbance over and above routine agricultural cropping, grazing and maintenance activities. To protect project biodiversity values LIW activities are limited to previously impacted land. Land **Status** (Table 1) has been conservatively derived from existing use and the vegetation zone (PCT and Condition as per the BDAR) where native vegetation is present at the LIW location. The land status used in Tables 1, 2 and 3 include:

- Existing roads and tracks
- Category 1 land (cropping land)
- Poor quality native vegetation (no shrubs & exotic groundcover), (Table 1)
- High quality native vegetation or unsurveyed land or derived grassland, (Table 1)

Table 1 Native Vegetation zones (PCT and condition) used to determine land status

Vegetation Type*	Condition*	Status
PCT 79 River Red Gum shrub/grass riparian tall woodland or open forest wetland mainly in the upper slopes sub-region of the NSW South Western Slopes Bioregion and western South Eastern Highlands Bioregion	Moderate	High
	Poor	Poor
PCT 76 Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	Good	High
	Moderate	High
	Poor	Poor
	Low -DNG	Poor
PCT 80 Western Grey Box – White Cypress Pine tall woodland on loam soil on	Moderate	High

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Vegetation Type*	Condition*	Status
alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Poor	Poor
PCT 266 White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion	Moderate	High
	Poor	Poor
	Low -DNG	Poor
PCT 276 Yellow Box grassy tall woodland on alluvium or parna loams and clays on flats in NSW South Western Slopes Bioregion	Moderate	High
	Poor, canopy only	Poor
PCT 277 Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	Moderate	High
	Poor	Poor
	Low -DNG	Poor
	Planted	Poor
PCT 309 Black Cypress Pine – Red Stringybark – red gum – box low open forest on siliceous rocky outcrops in the NSW South Western Slopes Bioregion	Moderate	High
PCT 347 White Box – Blakely's Red Gum shrub/grass woodland on metamorphic hillslopes in the mid-southern part of the upper slopes subregion of the NSW South Western Slopes Bioregion	Moderate	High
	Poor	Poor

*PCT condition derived from BDAR

Note: Planted native vegetation will generate offset requirements. Apply traffic controls as per Table 2 and Table 3.

Land previously assessed as native vegetation has been ascribed a status based on Vegetation zone, see Table 1 and the **Process** below.

The level of controls for LIW increases with the quality of biodiversity to protect project biodiversity values. Where the controls for LIW are implemented vegetation integrity, habitat suitability, threatened species abundance, vegetation abundance, habitat connectivity, threatened species movement, flight path integrity and water sustainability would be maintained across the project.

As such, conducting LIW activities would not adversely affect, potentially adversely affect or adversely impact the biodiversity values of threatened species or Critically Endangered Ecological Community (CEEC) / Endangered Ecological Community (EEC) / Threatened Ecological Community (TEC) and would be permissible under the consent when the traffic light controls are followed (Table 3).

Note, no threatened flora species were recorded on site during field surveys for the Environmental Impact Statement (EIS). Threatened fauna species recorded during field surveys for the EIS are highly mobile and unlikely to be impacted by LIW as their foraging, nesting and breeding habitat features would not be impacted. The minor transient and infrequent nature of LIW activities are unlikely to create sufficient noise and vibration to disturb roosting or nesting fauna.

A traffic light system of controls has been adopted to manage the potential for impacts to biodiversity values across the project from LIW activities. The traffic light system uses three terms, including:

- **Allow** – negligible potential for impact to project wide biodiversity values when controls followed

- **Caution** - low potential for impact to project wide biodiversity values additional controls to follow
- **Delay** – high risk of impact to project wide biodiversity values, delay until CEMP and subplans are approved, additional surveys completed and biodiversity offset credits are retired, unless otherwise approved by the minister

Process

An ecologist will assess LIW areas and complete an Ecological Clearance Form prior to works to reduce the potential for inadvertent impacts to biodiversity values as a result of LIW.

- Identify the location for the LIW and required access.
- Determine through reference to constraints mapping/site observations the land status in Table 2.
- Check Table 2 to determine the LIW and if access is allowed, check also if caution is required or if the LIW should be delayed until “construction”.
- If the LIW is allowed, or if caution is required, refer to the traffic light controls in Table 3.
- Determine if the traffic light controls can be implemented or not.
- Ecologist to complete an Ecological Clearance Form and lodge same with Senior Project Engineer (or delegate).
- If the traffic light controls can be implemented, document the above steps in an Excavation Permit and submit to the Senior Project Engineer (or delegate) for approval.
- Once the Excavation Permit is approved, implement the controls in Table 3 and proceed with works.
- Any breach of the controls should be reported to the supervising engineer as a non-conformance for assessment and subsequent action.

Where this procedure and controls can be implemented it is expected that there will be no impact to biodiversity values across the project adversely affecting threatened species or CEEC / EEC / TEC and would be permissible under the consent.

If you have any questions, please contact me or Jane Love. We would be pleased to discuss any aspect of this letter with you.

Yours sincerely,



Michial Sutherland

Manager

0427953053

Table 2: LIW activity v land type and traffic light controls

Low Impact Work	Existing roads and tracks.	Category 1 land (cropping land)	Poor quality native vegetation (Table 1)	High quality native veg or unsurveyed land or derived grassland (Table 1)
Cadastral survey	Allowed	Allowed	Allowed	Caution
Boreholes	Allowed	Allowed	Caution	Delay
Geotechnical test pits	Allowed	Allowed	Caution	Delay
Subsoil and topsoil test pits	Allowed	Allowed	Caution	Delay
Service investigations	Allowed	Allowed	Caution	Delay
Auger holes	Allowed	Allowed	Caution	Caution
Erosion threshold velocity testing	Allowed	Allowed	Caution	Delay
Pavement cores	Allowed	N/A	N/A	N/A
Geophysics	Allowed	Allowed	Allowed	Caution
Establish minor ancillary facilities	Allowed	Allowed	Caution	Delay
Enviro. survey, investigation / site works	Allowed	Allowed	Allowed	Caution
Construct minor access roads	Allowed	Allowed	Caution	Delay
Corridor fencing	Allowed	Allowed	Caution	Caution

Table 3: Traffic light controls

Low Impact Work	Existing roads and tracks	Category 1 land (cropping land)	Poor quality native vegetation defined in Table 1	Moderate to high quality native veg or unsurveyed land or derived native grassland defined in Table 1
Cadastral survey	• Use existing tracks • No removal of native trees • No pruning of limbs over 50 mm diameter. • Use existing creek crossings • Remove all waste • Use vehicle hygiene	• Use existing tracks where available • No removal of native trees • No pruning of limbs over 50 mm diameter • Use existing creek crossings • Remove all waste • Use vehicle hygiene	• Target previously disturbed areas only. • No removal of native trees • No pruning of limbs over 50 mm diameter or hollow-bearing • Use existing tracks where available • Avoid crossing flowing creeks • Use formed creek crossings where available • Remove all waste • Use vehicle hygiene	• Target previously disturbed areas only. • No more than 0.2 m² ground disturbance • No pruning of limbs over 50 mm diameter or hollow-bearing ** • No removal of native trees • Avoid crossings flowing creeks • Use formed creek crossings where available • Remove all waste • Use vehicle hygiene • Light vehicles only • Stable soil conditions • Use existing tracks. Where there is no existing track, limit vehicle movements to no more than twice at any given location.
Boreholes	• Use existing tracks • No removal of native trees • No pruning of limbs over 50 mm diameter • Use existing creek crossings • Remove all waste • Use vehicle hygiene	• Use existing tracks where available • No removal of native trees • No pruning of limbs over 50 mm diameter • Use existing creek crossings • Remove all waste • Use vehicle hygiene	• Target previously disturbed areas only • No more than 5 m² ground disturbance • No removal of native trees • No pruning of limbs over 50 mm diameter or hollow-bearing** • Use existing tracks where available • Avoid crossing flowing creeks • Use formed creek crossings where available • Remove all waste • Use vehicle hygiene • Light vehicles only • Stable soil conditions • Ecologist review and signoff	Delay
Geotechnical test pits	• Use existing tracks • No removal of native trees • No pruning of limbs over 50 mm diameter • Use existing creek crossings • Remove all waste • Use vehicle hygiene	• Use existing tracks where available • No removal of native trees • No pruning of limbs over 50 mm diameter • Use existing creek crossings • Remove all waste • Use vehicle hygiene • Topsoil, fertilise & reseed	• Target previously disturbed areas only • No more than 5 m² ground disturbance • No removal of native trees • No pruning of limbs over 50 mm diameter or hollow-bearing ** • Use existing tracks where available • Avoid crossing flowing creeks • Use formed creek crossings where available • Remove all waste	Delay

Low Impact Work	Existing roads and tracks	Category 1 land (cropping land)	Poor quality native vegetation defined in Table 1	Moderate to high quality native veg or unsurveyed land or derived native grassland defined in Table 1
	Topsoil, fertilise & reseed, or reseal		- Use vehicle hygiene - Light vehicles only - Stable soil conditions - Ecologist review and signoff - Topsoil, fertilise & reseed	
Subsoil & topsoil test pits	- Use existing tracks - No removal of native trees - No pruning of limbs over 50 mm diameter - Use existing creek crossings - Remove all waste - Use vehicle hygiene - Topsoil, fertilise & reseed, or reseal	- Use existing tracks where available - No removal of native trees - No pruning of limbs over 50 mm diameter - Use existing creek crossings - Remove all waste - Use vehicle hygiene - Topsoil, fertilise & reseed	- Target previously disturbed areas only - No more than 5 m² ground disturbance - No removal of native trees - No pruning of limbs over 50 mm diameter or hollow-bearing** - Use existing tracks where available - Avoid crossing flowing creeks - Use formed creek crossings where available - Remove all waste - Use vehicle hygiene - Light vehicles only - Stable soil conditions - Ecologist review and signoff - Topsoil, fertilise & reseed	Delay
Service investigations	- Use existing tracks - No removal of native trees - No pruning of limbs over 50 mm diameter - Use existing creek crossings - Remove all waste - Use vehicle hygiene - Topsoil, fertilise & reseed, or reseal	- Use existing tracks where available - No removal of native trees - No pruning of limbs over 50 mm diameter - Use existing creek crossings - Remove all waste - Use vehicle hygiene - Topsoil, fertilise & reseed	- Target previously disturbed areas only - No more than 5 m² ground disturbance - No removal of native trees - No pruning of limbs over 50 mm diameter or hollow-bearing** - Use existing tracks where available - Avoid crossing flowing creeks - Use formed creek crossings where available - Remove all waste - Use vehicle hygiene - Light vehicles only - Stable soil conditions - Ecologist review and signoff - Topsoil, fertilise & reseed	Delay
Auger holes	- Use existing tracks - No removal of native trees - No pruning of limbs over 50 mm diameter - Use existing creek crossings	- Use existing tracks where available - No removal of native trees - No pruning of limbs over 50 mm diameter - Use existing creek crossings	- Target previously disturbed areas only. - No more than 2 m² ground disturbance - No removal of native trees - No pruning of limbs over 50 mm diameter or hollow-bearing** - Use existing tracks where available	Delay

Low Impact Work	Existing roads and tracks	Category 1 land (cropping land)	Poor quality native vegetation defined in Table 1	Moderate to high quality native veg or unsurveyed land or derived native grassland defined in Table 1
	- Remove all waste - Use vehicle hygiene	- Remove all waste - Use vehicle hygiene	- Avoid crossing flowing creeks - Use formed creek crossings where available - Remove all waste - Use vehicle hygiene - Light vehicles only - Stable soil conditions - Ecologist review and signoff - Topsoil, fertilise & reseed	
Erosion threshold velocity testing	- Use existing tracks - No removal of native trees - No pruning of limbs over 50 mm diameter - Use existing creek crossings - Remove all waste - Use vehicle hygiene - Topsoil, fertilise & reseed, or reseal	- Use existing tracks where available - No removal of native trees - No pruning of limbs over 50 mm diameter - Use existing creek crossings - Remove all waste - Use vehicle hygiene - Topsoil, fertilise & reseed	- Target previously disturbed areas only. - No more than 4 m² ground disturbance - No removal of native trees - No pruning of limbs over 50 mm diameter or hollow-bearing** - Use existing tracks where available - Avoid crossing flowing creeks - Use formed creek crossings where available - Remove all waste - Use vehicle hygiene - Light vehicles only - Stable soil conditions - Ecologist review and signoff - Topsoil, fertilise & reseed	Delay
Pavement Cores	- Use existing tracks - No removal of native trees - No pruning of limbs over 50 mm diameter - Use existing creek crossings - Remove all waste - Use vehicle hygiene - Topsoil, fertilise & reseed, or reseal	Not Applicable	Not Applicable	Not Applicable
Geophysics	- Use existing tracks - No removal of native trees - No pruning of limbs over 50 mm diameter	- Use existing tracks where available - No removal of native trees - No pruning of limbs over 50 mm diameter	- No removal of native trees - No pruning of limbs over 50 mm diameter or hollow-bearing - Use existing tracks where available - Avoid crossing flowing creeks	- Use existing tracks where available - No removal of native trees - No pruning of limbs over 50 mm diameter or hollow-bearing** - Avoid crossings flowing creeks

Low Impact Work	Existing roads and tracks	Category 1 land (cropping land)	Poor quality native vegetation defined in Table 1	Moderate to high quality native veg or unsurveyed land or derived native grassland defined in Table 1
	• Use existing creek crossings • Remove all waste • Use vehicle hygiene	• Use existing creek crossings • Remove all waste • Use vehicle hygiene	• Use formed creek crossings where available • Remove all waste • Use vehicle hygiene	• Use formed creek crossings where available • Remove all waste • Use vehicle hygiene • Light vehicles only • Stable soil conditions • Use existing tracks. Where there is no existing track, limit vehicle movements to no more than twice at any given location.
Establish minor ancillary facilities	• Minimise the footprint • Use existing tracks • No removal of native trees • No pruning of limbs over 50 mm diameter • Use existing creek crossings • Remove all waste • Use vehicle hygiene • Topsoil, fertilise & reseed, or reseal	• Minimise the footprint • Use existing tracks where available • No removal of native trees • No pruning of limbs over 50 mm diameter • Use existing creek crossings • Remove all waste • Use vehicle hygiene • Topsoil, fertilise & reseed	Delay	Delay
Enviro. survey, investigation / site works	• Use existing tracks • No removal of native trees • No pruning of limbs over 50 mm diameter • Use existing creek crossings • Remove all waste • Use vehicle hygiene • Topsoil, fertilise & reseed, or reseal	• Use existing tracks where available • No removal of native trees • No pruning of limbs over 50 mm diameter • Use existing creek crossings • Remove all waste • Use vehicle hygiene • Topsoil, fertilise & reseed	• No removal of native trees • No pruning of limbs over 50 mm diameter or hollow-bearing • Use existing tracks where available • Avoid crossing flowing creeks • Use formed creek crossings where available • Remove all waste • Use vehicle hygiene • Light vehicles only • Stable soil conditions • Ecologist review and signoff • Topsoil, fertilise & reseed	• Target previously disturbed areas only • No more than 2 m² ground disturbance • Use existing tracks • No removal of native trees • No pruning of limbs over 50 mm diameter or hollow-bearing** • Avoid crossings flowing creeks • Use formed creek crossings where available • Remove all waste • Use vehicle hygiene • Light vehicles only • Stable soil conditions • Ecologist review and signoff • Topsoil, fertilise & reseed • Use existing tracks where available. Where there is no existing track, limit vehicle movements to no more than twice at any given location.

Low Impact Work	Existing roads and tracks	Category 1 land (cropping land)	Poor quality native vegetation defined in Table 1	Moderate to high quality native veg or unsurveyed land or derived native grassland defined in Table 1
Construct minor access roads	• Not connected to a public road • Use existing tracks • No removal of native trees • No pruning of limbs over 50 mm diameter • Use existing creek crossings • Remove all waste • Use vehicle hygiene • Topsoil, fertilise & reseed, or reseal	• Use existing tracks where available • No removal of native trees • No pruning of limbs over 50 mm diameter • Use existing creek crossings • Remove all waste • Use vehicle hygiene • Topsoil, fertilise & reseed	• Use existing tracks where available • No removal of native trees • No pruning of limbs over 50 mm diameter or hollow-bearing** • Avoid crossing flowing creeks • Use formed creek crossings where available • Remove all waste • Use vehicle hygiene • Light vehicles only • Stable soil conditions • Ecologist review and signoff • Topsoil, fertilise & reseed	Delay
Corridor fencing	• Use existing tracks • No removal of native trees • No pruning of limbs over 50 mm diameter. • Use existing creek crossings • Remove all waste • Use vehicle hygiene	• Use existing tracks where available • No removal of native trees • No pruning of limbs over 50 mm diameter • Use existing creek crossings • Remove all waste • Use vehicle hygiene	• Use existing tracks where available • No removal of native trees • No pruning of limbs over 50 mm diameter or hollow-bearing** • Avoid crossing flowing creeks • Use formed creek crossings where available • Remove all waste • Use vehicle hygiene • Light vehicles only • Stable soil conditions • Ecologist review and signoff	• Target previously disturbed areas only • No more than 2 m² ground disturbance • Use existing tracks • No removal of native trees • No pruning of limbs over 50 mm diameter or hollow-bearing** • Avoid crossing flowing creeks • Use formed creek crossings where available • Remove all waste • Use vehicle hygiene • Light vehicles only • Stable soil conditions • Ecologist pre-works inspection, review and signoff • Use existing tracks where available. Where there is no existing track, limit vehicle movements to no more than twice at any given location.

** - Pruning is not considered as clearing under NSW biodiversity legislation and guidance. The 50 mm limb diameter limitation on pruning restricts the potential to impact limbs that may provide habitat for any native fauna.

Table 4: SSI-940 CoAs and Terms and Definitions 6

Term	Definition
Construction	Includes work required to construct the CSSI as defined in the documents listed in Condition A1 , including commissioning trials of equipment and temporary use of any part of the CSSI, but excluding low impact work which is carried out or completed prior to approval of the CEMP.
Low Impact work	Work defined as low impact includes: (a) survey works including carrying out general alignment surveys, installing survey controls (including installation of global positioning system (GPS)), installing repeater stations, carrying out surveys of existing and future utilities and building and road dilapidation surveys; (b) investigations including investigative drilling, contamination investigations and excavation; (c) installation of mitigation measures including erosion and sediment controls, temporary exclusion fencing for sensitive areas and acoustic treatments; (d) property acquisition adjustment work including installation of property fencing; (e) archaeological testing under the <i>Code of practice for archaeological investigation of Aboriginal objects in NSW</i> (Department of Environment Climate Change and Water, 2010) or archaeological monitoring undertaken in association with Low Impact work to ensure that there is no impact on heritage items; (f) archaeological and cultural salvage undertaken in accordance with a strategy or salvage operation required by the conditions of this approval; (g) maintenance work to existing buildings and structures as required to facilitate the carrying out of the CSSI; and (h) other activities determined by the ER to have minimal environmental impact which may include relocation and connection of utilities, establishment of minor ancillary facilities in accordance with Condition C9 construction of minor access roads (other than access roads' connection to the road network), temporary relocation of pedestrian paths and the provision of property access. (i) Site establishment work approved under a Site Establishment Management Plan in accordance with Condition C5. Despite the above, the following works are not Low Impact Work: i. where heritage items, or threatened species or their habitat, or threatened ecological communities (within the meaning of the Biodiversity Conservation Act 2016), are adversely affected or potentially adversely affected by any low impact work as defined in (a) to (i) above, that work is construction, unless otherwise determined by the Planning Secretary in consultation with Heritage NSW, BCS or DPI Fisheries (in the case of impact upon fish, aquatic invertebrates or marine vegetation); and ii. any Work undertaken outside the hours specified in Condition E1 that exceeds noise management and vibration levels as identified in Condition E3(b). Notes: 1. Early stages of Work are not necessarily low impact work. 2. Low Impact work is not Construction as defined by this approval. 3. The low impact work described in this definition becomes Construction with the approval of a CEMP. Where low impact work has already commenced, this is considered to remain as low impact work and is managed in accordance with the framework under which it commenced.
C9: Minor Ancillary Facilities	Minor ancillary facilities including lunch sheds, office sheds, portable toilet facilities, material lay down sites, stockpile areas, areas used to assemble infrastructure and the like can be established and used where they satisfy the following criteria: (a) are located within the construction boundary; and (b) have been assessed by the ER to have -

	i. minimal amenity impacts to surrounding residences and businesses, after consideration of matters such as compliance with the Interim Construction Noise Guideline (DECC, 2009), traffic and access impacts, dust and odour impacts, and visual (including light spill) impacts, and ii. minimal environmental impact with respect to waste management and flooding, and iii. no impacts on biodiversity, soil and water, and heritage items beyond those already approved under other terms of this approval.
E26 Biodiversity	Prior to impacts on the biodiversity values of the CSSI, the number and classes of ecosystem credits and species credits (like-for-like) as set out in the BAM Biodiversity Credit Report which forms part of the Condition A1(c), must be retired. The number and classes of ecosystem credits and species credits that must be retired (prior to impacting the biodiversity values) are detailed in SCHEDULE 1 and SCHEDULE 2 of APPENDIX C. The Proponent may review and reduce the ecosystem and species credit requirements in Tables in SCHEDULE 1 and SCHEDULE 2 of APPENDIX C to reflect the final construction footprint; the further surveys required by Condition E31; and the resulting extent and type of plant community types to be cleared. Amendments to the ecosystem and species credit requirements must be undertaken in consultation with BCS and DECCEW(Cth) and documented in a report prepared in accordance the Biodiversity Assessment Method and accompanied by an updated Credit Report. The report and the updated Credit Report must be submitted to the Planning Secretary for approval prior to the retirement of credits.
E28 Biodiversity	The retirement of the credits must be carried out in accordance with the Biodiversity Conservation Act 2016 (BC Act), and can be achieved by: (a) acquiring and retiring “biodiversity credits” within the meaning of the BC Act; and / or (b) making a payment into the Biodiversity Conservation Fund of an amount equivalent to the class and number of ecosystem and species credits, as calculated by the Biodiversity Conservation Fund (BCF) Charge System; and/or (c) funding a biodiversity conservation action that benefits the entity impacted and is listed in the ancillary rules of the Biodiversity Offset Scheme.
E29 Biodiversity	Evidence of the retirement of credits in satisfaction of Condition E28 must be provided to the Planning Secretary prior to impacts to the biodiversity values occurring.

Definitions

Land Type

- Existing roads and tracks include formed roads and tracks, sealed or unsealed that may include cut, fill and pavement formations, routinely used/constructed creek crossings
- Category 1 land (cropping land):
 - Land cleared of native vegetation as at 1 January 1990 or lawfully cleared after 1 January 1990
 - Low conservation grasslands
 - Land containing only low conservation groundcover (not being grasslands)
 - Native vegetation identified as regrowth in a Property Vegetation Plan (PVP) under the repealed Native Vegetation Act 2003 only where the PVP specifies a regrowth date.
 - Land bio-certified under the Biodiversity Conservation Act 2016
- Poor quality native vegetation (no shrubs & exotic groundcover) as defined in the BDAR

- High quality native vegetation or unsurveyed land or derived grassland as defined in the BDAR where minimal disturbance would have a negligible impact on to biodiversity values across the project

Biodiversity Values

The NSW *Biodiversity Conservation Act* 2016 in Cl. 1.5 states:

Biodiversity and biodiversity values for purposes of Act

- 1) For the purposes of this Act, biodiversity is the variety of living animal and plant life from all sources, and includes diversity within and between species and diversity of ecosystems.
- 2) For the purposes of this Act, biodiversity values are the following biodiversity values—
 - (a) vegetation integrity—being the degree to which the composition, structure and function of vegetation at a particular site and the surrounding landscape has been altered from a near natural state,
 - (b) habitat suitability—being the degree to which the habitat needs of threatened species are present at a particular site,
 - (c) biodiversity values, or biodiversity-related values, prescribed by the regulations.

The *Biodiversity Conservation Regulation* 2017 in Cl. 1.4 states:

Additional biodiversity values (section 1.5 of the Act)

The following are prescribed as additional biodiversity values for the purposes of the Act—

- (a) threatened species abundance—being the occurrence and abundance of threatened species or threatened ecological communities, or their habitat, at a particular site,
- (b) vegetation abundance—being the occurrence and abundance of vegetation at a particular site,
- (c) habitat connectivity—being the degree to which a particular site connects different areas of habitat of threatened species to facilitate the movement of those species across their range,
- (d) threatened species movement—being the degree to which a particular site contributes to the movement of threatened species to maintain their lifecycle,
- (e) flight path integrity—being the degree to which the flight paths of protected animals over a particular site are free from interference,
- (f) water sustainability—being the degree to which water quality, water bodies and hydrological processes sustain threatened species and threatened ecological communities at a particular site.

The Updated BDAR for the project response to submissions in the definition states:

Biodiversity Are the following values:

value

- vegetation integrity--being the degree to which the composition, structure and function of vegetation at a particular site and the surrounding landscape has been altered from a near natural state
- habitat suitability--being the degree to which the habitat needs of threatened species are present at a particular site
- biodiversity values, or biodiversity-related values, prescribed by the regulations.



Appendix E—LIW Heritage Advice

WORK IN PROGRESS. SUBJECT TO ONGOING DISCUSSIONS BETWEEN JHG, IRPL AND HERITAGE SME's.

21 May 2025

Tess Anastakis
Environment and Sustainability Graduate
John Holland Pty Ltd
Level 5, 15 Bourke Road
Mascot NSW 2020

RE: Inland Rail, Illabo to Stockinbingal – Endorsement of the Low Impact Work (LIW) Cultural Heritage Management Framework

Dear Tess,

Thank you for seeking endorsement of the attached Cultural Heritage Management Framework for proposed Low Impact Work (LIW) for the Inland Rail Illabo to Stockinbingal Project (the Project). I understand that this framework is required as part of John Holland Group (JHG)'s Low Impact Work Assessment to confirm consistency with the definition of 'Low Impact work' under the planning approval. For this assessment low impact work must comply with the below clause:

the following works are not Low Impact Work:

(i) where heritage items, or threatened species or their habitat, or threatened ecological communities (within the meaning of the Biodiversity Conservation Act 2016), are adversely affected or potentially adversely affected by any low impact work as defined in (a) to (i) above, that work is construction, unless otherwise determined by the Planning Secretary in consultation with Heritage NSW, BCS or DPI Fisheries (in the case of impact upon fish, aquatic invertebrates or marine vegetation).

I understand that the intention of the Cultural Heritage Management Framework is to outline when LIW can proceed in relation to the ongoing heritage investigation for the Project, which is being managed by MTS Heritage Pty Ltd (MTS Heritage). The framework outlines the following:

- The Conditions of Approval (CoA) that relate to heritage for the Project as outlined in the State Significant Infrastructure Approval (Application No. SSI-9406);
- Details of the Additional Survey and Test Excavation Methodology prepared for the Project;
- A summary of works required in Indigenous Survey Zones 1 – 11 East prior to the commencement of LIW in each respective zone, in accordance with the Additional Survey and Test Excavation Methodology and the Aboriginal Cultural Heritage Assessment Report (ACHAR) prepared by GML for the Project; and
- Cultural heritage sensitivity mapping, showing the location of Aboriginal sites and Potential Archaeological Deposits (PAD) located within the Indigenous Survey Zones.

Following a detailed review of this framework, I can confirm that the details are correct and, following approval by Inland Rail Pty Ltd (IRPL), LIW can proceed in a staged approach as outlined in the framework.

Yours sincerely,



Fiona Leslie
Director / Principal Heritage Consultant

Attachment: LIW Cultural Heritage Management Framework + Cultural Heritage Sensitivity Mapping provided by JHG

Management of Aboriginal Cultural Heritage

Overview of Requirements

Additional archaeological works that were not able to be conducted during the EIS for the Project must occur prior to the commencement of ground disturbance works within areas marked as sensitive with respect to Aboriginal Cultural Heritage in the documents listed in CoA A1.

Table 1-1 provides the CoA relevant to the management of Aboriginal Cultural Heritage prior to the commencement of work within Indigenous Survey Zones 1-11 East.

Table 1-1: CoAs relevant to Aboriginal Cultural Values and Heritage prior to the commencement of ground disturbance works within areas identified as requiring archaeological investigation or salvage.

CoA Reference	Condition
E135	Prior to the commencement of any ground disturbance work within areas identified as requiring archaeological investigation or salvage identified in documents listed in Condition A1, the Proponent must prepare and implement an Additional Aboriginal Archaeological Survey Methodology and an Aboriginal Archaeological Test Excavation Methodology. The methodology must include procedures for additional archaeological survey of Zones 5, 6, 9 and 10, and management protocols including consultation with the Registered Aboriginal Parties, for any Aboriginal objects and sites identified during the survey.
E136	Following analysis of the test excavation results, the Proponent must prepare and implement an Aboriginal Archaeological Salvage Excavation Methodology.
E137	Following additional survey, test and salvage excavation, if sites are identified that exceed the expected level of significance identified in the Aboriginal Cultural Heritage Assessment Report, further consultation with Heritage NSW and the RAPs must be undertaken and consideration given, where feasible, for avoidance by the project.
E138	The Additional Aboriginal Archaeological Survey Methodology, Aboriginal Archaeological Test Excavation Methodology and Aboriginal Archaeological Salvage Excavation Methodology must be prepared by a suitably qualified expert in consultation with Heritage NSW and RAPs, and provided to the Planning Secretary for information at least one month prior to test or salvage excavation.
E139	At the completion of Aboriginal cultural heritage survey and test and salvage excavations, an Aboriginal Cultural Heritage Excavation Report(s) must be prepared by a suitably qualified expert. The Aboriginal Cultural Heritage Excavation Report(s), must: (a) be prepared in accordance with the Guide to Investigation, assessing and reporting on Aboriginal cultural heritage in NSW, OEH 2011 and the Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales, DECCW 2010; and (b) document the results of the archaeological survey and test excavations and any subsequent salvage excavations (with artefact analysis and identification of a final repository for finds). The RAPs must be given a minimum of 28 days to consider the report and provide comments before the report is finalised. The final report must be provided to the Planning Secretary, Heritage NSW, the relevant Councils, relevant LALCs and the RAPs within 24 months of the completion of the Aboriginal archaeological excavations (both test and salvage).
E140	Ground disturbance works and construction work may not commence in those areas where archaeological excavation and surface collection of Aboriginal objects is required (including areas identified as requiring further assessment) until the archaeological works described in the Aboriginal Cultural Heritage Assessment reports listed in Condition A1 have been completed.
E141	At the completion of surface collection, test excavations, and salvage excavations, Aboriginal site impact recording forms (ASIRF) must be submitted to the Aboriginal Heritage Information Management System (AHIMS) and evidence provided of submission to the AHIMS Registrar.
E142	Where previously unidentified Aboriginal objects or Aboriginal Places are discovered, all work must immediately stop in the vicinity of the affected area. Works potentially affecting the previously unidentified objects or places must not recommence until Heritage NSW has been informed. The measures to consider and manage this process must be specified in the Unexpected Heritage Finds and Human Remains Procedure required by Condition E143 and include registration in the Aboriginal Heritage Information Management System (AHIMS).

The Additional Survey and Test Excavation Methodology

An Additional Survey and Test Excavation Methodology has been prepared for the Project, available via Aconex (reference: **5-0019-220-PES-00-MS-0001**). The Methodology was distributed to RAPs on the 21/03/2025. The Methodology was provided to HNSW and DPHI via the Major Projects Planning Portal on the 1/05/2025. The Methodology details the outstanding archaeological test excavations, surveys and salvage that must occur prior to the commencement of ground disturbance within areas identified as requiring archaeological investigation or salvage identified in documents listed in Condition A1, and details for ongoing management and consultation. The Methodology was prepared in accordance with CoA E135.

Works Required in Indigenous Survey Zones 1-11 East

This section intends to provide a summary of the works required in Indigenous Survey Zones 1-11 East prior to the commencement of LIW in each respective zone, in accordance with the Additional Survey and Test Excavation Methodology and the Aboriginal Cultural Heritage Assessment Report (ACHAR) prepared by GML for the I2S EIS. Maps showing the exact locations of the Indigenous Survey Zones and identified artefacts along the I2S alignment are provided in Appendix A)

LIW must not commence until the relevant approvals in each zone have been satisfied. Evidence will be provided to IRPL and the ER to demonstrate compliance with the below criteria.

Indigenous Survey Zone	Has the zone been archaeologically assessed? (Y/N)	Pre-ground disturbance requirements
1	Y	For works occurring within Site Zone 1 and Zone 1 – Low density scatter, works cannot commence prior to the preparation of the Aboriginal Archaeological Salvage Excavation Methodology, and its review by HNSW and RAPs. The Aboriginal Archaeological Salvage Excavation Methodology must be provided to DPHI 1 month prior to salvage commencement. Site Zone 1 and Zone 1 – Low density scatter will be delineated with star pickets or bollards with high visibility fencing/bunting with at least a 5-meter buffer.
2	Y	For works occurring within Site Zone 2, works cannot commence prior to the Preparation of the Aboriginal Archaeological Salvage Excavation Methodology, and its review by HNSW and RAPs. The Aboriginal Archaeological Salvage Excavation Methodology must be provided to DPHI 1 month prior to salvage commencement. Site Zone 2 will be delineated with star pickets or bollards with high visibility fencing/bunting with at least a 5-meter buffer. The following scarred trees must also be protected: • ARTC6
3	Y	LIW may occur concurrently with survey and test excavation works scheduled to commence on the 2nd June, 2025. The following scarred trees must also be protected: • ARTC18 • ARTC20
4	Y	LIW may occur concurrently with survey and test excavation works scheduled to commence on the 2nd June, 2024. No further archaeological investigations required.
5	N	Following the archaeological survey, the Project heritage consultant and archaeologist will determine whether LIW may commence in consultation with RAPs. Evidence of this determination will be documented.

		Where cultural heritage sensitivity is determined within Indigenous Survey Zone 5, works may not commence in the area of defined cultural heritage sensitivity prior to the preparation of the Aboriginal Archaeological Salvage Excavation Methodology, and its review by HNSW and RAPs. The Aboriginal Archaeological Salvage Excavation Methodology must be provided to DPHI 1 month prior to salvage commencement.
6	N	Where cultural heritage sensitivity is determined within Indigenous Survey Zone 6, works may not commence in the area of defined cultural heritage sensitivity prior to the preparation of the Aboriginal Archaeological Salvage Excavation Methodology, and its review by HNSW and RAPs. The Aboriginal Archaeological Salvage Excavation Methodology must be provided to DPHI 1 month prior to salvage commencement. Preparation of the Aboriginal Archaeological Salvage Excavation Methodology, and its review by HNSW and RAPs. The Aboriginal Archaeological Salvage Excavation Methodology must be provided to DPHI 1 month prior to salvage commencement.
7	Y	Surface collection (or protection with bollards placed around the isolated artefacts at 5m) of four isolated artefacts is required (ARTC 10, 11, 12 + 16) prior to LIW commencement. It is noted that artefact sites ARTC 12 and ARTC 16 could not be relocated during the testing program undertaken by GML.
8	Y	LIW may occur concurrently with survey and test excavation works scheduled to commence on the 2nd June, 2025. No further archaeological investigations required.
9	N	Where cultural heritage sensitivity is determined within Indigenous Survey Zone 9, works may not commence in the area of defined cultural heritage sensitivity prior to the preparation of the Aboriginal Archaeological Salvage Excavation Methodology, and its review by HNSW and RAPs. The Aboriginal Archaeological Salvage Excavation Methodology must be provided to DPHI 1 month prior to salvage commencement. Preparation of the Aboriginal Archaeological Salvage Excavation Methodology, and its review by HNSW and RAPs. The Aboriginal Archaeological Salvage Excavation Methodology must be provided to DPHI 1 month prior to salvage commencement. Preparation of the Aboriginal Archaeological Salvage Excavation Methodology, and its review by HNSW and RAPs. The Aboriginal Archaeological Salvage Excavation Methodology must be provided to DPHI 1 month prior to salvage commencement.
10	N	Where cultural heritage sensitivity is determined within Indigenous Survey Zone 10, works may not commence in the area of defined cultural heritage sensitivity prior to the preparation of the Aboriginal Archaeological Salvage Excavation Methodology, and its review by HNSW and RAPs. The Aboriginal Archaeological Salvage Excavation Methodology must be provided to DPHI 1 month prior to salvage commencement. Preparation of the Aboriginal Archaeological Salvage Excavation Methodology, and its review by HNSW and RAPs. The Aboriginal Archaeological Salvage Excavation Methodology must be provided to DPHI 1 month prior to salvage commencement.
11 and 11 East	Y	LIW may occur concurrently with survey and test excavation works scheduled to commence on the 2nd June, 2025. The following scarred tree must also be protected: • ARTC19 No further archaeological investigations required.

Notes:

1. Protection of scarred trees will involve bollards placed at a 5m radius from the trunk of the tree, as described in the Additional Survey and Test Excavation Methodology.

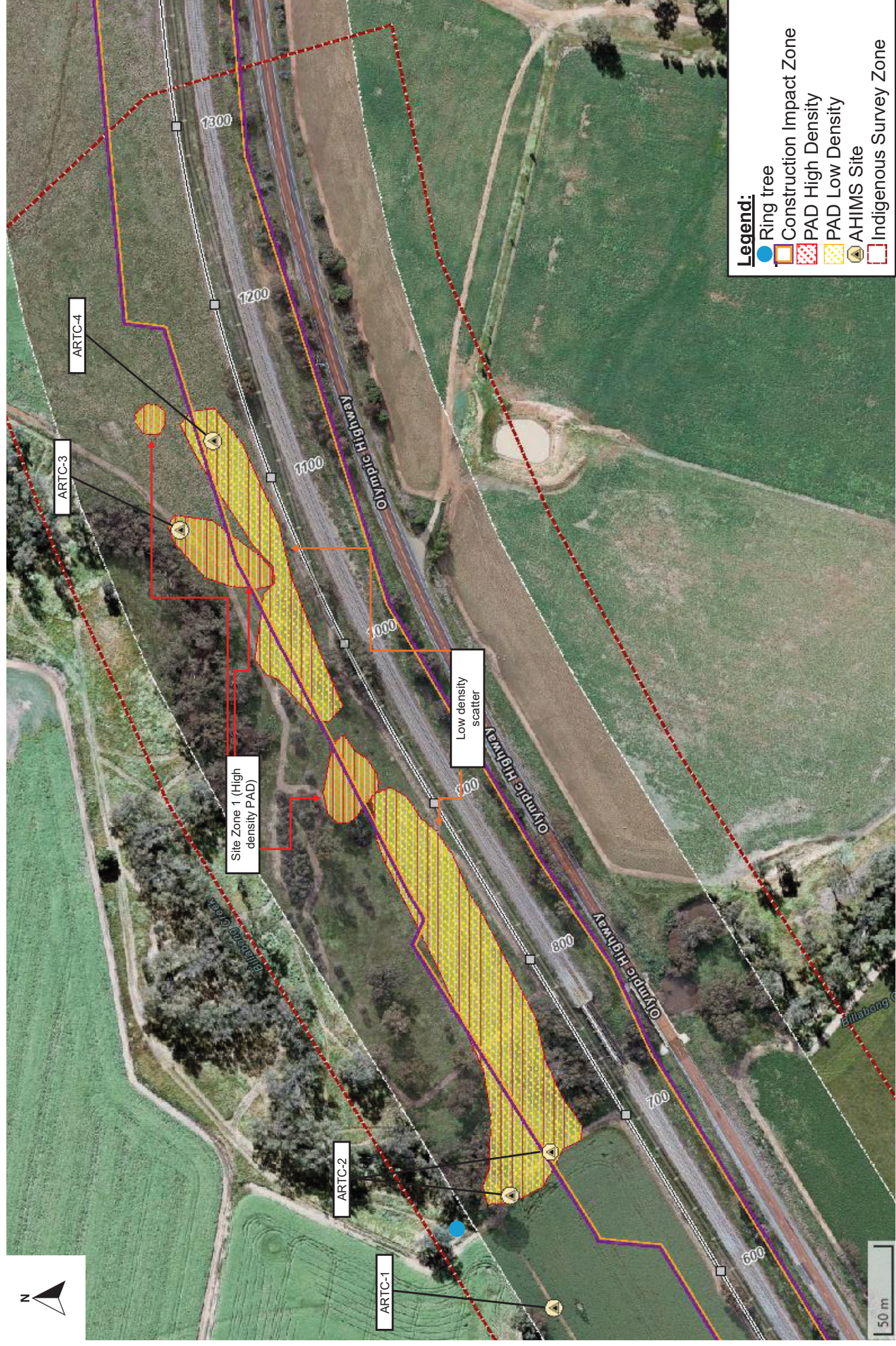


Appendix A – Cultural Heritage Sensitivity Mapping



Aboriginal Heritage Sensitivity Mapping

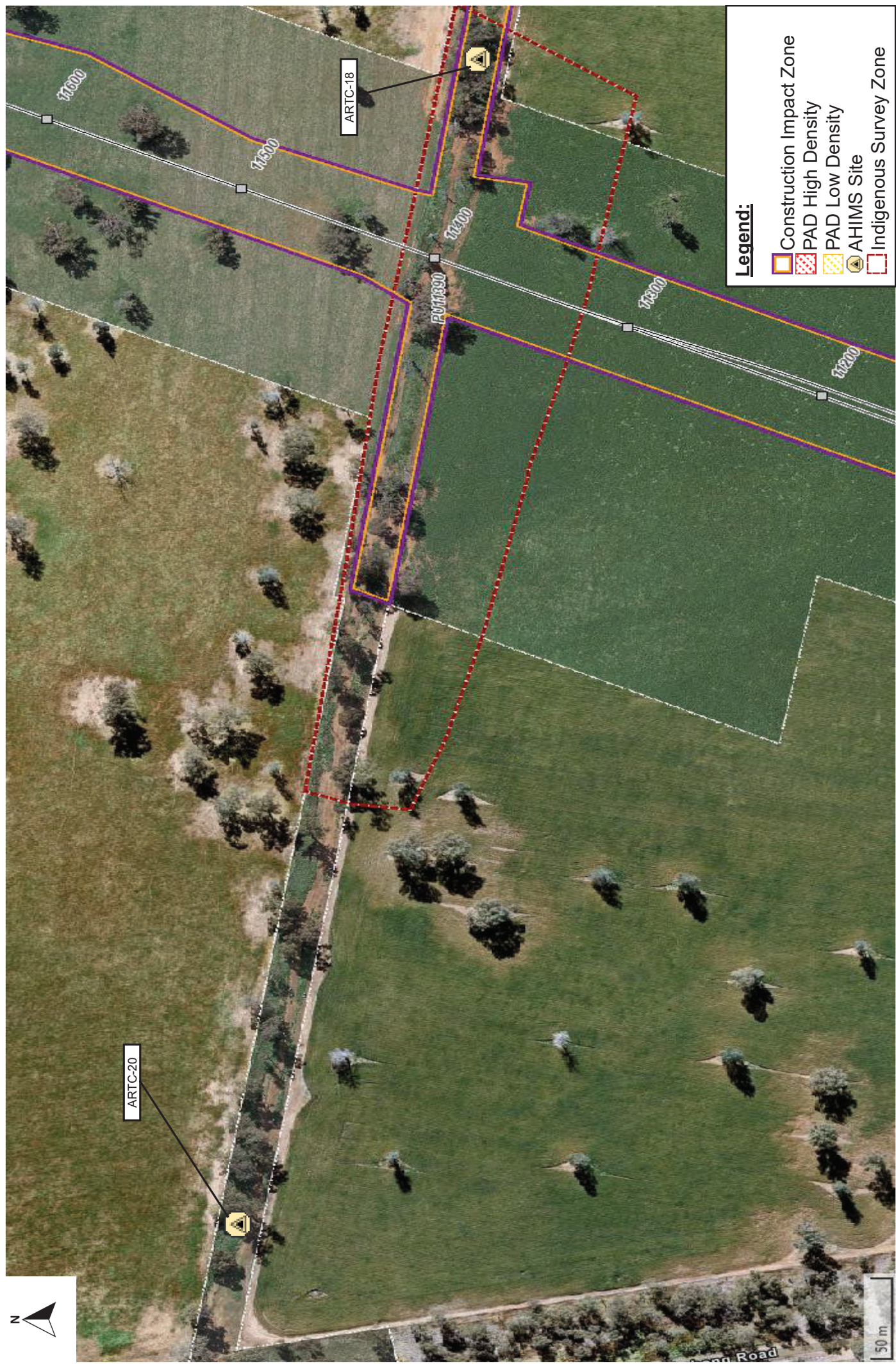
AHIMS ID	Site ID	Artefact type
50-5-0280	Site Zone 1, Zone 1 – Low density scatter	Zone of archaeological potential
50-05-0266, 50-5-0267, 50-5-0274, 50-5-0276	ARTC 1-4	Low density artefact scatter / isolated artefacts
50-5-0277	ARTC6	Scarred tree
50-5-0287	Site Zone 2	Zone of archaeological potential
50-5-0286	ARTC18	Scarred tree
AHIMS # pending	ARTC20	Scarred tree
50-5-0285	ARTC7	Isolated artefact
50-5-0284	ARTC8	Artefact scatter and zone of archaeological potential
50-5-0283	ARTC9	Isolated artefact
50-5-0268	ARTC12	Isolated artefact
50-5-0269	ARTC13	Isolated artefact
50-5-0270	ARTC14	Isolated artefact
50-5-0271	ARTC15	Isolated artefact
50-5-0272	ARTC16	Isolated artefact
50-5-0273	ARTC17	Isolated artefact
50-2-0054	ARTC10	Isolated artefact
50-2-0055	ARTC11	Isolated artefact
50-2-0058	ARTC19	Scarred tree

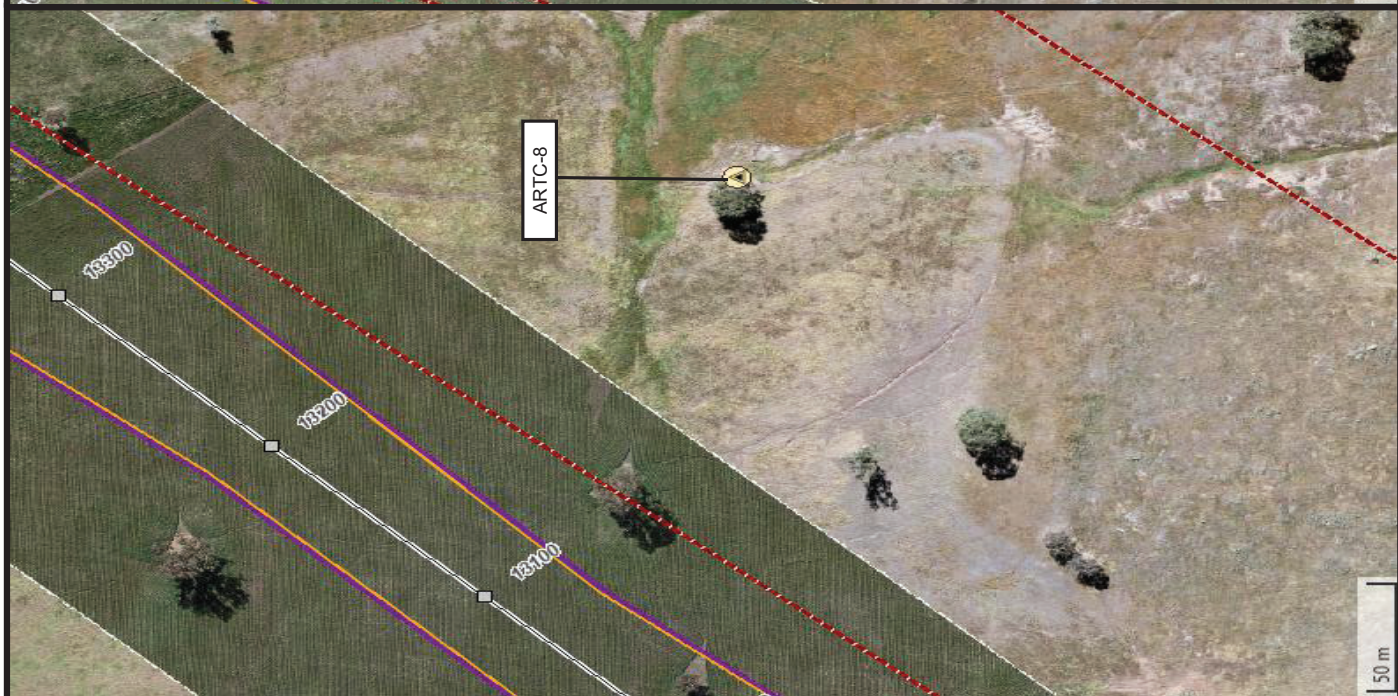




Legend:

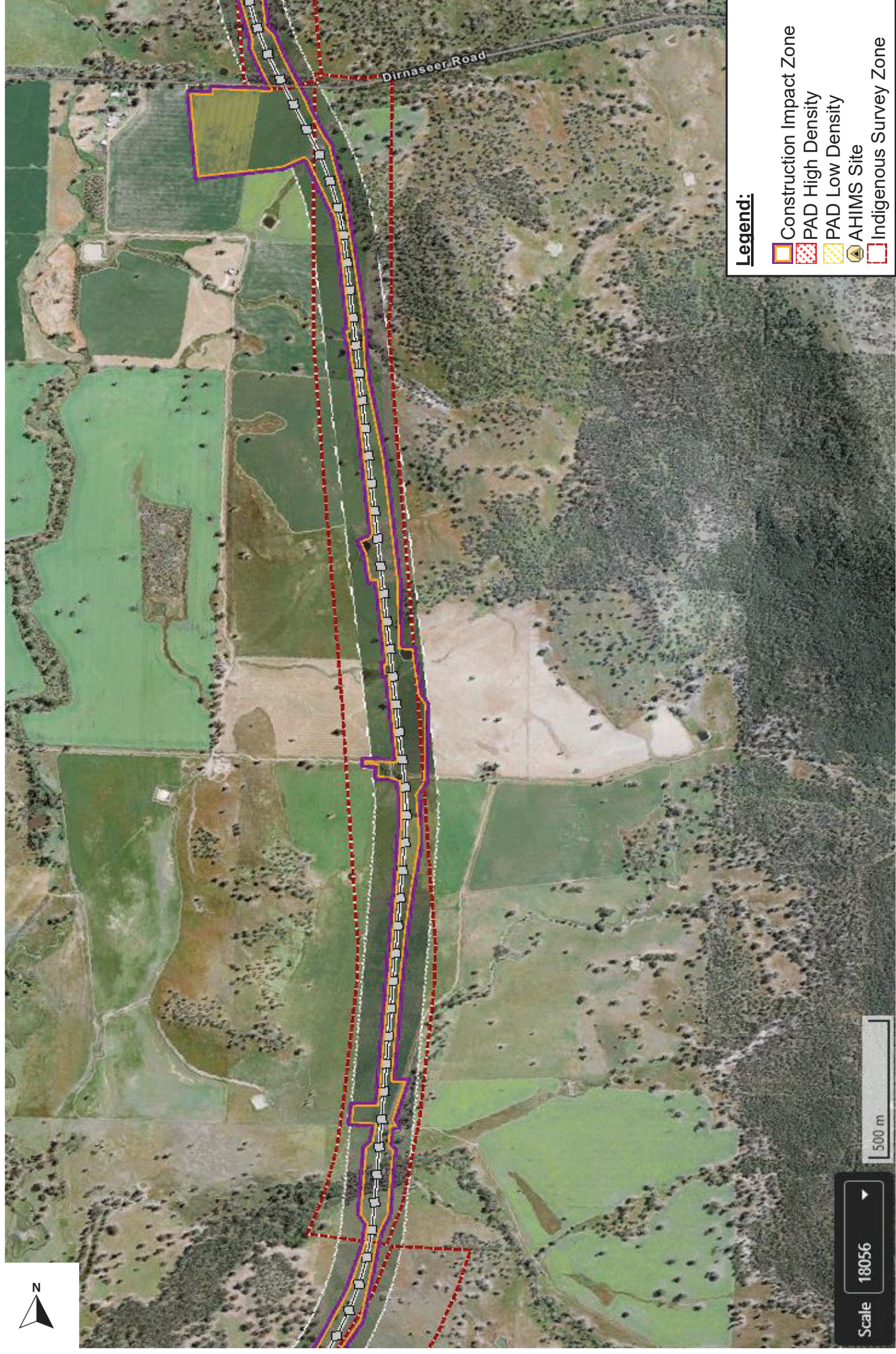
- Construction Impact Zone
- PAD High Density
- PAD Low Density
- AHIMS Site
- Indigenous Survey Zone

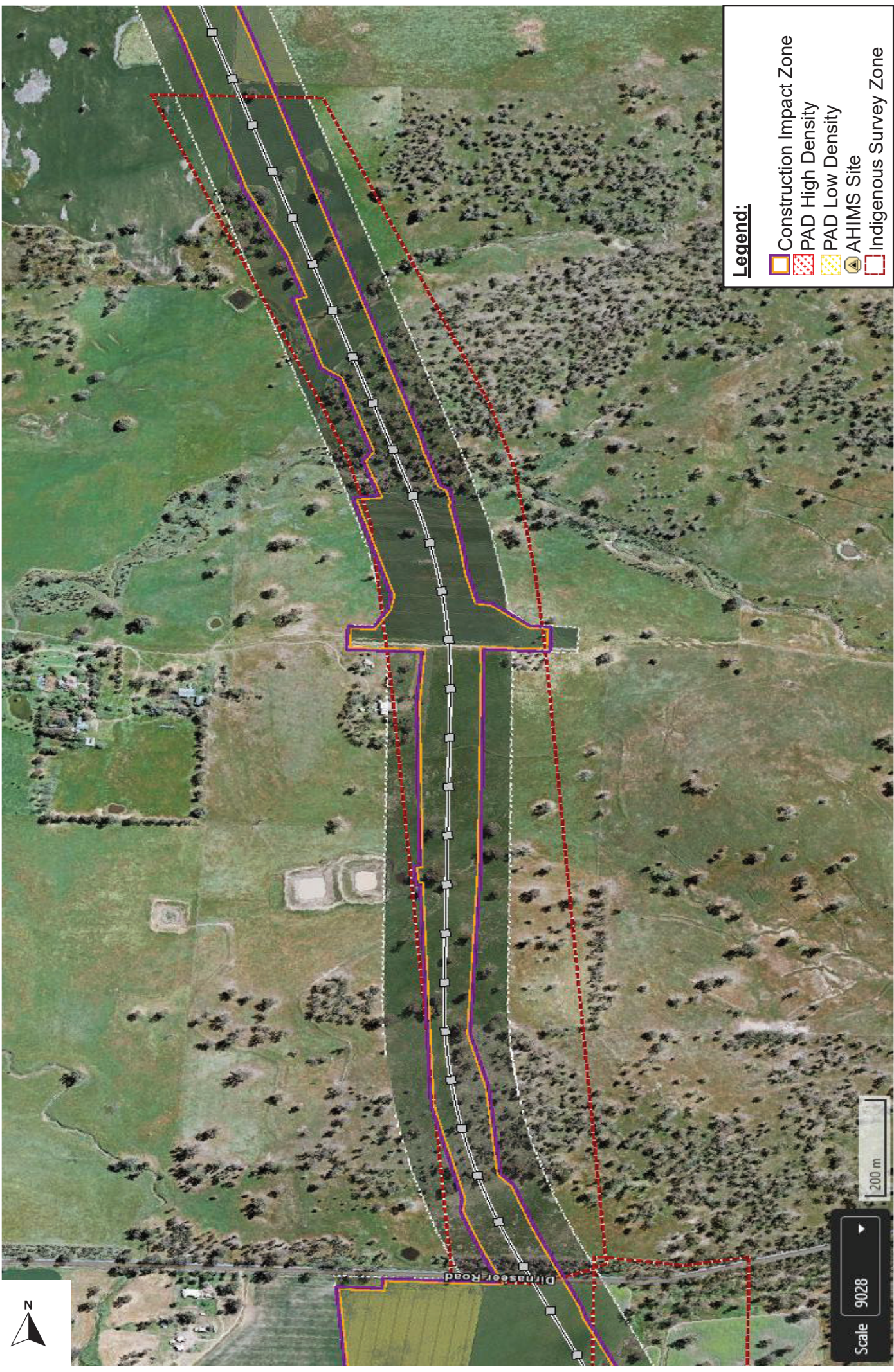




Legend:

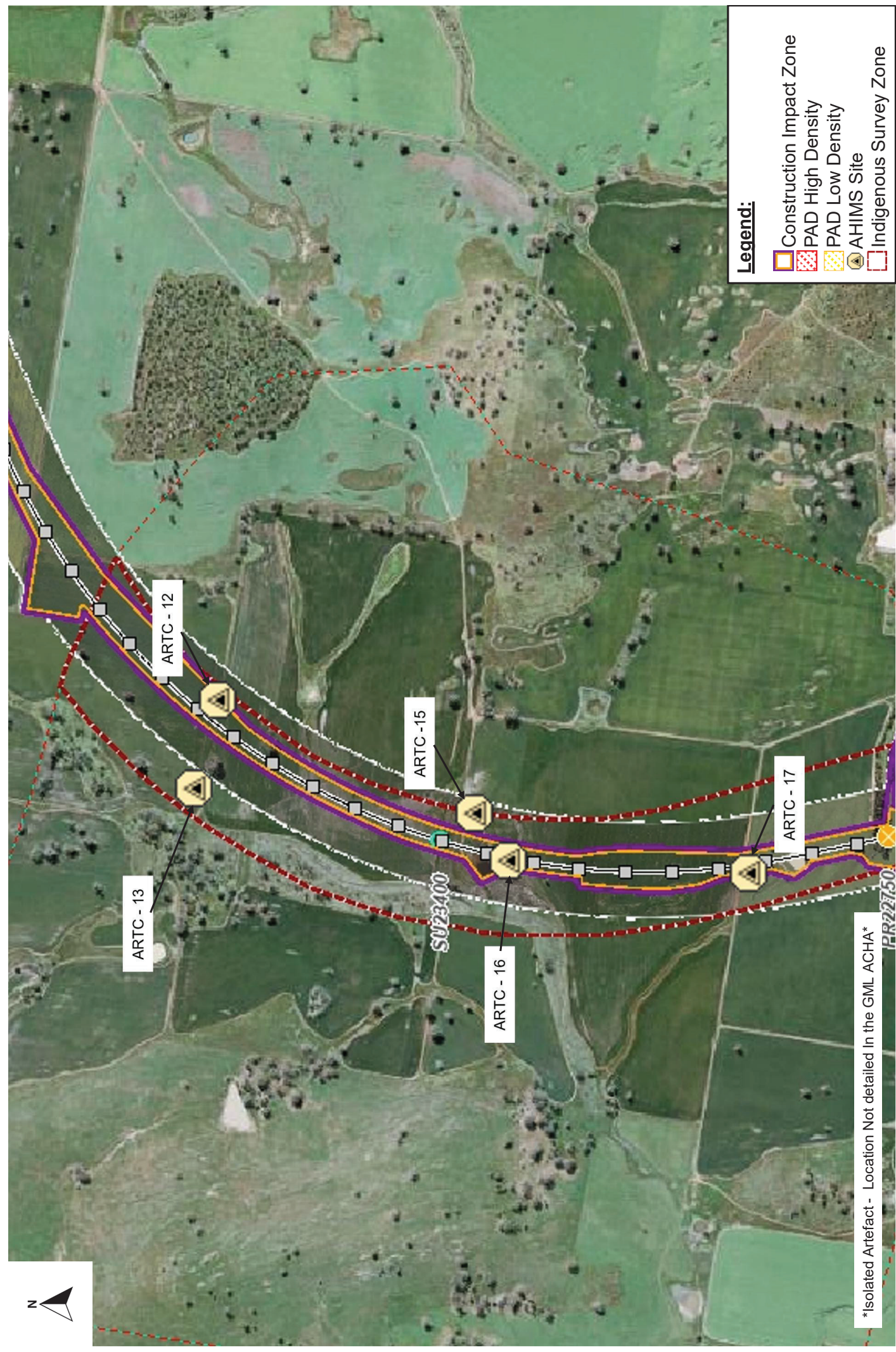
- Construction Impact Zone
- PAD High Density
- PAD Low Density
- AHIMS Site
- Indigenous Survey Zone





Legend:

- Construction Impact Zone
- PAD High Density
- PAD Low Density
- AHIMS Site
- Indigenous Survey Zone

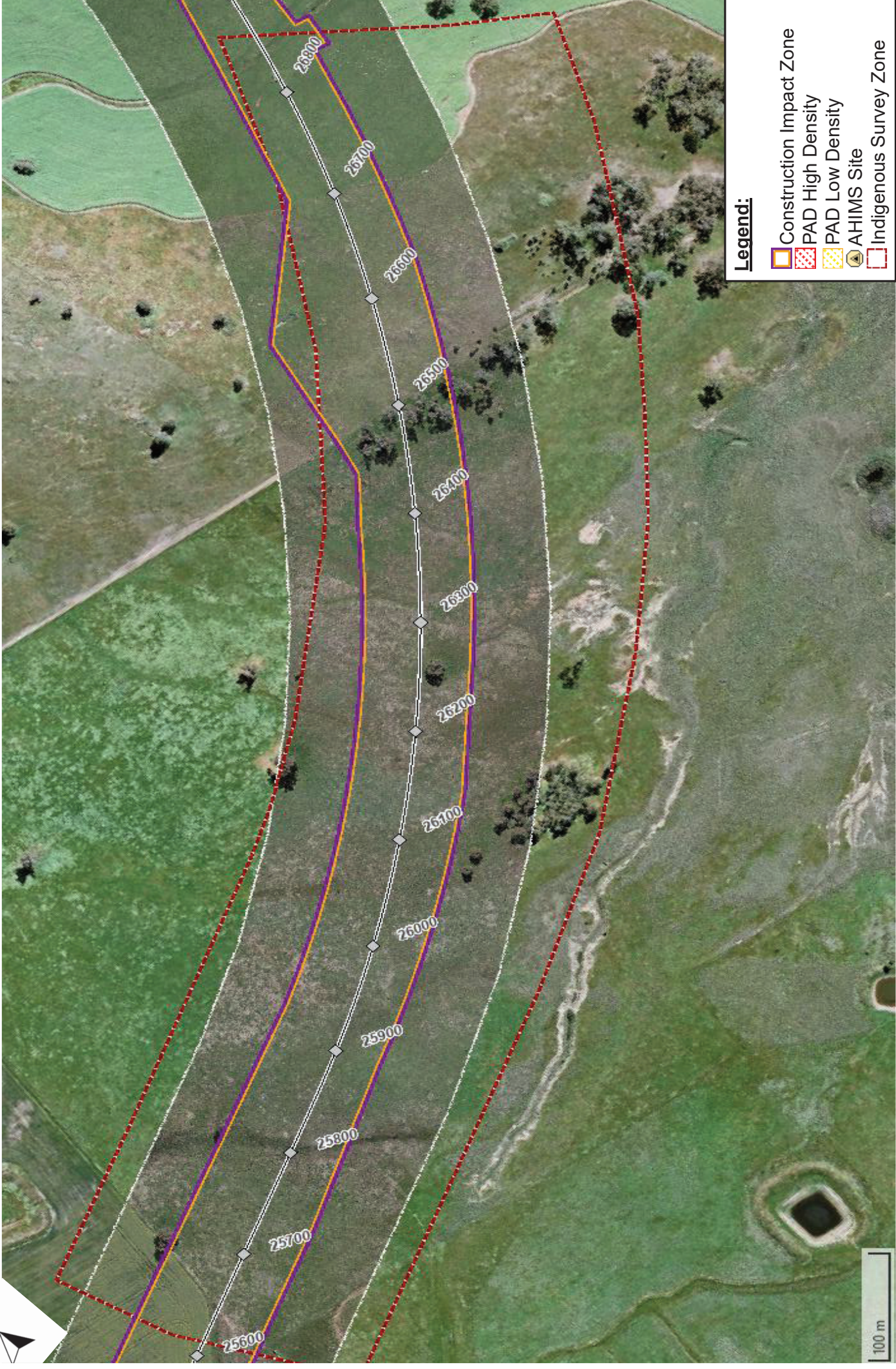


Legend:

- Construction Impact Zone
- PAD High Density
- PAD Low Density
- AHIMS Site
- Indigenous Survey Zone

Isolated Artefact - Location Not detailed In the GML ACHA

Indigenous Survey Zone 8
No items identified during GML survey and test.



Legend:

- Construction Impact Zone
- PAD High Density
- PAD Low Density
- AHIMS Site
- Indigenous Survey Zone



Legend:

- Construction Impact Zone
- PAD High Density
- PAD Low Density
- AHIMS Site
- Indigenous Survey Zone



Legend:

- Construction Impact Zone
- PAD High Density
- PAD Low Density
- AHIMS Site
- Indigenous Survey Zone



100 m

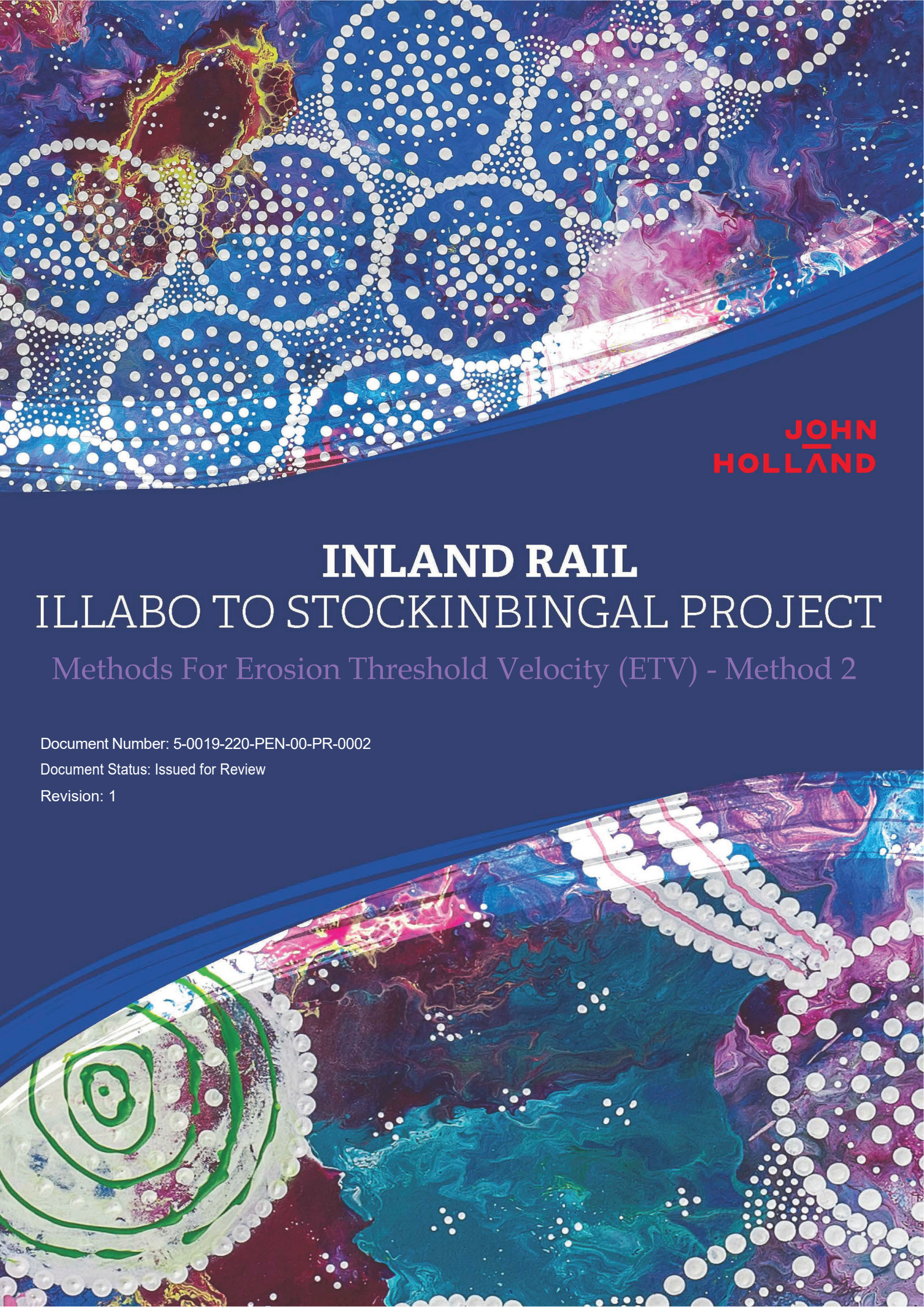


Legend:

-  Construction Impact Zone
-  PAD High Density
-  PAD Low Density
-  AHIMS Site
-  Indigenous Survey Zone



Appendix F – Landloch ETV Methodology



**JOHN
HOLLAND**

INLAND RAIL ILLABO TO STOCKINBINGAL PROJECT

Methods For Erosion Threshold Velocity (ETV) - Method 2

Document Number: 5-0019-220-PEN-00-PR-0002

Document Status: Issued for Review

Revision: 1



Document Control

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Prepared By	Rachel Wootton	
Document Owner	Jerome Cargnino	
	REVIEWED BY	APPROVED BY
Name	Vincent Chong	Jerome Cargnino
Title	Senior Engineering Coordinator	Design and Engineering Manager
Signature Date	Refer to Aconex Workflow 01/05/2025	Refer to Aconex Workflow 01/05/2025

Revision History

REVISION	DATE ISSUED	DESCRIPTION
A	01/05/2025	Issued for Review



METHODS FOR TESTING EROSION THRESHOLD VELOCITY (ETV)

METHOD 2 – DIRECT LABORATORY-BASED ETV TESTING

Inland Rail Pty Ltd

April 2025

0-0080-900-IHY-00-PR-0002

Revision 1



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Project Number: 3474.23a

Report Title: Methods for testing erosion threshold velocity (ETV). Method 2 – Direct laboratory-based ETV testing

Client: Inland Rail Pty Ltd (IRPL)

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2 (Landloch)	E. Howard	H. Bulcock (IRPL), W. Window (IRPL), K. Mitchell (IRPL)	09/08/2023
3 (Landloch) A (IRPL)	E. Howard	W. Elliot (independent reviewer) M. Gillies (independent expert) H. Bulcock (IRPL), W. Window (IRPL), K. Mitchell (IRPL)	18/08/2023

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C (IRPL)	E. Howard	T. Loch (Landloch), B. Godfrey (IRPL), D. Cresswell (IRPL), E. Whittington (IRPL), H. Bulcock (IRPL), M. Sams (IRPL), O. Lupton (IRPL)	06/03/2025
O (IRPL)	E. Howard	T. Loch (Landloch), H. Bulcock (IRPL), J. Stewart (IRPL)	31/03/2025
1 (IRPL)	E. Howard	-	30/04/2025

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PREFACE

Landloch Pty Ltd has developed a procedure by which large undisturbed surface soils samples can be collected and subjected to overland flows in a laboratory setting, with the outcome being the generation of a dataset from which Erosion Threshold Velocity (ETV) values can be determined.

This document outlines the method for the determination of the critical shear stress for initiation of erosion scour and the associated ETV for a range of slope gradients. The method was originally developed in August 2023 and used for 10 sites in southern NSW to demonstrate that ETV values could be measured within a laboratory setting. This document was independently reviewed by Dr William (Bill) Elliot in 2023 and revised based on the review comments and the experience gained from the initial work, and assigned Revision A within IRPL's document management system.

Revision A of the document was further reviewed by two independent reviewers, Dr William (Bill) Elliot and Dr Malcolm Gillies. A synthesis of their reviews was produced by Dr Elliot and is given as Appendix A to this document, along with the review from Dr Gillies. The synthesis of the reviews found that...

"The procedures described in the methods report are reasonable and widely used by the scientific community. The report is well written with only minor editorial or grammatical concerns".

"The method of on-site soil sampling described to Gillies and Foley, and the soil sampling apparatus are robust, and the novelty is to be applauded. The method is a technically sound process that will capture representative large samples of the soil surface conditions from many sites."

"...the testing methodology used by Landloch to establish the erosion threshold velocities for soils along the Inland Rail corridor is generally sound and robust. The methodology is scientifically defensible for determining critical shears and erosion threshold velocities. The approach tends to err towards the worst-case scenario for erosion, i.e. bare soil, water with low salinity, and relatively rapid increases in water velocity over unsaturated samples. We have confidence in the ability of Landloch to conduct this testing in a robust and repeatable manner and to respond to the challenges posed by this task over the Inland Rail corridor.

Several recommendations were made, and Revision B of the testing procedure considered these comments and adjusted the method where appropriate. The recommendations and adjustments made in Revision B were incorporated in Revision C and are detailed in the table below. Revision C was then further refined to remove typographical errors and improve clarity, with the result being Revision 0. Revision 0 was further reviewed by IRPL, with the result being Revision 1 (this document). No changes were made between Revision 0 and Revision 1.

Recommendation from Reviewers	Adjustment Made to Revision A and Incorporated into Revision B
The authors should report the depth of these samples as depth influences soil wetting and may limit some soil testing protocols.	Sample depth has been added to the lists of measurements/tests in Section 6.2.
The document should note the materials used on the bottom of the flume and whether the flume is solid or porous.	This detail was added along with greater detail on the sample frame in Section 6.1.
One concern we have with the preparation of the samples is the variance in antecedent moisture content. This concern may be addressed by either conducting a sensitivity analysis of ETV results to antecedent moisture content and/or using a standardised moisture content for testing.	Additional measurements of soil moisture have been added. Soil moisture is now measured in the field at the time of sampling, prior to application of overland flow, directly after application of overland flow and 24 hours after application of overland flow (i.e. when the soil has reached field capacity). The testing method also now includes the initial application of overland flows ($0.1-0.2\text{L.s}^{-1}$) at low gradients ($\sim 1\%$) as a means of initially wetting the surface and bringing the samples to a more standardised moisture content prior to scour-producing flows being applied.
There is also some concern here with the highly subjective selection of measurement positions, and implications on repeatability. This has been partly addressed by using the same experienced and competent operator for each test.	Along with the test being conducted by experienced and competent operators, the method now requires fixed measurement positions to be used during each test. This will further reduce the subjectivity in the measurement of flow widths and depths.
The authors should note when and where the soil strength measurements will be made. Will they be measured on field sites when collecting samples, in the tray before runoff simulation, in the tray sometime after the runoff simulation, or on sample collected at the same time and from the same place as the trays.	This was already detailed in Revision 3 of the procedure and can be found in Section 7 of this document.
The direct cone penetrometer test may not be useful for this study. The standard that was cited describes the method as requiring a soil depth of 450 mm. If this study is going to use a variation of this test, like less cone penetration, the modified method should be described.	Reference to a required soil depth of 450mm was removed. Direct Cone Penetrometer tests record DCP results for each 100mm thickness of soil down to a suitable depth. Words outlining this have been added in Section 7.1.18.
The size of the foot on the pocket penetrometer should be noted.	This requirement has been added to Section 7.1.19.
One additional property the authors may wish to consider is the slope [gradient] of the site where the soil sample was collected.	Slope gradient information is already collected as part of the site sample collection and is considered in the interpretation of the results. It is not appropriate to include in this procedure because it is limited to the laboratory testing of the samples that have been collected.
On page 15, the report states that the initial gradient is 1% in step 5, but in step 8 it states that the gradients considered are 10–30%. I suggest the authors state the purpose of the 1% run. Is it to measure a potential low critical shear, or to prewet the sample before starting the test at 5%; or should step 8 state that gradients ranged from 1–30%?	The gradients used in the testing have undergone adjustment as learnings from the earlier testing have been incorporated into the procedure. Revision 4 now has now adjusted the gradients so that testing now starts at 1%.
Several references are listed that are not cited in the text.	The reference list has been adjusted to include only cited references.

1 SCOPE

This document describes the method for the determination of the critical shear stress for initiation of erosion scour and the associated Erosion Threshold Velocity (ETV) for a range of slope gradients. The method described is laboratory-based and uses the application of overland flows in a hydraulic flume.

2 RELATED DOCUMENTS

Landloch (2025) *Methods for testing erosion threshold velocity (ETV). Method 1 – Collection of an undisturbed soil sample suitable for laboratory-based ETV testing*, Revision 1, IRPL Document 0-0080-900-IHY-00-PR-0001.

3 CONCEPTS

Management of scour potential in the engineering design of surface water control structures (e.g. channels, culverts) commonly use the concept that, for the soil at the location of the structure, there is a characteristic threshold value of flow velocity or bed shear stress that if exceeded, will produce scour. This threshold concept was described by Horton (1945) who stated that scour, 'only occurs where a threshold of soil resistance is exceeded'.

According to this threshold concept, the rate at which soil particles detach can be related to the amount by which a variable characterising the hydraulics of the flow exceeds a critical value of flow bed shear stress or velocity. The concepts of flow bed shear stress and velocity are briefly described below.

3.1 Flow bed shear stress

The threshold concept for flow bed shear was pioneered by M.P. du Boys (du Boys 1879), who expressed bedload sediment transport rate as a function of excess bed shear stress; that is the bed shear stress exceeding the threshold bed shear stress. A common expression of du Boys' sediment transport formula is:

$$D_c = K_c(\tau - \tau_c)^b \quad 1)$$

where D_c is flow detachment capacity¹ ($\text{kg} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$), K_c is concentrated flow erodibility² ($\text{s} \cdot \text{m}^{-1}$), τ is average bed shear stress (Pa), τ_c is critical bed shear stress (Pa), and b is

¹ The rate at which soil particles are detached when subjected to a clear water flow.

² Increase in soil detachment per unit increase in flow shear stress.

an exponent (unitless)³. Effectively, the bed shear stress (τ) exerted by the overland flow must exceed a critical shear stress (τ_c) to initiate movement of particles at the bed.

Determination of values for D_c , K_c , and b are not required in order to assess the critical flow bed shear stress (τ_c). All that is required is the application of sufficient flow bed shear stress (τ) such that the initiation of scour is achieved. At that point the applied flow bed shear stress (τ) is equal to the critical flow bed shear stress (τ_c).

3.2 Flow velocity

Velocity has historically been used as an indicator of conditions at which scour initiates. IECA (2008), Carey *et al.* (2015), and Christie (1982) are examples of Australian design guidelines that use velocity thresholds as a design criterion.

Despite the common use of flow velocity, bed shear stress is a more fundamentally related measure than flow velocity for the determination of the initiation of movement of bed particles. This is because bed shear stress is an independent, material-specific characteristic, whereas both flow velocity must be combined with slope gradient in order to estimate scour potential. That is, for a given flow velocity, the potential for scour is also dependent on slope gradient.

3.3 Erosion threshold velocity

The Erosion Threshold Velocity (ETV) can be determined by combining the flow bed shear stress equation rearranged to solve for flow depth (equation 2), and the Manning's flow equation (equation 3).

$$D = \frac{\tau_c}{\gamma \times S} \quad 2)$$

where D is average flow depth (m) required to achieve the critical flow bed shear stress, τ_c is critical flow bed shear stress (Pa), γ is the specific weight of water (N.m³), and S is slope gradient (m.m⁻¹).

$$ETV = \frac{1}{n} R_h^{\frac{2}{3}} S^{\frac{1}{2}} \quad 3)$$

where ETV is Erosion Threshold Velocity (m.s⁻¹), n is the Manning's coefficient, R_h is the hydraulic radius (m), and S is the slope gradient (m.m⁻¹).

For broad flows (>20m), as are common for floodplain flows, the flow width and wetted perimeter can be taken as essentially the same (Ponce 1989). This implies that the

³ The exponent b is used to fit the equation to experimental data. A value for b of 1.0 is often used, though 1.5 often better fits the data and facilitates simpler mathematical solutions of the Darcy-Weisbach flow equation (Foster 1982).

average flow depth (D) from equation 2 can be substituted for the hydraulic radius (R_h) in equation 3⁴ (Carey *et al.* 2015). This simplifies equation 3 to equation 4.

$$ETV = \frac{1}{n} D^{\frac{2}{3}} S^{\frac{1}{2}} \quad 4)$$

where n is the Manning's equation coefficient, D is average flow depth (m) to achieve the critical flow bed shear stress, and S is the slope gradient (m.m^{-1}).

Within a flume study, the flow area required to achieve the critical shear (A) can be determined by using equation 5:

$$A = D \times W \quad 5)$$

where D is the average flow depth (m) required to achieve the critical bed shear stress (τ_c) (equation 2) and W is the width of the flow (m).

In using these equations, it is noted that the calculated ETV remains a function the critical bed shear stress and the slope gradient. Therefore, in this procedure ETV is reported for a material tested for a range of slope gradient values.

It is also noted that at low gradients, such as those observed on floodplains, the flow depths and volumes required to achieve the necessary critical bed shear stress and ETV values can be large, making field-based methods of assessment both difficult, costly, and unsuitable. Therefore, a laboratory-based method using hydraulic flumes has been developed. This approach allows for slope gradients to be increased so that the critical bed shear values can be applied with less water. The critical bed shear values can then be used to calculate the corresponding ETV value for a range of slope gradients.

4 APPARATUS

4.1 Previous studies

Assessment of ETV values using laboratory-based methods requires the application of overland flow to an undisturbed sample within a hydraulic flume. A wide range of flume studies have occurred and have used an equally wide range of sample sizes. Table 1 summarises a range of flume studies that assessed flow bed shear and the sample dimensions used.

⁴ R_h can be determined using the equation $R_h = \frac{A}{P}$, where A is the flow area (m^2) required to achieve the critical bed shear stress and P is the wetted perimeter (m). The wetted perimeter (P) is determined using equation $P = 2D + W$ where D is the flow depth (m) required to achieve the critical bed shear stress (equation 2) and W is the width of the test flume (m).

Table 1: Summary of flow studies and the sample dimensions used.

Reference	Sample shape	Sample size (m)
Nearing <i>et al.</i> (1991)	Circle	0.127
McNeil <i>et al.</i> (1996)	Rectangle	0.15 X 0.10
Briaud <i>et al.</i> (2001)	Circle	0.075
Le Hir <i>et al.</i> (2008)	Circle	0.08
Mahalder (2018)	Circle	0.3 X 0.1
Mostafa <i>et al.</i> (2008)	Square	approx. 0.15 X 0.15
Nachtergaele and Poesen (2002)	Circle	0.05
Roberts <i>et al.</i> (2003)	Rectangle	0.15 X 0.10
Schaaff <i>et al.</i> (2006)	Circle	0.15

4.2 Hydraulic flume used for ETV determination

The hydraulic flume used in the determination of ETV for IRPL contains a testing area that houses the undisturbed soil sample (Figure 1). The testing area has a nominal length of 1.0m, width of 0.4m, and depth of 0.2m. This sample size is larger than the samples outlined in Table 1. The benefit of the use of a larger sample is that changes in soil properties that can occur over small distances and their impact on ETV can be incorporated into the testing of a single sample. It also minimises potential edge effects, such as the initiation of detachment from the disturbed soil surface at the interface between the sample and the testing area boundary⁵. The impact of disturbance of this interface area was further reduced through application of a tackifier to the disturbed zone prior to testing.

At the upslope edge of the testing area, an inlet area is installed that contains a stilling well (Figure 2) that discharges overland flow onto a 0.3m long section of inlet channel (Figure 1). The stilling well is used to ensure that water is supplied in a low turbulence state with an even flow depth across the width of the flume.

The bed of the inlet channel is roughened by the presence of a rough sandpaper. The roughness of the sandpaper was tested and found to have a Manning's coefficient (*n*) of ~0.02–0.04 for flume gradients ranging from 6–25%. This Manning's coefficient is consistent with coefficients measured for undisturbed soil samples tested in the study. Use of the roughened inlet channel ensures that the overland flow is introduced to the test surface at a similar velocity to that which will occur on the test surface itself. This reduces the possibility of scour occurring through turbulence caused by a difference in roughness. The inlet channel is rested on top of the testing area using an overlap of ~100mm. The join is sealed using bentonite so that overland flow cannot flow between the test surface and the inlet channel.

⁵ This area of disturbance is in the order of 1cm, resulting in a disturbance of 5% of the plot area (2cm of the 40cm plot width). Use of a narrower plot would increase this proportion of disturbance.



Figure 1: Hydraulic flume showing overland flowing being applied to the testing area.

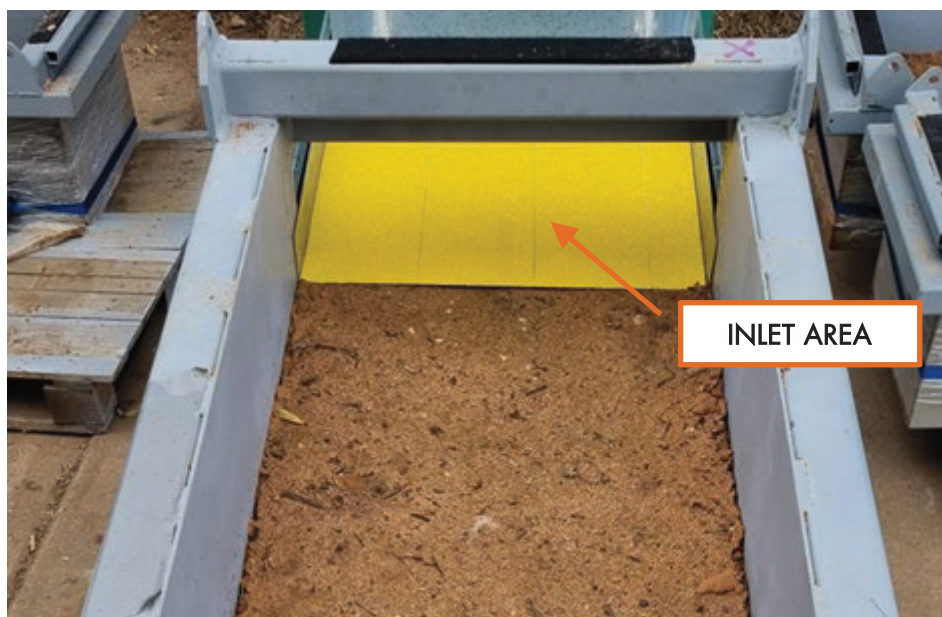


Figure 2: Inlet area roughened using sandpaper allows uniform overland flow to be introduced to the sample.

At the downslope edge of the testing area, an outlet structure is installed. It is trapezoidal in shape (Figure 3) and concentrates the flow prior to it being discharged to a sump (Figure 4). This is done to allow for easier sediment sample collection. The interface between the bottom end of the testing area and the outlet area is also sealed using bentonite so that overland flow cannot flow between the test surface and the outlet area.



Figure 3: Outlet area shaped to allow for easier collection of samples.

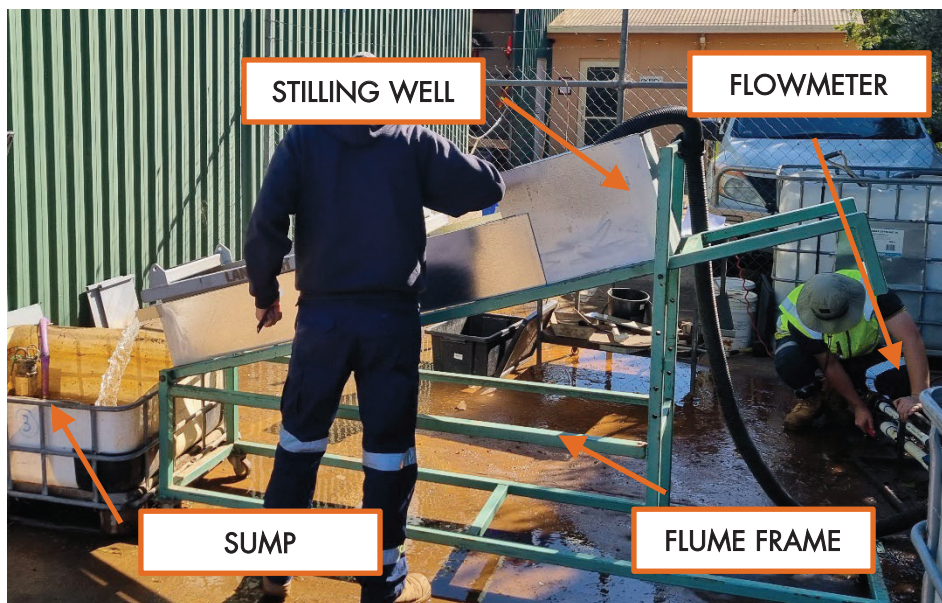


Figure 4: Hydraulic flume placed in an adjustable frame

The hydraulic flume is set in a frame that can be tilted to achieve a range of slope gradients, ranging from 0–40% (Figure 4). Water is supplied to the stilling well, with the flow rate measured using turbine flow meters, capable of applying flow rates of 38–380L.min⁻¹ (0.6–6.3L.s⁻¹) at a manufacturer's stated accuracy of $\pm 3\%$. The flow rate is regulated using a regulator valve positioned between the pump and the flowmeter (Figures 4 and 5).

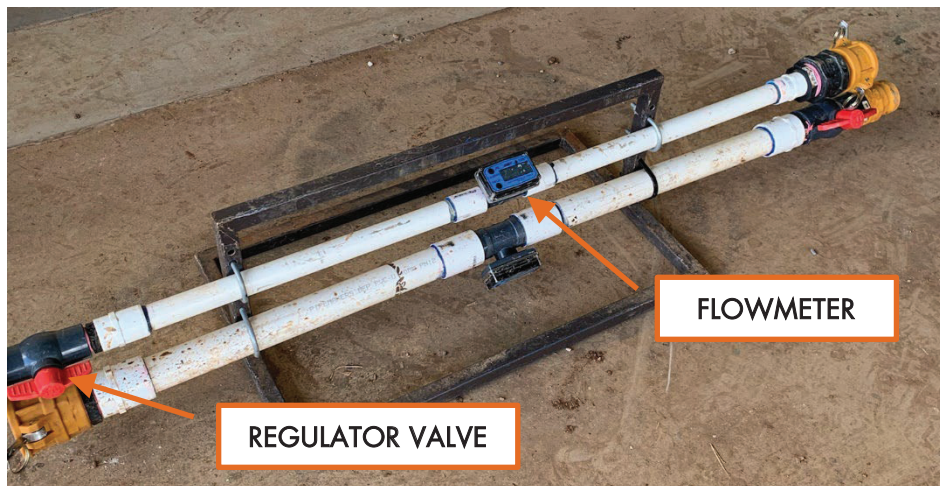


Figure 5: Flowmeter assembly used to regulate (note the valve) and measure (note the flowmeters) the applied flow rate. The assembly shown has two flowmeters with different ranges of measurable flow rates, allowing for a wider range of flow rates to be applied if necessary.

5 WATER

Rainwater is used in the application of overland flow. Rainwater has low salinity ($<0.3\text{dS}\cdot\text{m}^{-1}$). This is to ensure that the chemistry of the water applied does not influence the detachability of particle from the test surface.

6 UNDISTURBED SOIL SAMPLE

The method for collecting an undisturbed soil sample including more detail on the apparatus is described in Landloch (2025), IRPL Document 0-0080-900-IHY-00-PR-0002, Revision 0. Key aspects of the undisturbed sample are described below.

6.1 Sample frame

The sample is collected in a custom-fabricated, reinforced metal sampling frame that ensures that the sample is delivered to the testing laboratory in the same condition as it was collected.

The sampling frame has a length of 1.0m and a width of 0.4m. Samples are nominally 0.2m thick, leaving a space within the channel above that sample surface that is $\sim 0.2\text{m}$ high. The frame consists of an open channel section and two end plates that are inserted once the sample is taken to enclose the sample on all sides except the top surface (Figure 6). The open channel section and end plates are made from solid steel.

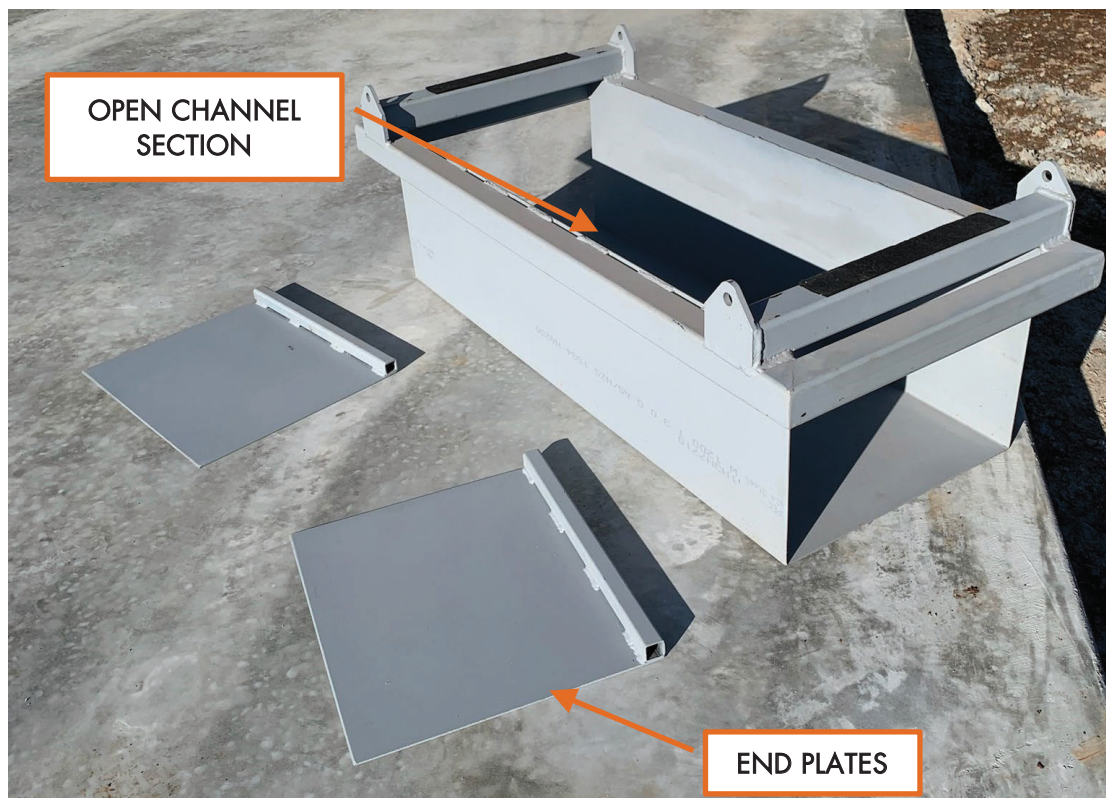


Figure 6: Sampling frame.

6.2 Sample collection

A small (3.5 tonne) tracked excavator is used to create an access trench in which the frame is placed in preparation for sampling. Sleepers are used to assist in guiding the frame during sampling (Figure 7).

The frame is then pushed laterally through the soil being sampled (Figure 8). The end plates are then installed and the sample lifted from the sampling location and prepared for transport. An overview of a sampling site is shown in Figure 9.

The top surface (i.e., the surface that is tested in the laboratory) is protected prior to transport to the laboratory by placement of a foam layer that fills the void between the sample surface and the top of the frame. A board is placed over the foam prior to the sample being wrapped in plastic wrap. The sample is wrapped to maintain its moisture content. An example of that data is given in Figure 10 and confirms that moisture content is maintained during transport, with the absolute mean variation between field and laboratory moisture content being 1%.

Bulk density of the sampled soil, both in the field and as delivered to the laboratory, are measured. An example of that data is given in Figure 11 and shows that bulk density is well maintained, with the absolute mean variation between measured field and sample bulk density being 0.01g.cm^{-3} .



Figure 7: Sampling frame placed into access trench between the guide sleepers.



Figure 8: Sampling frame being pushed through the soil using the excavator blade.

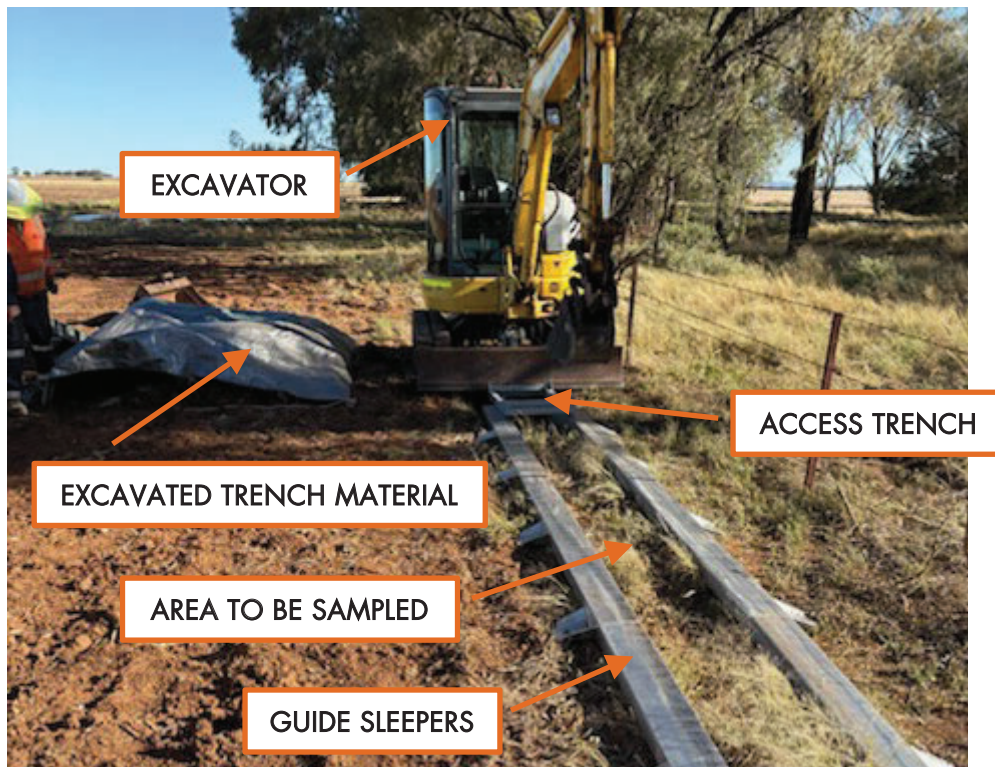


Figure 9: Overview of a sampling site.

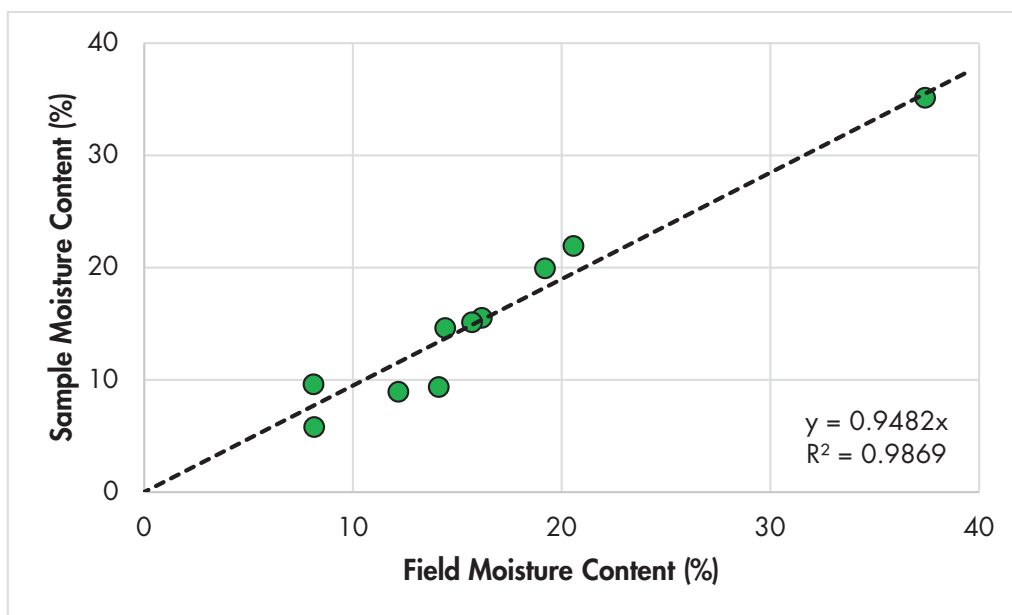


Figure 10: Example relationship between field and laboratory moisture content.

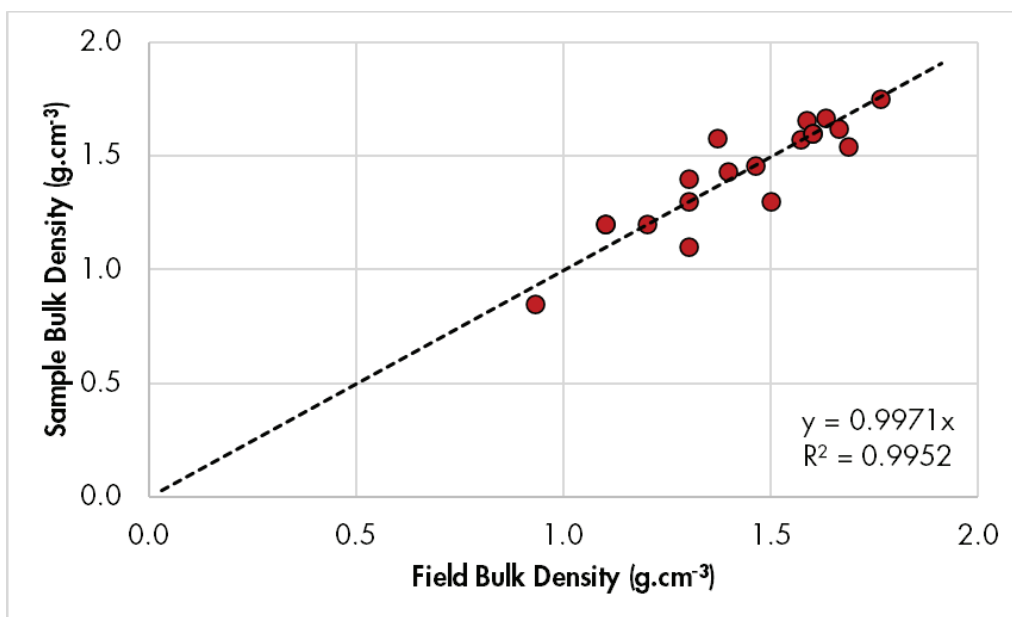


Figure 11: Example relationship between field and laboratory bulk density.

6.3 Soil surface condition

IRPL requires that the ETV assessment of a soil be for a 'worst case scenario' from a detachment perspective. For soils with naturally low vegetation groundcover levels (i.e. more arid zones), this is a soil that is bare of surface groundcover and that has little to no root mass. Such a condition could occur after a drought or fire, or may occur naturally given the rainfall-limiting environment. For soils with naturally high vegetation groundcover levels (i.e. higher rainfall zones), this is a soil that is bare of surface groundcover but that does contain a root mass. Such a condition could occur after a drought or fire that would remove the surface groundcover but leave a root mass behind that would have an impact on the detachability of soil particles. In both cases, the soil surface assessed aims to represent a surface that could exist in the long-term within or adjacent to the rail corridor, and excludes disturbed soils that exist soon after construction of the rail line.

For the samples taken that have a surface groundcover present, the vegetation is initially sprayed out prior to testing using glyphosate mixed as per the manufacturer's recommendation. The plots are then left for 1–2 weeks to allow for the spray to take effect. The remaining vegetation is then manually clipped using garden scissors. The remaining grass tufts were then burned off using a butane torch at low heat (red flame) applied only to the grass tuft areas (Figure 12). The vegetation residue produced is brushed from the plot using a banister brush or blown from the plot using a leaf blower (Figure 13).



Figure 12: Burning off grass tufts using a butane torch on low heat (red flame)



Figure 13: Removing excess vegetation debris using a leaf blower.

Vital Bon-Matt Stonewall is applied to the disturbed edges of the plot (Figure 14) at the application rate recommended by supplier (1 part Stonewall to 9 parts water)⁶.

Bentonite is applied to the plot edges to ensure no downward movement of overland flow between the plot edge of the sample frame (Figure 15). This is done to ensure that all overland flow introduced to the plot flows over the plot surface and contributes to the applied bed shear stress.

⁶ Stonewall is a polymer soil stabiliser commonly used to provide rapid stabilisation of soils. Testing of the impacts of Stonewall application to the sample surfaces showed that critical shear rates of the treated surfaces exceeded that of the untreated surfaces. From this it can be concluded that application of the stabiliser effectively stabilised the disturbed edges of the plots, eliminating them as a cause or contributor to scouring or sediment detachment.



Figure 14: Stabiliser applied to the disturbed edges of the plot prior to application of overland flow.



Figure 15: Bentonite (grey material) applied to the plot edge.

7 SAMPLE TESTING

Other properties of the soil sample are collected both in the field and within the sample. These are known as Indirect Tests. They will be used to consider the development of indirect estimates of ETV. The properties assessed include:

- Sample thickness;
- Moisture content;
- pH_w (1:5 water:solid solution) (pH units);
- EC_{1:5} (1:5 water:solid solution) (dS.m⁻¹);
- Gravel content (>2mm) (%);
- Particle size distribution of the fine fraction (<2mm) (%);
- Soil texture;
- Exchangeable cations (Ca²⁺, Mg²⁺, Na⁺, K⁺, Al³⁺) (meq.100g⁻¹);

- Effective Cation Exchange Capacity (ECEC) (meq.100g^{-1});
- Ca:Mg ratio (unitless);
- Exchangeable Sodium Percent (ESP) (%);
- ECEC to Clay ratio (CCR) (estimate of clay mineralogy);
- Total N and P (mg.kg^{-1});
- Organic C (%);
- Plant available P, K, and S (mg.kg^{-1});
- Dry bulk density (g.cm^{-1});
- Unified Soil Classification System (USCS) classification;
- Revised Universal Soil Loss Equation (RUSLE) erodibility factor (K-factor);
- Shear stress (shear vane) (kPa);
- Surface shear stress (torvane) (kPa);
- Liquid Limit (%) and Plastic Limit (%), also known as the Atterberg Limits;
- Plasticity Index (%);
- Linear Shrinkage (%);
- Direct Cone Penetrometer (blows/100mm);
- Pocket Penetrometer (kPa);
- Relative Density (cohesionless soil); and
- Emerson Class.

7.1 Indirect tests

7.1.1 Sample thickness

Sample thickness will be measured using a ruler. The recorded thickness will be the average value of thicknesses measured at 3 locations on either end of the sample once the end plates are removed (6 measurement in total).

7.1.2 Soil moisture

Soil moisture will be measured using a handheld soil moisture meter (Delta-T SM150T or equivalent). The recorded soil moisture will be the average value of soil moisture measured at 3 locations within the sample area.

7.1.3 pH_w

Testing of pH_w will be completed with method 4A1 in the *Soil Chemical Methods—Australasia* (Rayment and Lyons 2011).

7.1.4 $\text{EC}_{1:5}$

Testing of $\text{EC}_{1:5}$ will be completed with method 3A1 in the *Soil Chemical Methods—Australasia* (Rayment and Lyons 2011).

7.1.5 Gravel content, particle size distribution, and texture

Testing of the gravel content (>2mm) will be completed via dry sieving. Testing of the particle size distribution of the fine fraction (<2mm) will be performed in accordance with the Australian Standard AS 1289.3.6.3 (Standards Australia 2020). When completing the particle distribution testing, the following size classes, expressed as percent passing values, must be determined:

- 19.0mm;
- 13.2mm;
- 9.5mm;
- 6.7mm;
- 4.75mm;
- 2.36mm;
- 1.18mm;
- 0.600mm;
- 0.425mm;
- 0.300mm;
- 0.150mm;
- 0.075mm; and
- 0.002mm.

Texture of the fine fraction (<2mm) use be determined using the laboratory measures of particle size distribution. The texture assigned will be based on the Australian soil texture triangle (NCST 2009).

7.1.6 Exchangeable cations, ECEC, and ESP

Testing of exchangeable cations will be completed in accordance with method 15 in the *Soil Chemical Methods–Australasia* (Rayment and Lyons 2011). The appropriate sub-method will be selected based on material properties such as pH_w and $EC_{1:5}$.

Effective Cation Exchange Capacity (ECEC) will be calculated as the sum of exchangeable cations (Ca^{2+} , Mg^{2+} , Na^+ , K^+ , Al^{3+}).

The Ca:Mg ratio will be calculated as the ratio of exchangeable Ca^{2+} and Mg^{2+} .

Exchangeable Sodium Percentage (ESP) will be calculated as the exchangeable Na^+ concentration divided by the ECEC and expressed as a percent.

7.1.7 CCR

ECEC to Clay ratio (CCR) is an indicator of clay mineralogy (DERM 2011), and will be calculated as the ratio of ECEC ($meq. 100g^{-1}$) and clay content (%). Despite having units, it is normally reported without units.

7.1.8 Total N and P

Testing of total N will be completed with method 7A5 in the *Soil Chemical Methods–Australasia* (Rayment and Lyons 2011).

Testing of total P will be completed with ICP.

7.1.9 Organic C

Testing of plant available P will be completed with method 6B3 in the *Soil Chemical Methods–Australasia* (Rayment and Lyons 2011).

7.1.10 Plant available P, K, and S

Testing of plant available P, K, and S will be completed with the following methods in the *Soil Chemical Methods–Australasia* (Rayment and Lyons 2011):

- P – 9B1;
- K – 18A1; and
- S – 10D1.

7.1.11 Dry bulk density

Testing of the dry bulk density will be performed in accordance with method 503.01 in the *Soil Physical Measurement and Interpretation for Land Evaluation* (McKenzie *et al.* (2002).

7.1.12 Unified Soil Classification System (USCS) classification;

The Unified Soil Classification System (USCS) classification will be performed in accordance with the Australian Standard AS 1726 (Standards Australia 2017a).

7.1.13 RUSLE K-factor

The RUSLE K-factor will be calculated using the in accordance with method 528.01 in the *Soil Physical Measurement and Interpretation for Land Evaluation* (McKenzie *et al.* (2002).

7.1.14 Shear stress (shear vane)

The shear stress (shear vane) test will be performed in accordance with the Australian Standard AS 1289.6.2.1 (Standards Australia 2001).

7.1.15 *Surface shear stress (torvane)*

The surface shear stress (torvane) test will be performed in accordance with the ASTM International Standard D8121/D8121M-19 (ASTM 2019).

7.1.16 *Liquid Limit (%), Plastic Limit (%), and Plasticity Index (%):*

The liquid limit test will be performed in accordance with the Australian Standard AS 1289.3.9.1 (Standards Australia 2002). The plastic limit test will be performed in accordance with the Australian Standard AS 1289.3.2.1 (Standards Australia 2009a). These two limits are also known as the Atterberg limits.

The plasticity index will be performed in accordance with the Australian Standard AS 1289.3.3.2 (Standards Australia 2009b).

7.1.17 *Linear Shrinkage*

The linear shrinkage test will be performed in accordance with the Australian Standard AS 1289.3.4.1 (Standards Australia 2008).

7.1.18 *Direct Cone Penetrometer*

The DCP test will be performed in accordance with Australia Standard AS 1289.6.3.2 (Standards Australia 1997). DCP data are reported in the units of 'blows/100mm' to a maximum depth of 500mm (the actual depth depends on the soil). Given the thickness of the sample collected is nominally 200mm, the DCP readings for the surface 200mm are used when assessing relationships between DCP measurements and ETV. That said, measurements for the full depth are still taken in the field for the sake of completeness and to align with the requirements of the standard.

7.1.19 *Pocket Penetrometer*

The pocket penetrometer test evaluates approximate unconfined compressive strength of soils. There is currently no Australian or international standard for this test. Therefore, the measurement is to follow the manufacturers directions. The result reported is to be the average of a minimum of 3 individual tests (preferably more). The size of the foot of the pocket penetrometer used for the test must be recorded.

7.1.20 *Relative density (cohesionless soil)*

Relative density is defined as the ratio of difference of void ratios (denoted with the symbol 'e') of cohesionless soil in its loosest state ($e_{\max}$) and the natural state (e) (difference calculated as $e_{\max} - e$) to the difference between void ratio in its loosest and densest ($e_{\min}$) state (difference calculated as $e_{\max} - e_{\min}$).

This method is valid only for soils that contain up to 5% mass of soil passing a 75 μ m sieve, except that silty sands with non-plastic fines may contain up to 12% passing a

75µm sieve. In most cases, this tests will not be performed because the soils assessed have appreciable clay silt and clay contents.

Calculation of void ratios requires the assessment of minimum and maximum dry density of the cohesionless soil, and the dry bulk density in the soil's natural state. Measurement of a soils dry bulk density in its natural state is described in Section 7.1.11. Minimum and maximum dry bulk density will be performed in accordance with the Australian Standard AS 1289.5.5.1 (Standards Australia 1998).

7.1.21 Emerson Class

The Emerson Class evaluates the risk of clay dispersion. The test is done in accordance with AS 1289.3.8.1 (Standards Australia 2017b).

7.2 Direct testing of critical shear

The procedure for applying overland flows and determining the initiation of scour is as follows:

1. Prepare the undisturbed sample surface:
 - Remove vegetation if required;
 - Apply stabiliser to the disturbed sample edges; and
 - Apply bentonite to the sample edges.
2. Load the prepared undisturbed sample (still within the sampling frame) into the hydraulic flume frame:
 - Ensure that the gradient measured across the (shorter) plot width is near zero (target $\pm 0.5\%$);
 - Take care that the test surface is at a consistent height with the bottom end of the flume frame; and
 - Seal the gap between the bottom of the sample and the outlet area with bentonite; and
 - Measure soil moisture using a handheld moisture probe.
3. Attach the inlet area:
 - Overlap the inlet channel edge with the top edge of the sample;
 - Take care that the test surface is at a consistent height with the inlet area; and
 - Seal the overlap with bentonite.
4. Connect the water supply to the stilling well via a pump and flow meter.
5. Set the flume frame to the initial gradient. 1% is suggested, but can be altered depending on the soil type and anticipated resistance to scour).
6. Apply overland flow to the surface area at the initial flow rate. $0.1\text{--}0.2\text{L.s}^{-1}$ is suggested but could be altered depending on the soil type and anticipated resistance to scour.
7. Make observations of flow, scour, and sediment:
 - At each flow rate measure flow width in two locations and average flow depth at the same two locations.

- The locations are to remain constant throughout the duration of the test and are to be positioned in a location where flow turbulence is as low as possible, minimising the errors in flow depth measurements.
- Flow depth is recorded at a minimum of three positions across the flow width at each of the two locations where the flow width was recorded. More than three flow depths can be recorded if the flow depth is observed to be variable across the flow width. The average flow depth recorded for each point where flow width is recorded is taken as the average of all flow depths recorded. Flow depth is measured using a steel ruler with a small 'foot' attached to then end at right angles. This is done to assist in ensuring the end of the ruler is in contact with the surface and does not pierce the surface, leading to a recording of a larger depth of flow than actually occurs.
 - Observe whether scour has initiated by:
 - Visual inspection of the surface, or
 - Change in appearance of the generated sediment.
 - Take a runoff sample and derive a measure of sediment concentration.
- 8. If scour was not initiated, increase the flow rate and repeat step 7. Flow rates are typically increased by $\sim 0.3 \text{ L.s}^{-1}$ at each increase in flow rate as this is equal to an increase in applied shear of 1–3Pa over the range of gradients considered (<40%). A maximum flow rate of 4.8 L.s^{-1} is achievable with the pump used, though higher flow rates could be used if a different pump is employed. The size of flow rate increase can be adjusted, but it is critical that the actual applied flow rate is accurately recorded. Continue increasing flow rate until scour is initiated or until the maximum flow rate of the pump is achieved.
- 9. If after the maximum flow rate is achieved and no scour has been initiated, increase the gradient of the hydraulic flume, and repeat steps 6–8.
- 10. Application of overland flow is stopped when scour is initiated or if scour has not initiated and the maximum flow rate on the maximum flume gradient has been applied.
- 11. Measure soil moisture using a handheld moisture probe at the end of the application of overland flow.
- 12. Allow plots to drain under gravity (24 hours), and assess the surface. Assessment of both unscoured and scoured surfaces should be undertaken if scouring occurs and if an unscoured surface remains. Assessments include soil properties listed in Section 6.
- 13. Triplicate plots of each material are tested as outlined in steps 1–12.

For each run, photographs of the test sample prior to application of overland flow and after completion of the flume test should be taken. A video of the application of the overland flow should also be taken and can be used to support observations made during the test run.



Figure 16: Examples of scoured surfaces generated by application of overland flows.

8 DETERMINATION OF CRITICAL SHEAR

Critical flow shear stress is derived from the measures of flow width and depth for the flow rate and gradient at which scour was observed to initiate. Equation 2 can be used, rearranged to solve for τ_c :

$$\tau_c = D\gamma S \quad 6)$$

where τ_c is critical bed shear stress (Pa), D is average flow depth (m) at which the critical bed shear stress was reached, γ is the specific weight of water (N.m^{-3}), and S is slope gradient (m.m^{-1}) at which the critical bed shear stress was reached.

9 DETERMINATION OF ETV

ETV for the sample is determined as the velocity that is required to achieve the critical flow shear stress for a given slope gradient. Flow velocity is determined by solving the flow equation:

$$ETV = \frac{Q}{A} \quad 7)$$

where *ETV* is Erosion Threshold Velocity (m.s^{-1}), *Q* is the flow rate ($\text{m}^3.\text{s}^{-1}$) at which critical bed shear stress was achieved, and *A* is the flow area (m^2) at the point at which critical shear was achieved. Flow area at the point at which critical bed shear stress was achieved is calculated by multiplying the flow width by the average flow depth at the point at which the critical bed shear stress was achieved.

The Manning's coefficient (*n*) can be calculated by solving the Mannings equation (equation 3) for said coefficient. By doing this, the ETV for a range of slope gradients can then be calculated using equations 3 and 7.

10 REPORTING RESULTS

Values for ETV are calculated for triplicate samples of the same soil, and the average ETV of the three samples will be reported. The ETV value for a soil must be reported along with its associated slope gradient. This may be usefully achieved through the use of a graph showing ETV versus slope gradient.

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- Standards Australia (2008) *AS 1289.3.4.1: Methods of testing soils for engineering purposes Soil classification tests - Determination of the linear shrinkage of a soil - Standard method*.
- Standards Australia (2009a) *AS1289.3.2.1: Methods of testing soils for engineering purposes, Method 3.2.1: Soil classification tests – Determination of the plastic limit of a soil – Standard method*.
- Standards Australia (2009b) *AS1289.3.3.2: Methods of testing soils for engineering purposes, Soil classification tests – Calculation of the cone plasticity index of a soil*.
- Standards Australia (2015) *AS1289.3.9.1: Methods of testing soils for engineering purposes, Soil classification tests – Determination of the cone liquid limit of a soil*.
- Standards Australia (2017a) *AS1726: Geotechnical site investigations*.

Standards Australia (2017b) AS1289.3.8.1 *Methods of testing soils for engineering purposes, Method 3.8.1: Soil classification tests — Dispersion — Determination of Emerson class number of a soil*

Standards Australia (2020) AS1289.3.6.3: *Methods of testing soils for engineering purposes, Part 3.6.3: Soil classification tests — Determination of the particle size distribution of a soil — Standard method of fine analysis using a hydrometer.*

APPENDIX A: INDEPENDENT REVIEWS

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Synthesis of Reviews on Methods for Determining Erosion Threshold Velocity

William Elliot, PhD

21 January 2025

Client: Evan Howard, Landloch Pty Ltd

Background

Inland Rail Pty Ltd (IRPL) is building a new freight rail line to connect Melbourne to Brisbane. The proposed Inland Rail corridor will cross inland areas of Victoria, New South Wales and Queensland following ~1,000 km of existing lines and constructing about ~600 km of new line (Landloch 2024a). To support the design of railway channel crossings, IRPL has asked Landloch Pty Ltd to develop erosion threshold velocities (ETVs) for a range of soils. Landloch's approach is to collect large undisturbed trays of soil from along the proposed route (Landloch 2023a), and measure soil detachment critical shear (τ_{auc}) using simulated surface runoff. From τ_{auc} and channel gradient, ETV values can be calculated. The laboratory testing procedure is described in a technical report *Methods for Testing Erosion Threshold Velocity Method 2 – Direct Laboratory-based ETV Testing Rev 3* (Landloch 2023b).

As part of measuring critical shear, Landloch asked two independent scientists to review the *Methods for Testing Documents* (Landloch, 2023b) and to visit the Landloch Laboratory in Toowoomba, QLD, to evaluate the testing equipment and observe one of the tests. Review reports were submitted to Landloch by both reviewers (Elliot, 2024; Gillies, 2024). Additional feedback was obtained from Evan Howard, Principal Consultant with Landloch in correspondence and from other Landloch staff during a site visit. Feedback was also provided by Mr. Howard during the drafting of the initial reviews. This document is a synthesis of the two independent reviews provided by Elliot (2024) and Gillies (2024). This is the second review of the *Methods Report* by Elliot. The first review was submitted in August 2023 (Elliot, 2023). It was apparent that most of the suggestions for improvement in the first *Methods* document were incorporated into the 2023 revision 3 *Methods Document* (Landloch, 2023b).

In addition to the site visit, Dr. Gillies was provided with two reports: *Methods for Testing Erosion Threshold Velocity (ETV) Method 2 – Direct Laboratory-Based ETV Testing* (Landloch 2023b) and the *Erosion Threshold Velocities Report, Illabo to Stockinbingal Inland Rail Project* (Landloch 2024b). The scope of this review is limited to the *Methods Report* and onsite observations of the testing procedure only and does not consider the wider use of this information in any design or planning by ARTC.

Background of Reviewers

Dr. William Elliot has a PhD in Agricultural Engineering with a minor in Soil Management. He has taught in agriculture colleges in Kenya, Liberia, and England, and in Universities in Scotland, and Iowa, Ohio, and Idaho USA. He has more than 100 peer-reviewed publications and book chapters. He was a Research Engineer for the USDA Forest Service Rocky Mountain Research Station in Moscow, Idaho for 26 years, managing research teams of up to a dozen specialists and scientists. His area of expertise is forest soil erosion processes and prediction. He has carried out erosion field studies associated with natural rainfall and snowmelt, as well as erosion associated with simulated rainfall and runoff on croplands, rangelands, and forests.

Synthesis of Reviews on Methods for Determining Erosion Threshold Velocity

William Elliot, PhD

21 January 2025

Dr. Malcolm Gillies is a Senior Lecturer (Water Engineering) at the University of South Queensland, Toowoomba. Dr. Gillies has taught courses in agricultural science, water hydraulics and soil and water engineering for more than 14 years. His research interests are in field irrigation science and management where he has authored or coauthored more than 50 articles. Dr. Gillies was accompanied on his site visit by Dr. Joseph Foley, Associate Professor in Water Engineering and Irrigation at the same university.

General Comments

The Inland Rail corridor spans a large geographical area and therefore encompasses a wide range of challenges due to varied hydrological factors and soil conditions. Inland Rail are to be applauded for any attempts to improve upon design and subsequent channel crossing infrastructure expenditure costs with actual measurements of erosion threshold velocities.

The procedures described in the methods report are reasonable and widely used by the scientific community. The report is well written with only minor editorial or grammatical concerns as noted below.

The method of on-site soil sampling described to Gillies and Foley, and the soil sampling apparatus are robust, and the novelty is to be applauded. The method is a technically sound process that will capture representative large samples of the soil surface conditions from many sites; except for very stony soils and soils immediately following tillage. These two particular exceptions are well understood by the Landloch team, and they have verbally indicated that they carefully locate sample sites or choose alternative sites when such conditions are encountered.

As reported in Landloch (2023b) the size of the soil sample is larger than most other laboratory testing apparatus in published literature. The large size of the flume is one of the strong features of this study. This permits the testing procedure to more accurately account for the ground surface conditions present on site including microtopography, plant roots and surface roughness. The larger flume will better address variability within a soil sample, a problem associated with all erosion studies. The disadvantage is the difficulty in obtaining such large undisturbed samples for testing. The authors should report the depth of these samples as depth influences soil wetting and may limit some soil property testing protocols, like the cone penetrometer test. The document should also note the materials used on the bottom of the flume and whether the flume is solid or porous (page 16 in report). In a subsequent email, Howard stated that the bottom of the flume was solid.

Gillies and Foley were generally impressed by the testing apparatus in which the soil sample is placed and were comfortable with the efforts to address the transition between the metal flume and the soil surface. Water is applied to the top end of the sample via a wide stilling well and passes over a region surfaced with sandpaper with a similar surface roughness to bare soil, ensuring that the flow transition is as smooth as possible. The edges of the soil sample,

Synthesis of Reviews on Methods for Determining Erosion Threshold Velocity

William Elliot, PhD

21 January 2025

including the upstream transition are sealed with bentonite which appears to function as designed. Care should be taken to ensure that the soil surface is at a consistent height with respect to the entry manifold. The application of a soil stabilizer to the sides of the flume is a good practice to minimize edge effects and support the assumption that the hydraulic radius is equal to the depth.

One concern we have with the preparation of the samples is the variance in antecedent moisture content. For cohesive sediments, i.e. clay and loam soils, the structural strength and therefore susceptibility to erosion is potentially influenced by the moisture content. The sampling procedure includes a measurement of moisture content in the field prior to extracting the sample and again at the completion of the flowing water tests in the lab. The procedure also attempts to preserve the moisture content between the time of field sampling and beginning of laboratory testing. While this process is sound the concern is that there will be a range of possible moisture levels in the samples at the time of laboratory testing. This concern may be addressed by either conducting a sensitivity analysis of ETV results to antecedent moisture content and/or using a standardised moisture content for testing. Howard indicated that Landloch have already investigated the impact of wetting the surface prior to the testing procedure and that this had a relatively small impact on the ETV. Formally documenting this investigation should improve our trust in this method¹.

The ability to retain in situ bulk densities and water contents in the soil samples as shown in figs. 7 and 8 in the Methods Report improves the confidence that the results of the study will be reasonable. Many similar studies use disturbed soil samples and repack them to a field bulk density, but such a practice fails to retain inherent mechanical, chemical and biological bonds between soil particles.

The testing method is based on established theory to determine shear stress from water depth and bed slope. This theory requires a normal flow regime, a condition that normally occurs after a sufficient distance of flow in open channel of uniform cross section. The distance to establish normal flow may exceed hundreds of metres for deeper water depths. The use of shallow flows in the testing apparatus appears to be an attempt to induce normal flow over a short distance. The error induced by flow regimes other than normal flow is likely to be within the current measurement error for water depth.

Rainwater, i.e. with low salinity, is used for the testing procedure to ensure the water chemistry does not influence the soil detachability (Landloch 2023b). This is a positive feature of this study as it will more nearly mimic field conditions. Higher salinity water, i.e. bore water, may reduce the susceptibility to slaking and dispersion and lead to erroneous results. Use of rainwater means that the adopted methodology is repeatable and will yield lower erosive threshold velocities than if other water sources were used.

¹ Although beyond the scope of this review, in the Landloch (2024c) Correlation Report, the correlation coefficient r between τ_{auc} and soil water content for 19 soils was -0.27 (P value = 0.26, N.S.).

Synthesis of Reviews on Methods for Determining Erosion Threshold Velocity

William Elliot, PhD

21 January 2025

The approach to measure and control flowrates is sound and should lead to accurate results. The inline turbine meters are of acceptable quality and installed correctly. The use of two separate meters and the associated pipework permits accuracy at both low and high flows.

The greatest concern with the testing procedure is in regard to the accuracy and repeatability of the flow depth and width as water flows over the soil surface. The depth is measured manually with a steel rule by an experienced operator, while attempting to contact the saturated soil surface underwater in the turbulent water flow in which significant distortion in the fluid surface exists. The shallow depths being measured, and the quick measurement process required, undermines the accuracy of water depth data. The accuracy of the velocity is directly related to the accuracy of this measured water depth. Water depth has an inverse relationship with the slope of the soil surface in the testing apparatus, hence potential errors in water depth will be greater at higher grades. Whilst not clearly stated in the current testing procedure from Landloch (2023b) each sample is tested first at low slopes and only progresses to steeper grades if the threshold of erosion is not met. Although not explicitly stated this method inherently utilises greater water depths where possible, thus minimising the impact of shallow water induced measurement error. The impact of potential errors in water depth are also reduced by measuring the depth at a minimum of six locations and taking an average to produce the final depth.

Operators using steel rulers will face some difficulty in correctly positioning the base of the ruler at the wet soil surface and may inadvertently push the ruler into the soil altering the water depth measurement. LandLoch have already identified this problem and are now using a small foot at the base of the ruler to assist the operator in correctly identifying the soil surface.

Similarly, the flow width is captured quickly by measuring the top width by hand with a steel ruler. Calculations for flow velocity would require average width, while the use of top width would tend to skew results, particularly as the flow width becomes narrower. There is also some concern here with the highly subjective selection of measurement positions, and implications on repeatability. This has been partly addressed by using the same experienced and competent operator for each test. The potential errors caused by difficulty in measuring flow width are also minimised by commencing tests using shallower slopes as this would tend to increase the width of flow and reduce error.

Despite these concerns with measuring flow width and water depth, the method adopted is likely the only practical and feasible manner to capture this information in the rapid timeframe required in this testing. Similar measurement methods have been employed in U.S. erosion studies in forests (Robichaud et al., 2010) and rangelands (Pierson et al., 2009). Gillies and Foley are not aware of alternative means to capture these data that would be appropriate for this type of testing. Elliot et al. (1997) measured widths of rills for a range of flow rates on high resolution photographs projected on a screen taken from an overhead camera, but did not directly measure flow depths in that study.

Synthesis of Reviews on Methods for Determining Erosion Threshold Velocity

William Elliot, PhD

21 January 2025

The sediment samples at the end of the flume were collected by taking several short grab samples. Instead, it would be advised to capture the entire width of flow over a single standardised time period, possibly employing a sampling mechanism downstream of the flume. This suggestion may be impractical at higher discharges than our observations during our visit. It is noted that these sediment samples are merely used to detect the threshold of entrainment and thus the quantity of sediment captured is not important.

The authors should note when and where the soil strength measurements will be made. Will they be measured on field sites when collecting samples, in the tray before runoff simulation, in the tray sometime after the runoff simulation, or on sample collected at the same time and from the same place as the trays.

The direct cone penetrometer test may not be useful for this study. The standard that was cited describes the method as requiring a soil depth of 450 mm. If this study is going to use a variation of this test, like less cone penetration, the modified method should be described. If this test is found to be useful for estimating ETV then others will be able to apply the same test.

The size of the foot on the pocket penetrometer should be noted. Typically, this tool is equipped with the shaft of the penetrometer for use on compacted soils 6.4 mm diameter and attaching a 25 mm diameter foot for less compacted soils. In the USDA WEPP cropland field studies (Elliot et al., 1989), the researchers found it necessary to fabricate a 50 mm diameter foot to test the strength of the weak saturated soils following their rainfall/runoff erosion studies. The timing of this test, and whether done in the field or the lab should be reported.

One additional property the authors may wish to consider is the slope of the site where the soil sample was collected. Elliot and Flanagan (2023) reported a correlation coefficient (r) of 0.6 between critical shear and slope of the research site for 36 cropland soils in the U.S., greater than any other property in their study.

No mention is made of the statistical analyses that will be carried out to relate soil properties to ETV. This will likely be covered in reports presenting the results of the study. I assume that the authors will do correlation analyses for all properties, and then some sort of stepwise regression to develop predictive equations.

On page 15, the report states that the initial gradient is 1% in step 5, but in step 8 it states that the gradients considered are 10—30%. I suggest the authors state the purpose of the 1% run. Is it to measure a potential low critical shear, or to prewet the sample before starting the test at 5%; or should step 8 state that gradients ranged from 1—30%?

On the bottom of page 15, the document suggests that a graph may be used to show the relationship between ETV and slope gradient. Once the testing is complete and there is a sufficiently large data set, it might be useful to develop a multiple regression equation to

Synthesis of Reviews on Methods for Determining Erosion Threshold Velocity

William Elliot, PhD

21 January 2025

estimate ETV from ETV for a standard slope, channel roughness, slope steepness and maybe even channel shape (flat, parabolic or rectangular) and vegetation. Such information would a great improvement on current information on ETV and how it varies with channel gradient (<https://www.agric.wa.gov.au/water-management/suggested-maximum-velocities-surface-water-flow>).

Several references are listed that are not cited in the text. The authors may wish to delete those references. Although not cited, they are good references for this study. Retaining or deleting those references is left to the authors' discretion.

This review has the following suggestions on possible improvements to the testing procedure:

- Objectivity (less subjectivity) determine locations for measuring channel widths and depths, both along the length of the sample, and across the width of soil sample.
- Strengthen the existing focus on capturing measurements at lower surface slopes to reduce possible errors in water depth.
- Further investigation on the sensitivity of ETV results to antecedent moisture content of the sample.
- Add further details in the Methods report describing the sampling tray design if this is not covered in other reports.
- Provide more detail about the soil strength measurement methods and proposed statistical analyses.

These are recommendations only and are not required for our favourable views on the adequacy of the current method to assess the ETV currently employed by Landloch.

In conclusion, the testing methodology used by Landloch to establish the erosion threshold velocities for soils along the Inland Rail Corridor is generally sound and robust. The methodology is scientifically defensible for determining critical shears and erosion threshold velocities. The approach tends to err towards the worst-case scenario for erosion, i.e. bare soil, water with low salinity, and relatively rapid increases in water velocity over unsaturated samples. We have confidence in the ability of Landloch to conduct this testing in a robust and repeatable manner and to respond to the challenges posed by this task over the Inland Rail corridor.

Editorial Suggestions

Cover page, update the date to the latest revision.

Page 1, first line under scope change "method" to "document"

Page 2, line 2 change "*b* is" to "*b* are"

Footnote on the bottom is too long for the footer and was carried over to the bottom of page 3.

Consider increasing the size of the footer or moving this footnote into the main text.

Page 3, second paragraph below equation 5, line 5, change "modified" to "increased"

Page 4, 8 lines from the bottom, change "flumes" to "flume gradients"

Synthesis of Reviews on Methods for Determining Erosion Threshold Velocity

William Elliot, PhD

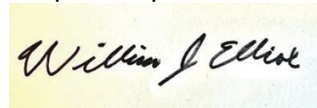
21 January 2025

Page 17, line before “11 INTERPRETING RESULTS”, suggest changing “equation 3” to “equations 3 and 8”

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Respectfully Submitted



William J. Elliot, PhD



Dr Malcolm Gillies PhD
Senior Lecturer
Centre for Agricultural Engineering
Em: Malcolm.Gillies@unisq.edu.au
Ph: 0746311715
25th November, 2024

To whom this may concern,

The purpose of this letter is to provide a brief technical review of the testing methodology for threshold erosion velocities developed by and undertaken by LandLoch. This testing is being conducted to determine erosion risk and inform engineering designs along the Inland Rail corridor. The review was informed by one visit to the LandLoch Site by Dr Malcolm Gillies and A/Prof. Joseph Foley to view the hydraulic testing of two soil samples. We were also provided two reports: "Methods for Testing Erosion Threshold Velocity (ETV) Method 2 – Direct Laboratory-Based ETV Testing" (LandLoch 2023) and the "Erosion Threshold Velocities Report, Illabo to Stockinbingal Inland Rail Project" (LandLoch 2024). The scope of this review is limited to this testing procedure only and does not consider the wider use of this information in any design or planning by ARTC.

The Centre for Engineering in Agriculture (CAE) at the University of Southern Queensland (UniSQ) were invited to conduct this review by Inland Rail/ARTC. We would prefer if UniSQ was contracted by Inland Rail/ARTC or Bill Elliot rather than through LandLoch in order to remove any perceived impropriety and/or conflict of interest between CAE and LandLoch. Moving forward we are comfortable acting as the local reviewer for the US based discipline expert, Dr Bill Elliott.

The Inland Rail corridor spans a large geographical area and therefore also encompasses a wide range of challenges due to varied hydrological factors and soil conditions. ARTC/Inland Rail are to be applauded for any attempts to improve upon design and subsequent crossing infrastructure expenditure costs with actual measurements of erosion threshold velocities.

The method of on-site soil sampling described to us, and the soil sampling apparatus is robust, and its novelty is to be applauded. It is a technically sound process that will capture representative large samples of the soil surface conditions from many sites; except for very stony soils and soils immediately following tillage. These two particular exceptions are well understood by the Landloch team, and they have verbally indicated that they carefully locate the sample or choose new sample sites when such conditions are encountered. As mentioned in LandLoch (2023) the size of the soil sample is larger than other laboratory testing apparatus in any published literature. This permits the testing procedure to more accurately account for the ground surface conditions present on site including microtopography, plant roots and surface roughness.

We are generally impressed by the testing apparatus in which the soil sample is placed and are comfortable with the efforts to address the transition between the metal flume and the soil surface. Water is applied to the top end of the sample via a wide stilling well and passes over a region surfaced with sandpaper with a similar surface roughness to bare soil, ensuring that the flow transition is as smooth as possible. The edges of the soil sample, including the upstream transition are sealed with

bentonite which appears to function as designed. Care should be taken to ensure that the soil surface is at a consistent height with respect to the entry manifold.

One concern we have with the preparation of the samples is the variance in antecedent moisture content. For cohesive sediments, i.e. clay and loam soils, the structural strength and therefore susceptibility to erosion is potentially influenced by the moisture content. The sampling procedure includes a measurement of moisture content in the field prior to extracting the sample and again at the completion of the flowing water tests in the lab. The procedure also attempts to preserve the moisture content between the time of field sampling and beginning of laboratory testing. While this process is sound the concern is that there will be a range of possible moisture levels in the samples at the time of laboratory testing. This concern may be addressed by either conducting a sensitivity analysis of ETV results to antecedent moisture content and/or using a standardised moisture content for testing. Evan Howard indicated that LandLoch have already investigated the impact of wetting the surface prior to the testing procedure and that this has relatively small impact on the ETV. Formally documenting this investigation should improve our trust in this method.

The testing method is based on established theory to determine shear stress from water depth and bed slope. This theory requires a normal flow regime, a condition that normally occurs after a sufficient distance of flow in open channel of uniform cross section. The distance to establish normal flow may exceed hundreds of metres for deeper water depths. The use of shallow flows in the testing apparatus appears to be an attempt to induce normal flow over a short distance. The error induced by flow regimes other than normal flow is likely to be within the current measurement error for water depth.

Rainwater, i.e. with low salinity, is used for the testing procedure to ensure the water chemistry does not influence the soil detachability (LandLoch 2023). Higher salinity water, i.e. bore water, may reduce the susceptibility to slaking and dispersion and lead to erroneous results. Use of rainwater means that the adopted methodology is repeatable and will yield lower erosive threshold velocities than if other water sources were used.

The approach to measure and control flowrates is sound and should lead to accurate results. The inline turbine meters are of acceptable quality and installed correctly. The use of two separate meters and the associated pipework permits accuracy at both low and high flows.

The greatest concern with the testing procedure is in regard to the accuracy and repeatability of the flow depth and width as water flows over the soil surface. The depth is measured manually with a steel rule by an experienced operator, while attempting to contact the saturated soil surface underwater in the turbulent water flow in which significant distortion in the fluid surface exists. The shallow depths being measured, and the quick measurement process required, undermines the accuracy of water depth data. The accuracy of the velocity is directly related to the accuracy of this measured water depth. Water depth has an inverse relationship with the slope of the soil surface in the testing apparatus, hence potential errors in water depth will be greater at higher grades. Whilst not clearly stated in the current testing procedure from LandLoch each sample is tested first at low slopes and only progresses to steeper grades if the threshold of erosion is not met. Although not explicitly stated this method inherently utilises greater water depths where possible, thus minimising the impact of shallow water induced measurement error. The impact of potential errors in water depth are also reduced by measuring the depth at a minimum of six locations, and taking an average to produce the final depth.

Operators using steel rulers will face some difficulty in correctly positioning the base of the ruler at the wet soil surface and may inadvertently push the ruler into the soil altering the water depth

measurement. LandLoch have already identified this problem and are now using a small foot at the base of the ruler to assist the operator in correctly identifying the soil surface.

Similarly, the flow width is captured quickly by measuring the top width by hand with a steel ruler. Calculations for flow velocity would require average width, while the use of top width would tend to skew results, particularly as the flow width becomes narrower. There is also some concern here with the highly subjective selection of measurement positions, and implications on repeatability. This has been partly addressed by using the same experienced and competent operator for each test. The potential errors caused by difficulty in measuring flow width are also minimised by commencing tests using shallower slopes as this would tend to increase the width of flow and reduce error.

Despite these concerns with measuring flow width and water depth, the method adopted is likely the only practical and feasible manner to capture this information in the rapid timeframe required in this testing. We are not aware of alternative means to capture this data that would be appropriate for this type of testing.

The sediment samples at the end of the flume were collected by taking several short grab samples. Instead it would be advised to capture the entire width of flow over a single standardised time period, possibly employing a sampling mechanism downstream of the flume. This suggestion may be impractical at higher discharges than our observations during our visit. It is noted that these sediment samples are merely used to detect the threshold of entrainment and thus the quantity of sediment captured is not important.

This review has the following suggestions on possible improvements to the testing procedure:

- Objectivity (less subjectivity) of on-surface flow measurement position selections, both along the length of the sample, and across the width of soil sample.
- Strengthen the existing focus on capturing measurements at lower surface slopes to reduce possible errors in water depth.
- Further investigation on the sensitivity of ETV results to antecedent moisture content of the sample.

These are recommendations only and are not required for our favourable views on the adequacy of the current method to assess the ETV currently employed by LandLoch.

In conclusion, the testing methodology used by LandLoch to establish the erosion threshold velocities for soils along the Inland Rail Corridor is generally sound and robust. The approach tends to err towards the worst-case scenario for erosion, i.e. bare soil, water with low salinity, and relatively rapid increases in water velocity over unsaturated samples. We have confidence in the ability of LandLoch to conduct this testing in a robust and repeatable manner and to respond to the challenges posed by this task over the Inland Rail corridor.

Sincerely,

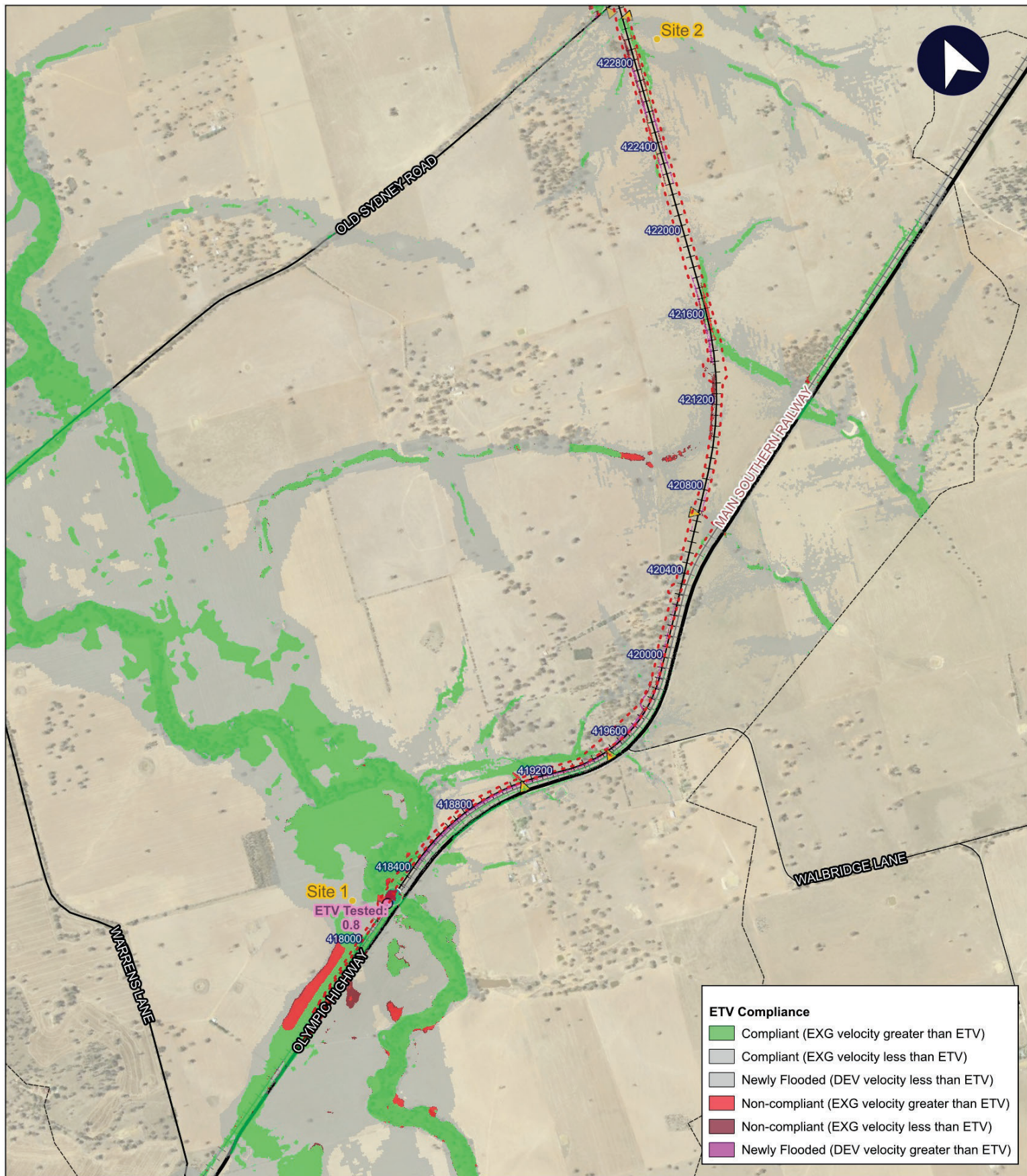


Malcolm Gillies

Dr Malcolm Gillies BEng(Agr) PhD
Senior Lecturer (Water Engineering)
Centre for Agricultural Engineering & School of Agriculture and Environmental Science
University of Southern Queensland



Appendix G – Flood Mapping



ETV Compliance	
■	Compliant (EXG velocity greater than ETV)
■	Compliant (EXG velocity less than ETV)
■	Newly Flooded (DEV velocity less than ETV)
■	Non-compliant (EXG velocity greater than ETV)
■	Non-compliant (EXG velocity less than ETV)
■	Newly Flooded (DEV velocity greater than ETV)

0 250 500 m

Figure: 1.1 - 1% AEP Design Velocity Above QDL

DATUM GDA2020 / MGA
zone 55

Date: 23/05/2025

Drawn: NB

Reviewed: KJ

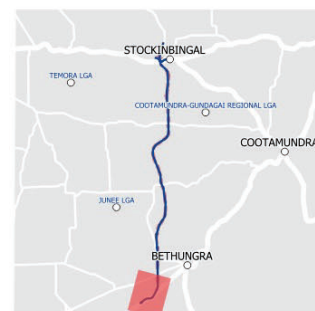
Approved: IV

Project: Illabo to

Stockinbingal

Client: John Holland

- Permanent Acquisition Boundary
- Overbridge
- Underbridge
- Burley Griffin Way Realignment
- + + + Railway
- + + + New Track
- Local Roads
- Sub-arterial Roads
- Arterial Roads
- ➡ Culverts
- ETV Locations
- Mapped Extent



Map 1 of 9

**BG
&E**

Disclaimer: This map is current at the time of publication and has been prepared, in part, from unverified data and information (Data) supplied by other parties. Whilst BG&E takes due care in providing its services, BG&E accepts no liability for any loss or damage suffered which is caused by any inaccuracy in the design or drawing which has resulted from the use of any unverified, inaccurate or misleading Data supplied by other parties.

Aerial Imagery Source: Sixmaps

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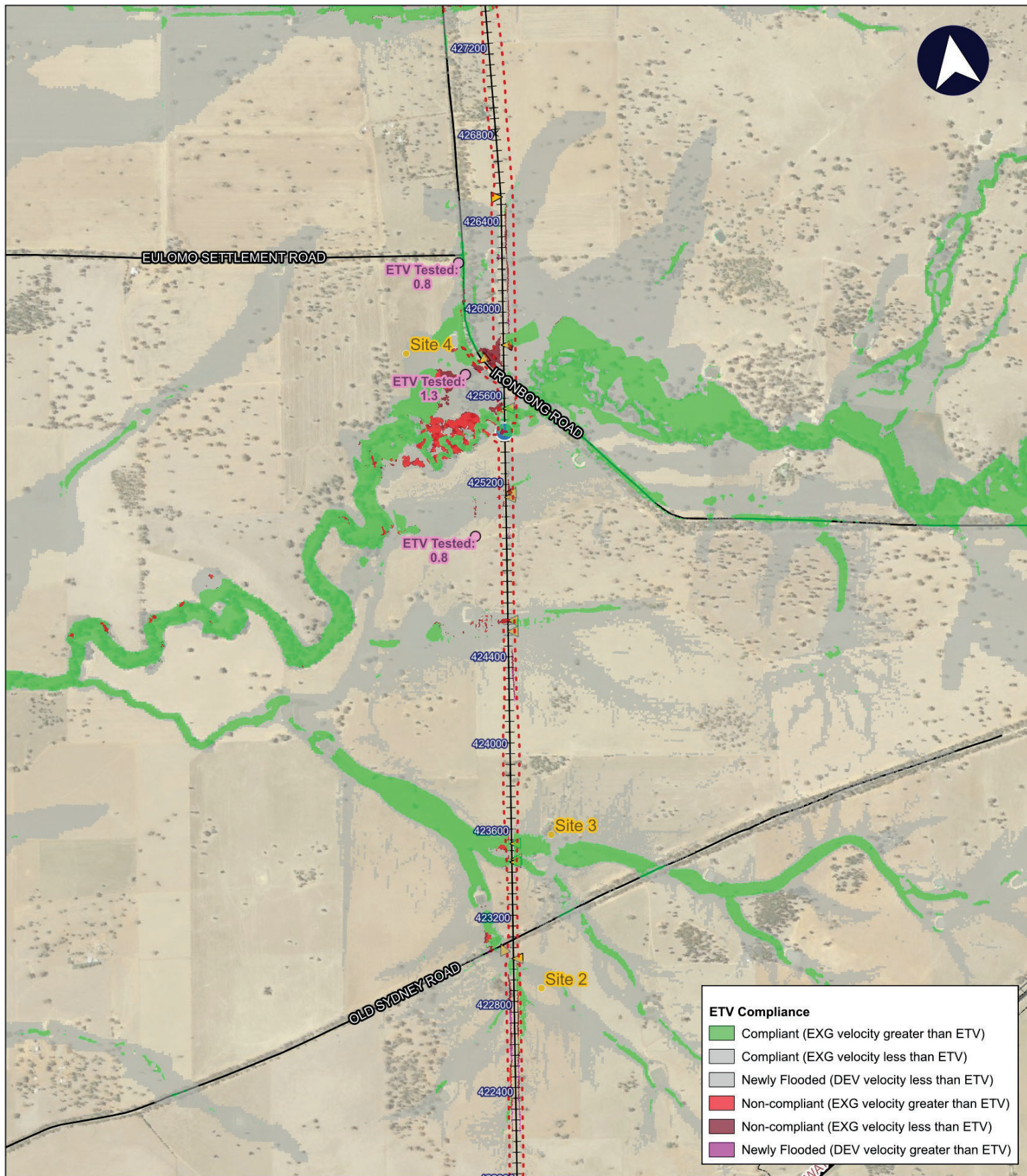


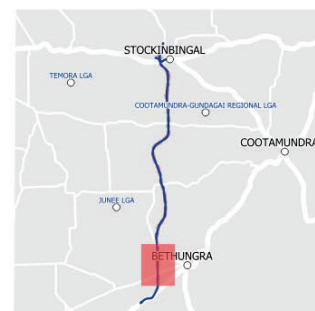
Figure: 1.2 - 1% AEP Design Velocity Above QDL

- Permanent Acquisition Boundary
- Overbridge
- Underbridge
- Burley Griffin Way Realignment
- +++ Railway
- +++ New Track
- Local Roads
- Sub-arterial Roads
- Arterial Roads
- ➡ Culverts
- ETV Locations
- Mapped Extent

0 250 500 m

DATUM GDA2020 / MGA
zone 55

Date: 23/05/2025
Drawn: NB
Reviewed: KJ
Approved: IV
Project: Illabo to
Stockinbingal
Client: John Holland



Map 2 of 9

**BG
&E**

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Aerial Imagery Source: Sixmaps

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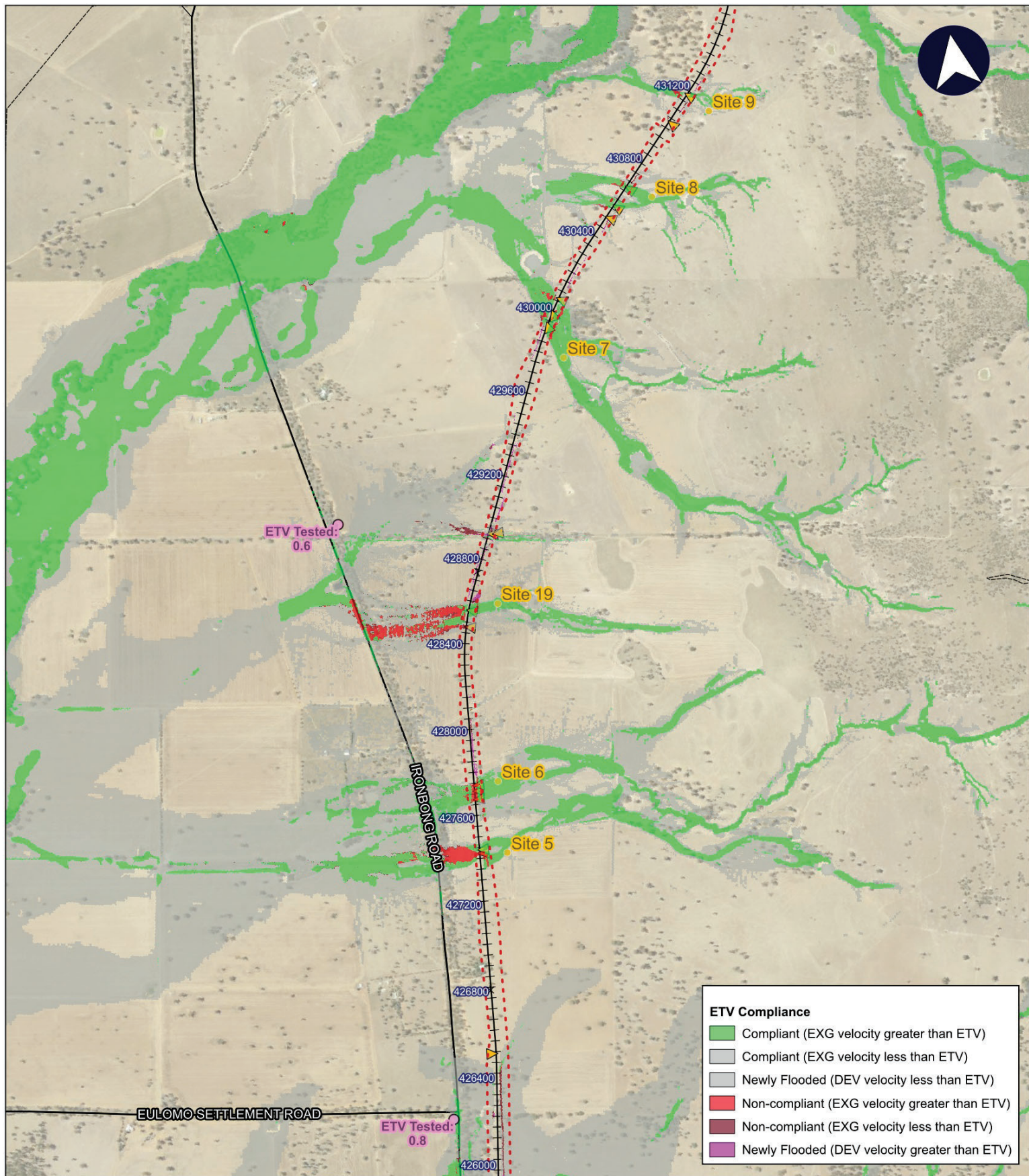
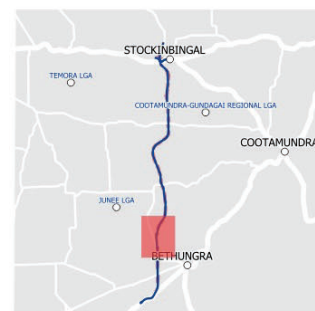


Figure: 1.3 - 1% AEP Design Velocity Above QDL

- Permanent Acquisition Boundary
- Overbridge
- Underbridge
- Burley Griffin Way Realignment
- Railway
- New Track
- Local Roads
- Sub-arterial Roads
- Arterial Roads
- Culverts
- ETV Locations
- Mapped Extent



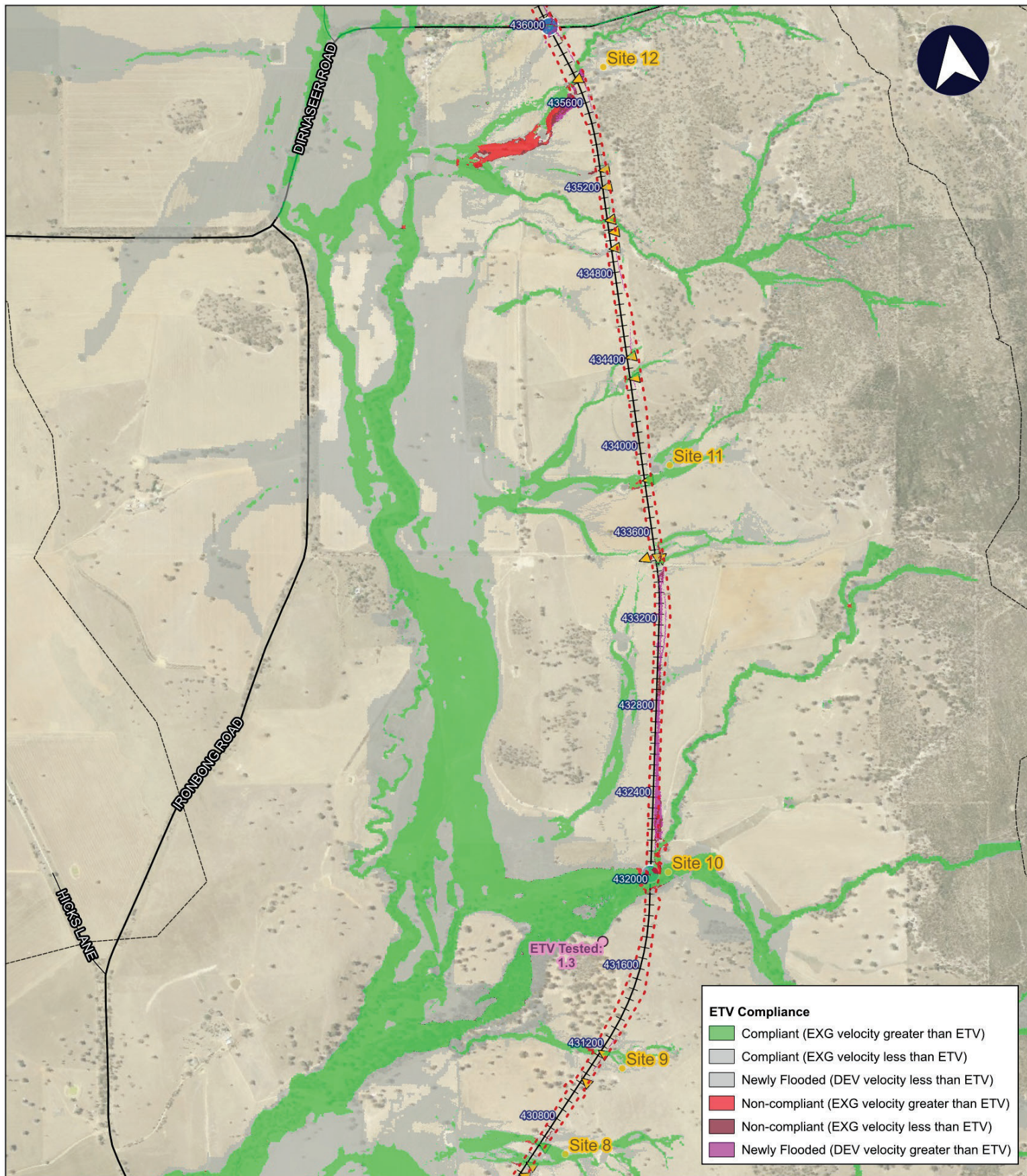
Map 3 of 9

**BG
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Aerial Imagery Source: Sixmaps

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ETV Compliance	
■	Compliant (EXG velocity greater than ETV)
■	Compliant (EXG velocity less than ETV)
■	Newly Flooded (DEV velocity less than ETV)
■	Non-compliant (EXG velocity greater than ETV)
■	Non-compliant (EXG velocity less than ETV)
■	Newly Flooded (DEV velocity greater than ETV)

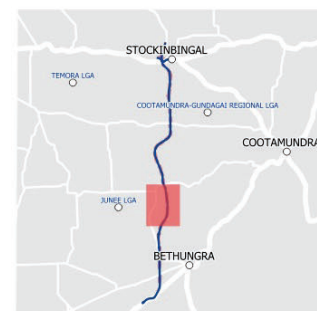
Figure: 1.4 - 1% AEP Design Velocity Above QDL

- | | |
|------------------------------------|----------------------|
| --- Permanent Acquisition Boundary | — Local Roads |
| ● Overbridge | — Sub-arterial Roads |
| ● Underbridge | — Arterial Roads |
| — Burley Griffin Way Realignment | ➡ Culverts |
| +++ Railway | ● ETV Locations |
| +++ New Track | □ Mapped Extent |

0 250 500 m

DATUM GDA2020 / MGA
zone 55

Date: 23/05/2025
Drawn: NB
Reviewed: KJ
Approved: IV
Project: Illabo to
Stockinbingal
Client: John Holland



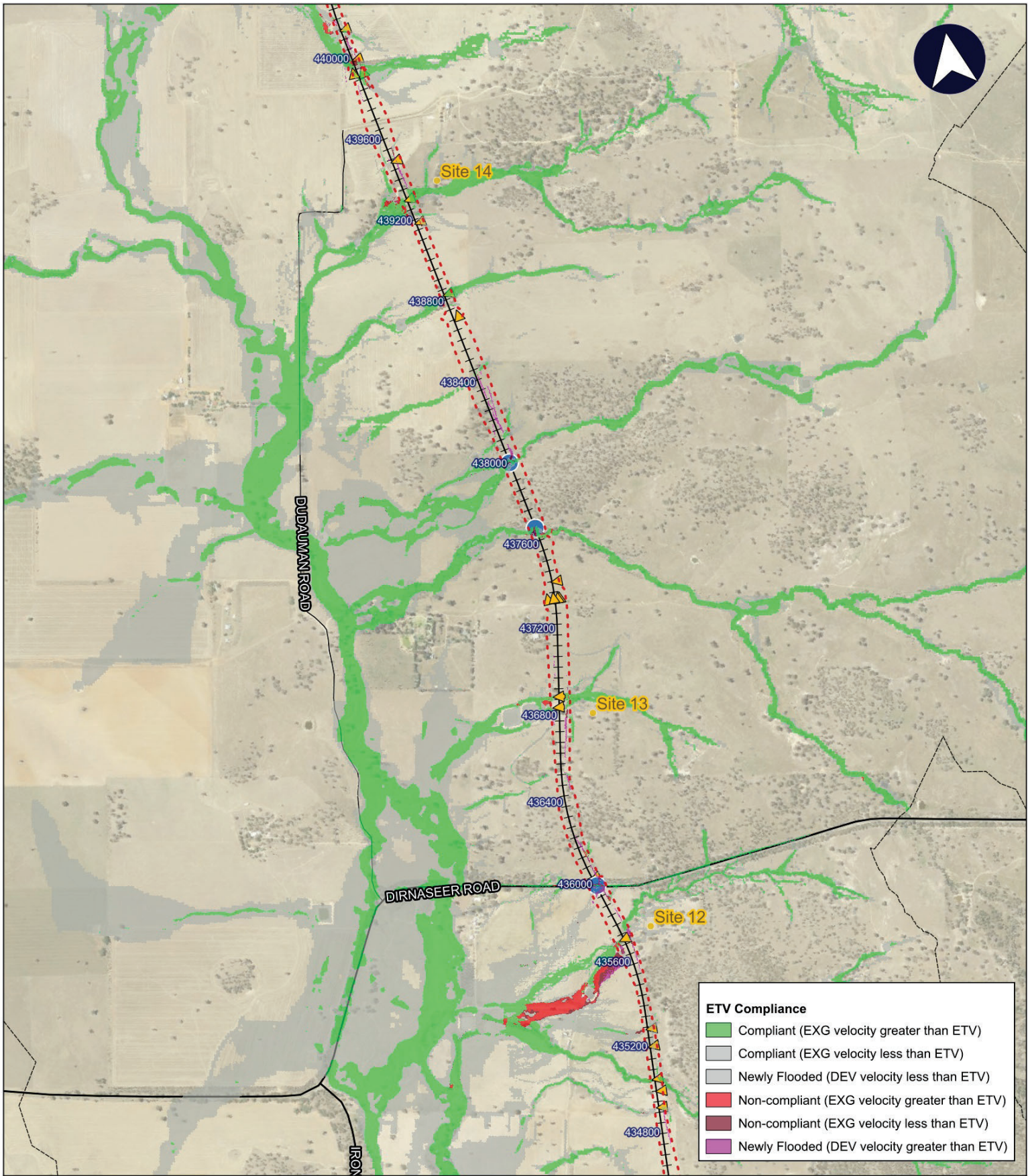
Map 4 of 9

**BG
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Aerial Imagery Source: Sixmaps

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0 250 500 m

DATUM GDA2020 / MGA
zone 55

Date: 23/05/2025
Drawn: NB
Reviewed: KJ
Approved: IV
Project: Illabo to
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Client: John Holland

Figure: 1.5 - 1% AEP Design Velocity Above QDL

- Permanent Acquisition Boundary
- Local Roads
- Sub-arterial Roads
- Arterial Roads
- Burley Griffin Way Realignment
- Railway
- New Track
- Overbridge
- Underbridge
- Culverts
- ETV Locations
- Mapped Extent

- ETV Compliance**
- Compliant (EXG velocity greater than ETV)
 - Compliant (EXG velocity less than ETV)
 - Newly Flooded (DEV velocity less than ETV)
 - Non-compliant (EXG velocity greater than ETV)
 - Non-compliant (EXG velocity less than ETV)
 - Newly Flooded (DEV velocity greater than ETV)



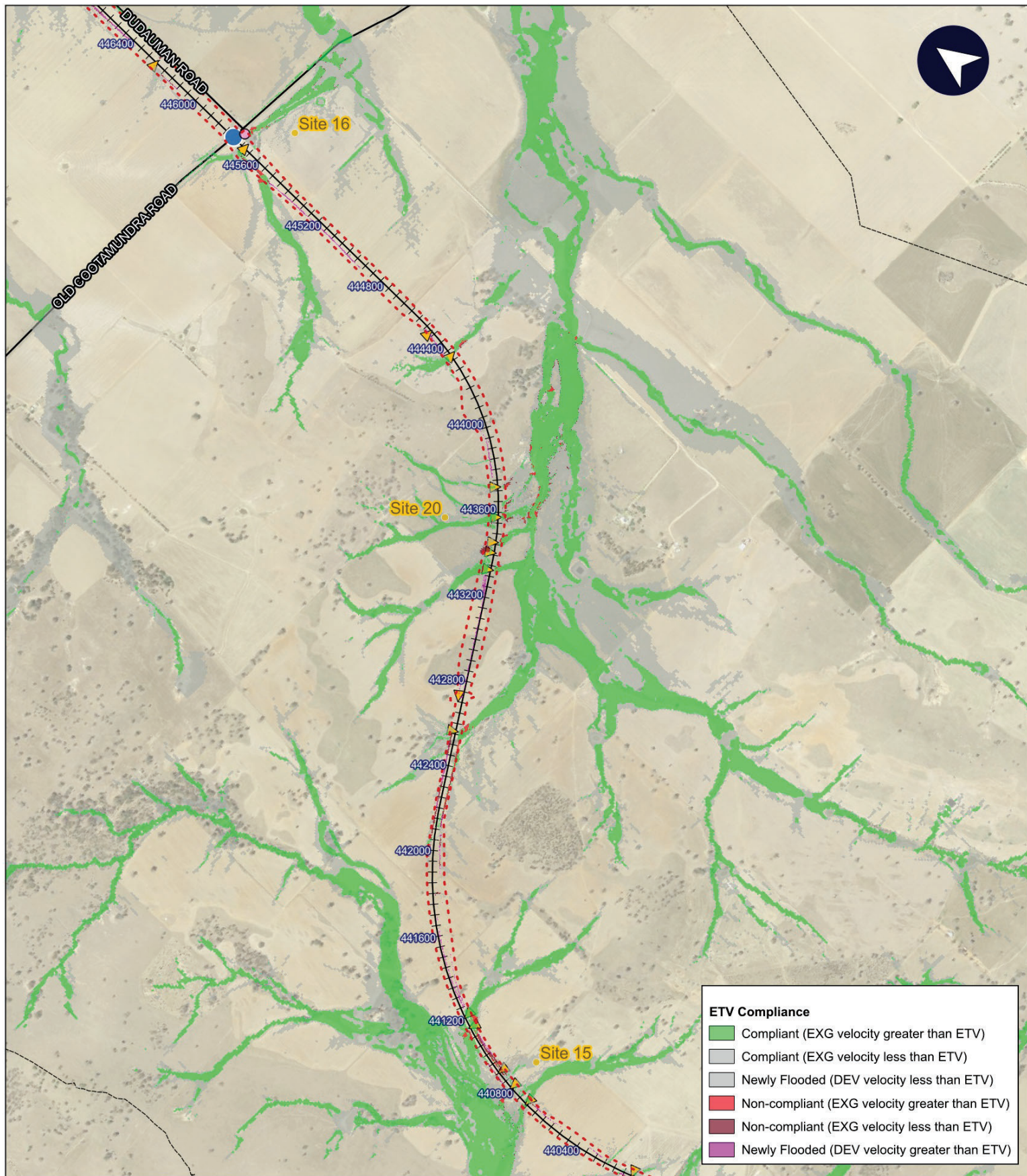
Map 5 of 9

**BG
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Aerial Imagery Source: Sixmaps

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ETV Compliance	
■	Compliant (EXG velocity greater than ETV)
■	Compliant (EXG velocity less than ETV)
■	Newly Flooded (DEV velocity less than ETV)
■	Non-compliant (EXG velocity greater than ETV)
■	Non-compliant (EXG velocity less than ETV)
■	Newly Flooded (DEV velocity greater than ETV)

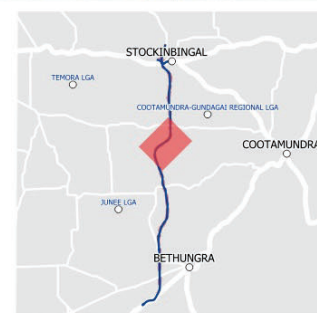
0 250 500 m

Figure: 1.6 - 1% AEP Design Velocity Above QDL

- Permanent Acquisition Boundary
- Overbridge
- Underbridge
- Burley Griffin Way Realignment
- + Railway
- + New Track
- Local Roads
- Sub-arterial Roads
- Arterial Roads
- ➡ Culverts
- ETV Locations
- Mapped Extent

DATUM GDA2020 / MGA
zone 55

Date: 23/05/2025
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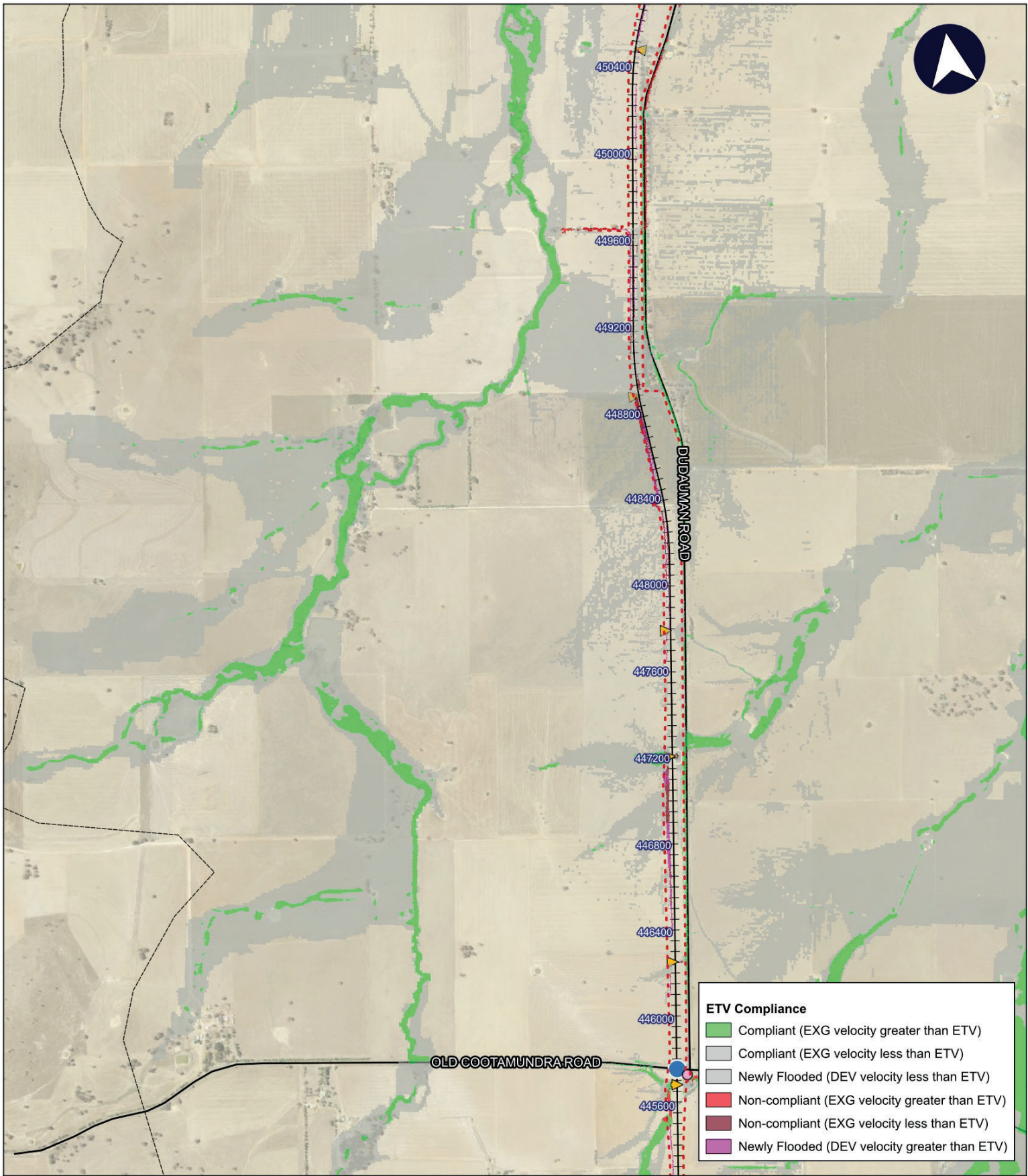
Map 6 of 9

**BG
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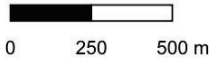
Aerial Imagery Source: Sixmaps

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ETV Compliance

- Compliant (EXG velocity greater than ETV)
- Compliant (EXG velocity less than ETV)
- Newly Flooded (DEV velocity less than ETV)
- Non-compliant (EXG velocity greater than ETV)
- Non-compliant (EXG velocity less than ETV)
- Newly Flooded (DEV velocity greater than ETV)



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zone 55
Date:23/05/2025
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Reviewed: KJ
Approved: IV
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Client: John Holland

Figure: 1.7 - 1% AEP Design Velocity Above QDL

- Permanent Acquisition Boundary
- Overbridge
- Underbridge
- Burley Griffin Way Realignment
- Railway
- New Track
- Local Roads
- Sub-arterial Roads
- Arterial Roads
- Culverts
- ETV Locations
- Mapped Extent



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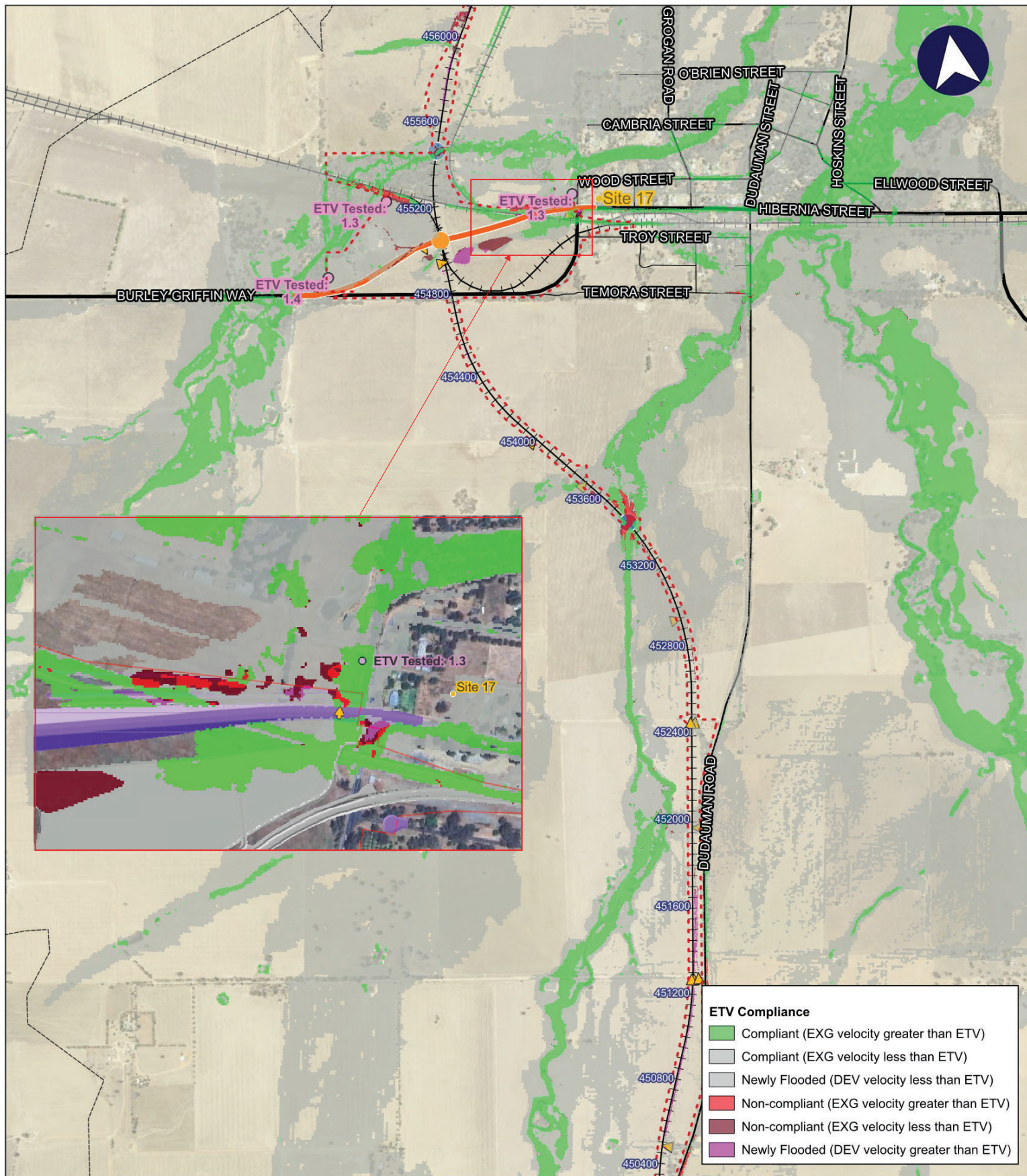


Figure: 1.8 - 1% AEP Design Velocity Above QDL

- Permanent Acquisition Boundary
- Overbridge
- Underbridge
- Burley Griffin Way Realignment
- +++ Railway
- +++ New Track
- Local Roads
- Sub-arterial Roads
- Arterial Roads
- ➡ Culverts
- ETV Locations
- Mapped Extent

ETV Compliance

- Compliant (EXG velocity greater than ETV)
- Compliant (EXG velocity less than ETV)
- Newly Flooded (DEV velocity less than ETV)
- Non-compliant (EXG velocity greater than ETV)
- Non-compliant (EXG velocity less than ETV)
- Newly Flooded (DEV velocity greater than ETV)

0 250 500 m

DATUM GDA2020 / MGA
zone 55

Date: 23/05/2025

Drawn: NB

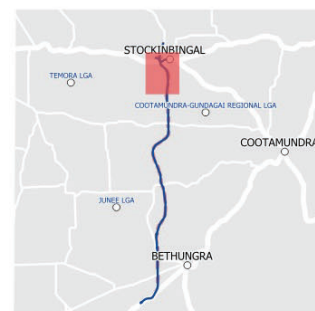
Reviewed: KJ

Approved: IV

Project: Illabo to

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Client: John Holland



Map 8 of 9

BG
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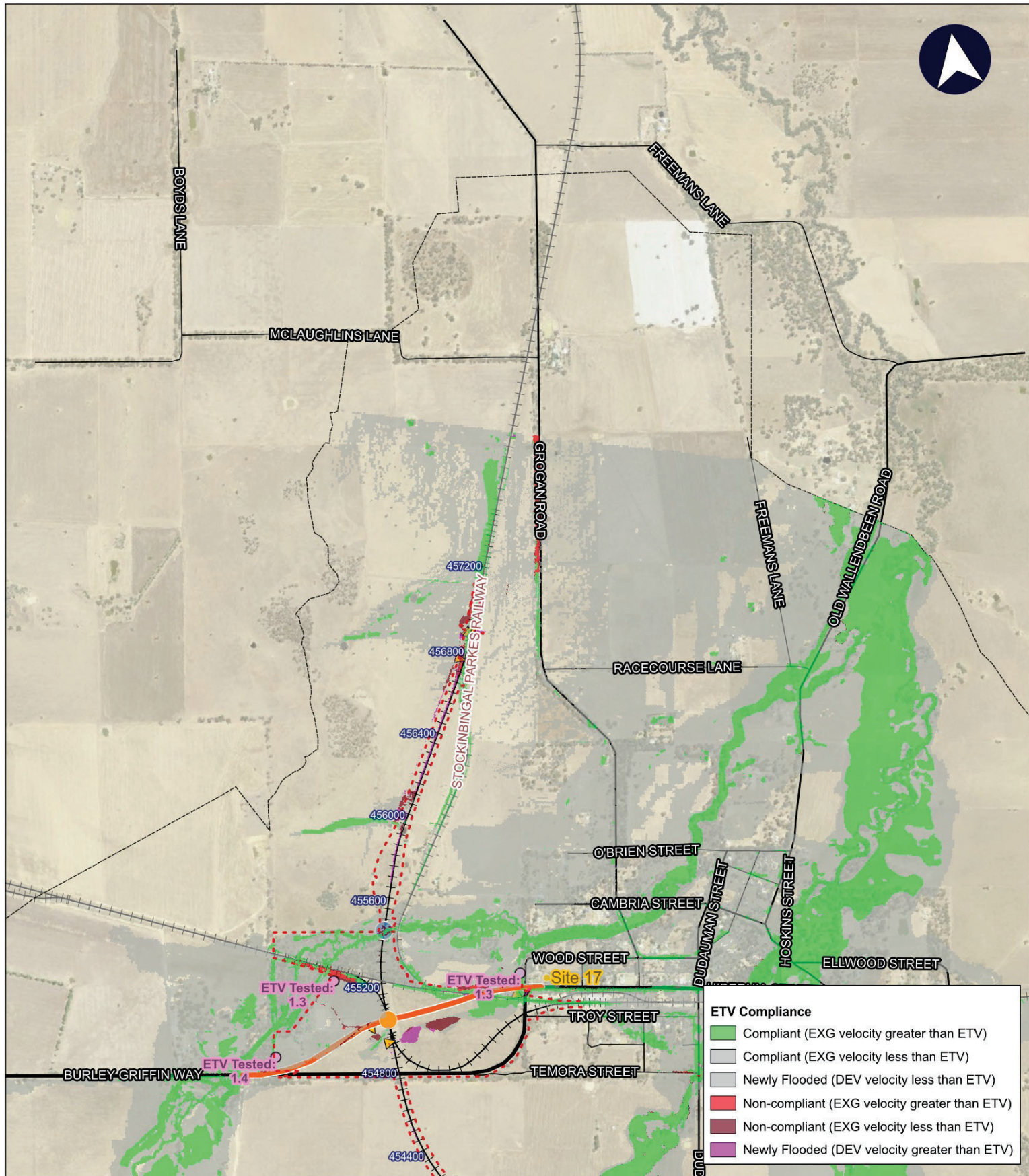


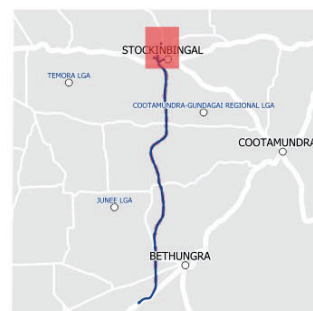
Figure: 1.9 - 1% AEP Design Velocity Above QDL

- Permanent Acquisition Boundary
- Local Roads
- Sub-arterial Roads
- Arterial Roads
- Burley Griffin Way Realignment
- Railway
- New Track
- Overbridge
- Underbridge
- Culverts
- ETV Locations
- Mapped Extent

0 250 500 m

DATUM GDA2020 / MGA
zone 55

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Map 9 of 9

BG
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Aerial Imagery Source: Sixmaps

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