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FLOOD DESIGN REPORT

A2I | Albury to Illabo

Package: A2I – Murray River Bridge

CONTRACT NUMBER: 0052

PROJECT DOCUMENT NUMBER:

5-0052-210-IHY-B1-RP-0001

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Revision History

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GLOSSARY

Specific terms and acronyms used throughout this plan and sub-plans are listed and described in Table 0-1 below.

Table 0-1: Definitions

Term	Definition
A2I	Albury to Illabo
A2P	Albury to Parkes Enhancement Project
AEP	Annual Exceedance Probability
ADC	Assumptions, Dependencies and Constraints
AHD	Australian Height Datum
ALCAM	Australian Level Crossing Assessment Model
ARF	Areal Reduction Factor
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
ARTC	Australian Railway Track Corporation
BoD	Basis of Design
BoM	Bureau of Meteorology
CIZ	Construction Impact Zone
CO	Construct Only
CRS	Coordination Reference System
CSSI	Critical State Significant Infrastructure
D&C	Design and Construct
DCN	Design Change Notice
DDR	Detailed Design Review
EMC	Electromagnetic compatibility
EDPM	Engineering, Design and Project Management
ECMP	Electromagnetic compatibility management plan
EIS	Environmental Impact Statement
FDR	Feasibility Design Review
FFA	Flood Frequency Analysis
FS	Finish-Start constraint type
FSL	Finished Surface Level
GDA	Geocentric Datum of Australia
GIR	Geotechnical Interpretative Report
HF	Human Factors
I2S	Illabo to Stockinbingal
IFC	Issued for Construction
IR	Inland Rail
ITC	Incentivised Target Cost
IV	Independent Verifier

Term	Definition
Km	Kilometres
LPA	Licensed Project Area
LiDAR	Light Detection and Ranging
MGA	Map Grid of Australia
MIRDA	Master Inland Rail Development Agreement
NCR	Non-Conformance Report
NLPA	Non-Licensed Project Area
NtP	Notice to Proceed
PDR	Preliminary Design Review
PMF	Probable Maximum Flood
PSR	Project Scope and Requirements
QDL	Quantitative Design Limits
RCP	Representative Concentration Pathways
REF	Review of Environmental Factors
RFI	Request for Information
S2P	Stockinbingal to Parkes
SAQP	Sampling, Analysis and Quality Plan
SDR	Systems Definition Review
SEMP	System Engineering Management Plan
TfNSW	Transport for New South Wales
TWL	Tail Water Level
UMM	Updated Mitigation Measures
V & V	Verification and Validation
WAD	Works Authorisation Deed
WAE	Work-as-Executed

1 A2P PROJECT INTRODUCTION

1.1 Albury to Parkes (A2P)

As part of the Inland Rail program of projects, the Australian Rail Track Corporation (ARTC) has appointed Martinus as the delivery contractor for the Albury to Parkes (A2P) project, which comprises the brownfield sections between Albury and Illabo (A2I) and Stockinbingal to Parkes (S2P). The greenfield portion between Illabo to Stockinbingal (I2S) is not a part of the A2P project scope.

1.2 Project Scope

The S2P section will be delivered under an REF and as such construction works associated with the two (2) Construct Only packages can commence at Contract Award. The Design and Construct for the other seven (7) projects sites will also commence at Contract Award.

The A2I section will be delivered under an EIS and requires a Notice to Proceed from ARTC before works can commence on site. Design for A2I will however commence at Contract Award. The project received State Planning approval on 8th Oct 2024, and Martinus received the Notice to Proceed from IRPL on 18 Oct 2024.

Within the A2I section there are twenty-one (21) Design and Construct (D&C) projects:

- Murray River bridge (Structure modifications)
- Albury Station Yard (Track slews, track reconfiguration and footbridge replacement)
- Riverina Highway bridge (Track lowering)
- Billy Hughes bridge (Track lowering)
- Tabletop Yard (Structure modification)
- Culcairn Station Yard (Track slews and bridge removal)
- Henty Yard (Track slews)
- Yerong Creek Yard (Track slews)
- The Rock Yard (Structure modification)
- Uranquinty Yard (Track slews)
- Pearson Street bridge (Track lowering)
- Cassidy Parade footbridge (Bridge replacement)
- Edmondson Street bridge (Bridge replacement)
- Wagga Wagga Station Yard (Track slews and Bridge replacement)
- Bomen Yard (Track slews)
- Harefield Yard (Track slews)
- Kemp Street footbridge and road bridge (Bridge replacement)
- Junee Station Yard (Track slews and bridge removal)
- Olympic Highway Underbridge (Track reconfiguration and Structure modification)
- Junee to I2S dual track section (Track slews)
- LX605 & LX1472 Activations

Within the S2P section, there are two (2) Construct only projects:

- Daroobalgie New Loop
- Wyndham Avenue (Track lowering)

and seven (7) Design and Construct (D&C) projects:

- Milvale Yard (Structure modification)
- Bribbaree Yard (Track slews)
- Quandialla Yard (Structure modification)
- Caragabal Yard (Track slews)
- Wirrinya Yard (Track slews)
- Lachlan River bridge (Structure modifications)
- Forbes Station (Track slews and awning modifications)

The D&C scope typically includes works associated with route clearance to accommodate the new F2M clearance envelope, necessary to accommodate the double-stacked freight container trains and this includes.

- Structure modifications
- Track reconfigurations
- Bridge replacements
- Track lowering
- Track slews and level crossing upgrades
- Bridge removal

1.3 Site Description

Murray River Bridge package forms part of the Albury to Illabo (A2I) section works. The existing structure requires modifications to enable passing clearances of the Inland Rail F2M rollingstock envelope trains.

This flood study conducts a flood assessment for the Murray River Bridge (refer to Figure 1-1 for site location) for both the existing and design conditions. The background and previous studies for each site are listed below.

Figure 1-1: Site Locations

Background

Murray River Bridge forms part of the Albury to Illabo Section works at Chainage (CH) 648466 to CH648566. The Murray River Bridge is located in South Albury and accessible through Townsend Street. The structure accommodates the Main Line and requires modification to the bridge superstructure to accommodate running of trains to the F2M KE+200 clearance envelope trains. No changes are proposed to the current horizontal or vertical track alignment.

1.4 Objectives

This report has been prepared to support the delivery of the Murray River bridge works and comply with the CSSI Condition of Approval and updated mitigation measures for quantitative flood modelling demonstrating compliance with pre- and post-development criteria. This report provides a flood impact assessment for the Issued for Construction (IFC). The flood assessment aims to estimate the flood behaviour within the study area and assess the potential flood impacts as a result of the design outside of the project boundary.

This report should be read in conjunction with the Detailed Design Report – Murray River Bridge (5-0052-210-PEN-B1-RP-0001)

1.5 Scopes

The scope of this study includes:

- Carrying out the flood assessment for the design in the IFC stage for the design events of 5%, 2%, 1%, 0.5% (Climate Change Scenario 1), 0.2% (Climate Change Scenario 2), and 0.05% (Bridge Assessment) Annual Exceedance Probability (AEP); and the Probable Maximum Flood (PMF).
- Checking flood assessment results against the criteria specified in Section 2, including flood impact and flood immunity.
- Proposing any mitigation measures (if required).

1.6 Previous Studies

Flood Studies

Table 1-1 summarises all the flood studies associated with the Murray River area.

Table 1-1: Summary of Previous Flood Studies

Item No.	Flood Study	Description
1	Albury City to Greater Hume Murray River Flood Study (GHD, 2012)	The flood study adopted Flood Frequency Analysis (FFA) based on ARR1987 to determine the Murray River constant inflow for the events of 50%, 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2% AEPs. The hydraulic model was calibrated and validated against historical events.
2	Albury Floodplain Risk Management Study and Plan (WMA Water, 2016)	This study adopted the same model as item 1. The only update is inclusion of a PMF inflow of 14,900 m^3/s in the model and used the model to inform the Albury flood behaviour.

Reference Design

The prior Reference Design, by Others, was documented within the below report:

- Albury to Illabo (A2I) and Stockinbingal to Parkes (S2P) Projects Reference Design Report – Albury (June 2022)

There is no scope for flooding in the Reference Design.

Environmental Impact Statement

The Environmental Impact Statement (EIS) was supported by the following report, compiled by Others:

- Albury to Illabo Environmental Impact Statement (EIS) Technical Paper 11 – Hydrology, flooding and water quality (July 2022)

This technical paper indicates that the Murray River is not subject to flooding (refer to Figure 1-2) because of the Hume Dam upstream of it.

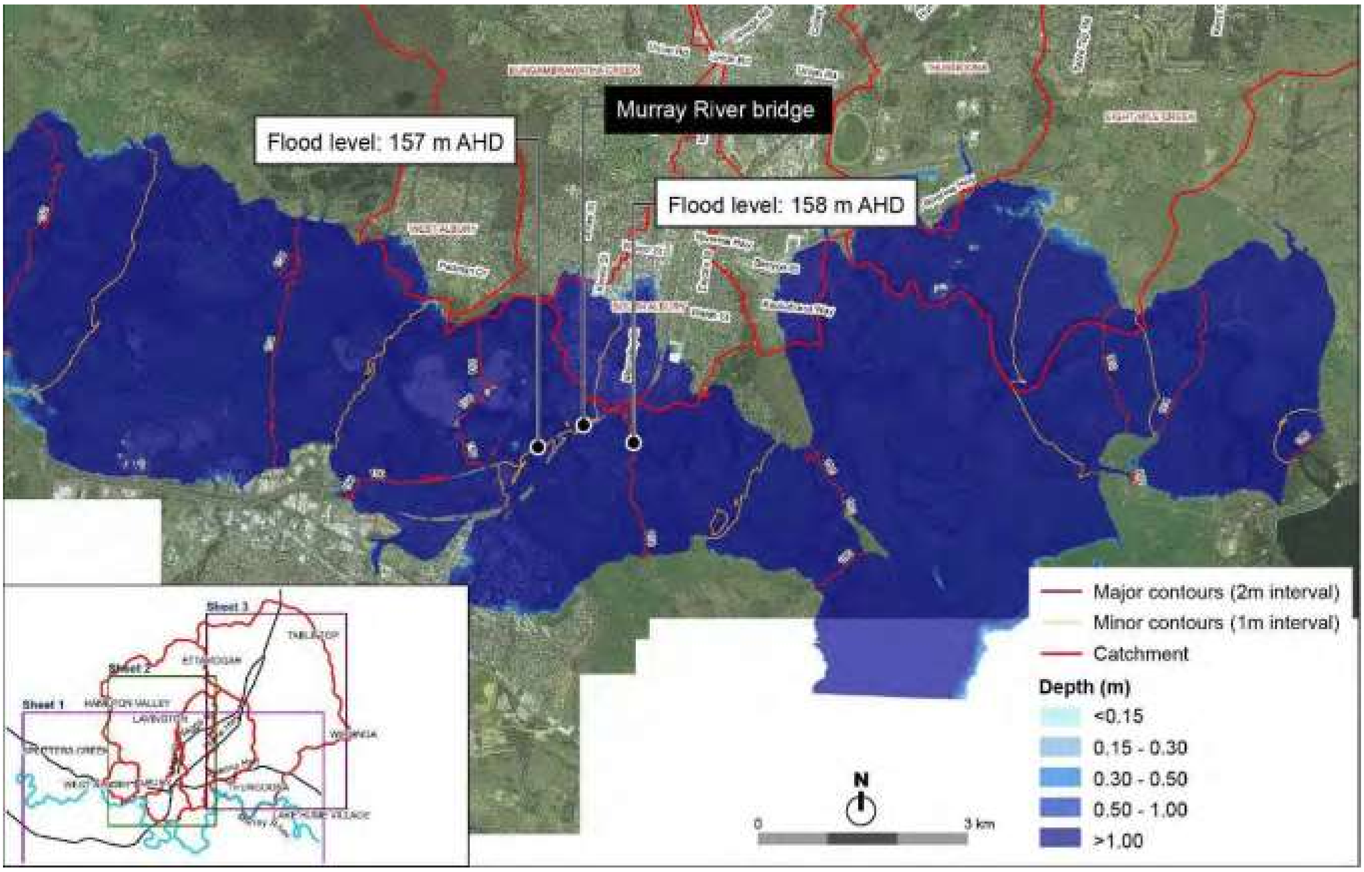


Figure 1-2: PMF Regional Flooding (Image source: Albury to Illabo EIS Technical Paper 11 Figure 4.37 (July 2022))

1.7 Purpose and Requirements

The primary purpose of this IFC flood assessment report is to describe how the design development and the associated review process will be managed.

The secondary purpose of this report is to provide evidentiary documentation of consultation and review by external stakeholders, and the independent suitably-qualified flood consultant, in demonstrating compliance with the CSSI conditions of approval. Refer Appendix B for ARTC review, Appendix C for external consultation review, and Appendix D for the independent flood consultant review.

1.8 Information Documents

The following documents have been provided 'For Information' and have been referenced/ reviewed as part of the design development:

- Albury Floodplain Risk Management Study and Plan (WMA Water, 2016).
- Albury to Illabo Environmental Impact Statement (EIS) Technical Paper 11 – Hydrology, flooding and water quality (WSP, July 2022), 2-0008-210-EAP-00-RP-0010

1.9 Inputs

The inputs to this flood assessment report include:

- Australian Standards and Guidelines: AS 7637 Railway Infrastructure – Hydrology and Hydraulics
- Australian Rainfall and Runoff: A Guide to Flood Estimation 2019
- Austroads Guide to Bridge Technology – Part 8: Hydraulic Design of Waterway Structures
- Inland Rail Climate Change Risk Assessment Framework

Input Data

Table 1-2 outlines the available information relevant to the site and used for flood modelling.

Table 1-2: Available Information

Item	Information	Type	Description / Comments
1	Flood model used in ALBURY Floodplain Risk Management Study and Plan (AFRMSP) (WMA Water, 2016)	TUFLOW model in GDA94 projection	Received on 29/08/2023
2	5-0052-210-PEN-B1-DR-9999_Combined_IFC	PDF	Structure model. Received from DJV structure team on 16/12/2024

1.10 Outputs

The list of flood maps and the flood maps are included in Appendix A.

1.11 Limitations and Assumptions

The following limitations and assumptions apply to the Murray River Bridge site.

- The bridge modelling parameters are retained in the same way as per the approved model received from Albury Floodplain Risk Management Study and Plan (WMA Water, 2016) (item 1 in Table 1-2) because the model is well-calibrated and validated.
- The site was not subjected to flooding as per the EIS (Technical Paper 11, Hydrology, Flooding and Water Quality, Albury to Illabo Environmental Impact Statement).
- An assessment of temporary works and staging has not been undertaken.
- According to Clause 5.4.2 and Clause 5.4.3 in Annexure B of PSR (Table 2-1), the highest flood event shall be the one stipulated by the ARTC Safety Management System (SMS). As per Section 10.1.3 of Track and Civil Code of Practise Section 10 Flooding, the 1% AEP shall be used. The flood impact would be assessed up to the 1% AEP for the project.
- Blockage assessment is carried out for the 1% AEP design scenario as per the guidance set out in ARR2019 for the culverts within the project boundary, while 20% blockage is adopted for all the other culverts, pits and pipes outside the project boundary.
- The hydrology approach and the flows used for hydraulic model are for the purpose of this assessment and should not be adopted for purpose beyond this report.
- The events of 0.5% AEP and 0.2% AEP are used to represent climate change (refer to Section 4.2.3.1 for details).

2 COMPLIANCE WITH REQUIREMENTS

2.1 Project Scope and Requirements

Assessment of the IFC stage, to determine if it meets the Project Scope and Requirements (PSRs), has been undertaken. This is demonstrated throughout the flood assessment with Table 2-1 below summarising the Murray River site's Design Compliance with the PSRs.

Table 2-1: Flooding Criteria within PSR Annexure B Technical Requirements

Requirement	Identifier	A2P Technical Requirements Description	Compliance Evidence Reference
Project Wide	5.4.10	Without limiting the environmental management requirements in Annexure F, section 6.1.1, all D&C Works in watercourses shall comply with the NSW Department of Primary Industries Standards: Policy and Guidelines for Fish Friendly Waterway Crossings; Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings; and Policy and Guidelines for Fish Habitat Conservation and Management Update.	N/A (structure modifications do not affect waterway flow)
Project Wide	5.4.2	Where existing flood immunity is lower than ARTC SMS minimum requirements, the functional requirements for flood immunity take precedence over the ARTC SMS.	The existing flood immunity is more than 1% AEP and the structure modifications is above 1% AEP level. .
Project Wide	5.4.3	Where existing flood immunity is higher than ARTC SMS minimum requirements, the ARTC SMS requirements for flood immunity take precedence over the functional requirements.	The existing flood immunity is more than 1% AEP and structure modifications have no impact on the existing flood immunity.
Project Wide	5.4.5	Bridge and culvert hydraulics shall comply with Austroads Guide to Bridge Technology Part 8: Hydraulic Design of Waterway Structures.	The above bridge structure modifications do not change existing flooding condition. Refer to Section 6.4
A2I Technical Requirements*	IR-SR-A2I-116	The System shall comply with 0-0000-900-ESS-00-ST-0001 Inland Rail Climate Change Risk Assessment Framework.	Climate change assessment was carried out by running the 0.5% AEP (Climate Change Scenario 1) and 0.2% AEP (Climate Change Scenario 2). Refer to Section 6.4.
A2I Technical Requirements*	IR-SR-A2I-349	The Corridor System for Enhancement Corridors shall have a flood immunity of no worse than existing.	The existing immunity is maintained under design conditions.
A2I Technical Requirements*	IR-SR-A2I-350	The Corridor System, where the existing track is lowered, shall maintain the existing flood immunity.	N/A (No track lowering for Murray River Bridge site.)
A2I Technical Requirements*	IR-SR-A2I-352	The Corridor System shall prevent damage of the formation due to ponding of water.	No damage to the formation due to ponding of water. Existing condition is maintained. Refer to Section 6.4.

Requirement	Identifier	A2P Technical Requirements Description	Compliance Evidence Reference
A2I Technical Requirements*	IR-SR-A2I-458	The Corridor System shall prevent ponding in longitudinal open channels.	N/A - There is no longitudinal open channels.
A2I Technical Requirements*	IR-SR-A2I-459	The Corridor System for Enhancement Corridors shall provide mitigation for flood impacts no worse than existing condition.	Existing condition is maintained. Refer to Section 6.4.
A2I Technical Requirements*	IR-SR-A2I-464	The Corridor System shall cause no adverse impacts either inside or outside the rail corridor when diverting water away from the track.	Existing condition is maintained. Refer to Section 6.4.
A2I Technical Requirements*	IR-SR-A2I-465	The Corridor System shall minimise changes to the existing or natural flow patterns.	Existing condition is maintained. Refer to Section 6.4.
A2I Technical Requirements*	IR-SR-A2I-541	The Structures System new underbridges shall withstand the 0.05% annual exceedance probability design flood event.	N/A. There is no new underbridge structure change.
A2I Technical Requirements*	IR-SR-A2I-735	The Third-Party System private roads shall have flood immunity no worse than existing.	No third-party private roads are impacted.
A2I (Annexure F)	6.1.1	Without limiting clauses 8 and 14 of the Deed, the Contractor shall ensure that the Contractor's Activities and the Works comply with the following for A2I, the Conditions of Approval and the environmental assessment reports available on https://www.planningportal.nsw.gov.au/major-projects/projects/inland-rail-albury-illabo"	Refer to Table 2-2

*A2I Technical requirements are used in A2P as A2P forms part of A2I.

2.2 Conditions of Approval – Flooding

The Conditions of Approval (CoA) have been provided under cover of IR2140-TRANSMIT-002001. The detailed design has been assessed to check if it meets the CoA and the compliance is presented in Table 2-2 below.

Table 2-2: Conditions of Approval Compliance Table – Flooding

Condition	Condition or Criteria	Compliance Evidence Reference
E38	All practicable measures must be implemented to ensure the design, construction and operation of the CSSI will not adversely affect flood behaviour, or adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.	Compliant. Refer to Section 6
E39	The CSSI must be designed with the objective to meet or improve upon the flood performance identified in the documents listed in **Condition A1**. Variation consistent with the requirements of this approval at the rail corridor is permitted to effect minor changes to the design with the intent of improving the flood performance of the CSSI.	Compliant. Refer to Section 6
E40	Updated flood modelling of the project's detailed design must be undertaken for the full range of flood events, including blockage of culverts and flowpaths, considered in	Compliant. The model was evaluated for 5%AEP, 2%AEP, 1%AEP, 0.5%AEP (Climate Change Scenario1), 0.2% (Climate Change

Condition	Condition or Criteria	Compliance Evidence Reference
	the documents listed in **Condition A1**. This modelling must include:	Scenario 2), and 0.05% (bridge Assessment) and PMF. Aside from those, the model is also evaluated for 1%AEP with blockage assessment. Refer to Sections 4 and 6.
E40	a) Hydrologic and hydraulic assessments consistent with *Australian Rainfall and Runoff – A Guide to Flood Estimation* (GeoScience Australia, 2019);	Compliant. Section 4 and Appendix B shows that ARR2019 guidelines were used for this assessment.
E40	b) Use of modelling software appropriate to the relevant modelling task;	Compliant. Section 4 shows that the appropriate software (TUFLOW) was used
E40	c) Field survey of the existing rail formation and rail levels, should be included within the models; and	Compliant. The existing rail level was used to inform the flood immunity. Refer to Section 6.
E40	d) Confirmation of predicted afflux at industrial properties adjacent to Railway Street, Wagga Wagga based on field survey.	N/A – Railway Street, Wagga Wagga is not within this package.
E40	Updated flood modelling must be made publicly available in accordance with **Condition B18**.	Flood design report and independent review of the flood design report shall be provided to IR, through this submission, for IR to upload on the IR website, as per CoA B18 responsibility allocation.
E41	The Proponent's response to the requirements of **Conditions E42** and **E44** must be reviewed and endorsed by a suitably qualified flood consultant, who is independent of the project's design and construction and approved in accordance with **Condition A16,** in consultation with directly affected landowners, DCCEEW Water Group, TfNSW, DPI Fisheries, BCS, NSW State Emergency Service (SES) and relevant Councils.	Independent review of the flood modelling, model and Flood Design Report is undertaken by the Proof Engineer's specialist contractor, who satisfies and complies with the requirements of A16. Consultation with Council will be undertaken through a formal review of this Flood Design Report. Consultation with other stakeholders will occur prior to finalisation of the report.
E42	The CSSI must be designed and constructed to limit impacts on flooding characteristics in areas outside the project boundary during any flood event up to and including the 1% AEP flood event, to the following:	See items below
E42	(a) a maximum increase in inundation time of one hour, or 10%, whichever is greater;	Compliant. Refer to Section 0
E42	(b) a maximum increase of 10 mm in above-floor inundation to habitable rooms where floor levels are currently exceeded;	Compliant. No flood level increase of 10 mm in above-floor inundation on any properties. Section 0
E42	(c) no above-floor inundation of habitable rooms which are currently not inundated;	Compliant. No increase for above floor inundation of habitable rooms on any properties. Section 0

Condition	Condition or Criteria	Compliance Evidence Reference
E42	(d) a maximum increase of 50 mm in inundation of land zoned as residential, industrial or commercial;	Compliant. No flood level increase of more than 50mm in residential, industrial and commercial areas. Section 0
E42	(e) a maximum increase of 100 mm in inundation of land zoned as environment zone or public recreation;	Compliant. No flood level increase of more than 100mm in the environment zone or public recreation (refer to Section 0)
E42	(f) a maximum increase of 200 mm in inundation of land zoned as rural or primary production, environment zone or public recreation;	Compliant. No flood level increase of more than 200mm in rural or primary production, environment zone or public recreation (refer to Section 0)
E42	(g) no increase in the flood hazard category or risk to life; and	Compliant (refer to Section 0)
E42	(h) maximum relative increase in velocity of 10%, or to 0.5m/s, whichever is greater, unless adequate scour protection measures are implemented and/or the velocity increases do not exacerbate erosion as demonstrated through site-specific risk of scour or geomorphological assessments	Compliant (refer to Section 0)
E42	Where the requirements set out in clauses (d) to (f) inclusive cannot be met alternative flood levels or mitigation measures must be agreed to with the affected landowner.	N/A – clause (d) to (f) are compliant
E43	A **Flood Design Report** confirming the:	
E43	a) final design of the CSSI meets the requirements of **Condition E42;** and	Compliant (refer to Section 6)
E43	b) the results of consultation with the relevant council in accordance with **Condition E46**	Refer to E46
E43	must be submitted to and approved by the Planning Secretary prior to the commencement of permanent works that would impact on flooding.	This report will be submitted to the Planning Secretary for approval prior to the commencement of permanent works that would impact on flooding
E44	The **Flood Design Report** required by **Condition E43** must be approved by the Planning Secretary prior to works that may impact on flooding or the relevant council's stormwater network.	This report will be submitted to the Planning Secretary for approval prior to the commencement of permanent works that would impact on flooding
E45	Flood information including flood reports, models and geographic information system outputs, and work as executed information from a registered surveyor certifying finished ground levels and the dimensions and finished levels of all structures within the flood prone land, must be provided to the relevant Council, BCS and the SES in order to assist in preparing relevant documents and to reflect changes in flood behaviour as a result of the CSSI. The Council, BCS and the SES must be notified in writing that the information is available no later than one (1) month following the completion of construction. Information	Flood information will be provided to the relevant Council, BCS and the SES in order to assist in preparing relevant documents and to reflect changes in flood behaviour as a result of the CSSI in accordance with the requirements of CoA E45

Condition	Condition or Criteria	Compliance Evidence Reference
	requested by the relevant Council, BCS or the SES must be provided no later than six (6) months following the completion of construction or within another timeframe agreed with the relevant Council, BCS or the SES.	
E46	The design, operation and maintenance of pumping stations and storage tanks and discharges to council's stormwater network must be developed in consultation with the relevant council. The results of the consultation are to be included in the report required in **Condition E47.**	N/A – No drainage design in the scope of works at this site

2.3 Updated Mitigation Measures - Flooding

The Updated Mitigation Measures (UMM) have been provided and the detailed design has been assessed to meet the UMM and the compliance is presented in Table 2-3 below.

Table 2-3 Updated Mitigation Measures Compliance Table - Flooding

Condition	Condition or Criteria	Compliance Evidence Reference	Comment if non-compliant
HFWQ3	Further consultation will be undertaken with local councils and other relevant authorities to identify opportunities to coordinate the proposal with flood mitigation works committed to as part of the council's flood management plans, or other strategies.	Consultation with Council and other relevant authorities will be undertaken through formal review of this Flood Design Report.	-
HFWQ4	At Wagga Wagga Yard enhancement site, flood modelling would be carried out during detailed design to confirm predicted afflux at industrial properties located at Railway Street and compliance with the Quantitative Design Limits for Inland Rail. This would be informed by topographic and building floor surveys and a review of localised drainage structures (as required). Quantitative assessment of the sites of low and moderate hydraulic complexity will be carried out during detailed design, and will consider the impact of the Possible Maximum Flood event at built-up areas (where information is available) and the tenure of the upstream areas that are impacted by drainage and/or flooding. The outcomes of the assessment are to be provided to DCCEW– BCS	This report relates to the Murray River site, and so if not relevant to Wagga Wagga Yard. Compliant. Quantitative assessment has been undertaken. Refer to Section 6.	-
HFWQ5	At Riverina Highway bridge enhancement site, flood and drainage network modelling (including capacity and operation of the stormwater storage and pump system) will be carried out during detailed design to confirm predicted compliance with the Quantitative Design Limits (QDLs)* for Inland Rail. The modelling would be undertaken in consultation with Albury City Council.	This report relates to the Murray River site, and so is not relevant to the Riverina Highway track lowering site.	-

3 CHANGE MANAGEMENT

This section summarises the changes made to this design package due to changes in the project scope and/or evolution of the design.

3.1 Concept Design to SDR

Flood modelling is not applicable to this stage.

3.2 SDR to PDR

Flood modelling is not applicable to this stage.

3.3 PDR to DDR

The received TUFLOW model (item 1 in Table 1-2) was updated to be in line with ARR2019 for this DDR assessment.

Table 3-1: Design Differences Between PDR and DDR

Item	Difference	Reason for Change
1	ARR2019 update	To fulfill the Murray River site assessment based on CoA.

3.4 DDR to IFC

The table below outlines the changes occurring between DDR and IFC submissions.

Table 3-2: Design Differences Between DDR and IFC

Item	Difference	Reason for Difference
1	Updates to the report as per the comments from ARTC (5-0052-210-IHY-B1-CS-0001_C)	Addressing the comments
2	Updates to the report as per the comments from PE (5-0052-210-IHY-B1-CS-0001-PE_C)	Addressing the comments

4 MODELLING METHODOLOGY

The overall approach for the flood modelling is listed below:

- Based on ARR2019, Flood Frequency Analysis (FFA) is utilised to determine the flow for input to the hydraulic model for all the events (5% AEP, 2%AEP, 1%AEP, 0.5%AEP (Climate Change Scenario 1), 0.2%AEP (Climate Change Scenario 2), 0.05%AEP, and PMF).
- Update the received TUFLOW model by incorporating the updated hydrology. Use the updated TUFLOW model to predict hydraulic behaviour, which will be formed as the existing model for this study.
- The updated existing condition's TUFLOW model results were compared against the received model results (refer to Section 5).
- Update the TUFLOW model from the existing condition to the design condition model by incorporating the Murray River Bridge design into the existing model.
- The flood impact was assessed up to the 1% AEP Climate change and the flood results were shown.
- Conduct a climate change sensitivity assessment for the 1% AEP to inform the potential impact on the railway track flood immunity.
- The blockage assessment is undertaken for 1% AEP design event in line with ARR2019 guideline (Refer to Section 0).

4.1 Hydrology Modelling

The FFA (using TUFLOW FLIKE) at GS409017 (Murray River at Doctors Point) was utilised to generate flow for Murray River for input to the hydraulic model, which is in line with the method adopted in Albury Floodplain Risk Management Study and Plan (WMA Water, 2016, item 2 in Table 1-1). The flow record used for FFA is from 1929 to 2024 (post-Hume Dam period) while the period in the Murray River Flood Study is from 1929 to 2010. As recommended by the ARR2019 (Book3, Chapter 2.4.2), Generalized Extreme Value (GEV) and Log Pearson III (LP III) should be chosen for FFA fitting. LP III (Figure 4-2) shows a better fitting visually than GEV (Figure 4-3). Therefore, LP III was used.

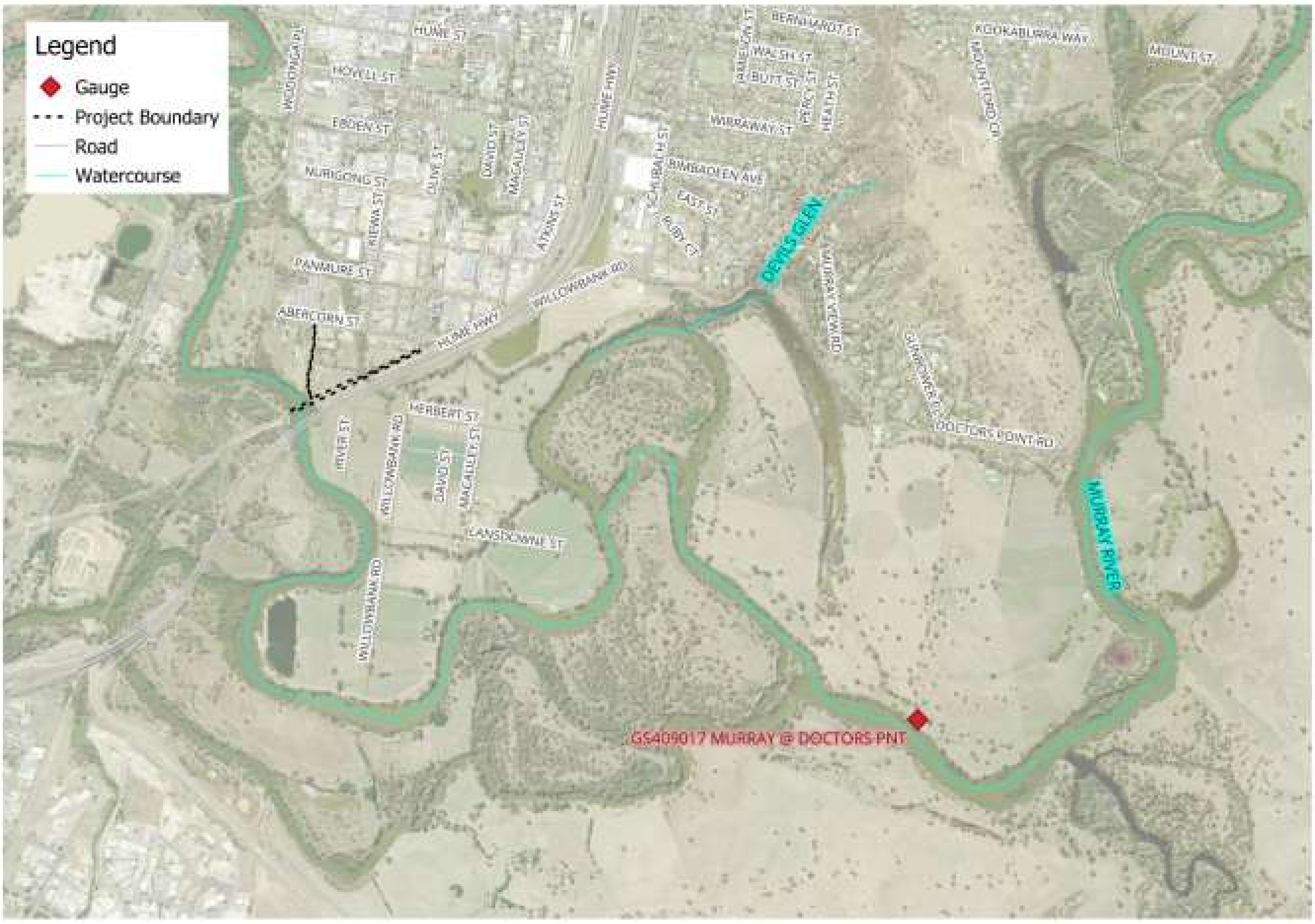


Figure 4-1 Gauge Station

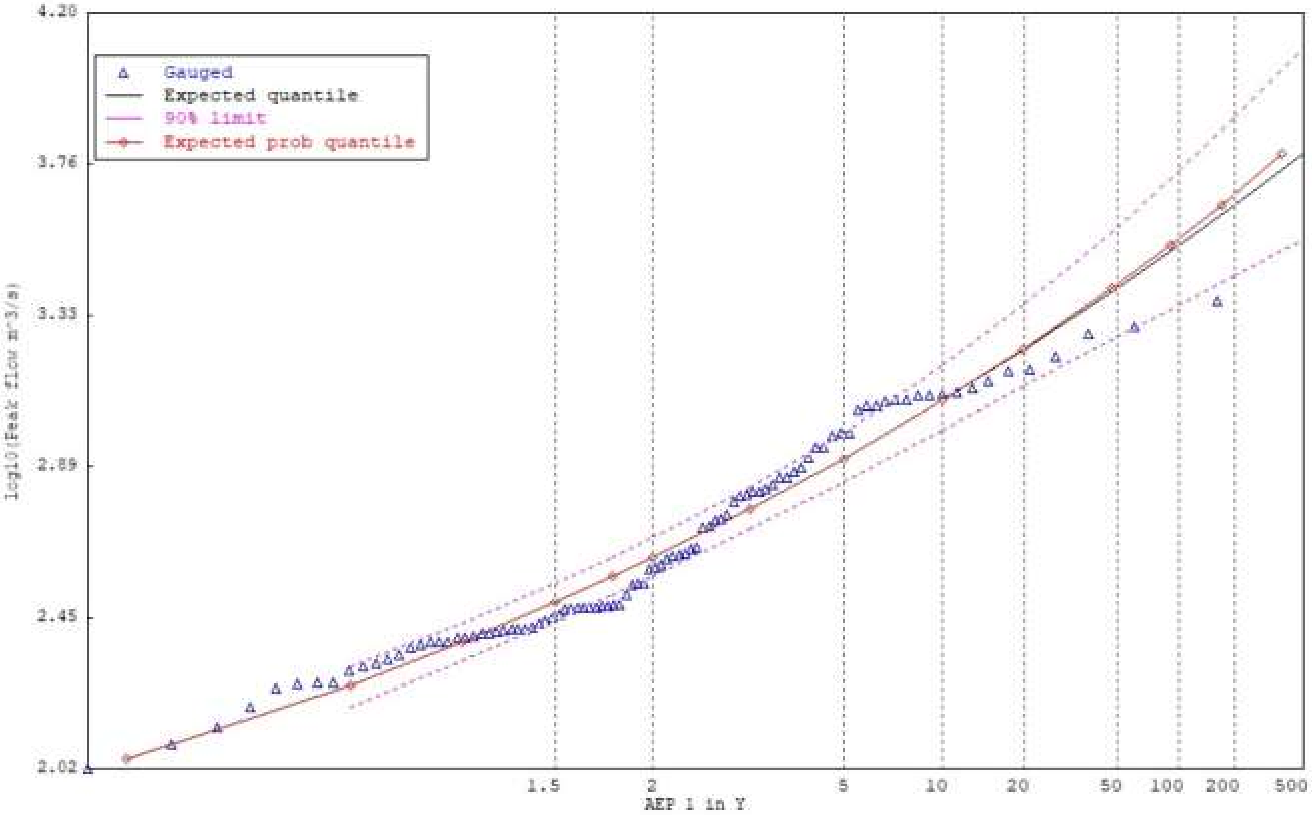


Figure 4-2 LP III FFA Results for GS409017 (Murray River @ Doctors Point)

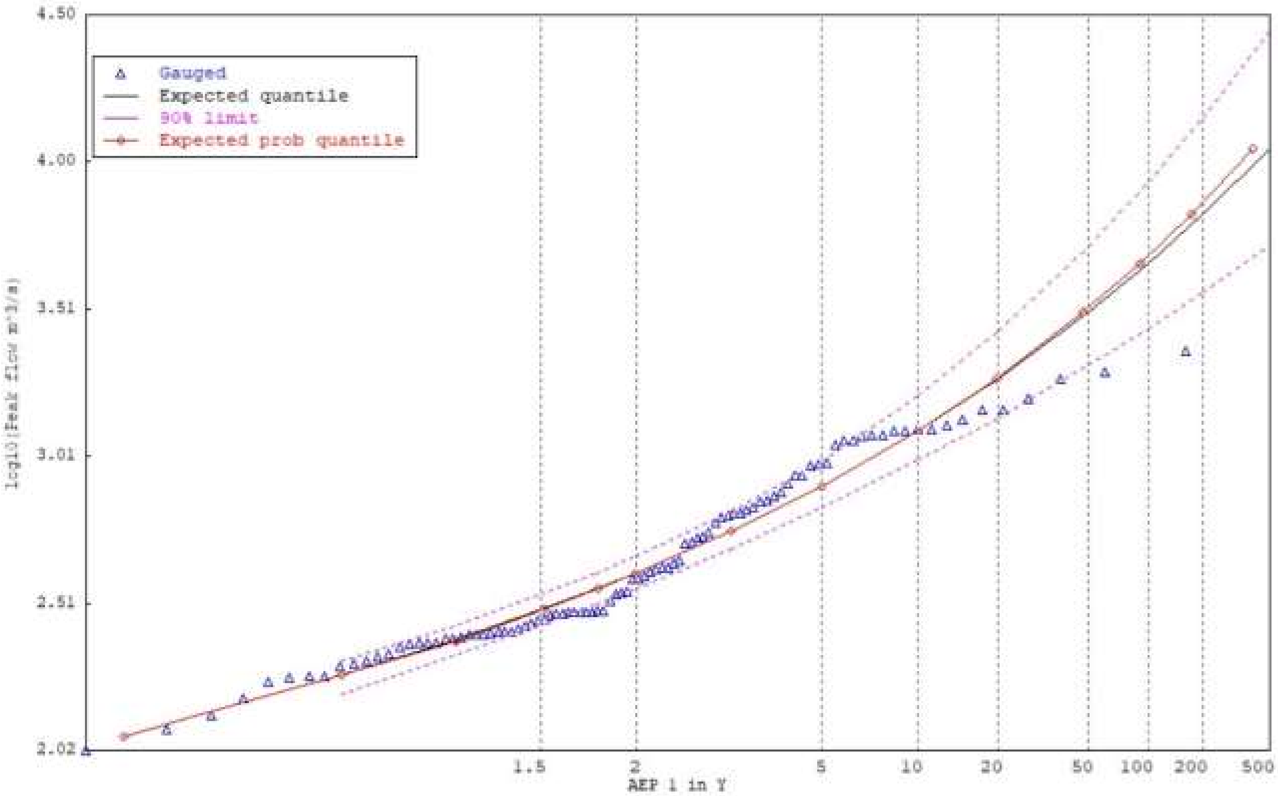


Figure 4-3 GEV FFA Results for GS409017 (Murray River @ Doctors Point)

The FFA above, generated the flows for the events of 5%, 2%, 1%, 0.5%, 0.2% and 0.05% AEPs. In the Albury Floodplain Risk Management Study and Plan (WMAwater, 2016), PMF flow of 14,900m^3/s was adopted. It was justified that 14,900m^3/s is still valid under the ARR2019 procedure (refer to Appendix B for detailed analysis). Based on the above, the flow for events of 5%, 2%, 1%, 0.5%, 0.2% and 0.05% AEPs and PMF are displayed in Table 4-1. It can be seen that the FFA results in this study are higher than the ones adopted in the Albury Floodplain Risk Management Study and Plan. There are two main reasons accounting for this. Firstly, the latest FLIKE adopts the latest LP III fitting method in ARR2019 Book 3 Chapter 2.4.2.2. In addition, in the period of 2011-2024, there is some high flow happening (1211m^3/s in 2022; 1156m^3/s in 2016).

Table 4-1 Flow Comparisons

Design Events	Flow (m^3/s) (This study)	Flow (m^3/s) (Albury Floodplain Risk Management Study and Plan)*
5% AEP	1691	1678
2% AEP	2539	2372
1% AEP	3376	2893
0.5% AEP	4428	3819
0.2% AEP	6231	5092
0.05% AEP	10167	N/A
PMF	14900	14900

Note: The flow adopted in Albury Floodplain Risk Management Study and Plan and Murray River Flood Study are the same except for the PMF.

4.2 Hydraulic Modelling

Existing Model Update

The existing model was updated based on the received TUFLOW model, from the Albury Floodplain Risk Management Study and Plan (AFRMSP, 2016). A summary of the received model and updated model parameters can be found in Table 4-2. The model extent encompasses an area of around 222 km^2 of Murray River (Refer to Figure 4-4).

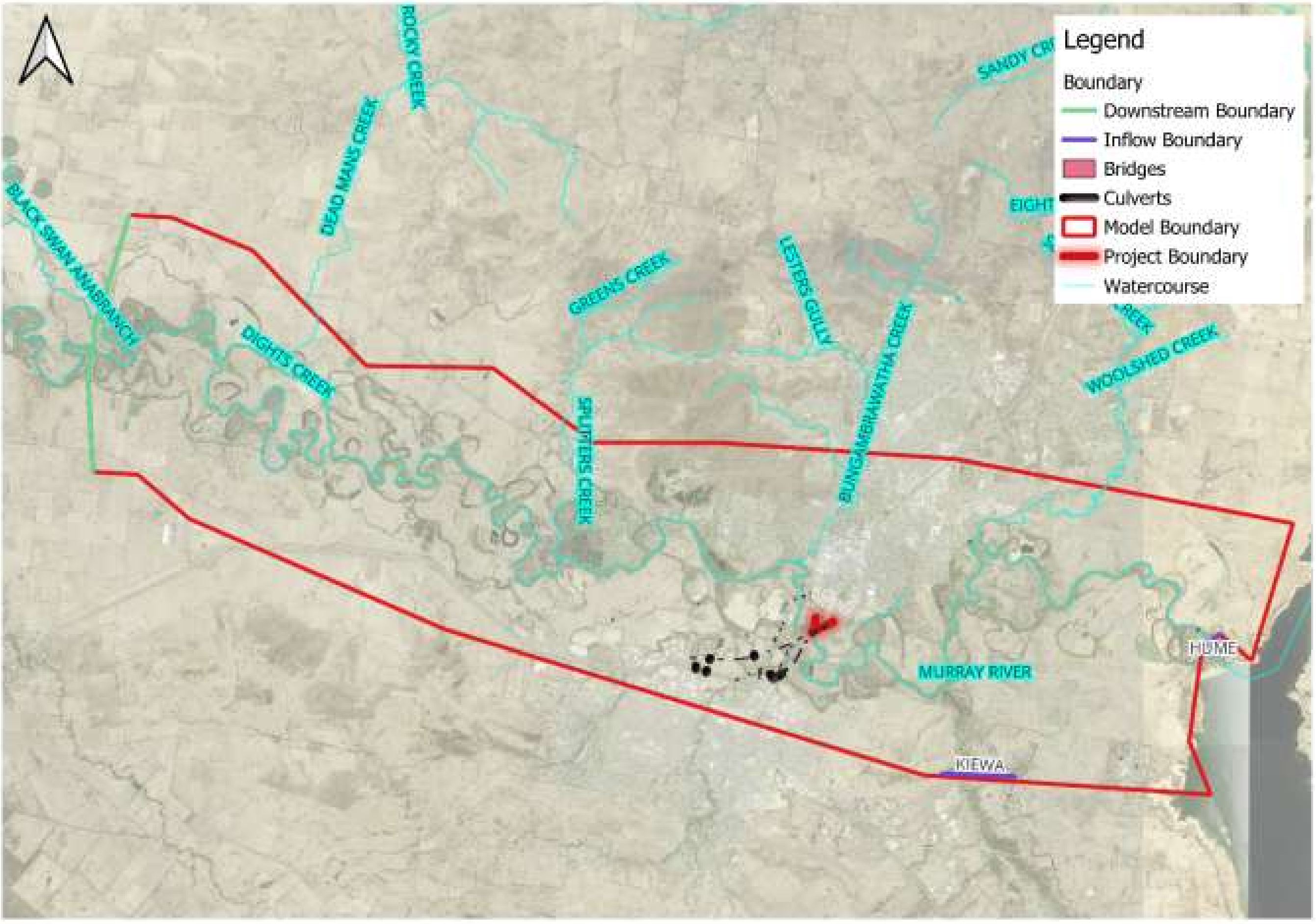


Figure 4-4 TUFLOW Model Extent – Murray River Bridge IFC Model

Table 4-2: Model Parameters in the IFC Existing Model; and Albury Floodplain Risk Management Study and Plan TUFLOW Model

Parameters	Albury Floodplain Risk Management Study and Plan (WMA Water, 2016) TUFLOW Model	IFC Existing Model
Build	TUFLOW 2016-03-AF Classic	TUFLOW 2023-03-AE HPC
Coordination Reference System (CRS)	GDA94 MGA 55	GDA2020 MGA 55
Grid Size	10m	10m
Hydrology	FFA (LP III) GS409017 (Murray River @ Doctors Point (1929 - 2010)	FFA (LP III) GS409017 (Murray River @ Doctors Point (1929 - 2024)
Inflow type	QT constant inflow • Hume: 90% of the GS409017 (Murray River @ Doctors Point)	QT constant inflow* • Hume: 90% of the GS409017 (Murray River @ Doctors Point)

Parameters	Albury Floodplain Risk Management Study and Plan (WMA Water, 2016) TUFLOW Model	IFC Existing Model
	• KIEWA: 10% of the GS409017 (Murray River @ Doctors Point)	• KIEWA: 10% of the GS409017 (Murray River @ Doctors Point)
Downstream Boundary	Static downstream water boundary (HT)	Static downstream water boundary (HT)
Timestep	5s	Dynamic
Topography	▪ 1m and 10m resolutions LiDAR collected in 2001 ▪ 10m and 20m resolutions DTM collected in 2010 ▪ Murray River in-channel cross section collected in 2007 and 1984. ▪ 2006 crest survey of the Albury levee bank ▪ 2005 ALS terrain data covering the whole Albury local government area carried out by AAMHatch. ▪ 2001 photogrammetric survey	▪ 1m and 10m resolutions LiDAR collected in 2001 ▪ 10m and 20m resolutions DTM collected in 2010 ▪ Murray River in-channel cross section collected in 2007 and 1984. ▪ 2006 crest survey of the Albury levee bank ▪ 2005 ALS terrain data covering the whole Albury local government area carried out by AAMHatch. ▪ 2001 photogrammetric survey
Bridges	Murray River Rail Bridge: 2d_lfcsh with 4% blockage for pier Spirit of Progress Bridges: 2d_lfcsh with 3% blockage for pier	The bridge modelling parameters are retained in the same way as per the received model of Albury Floodplain Risk Management Study and Plan (WMA Water, 2016) (item 1 in Table 1-2) because the model is calibrated and validated. Murray River Rail Bridge: 2d_lfcsh with 4% blockage for pier Spirit of Progress Bridges: 2d_lfcsh with 3% blockage for pier
Roughness	Grass: 0.05 Scattered vegetation: 0.10 Thick vegetation: 0.15 Water/lakes: 0.04 Reduced conveyance through built up areas: 0.30 Calibration of levels upstream of Kiewa confluence: 0.07 Calibration of levels - channel u/s of Keiwa us end of Wodonga Creek: 0.07 Calibration of levels near Haywards Bridge: 0.09	Grass: 0.05 Scattered vegetation: 0.10 Thick vegetation: 0.15 Water/lakes: 0.04 Reduced conveyance through built up areas: 0.30 Calibration of levels upstream of Kiewa confluence: 0.07 Calibration of levels - channel u/s of Keiwa us end of Wodonga Creek: 0.07 Calibration of levels near Haywards Bridge: 0.09
Design Events	PMF, 0.2% AEP, 0.5% AEP, 1% AEP, 2% AEP, 5% AEP, 10% AEP, 20%AEP	PMF, 0.05%AEP (Bridge Assessment), 0.2% AEP (Climate Change Scenario 2), 0.5%AEP (Climate Change Scenario 1) 1% AEP, 2% AEP and, 5% AEP

* Apart from Kiewa River (1650 km^2 catchment while Murray River has a catchment of 17000 km^2), there are no significant inflows into the Murray River within the study area. Some of the small creek systems flow into Murray River at Albury/Wodonga (e.g. Eight Mile Creek, Bungambrawatha Creek, House Creek, Felltimber Creek). However, peak flows from those creeks will occur well in advance of the peak flows in the Murray River. Therefore, only Kiewa River inflow is accounted as an inflow apart from Murray River. This method is also consistent with the one from the TUFLOW model adopted in Albury Floodplain Risk Management Study and Plan (WMA, 2016).

GDA2020 Conversion

The conversion to GDA2020 represents a crucial update to modernise and align the model with the latest geodetic standards and reference systems, and to meet project requirements on the CRS. The model layers and the rasters were converted into GDA2020 MGA 55 from GDA94 MGA 55.

Topography

The latest Lidar collected in 2020 (https://elevation.fsdf.org.au/) does not provide the in-channel definition below the water surface level, while the original terrain model reflects the in-channel level. As such, the model topography was maintained the same, as the received model.

Existing Track Level

As per the drawing received (item 2 in Table 1-2), the surveyed existing track level is 156.74 mAHD and this level is used to determine the flood immunity of the track.

Design Model Update

The design model was updated from the existing condition by incorporating the Inland Rail Project Works as part of the IFC stage, including (refer Figure 4-5):

- The blockage due to the new handrail next to the footpath above the bridge.
- There is a new stanchion added above the existing structure to support the new top chord bracing. However, since the PMF flood levels do not reach the existing structure, the stanchion is not incorporated into the updated model.

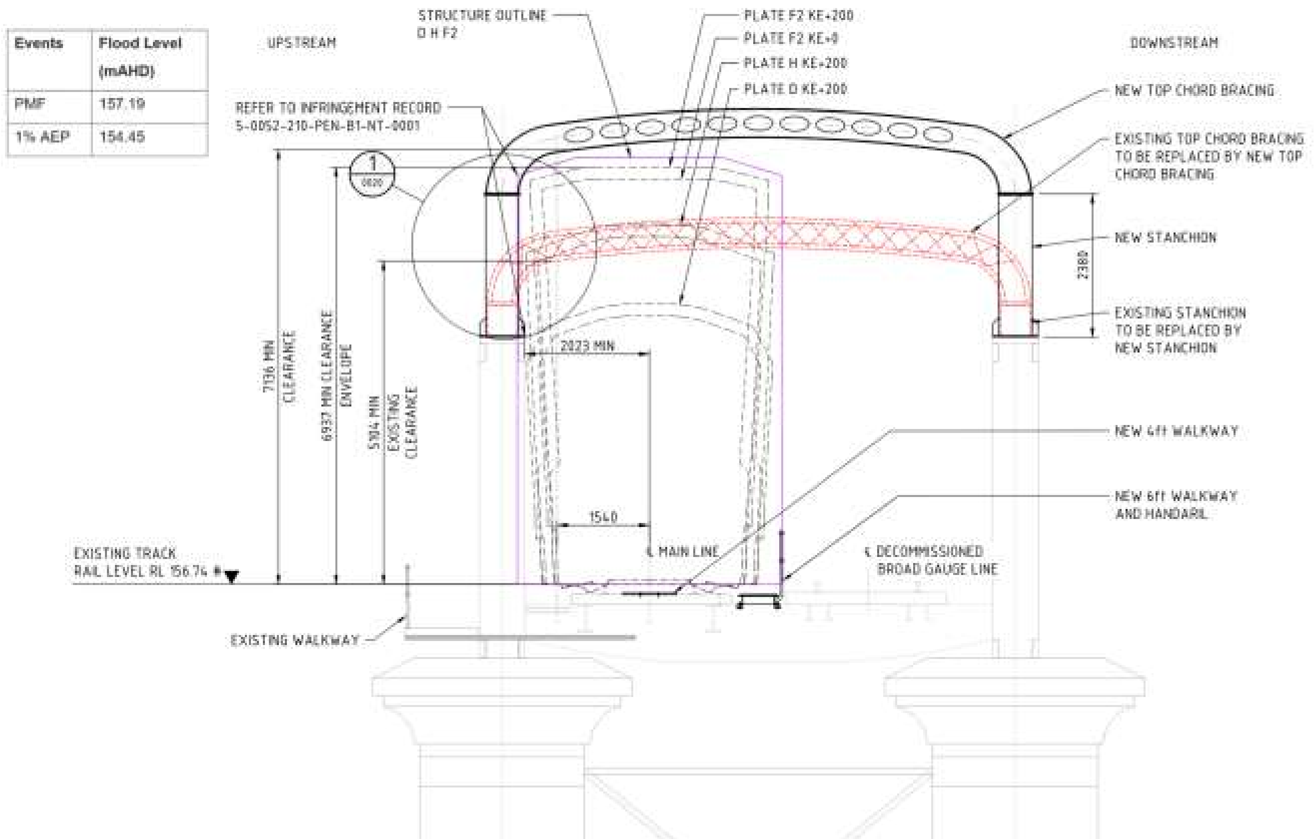


Figure 4-5 Murray River Site – Design Cross-section (Item 2 in Table 1-2)

Design Events

The design events of 5% AEP, 2%AEP, 1%AEP, 0.5%SEP (Climate Change Scenario 1), 0.2%AEP (Climate Change Scenario 2), 0.05%AEP, and PMF were run.

Climate Change

The FFA did not generate the flow for 1% AEP + Year 2090 Representative Concentration Pathway (RCP) 8.5 directly. Generally, the rainfall depth for 1% AEP + RCP 8.5 is between 0.5% AEP and 0.2% AEP. A check of the rainfall depth upstream of the site (at the location of GS409017 Murray River @ Doctors Point) was carried out. Based on the ARR

DataHub, the interim climate change factor for Year 2090 RCP 8.5 for Muray-Darling Basin is 18.7%. Table 4-3 summarises the design rainfall depth values and shows that climate change values fall between the 0.5% AEP and 0.2% AEP events.

Therefore, as a justification, the 0.5% AEP and 0.2% AEP will be used as climate change scenarios, namely, 0.5% AEP (Climate Change Scenario 1) and 0.2% AEP (Climate Change Scenario 2).

Table 4-3: ARR DataHub Design Rainfall Depth

Duration (hour)	Design Rainfall Depth (mm)			
	1% AEP	0.5% AEP (Climate Change Scenario 1)	1% AEP + 18.7%	0.2% AEP (Climate Change Scenario 2)
1.0	47.20	51.90	56.03	58.70
1.5	52.20	57.30	61.96	64.80
2.0	55.80	61.20	66.23	69.10
3.0	61.40	67.00	72.88	75.50
4.5	67.90	73.70	80.60	82.90
6.0	73.30	79.40	87.01	89.10
9.0	82.50	89.20	97.93	99.90
12.0	90.40	97.80	107.30	110.00
18.0	104.00	113.00	123.45	127.00

5 HYDRAULIC MODEL COMPARISONS

The comparison in this section involved the results from the updated IFC model's existing condition, against the results from the AFRMSP TUFLOW model for the 1% AEP (Figure 5-1 and Figure 5-2 below).

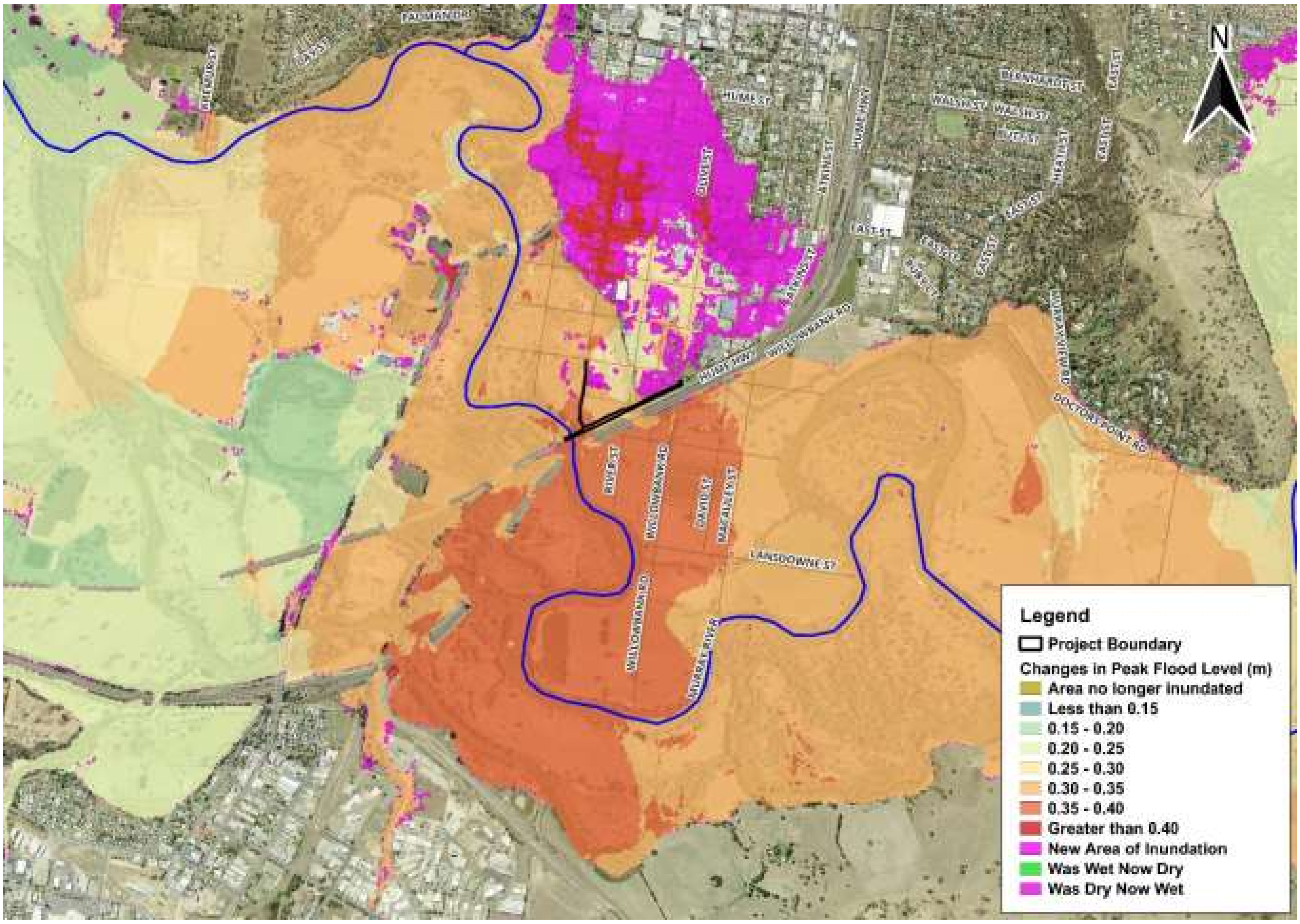


Figure 5-1: **Flood Level Comparison for 1% AEP Event – Murray River Bridge IFC Existing Model vs AFRMSP Model**

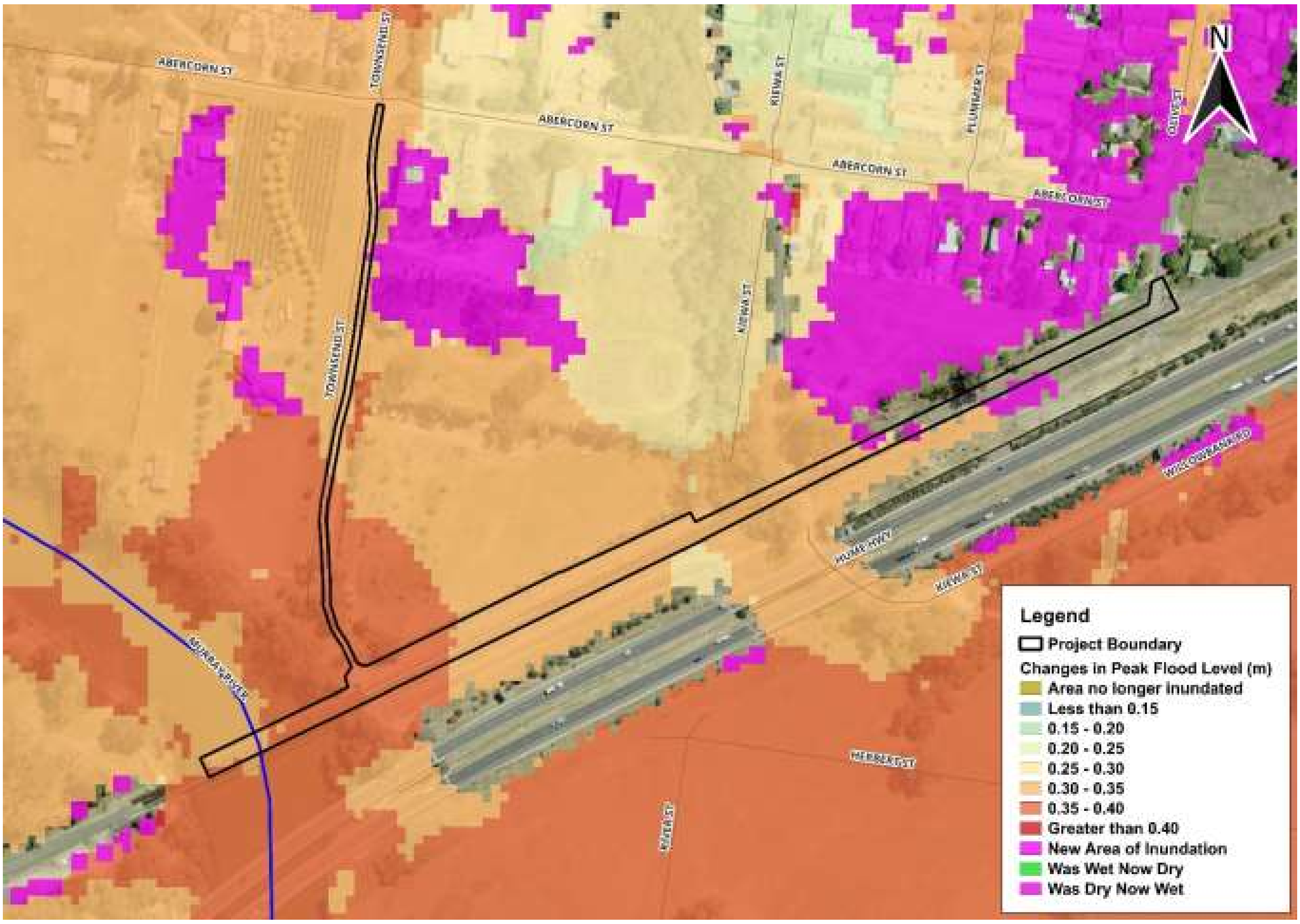


Figure 5-2: **Flood Level Comparison (Zoomed In) for 1% AEP Event – Murray River Bridge IFC Existing Model vs AFRMSP Model**

Generally, the comparison shows the updated TUFLOW model produced a higher flood level around 0.3 to 0.4m than the AFRMSP TUFLOW model. This difference is mostly attributed to the following:

- The AFRMSP TUFLOW model used a Classic solver, which utilizes a single CPU core for the simulations, while the updated model used a Heavily Parallelized Compute (HPC) solver, which utilises multiple graphics card cores.
- The AFRMSP TUFLOW Model utilised a hydrology model using ARR1987 while the updated model's hydrology is based on ARR2019. Comparing the ARR2019 hydrology model against the ARR1987 hydrology model saw an increase of about 480m^3/s in the flow in the project area, in the 1% AEP event.

6 FLOOD ASSESSMENT

Existing flood maps, including peak flood depth and levels, peak flood velocity, and peak flood hazard for the modelled events, are provided in Appendix A. The water from the southeast flows towards the northwest as shown in Figure 6-1. Figure 6-1 also shows the selected location for reporting results.

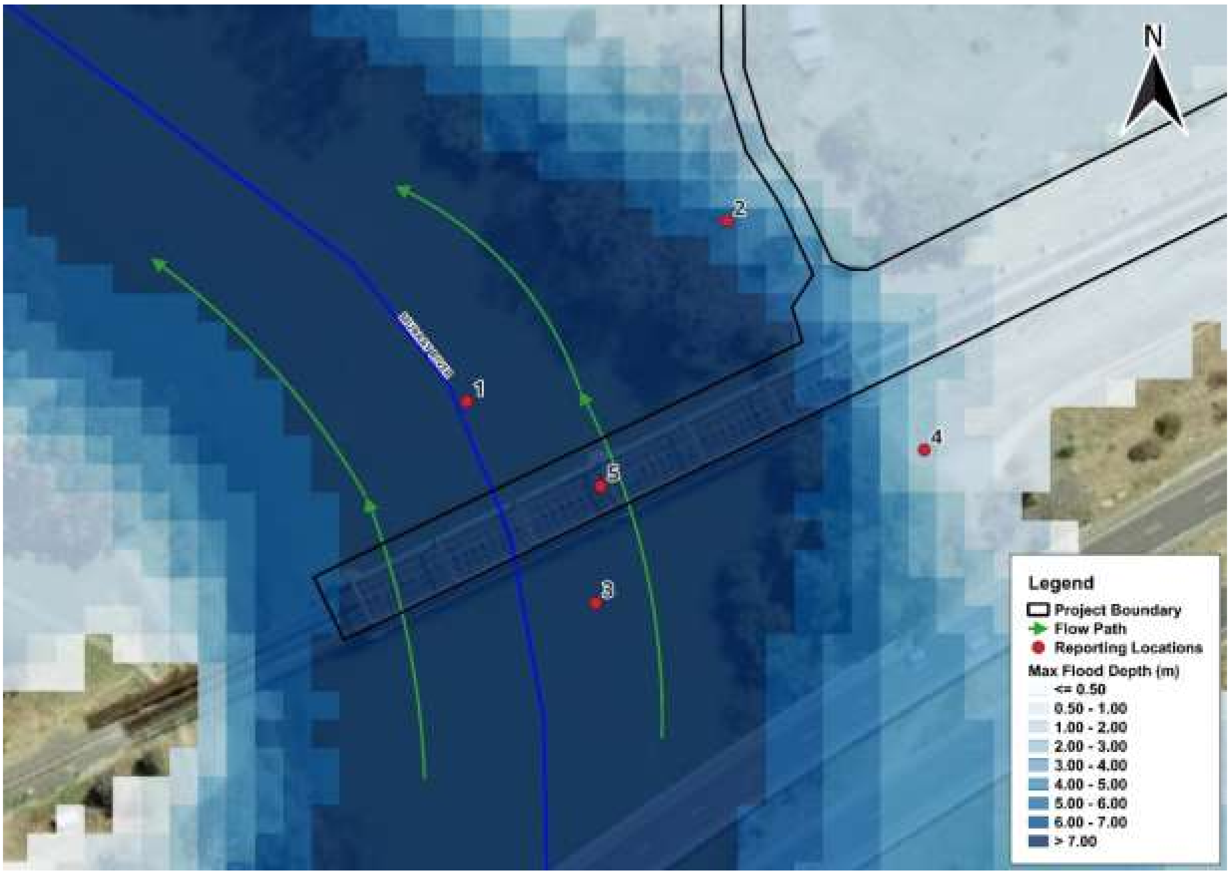


Figure 6-1: Murray River Bridge Site Flow Paths

6.1 Existing Condition

Figure 6-1 (above) shows points of interest that have been used for the flood impact assessment presented in the following sections and Table 6-1 below describes the location at each point of interest.

Table 6-1: Points of Interest

Point of Interest	Description
Point 1	Downstream of the Murray River Bridge along the river
Point 2	Downstream of the Murray River Bridge on land
Point 3	Upstream of the Murray River Bridge along the river
Point 4	Upstream of the Murray River Bridge on land
Point 5	Directly under the Murray River Bridge

The existing condition flood behaviour is discussed from Table 6-2 to Table 6-6.

Table 6-2: Peak Flood Levels – Existing Conditions

Design Events	Flood Levels
All other % AEP events	Aside from the PMF, all events did not overtop the track level (156.74 mAHD).

Table 6-3: Peak Flood Levels (mAHD) at Points of Interest – Existing Conditions

Locations	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	0.05% AEP (Bridge Assessment)	PMF
Point 1	153.38	153.96	154.41	154.84	155.38	156.26	157.14
Point 2	153.40	153.99	154.45	154.89	155.45	156.35	157.19
Point 3	153.40	153.99	154.44	154.87	155.43	156.33	157.23
Point 4	153.40	153.99	154.44	154.86	155.40	156.25	157.07
Point 5	153.39	153.98	154.43	154.86	155.40	156.29	157.16

Table 6-4: Peak Flood Velocity – Existing Conditions

Design Events	Flood Velocity
Probable Maximum Flood (PMF)	▪ Peak velocity within the site is generally between 0.1m/s to 2.9m/s
All % AEP events	▪ Peak velocity under the bridge reaches up to around 2.4m/s ▪ Refer to Table 6-5 for flood velocity comparison based on points of interest.

Table 6-5: Peak Flood Velocity (m/s) at Points of Interest – Existing Conditions

Locations	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	0.05% AEP (Bridge Assessment)	PMF
1	1.1	1.2	1.4	1.6	2.0	2.5	2.9
2	0.4	0.5	0.6	0.7	1.0	1.4	1.5
3	0.9	1.0	1.2	1.4	1.8	2.3	2.6
4	0.2	0.2	0.2	0.4	0.6	1.0	1.0
5	0.9	1.0	1.3	1.5	1.9	2.4	2.8

The flood hazard assessment is based on the general flood hazard classification set by the Australian Institute for Disaster Resilience in Australian Disaster Resilience Handbook Collection - Flood Hazard, 2017. The figure and tables below describe the hazards.

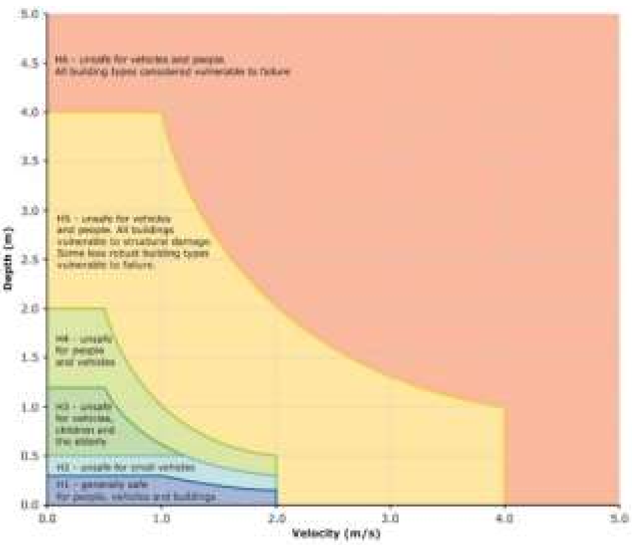


Figure 6-2: Hazard Category Classification

Table 6-6: Flood Hazard – Existing Conditions

Design Events	Flood Hazard
All % AEP events	▪ Aside from Point 4, which has H4 and H5 for smaller events, all events have H6 classification. ▪ Refer to Table 6-7 for flood hazard comparison based on points of interest.

Table 6-7: Peak Flood Hazard Category at Points of Interest – Existing Conditions

Locations	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	0.05% AEP (Bridge Assessment)	PMF
Point 1	H6	H6	H6	H6	H6	H6	H6
Point 2	H6	H6	H6	H6	H6	H6	H6
Point 3	H6	H6	H6	H6	H6	H6	H6
Point 4	H4	H4	H5	H5	H5	H6	H6
Point 5	H6	H6	H6	H6	H6	H6	H6

6.2 Design Condition

Design condition flood maps, including peak flood depth and levels, peak flood velocity, and peak flood hazard for the events modelled, are provided in Appendix A.

Same as the existing condition simulations, PMF is the only event that will result to water levels overtopping the railway track. It means for the assessed events up to 0.05% AEP, the design flood behaviour and levels are expected to be identical to the existing (refer to Figures A19 to A24 in Appendix A for the flood maps).

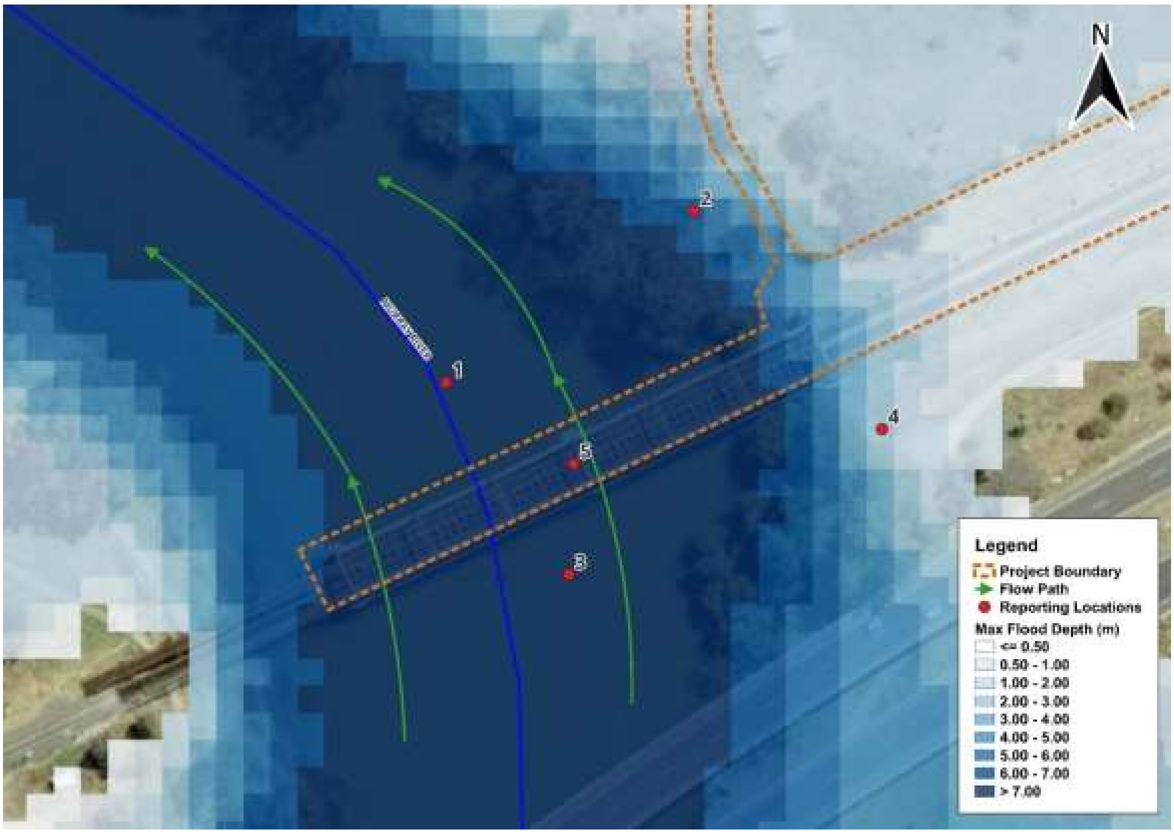


Figure 6-3: 1% AEP Flood Depth - Design

The design conditions for flooding behavior are discussed below from Table 6-8 to Table 6-13.

Table 6-8: Peak Flood Levels – Design Conditions

Design Events	Flood Levels
All % AEP events	▪ Aside from the PMF, all events did not overtop the track level (156.74 mAHD).

Table 6-9: Peak Flood Levels (mAHD) at Points of Interest – Design Conditions

Locations	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	0.05% AEP (Bridge Assessment)	PMF
Point 1	153.38	153.96	154.41	154.84	155.38	156.26	157.14
Point 2	153.40	153.99	154.45	154.89	155.45	156.35	157.19
Point 3	153.40	153.99	154.44	154.87	155.43	156.33	157.23
Point 4	153.40	153.99	154.44	154.86	155.40	156.25	157.07
Point 5	153.39	153.98	154.43	154.86	155.40	156.29	157.16

Table 6-10: Peak Flood Velocity – Design Conditions

Design Events	Flood Velocity
PMF	▪ Peak velocity within the site is generally between 0.1m/s to 2.9m/s
All % AEP events	▪ Peak velocity under the bridge reaches up to around 2.4m/s ▪ Refer to Table 6-11 for flood velocity comparison based on points of interest.

Table 6-11: Peak Flood Velocity(m/s) at Points of Interest – Design Conditions

Locations	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	0.05% AEP (Bridge Assessment)	PMF
Point 1	1.1	1.2	1.4	1.6	2.0	2.5	2.9
Point 2	0.4	0.5	0.6	0.7	1.0	1.4	1.5
Point 3	0.9	1.0	1.2	1.4	1.8	2.3	2.6
Point 4	0.2	0.2	0.2	0.4	0.6	1.0	1.0
Point 5	0.9	1.0	1.3	1.5	1.9	2.4	2.8

Table 6-12: Flood Hazard – Design Conditions

Design Events	Flood Hazard
All %AEP events	▪ Aside from Point 4, which has H4 and H5 for smaller events, all events have H6 classification. ▪ Refer to Table 6-13 for flood hazard comparison based on points of interest.

Table 6-13: Peak Flood Hazard Category at Points of Interest – Design Conditions

Locations	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	0.05% AEP (Bridge Assessment)	PMF
Point 1	H6	H6	H6	H6	H6	H6	H6
Point 2	H6	H6	H6	H6	H6	H6	H6
Point 3	H6	H6	H6	H6	H6	H6	H6
Point 4	H4	H4	H5	H5	H5	H6	H6
Point 5	H6	H6	H6	H6	H6	H6	H6

6.3 Flood Immunity and Scour Protection

The track along Murray River Bridge has flood immunity of at least 0.05% AEP for both existing and design conditions, which complies with the criteria in PSRs. Furthermore, in the design condition, results for flood depths, flood levels, flood velocities and flood hazard, are all the same with the existing condition for all events including PMF. The design works are above the 1%AEP flood level and there is no impact on flow velocity beyond 0.5m/s or 10% increases. Scour protection measures to protect the proposed works or velocity impacts are not required.

6.4 Flood Impact Assessment

The following sections show the flood level, flood velocity, flood hazard and flood duration comparison between the design and existing conditions. The results show the design has a negligible effect on the flood results.

Changes in Peak Flood Levels

Table 6-14 provides details regarding the changes in peak flood levels during the design scenario.

Table 6-14: Flood Levels Impact Assessment

Design Events	Changes in Peak Flood Levels
All % AEP events	▪ No changes in flood levels for all points of interest. ▪ Areas outside the project boundary experienced no changes in flood levels, which is compliant with the CoA E42(e).

Based on the above, the changes in flood levels comply with the CoA E42(e).

Changes in Peak Flood Velocity

Table 6-15: Flood Velocity Impact Assessment

Design Events	Changes in Peak Flood Velocity
All % AEP events	▪ No changes in flood velocities for all points of interest. ▪ Areas outside the project boundary experienced no changes in flood velocity, which complies with the CoA E42(h).

Based on the above, the changes in flood velocity comply with the CoA E42(h).

Changes in Peak Flood Hazard

Table 6-16: Flood Hazard Impact Assessment

Design Events	Changes in Peak Flood Hazard
All %AEP events	▪ No changes in flood hazard for all points of interest. ▪ Areas outside the project boundary experienced no changes in flood hazard, which is compliant with the CoA E42(g).

Based on the above, the changes in flood hazard comply with the CoA E42(g).

Changes in Duration of Inundation

As per Table 4-2, the TUFLOW model is running to a steady state (i.e. constant inflow and outflow), so the derivation of the duration of inundation is not applicable.

As stated in Section 6.4, the design works are above the 1% AEP flood level, and the flood level is unchanged between existing and design conditions. As such, there is no impact on the changes in duration of inundation due to the design for the events up to the 1% AEP. The changes in duration of inundation comply with the CoA E42(a).

6.5 Sensitivity Test

Blockage Assessment

A hydraulic blockage assessment was carried out for the 1% AEP design scenario as per the guidance set out in ARR2019. The assessment involved assessing the site area for debris availability, mobility and transportability (Table 6-18) in conjunction with the structure dimension used to determine the relevant blockage factors shown in Table 6-17.

Table 6-17: Structure Blockage Percentages

Structure	Blockage Percentage (1% AEP)	Comments
Culvert, pit and pipe	20%	Outside of the project boundary
Bridge	20%	Outside of the project boundary
Bridge (CH648550)	20%	Inside of the project boundary

Table 6-18: Structure Blockage Parameters based on ARR2019

Structure	Debris Availability	Debris Mobility	Debris Transportability	AEP Adjusted Debris Potential
Bridge	High	High	High	High

A flood level comparison between the blockage scenario and design is shown in Figure 6-4. In general, based on the results of the comparison, areas around the project site experienced increase flood level of up to 40mm due to the blockage. No compliance requirements for blockage assessments.

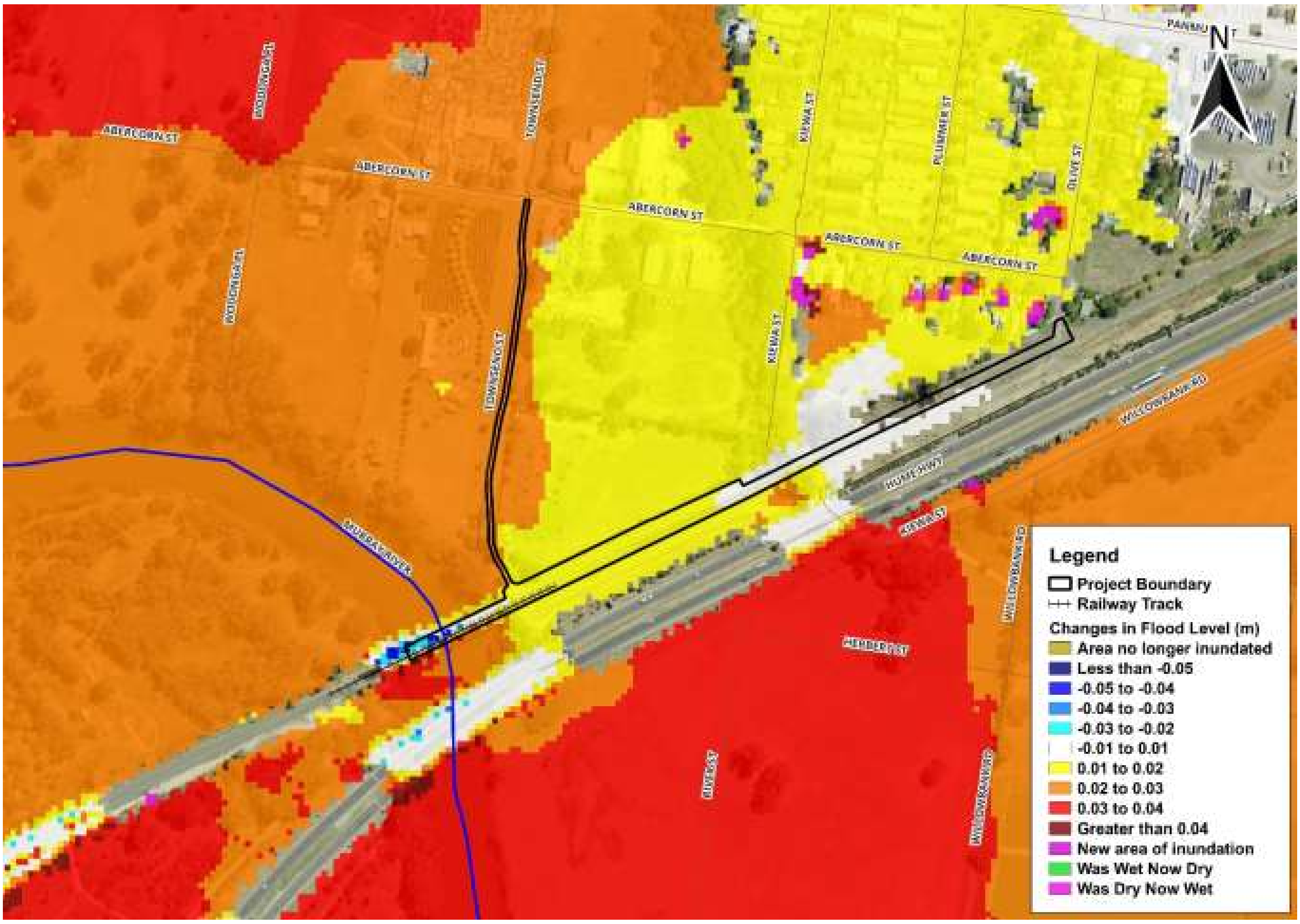


Figure 6-4: Flood Level Comparison for 1% AEP Design Condition – Blockage vs Design

Climate Change Risk Assessment

As per Section 0, 0.5% AEP (Climate Change Scenario 1) and 0.2% AEP (Climate Change Scenario 2) were run to inform the climate change.

Based on the results in Section 6.4, under climate change scenarios, the flood level, flood velocity, flood hazard and flood duration remain the same between existing and design conditions.

7 MITIGATION MEASURES

Since the impact of the project does not extend outside the project boundary and no instances of non-compliance in terms of flood impact were identified, no mitigation measures are necessary at this stage.

8 RECOMMENDATIONS AND NEXT STAGE

This is the final IFC stage of the report, and the followings are finalised:

- No instances of non-compliance have been identified through the assessment.
- All comments raised by relevant parties have been resolved (refer to Appendices C, D, and E)

Consequently, there are no further recommendations.

APPENDICES

APPENDIX A

Flood Maps

Table 0-1: List of Maps in Appendix A

Map ID	Map description
Figure A1	5% AEP Peak Flood Depth and Levels (Existing Condition)
Figure A2	2% AEP Peak Flood Depth and Levels (Existing Condition)
Figure A3	1% AEP Peak Flood Depth and Levels (Existing Condition)
Figure A4	0.5% AEP (Climate Change Scenario 1) Peak Flood Depth and Levels (Existing Condition)
Figure A5	0.2% AEP (Climate Change Scenario 2) Peak Flood Depth and Levels (Existing Condition)
Figure A6	0.05% AEP (Bridge Assessment) Peak Flood Depth and Levels (Existing Condition)
Figure A7	PMF Peak Flood Depth and Levels (Existing Condition)
Figure A8	5% AEP Peak Flood Velocity (Existing Condition)
Figure A9	2% AEP Peak Flood Velocity (Existing Condition)
Figure A10	1% AEP Peak Flood Velocity (Existing Condition)
Figure A11	0.5% AEP (Climate Change Scenario 1) Peak Flood Velocity (Existing Condition)
Figure A12	0.2% AEP (Climate Change Scenario 2) Peak Flood Velocity (Existing Condition)
Figure A13	0.05% AEP (Bridge Assessment) Peak Flood Velocity (Existing Condition)
Figure A14	PMF Peak Flood Velocity (Existing Condition)
Figure A15	5% AEP Peak Flood Hazard (Existing Condition)
Figure A16	2% AEP Peak Flood Hazard (Existing Condition)
Figure A17	1% AEP Peak Flood Hazard (Existing Condition)
Figure A18	0.5% AEP (Climate Change Scenario 1) Peak Flood Hazard (Existing Condition)
Figure A19	0.2% AEP (Climate Change Scenario 2) Peak Flood Hazard (Existing Condition)
Figure A20	0.05% AEP (Bridge Assessment) Peak Flood Hazard (Existing Condition)
Figure A21	PMF Peak Flood Hazard (Existing Condition)
Figure A22	5% AEP Peak Flood Depth and Levels (Design Condition)
Figure A23	2% AEP Peak Flood Depth and Levels (Design Condition)
Figure A24	1% AEP Peak Flood Depth and Levels (Design Condition)
Figure A25	0.5% AEP (Climate Change Scenario 1) Peak Flood Depth and Levels (Design Condition)
Figure A26	0.2% AEP (Climate Change Scenario 2) Peak Flood Depth and Levels (Design Condition)
Figure A27	0.05% AEP (Bridge Assessment) Peak Flood Depth and Levels (Design Condition)
Figure A28	PMF Peak Flood Depth and Levels (Design Condition)
Figure A29	5% AEP Peak Flood Velocity (Design Condition)
Figure A30	2% AEP Peak Flood Velocity (Design Condition)
Figure A31	1% AEP Peak Flood Velocity (Design Condition)
Figure A32	0.5% AEP (Climate Change Scenario 1) Peak Flood Velocity (Design Condition)
Figure A33	0.2% AEP (Climate Change Scenario 2) Peak Flood Velocity (Design Condition)
Figure A34	0.05% AEP (Bridge Assessment) Peak Flood Velocity (Design Condition)
Figure A35	PMF Peak Flood Velocity (Design Condition)
Figure A36	5% AEP Peak Flood Hazard (Design Condition)
Figure A37	2% AEP Peak Flood Hazard (Design Condition)
Figure A38	1% AEP Peak Flood Hazard (Design Condition)

MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

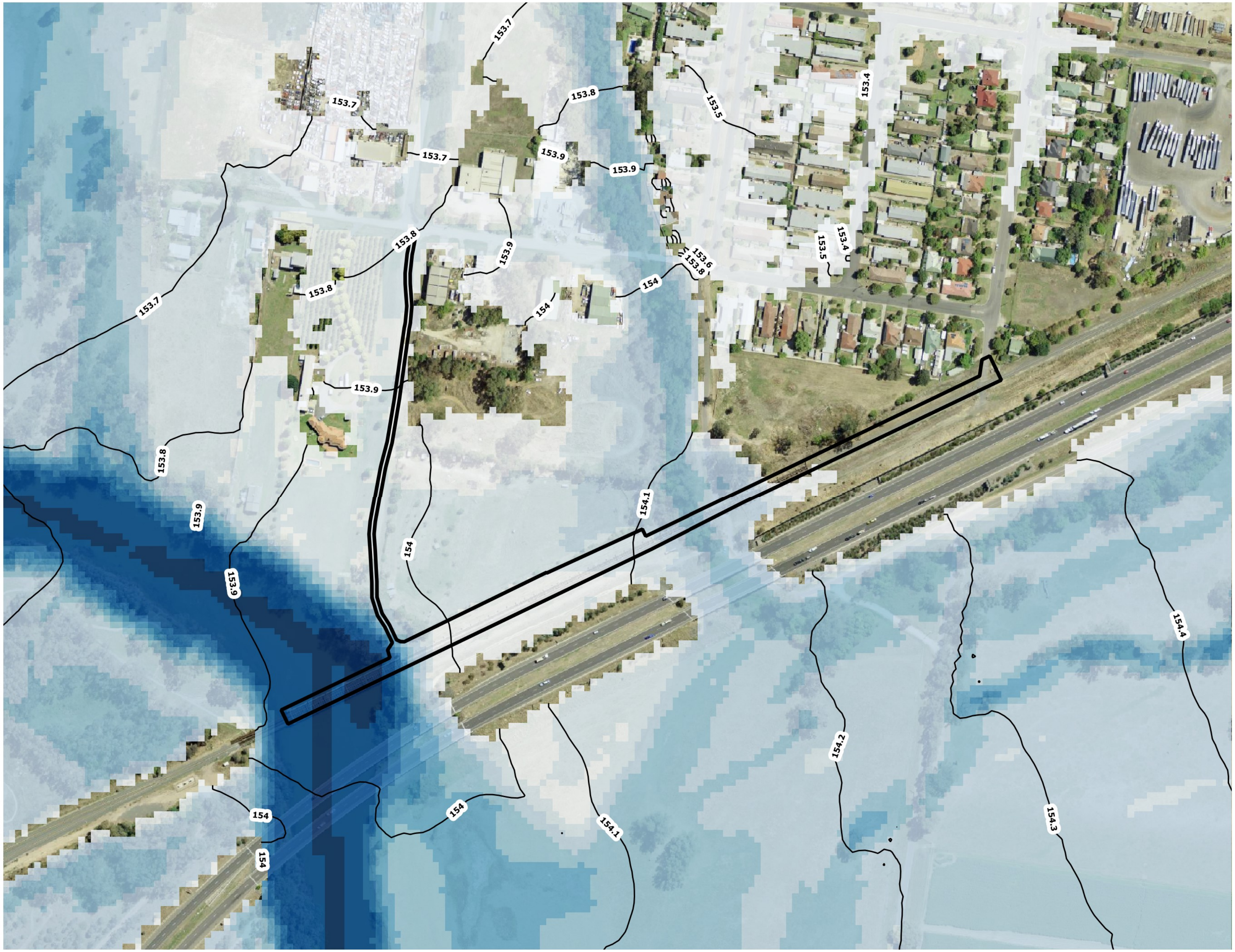
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A1 : 5% AEP Peak Flood Depth and Levels (Existing Condition)



MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

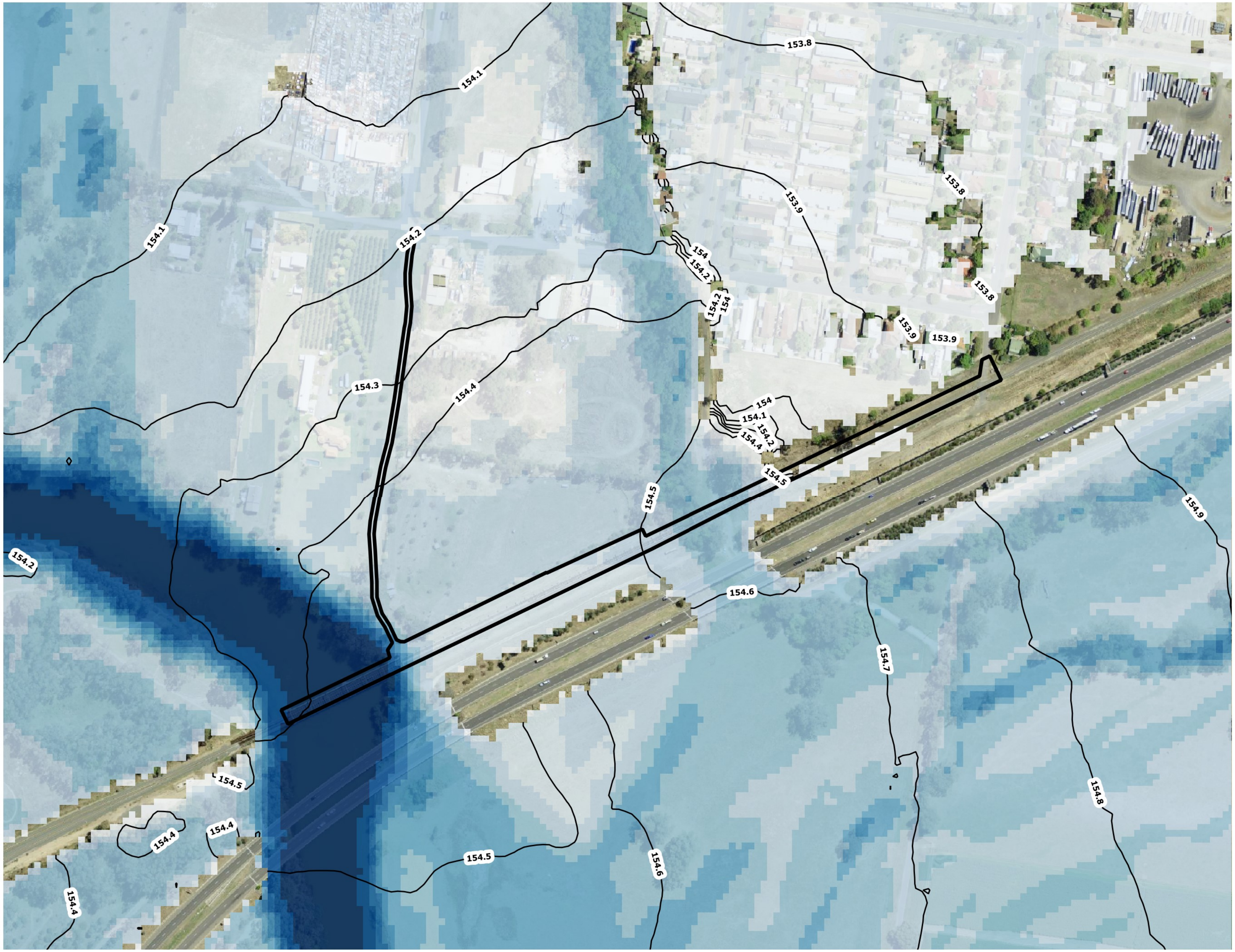
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A2 : 2% AEP Peak Flood Depth and Levels (Existing Condition)



MARTINUS
aurecon BG&E

Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

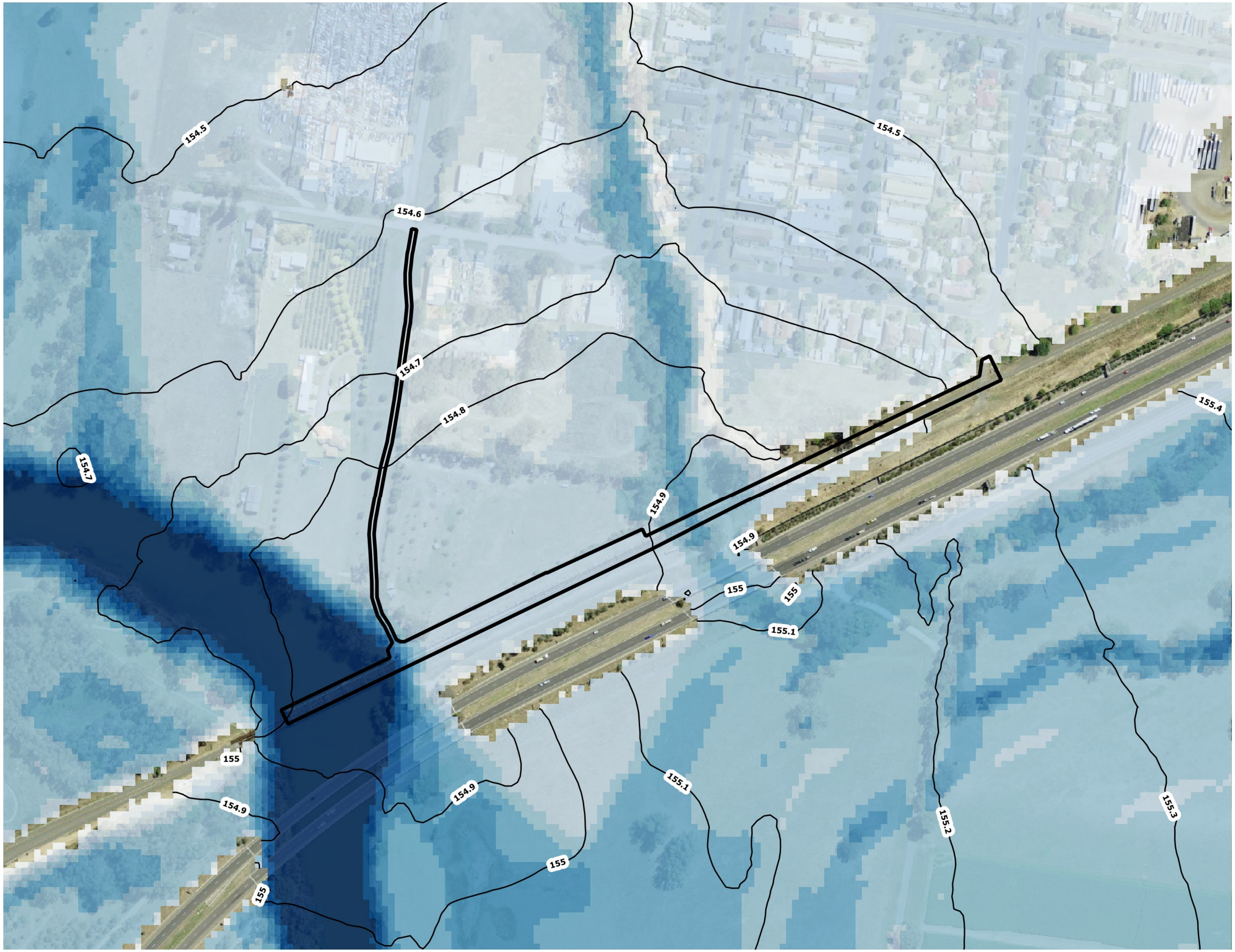
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A3 : 1% AEP Peak Flood Depth and Levels (Existing Condition)



MARTINUS
aurecon BG&E

Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

0 190 380 m

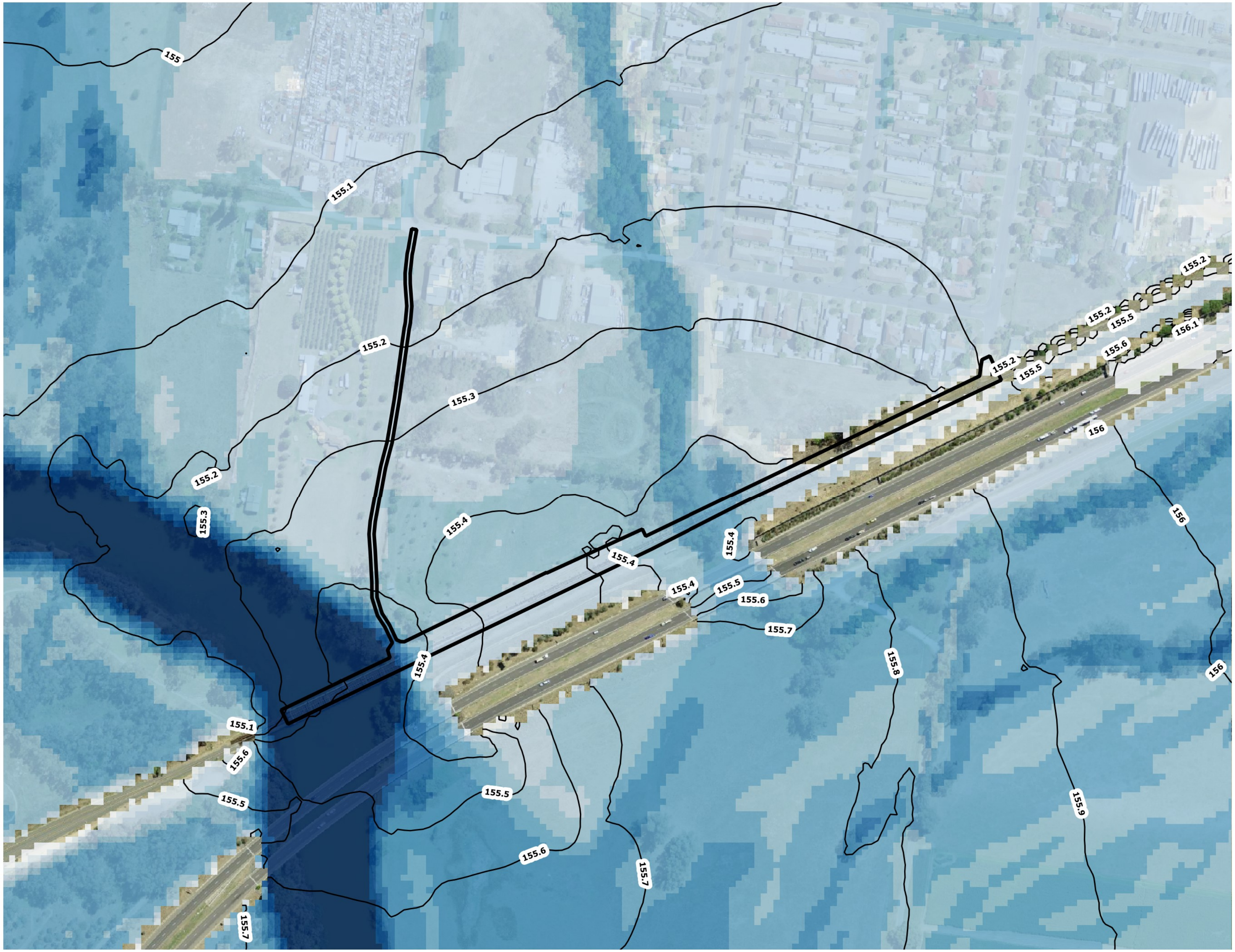
A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A4 : 0.5% AEP (Climate Change Scenario 1) Peak Flood Depth and Levels (Existing Condition)

MARTINUS
aurecon
BG&E



Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

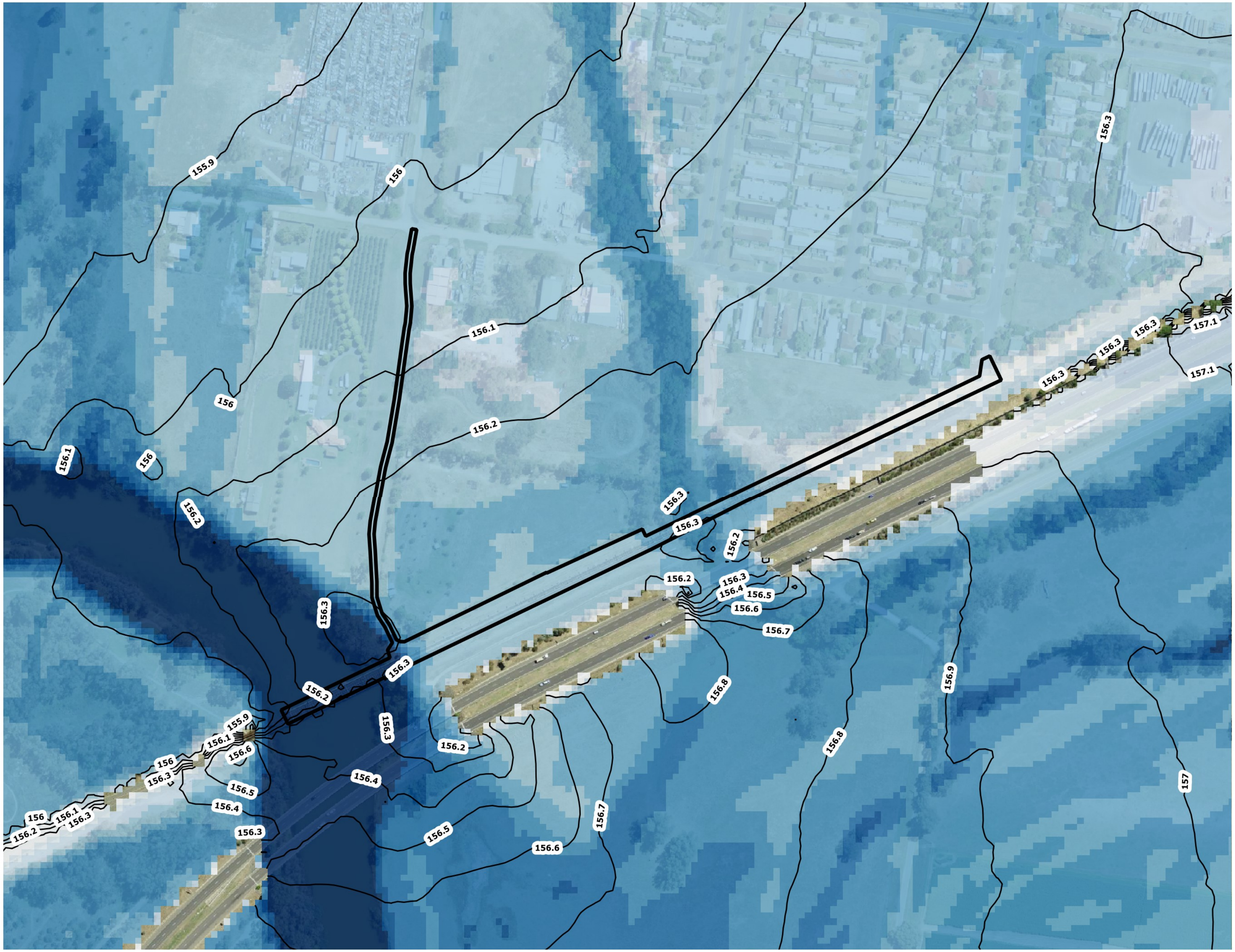
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A5 : 0.2% AEP (Climate Change Scenario 2) Peak Flood Depth and Levels (Existing Condition)



MARTINUS
aurecon BG&E

Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

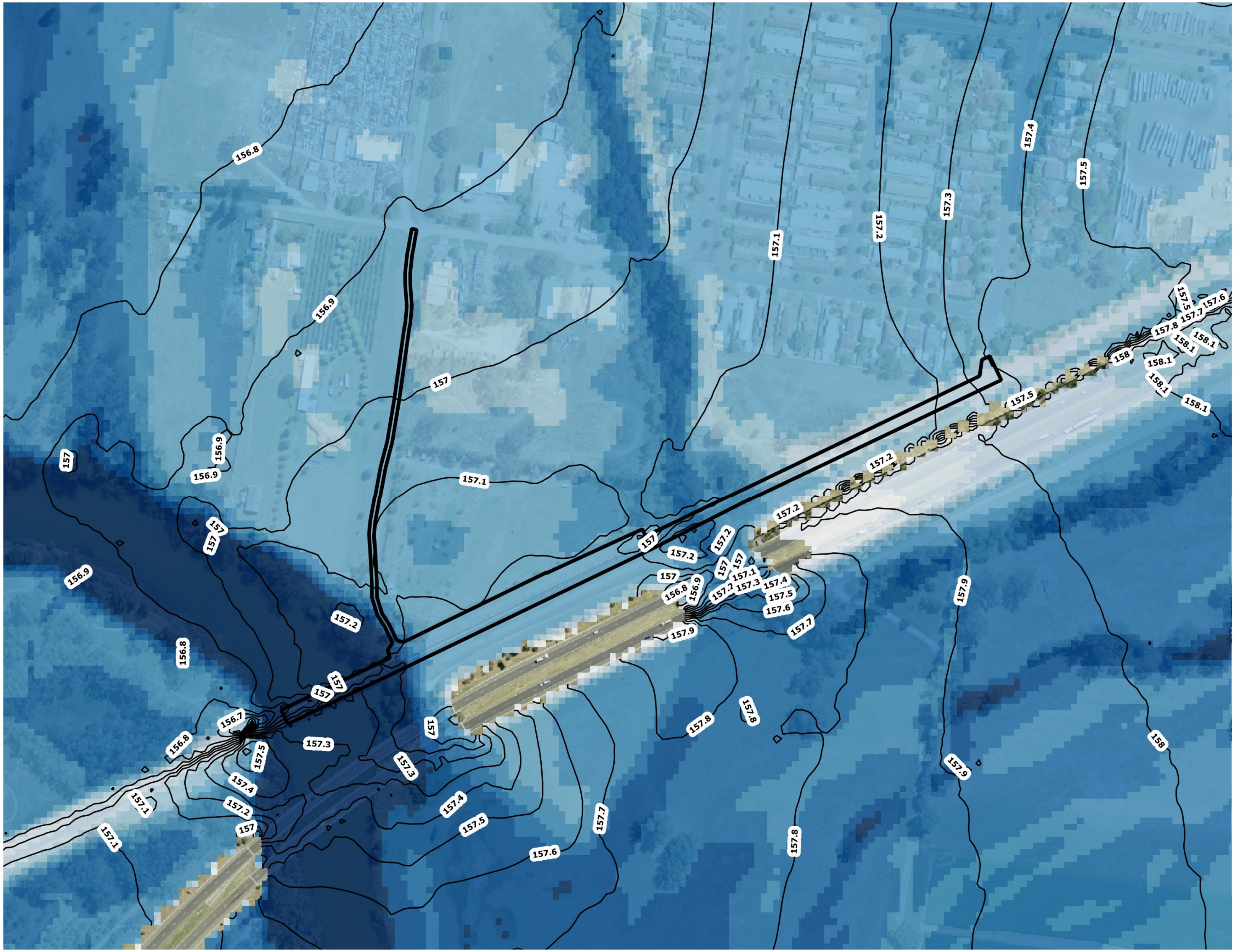
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A6 : 0.05% AEP (Bridge Assessment) Peak Flood Depth and Levels (Existing Condition)



MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

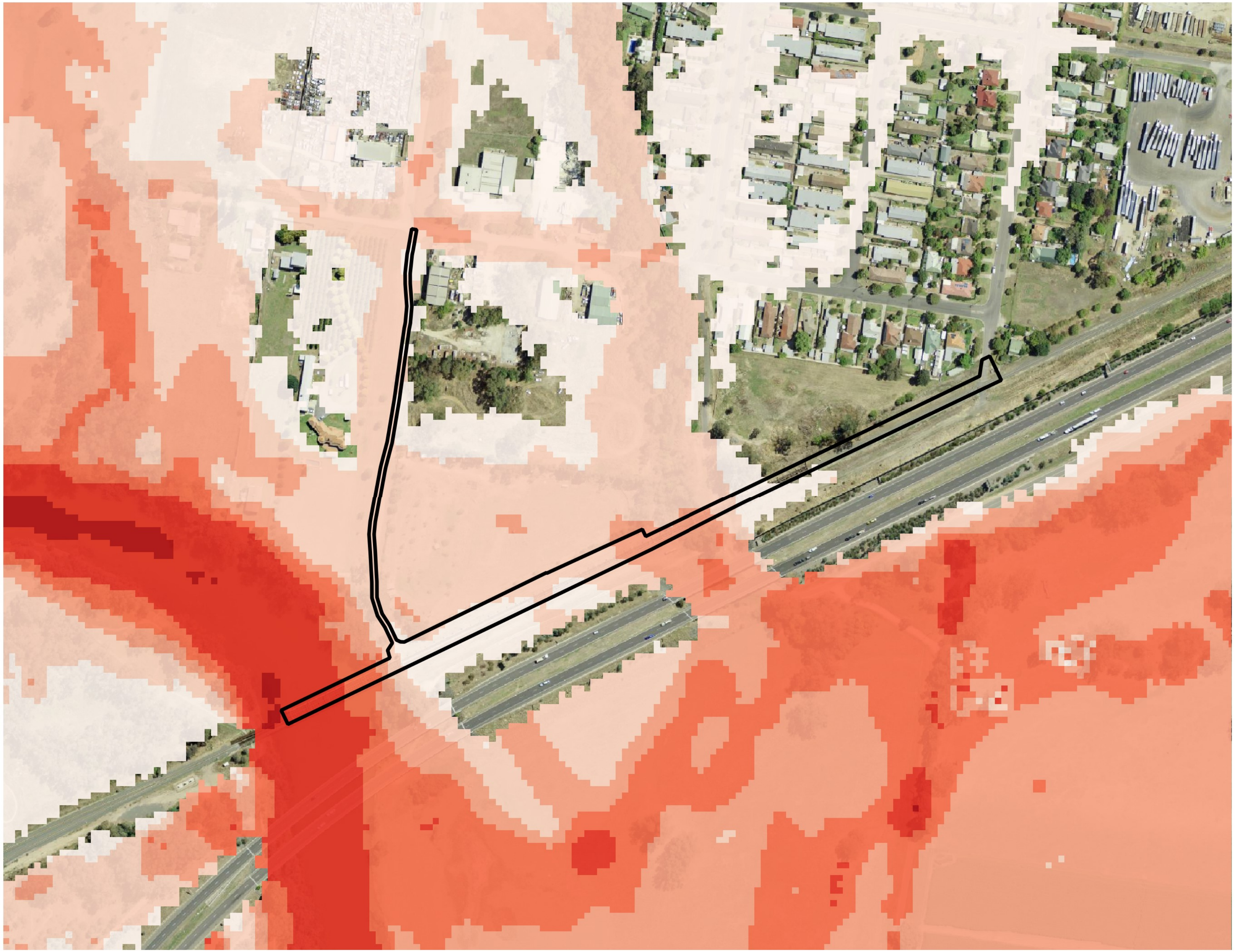
Figure A7 : PMF Peak Flood Depth and Levels (Existing Condition)

MARTINUS aurecon BG&E

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A8 : 5% AEP Peak Flood Velocity (Existing Condition)



MARTINUS
aurecon
BG&E

Legend

Project Boundary

Peak Flood Velocity (m/s)

- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 100 - 1.50
- 1.50 - 2.00
- > 2.00

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A9 : 2% AEP Peak Flood Velocity (Existing Condition)

MARTINUS
aurecon
BG&E

Legend

Project Boundary

Peak Flood Velocity (m/s)

- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 100 - 1.50
- 1.50 - 2.00
- > 2.00

Notes:

DRAFT

Map by: JPE

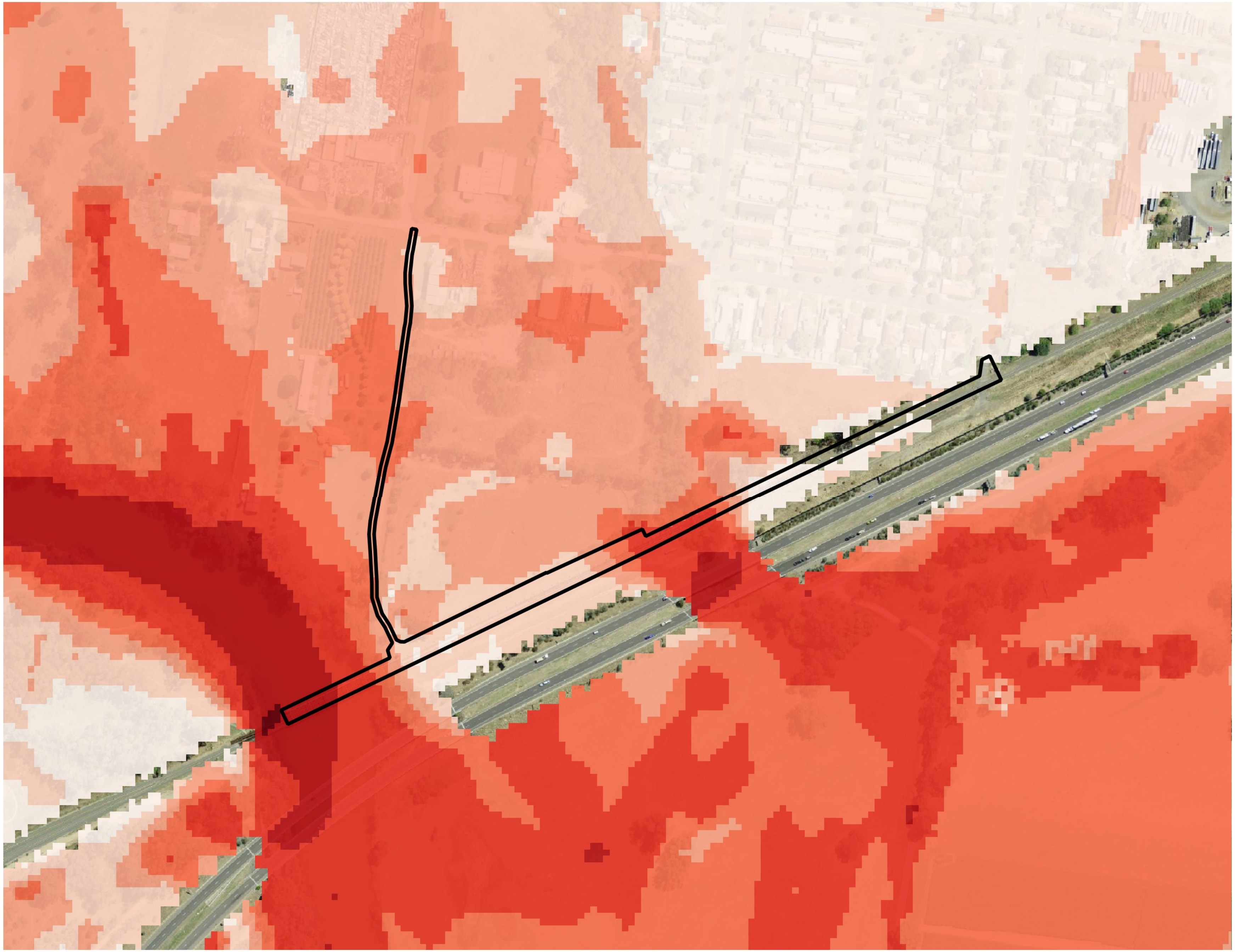
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A10 : 1% AEP Peak Flood Velocity (Existing Condition)



MARTINUS
aurecon
BG&E

Legend

Project Boundary

Peak Flood Velocity (m/s)

- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 100 - 1.50
- 1.50 - 2.00
- > 2.00

Notes:

DRAFT

Map by: JPE

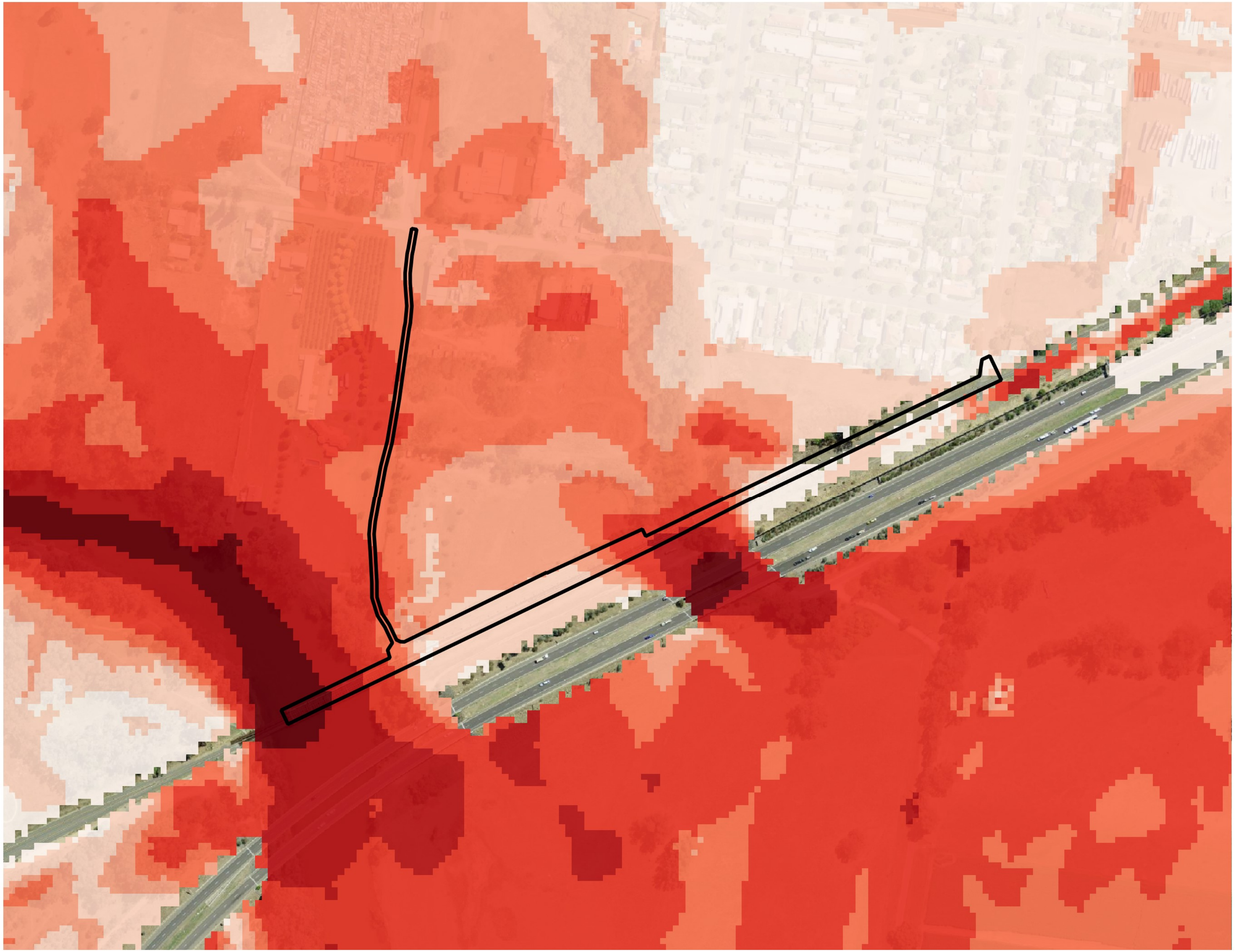
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A11 : 0.5% AEP (Climate Change Scenario 1) Peak Flood Velocity (Existing Condition)



MARTINUS
aurecon BG&E

Legend

Project Boundary
Peak Flood Velocity (m/s)
<= 0.25
0.25 - 0.50
0.50 - 0.75
0.75 - 1.00
100 - 1.50
1.50 - 2.00
> 2.00

Notes:

DRAFT

Map by: JPE

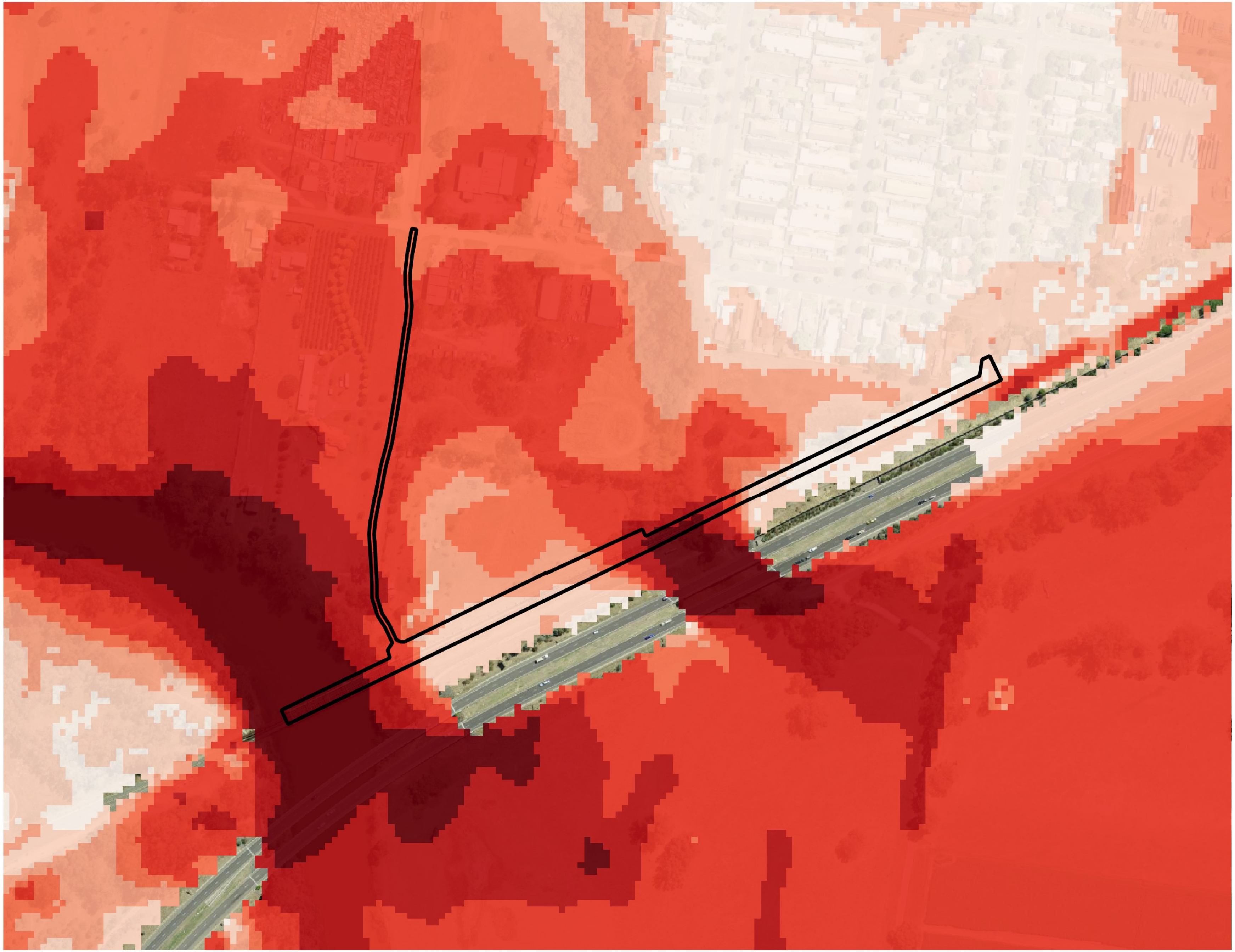
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A12 : 0.2% AEP (Climate Change Scenario 2) Peak Flood Velocity (Existing Condition)



MARTINUS
aurecon
BG&E

Legend

Project Boundary
Peak Flood Velocity (m/s)
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 100 - 1.50
- 1.50 - 2.00
- > 2.00

Notes:

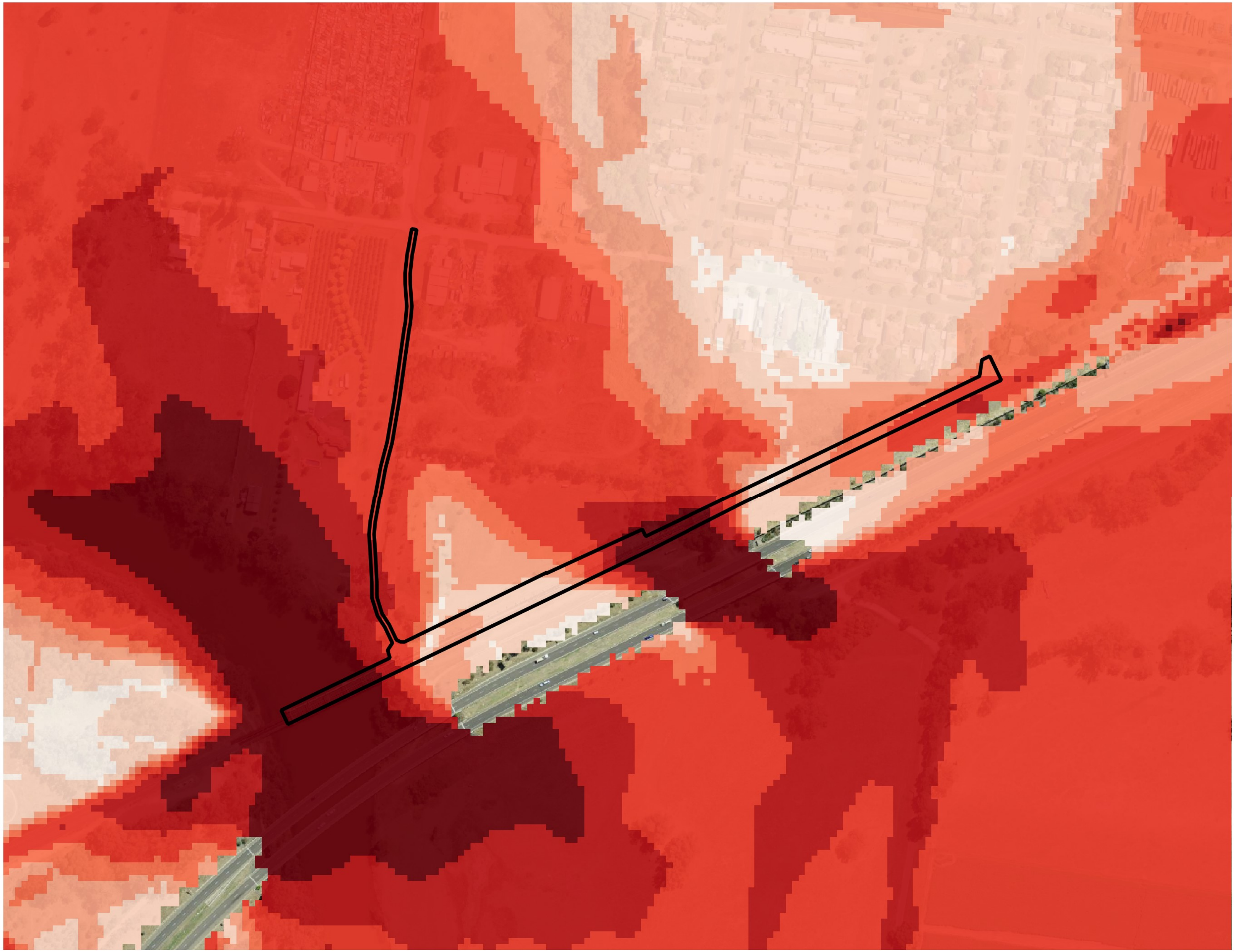
DRAFT

0 190 380 m
A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A13 : 0.05% AEP (Bridge Assessment) Peak Flood Velocity (Existing Condition)



MARTINUS
aurecon
BG&E

Legend

Project Boundary

Peak Flood Velocity (m/s)

- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 100 - 1.50
- 1.50 - 2.00
- > 2.00

Notes:

DRAFT

Map by: JPE

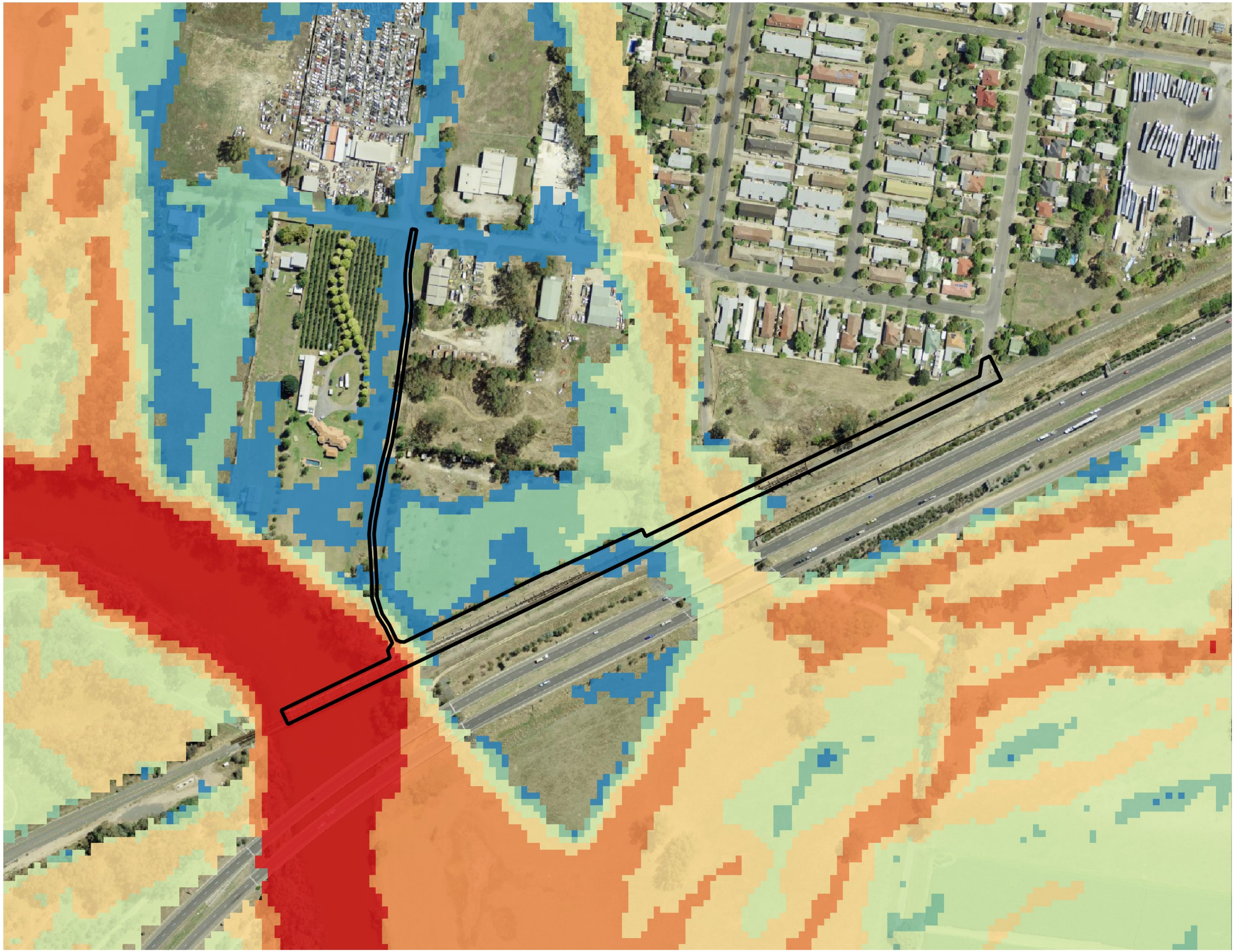
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A14 : PMF Peak Flood Velocity (Existing Condition)



Legend

Project Boundary

Peak Flood Hazard

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

Notes:

DRAFT

Map by: JPE

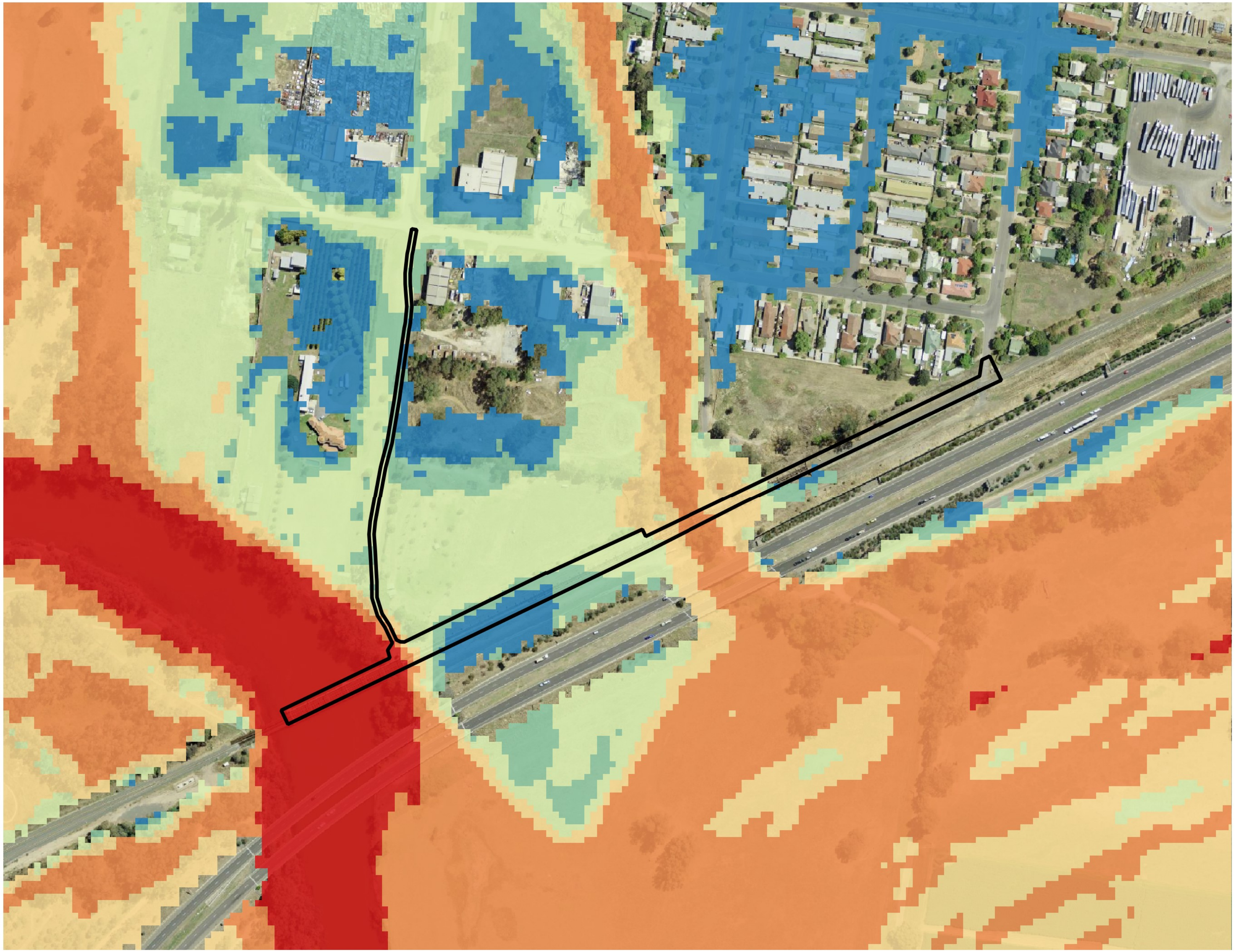
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A15 : 5% AEP Peak Flood Hazard (Existing Condition)



MARTINUS
aurecon BG&E

Legend

Project Boundary

Peak Flood Hazard

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

Notes:

DRAFT

Map by: JPE

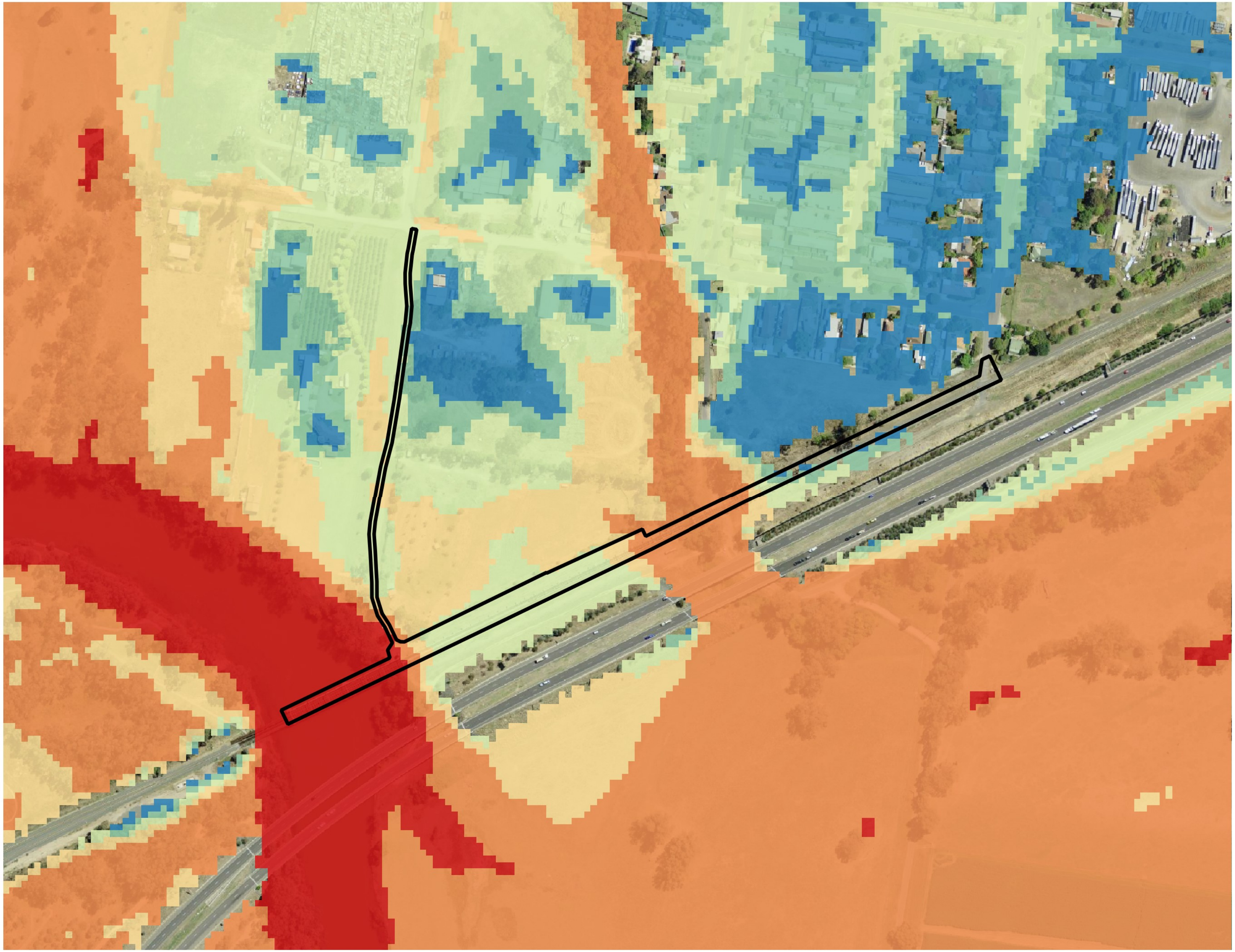
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A16 : 2% AEP Peak Flood Hazard (Existing Condition)



MARTINUS
aurecon
BG&E

Legend

Project Boundary

Peak Flood Hazard

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

Notes:

DRAFT

Map by: JPE

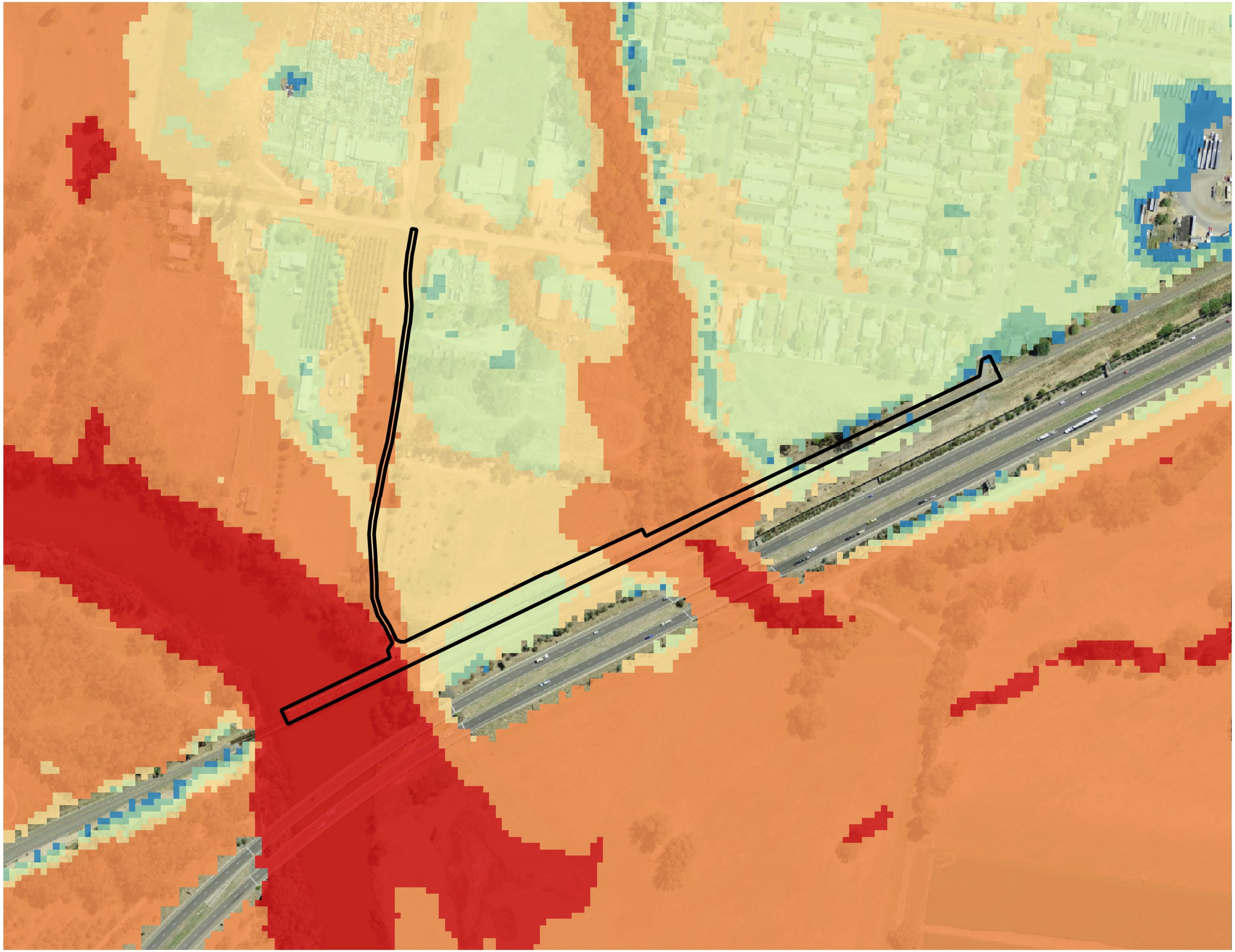
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

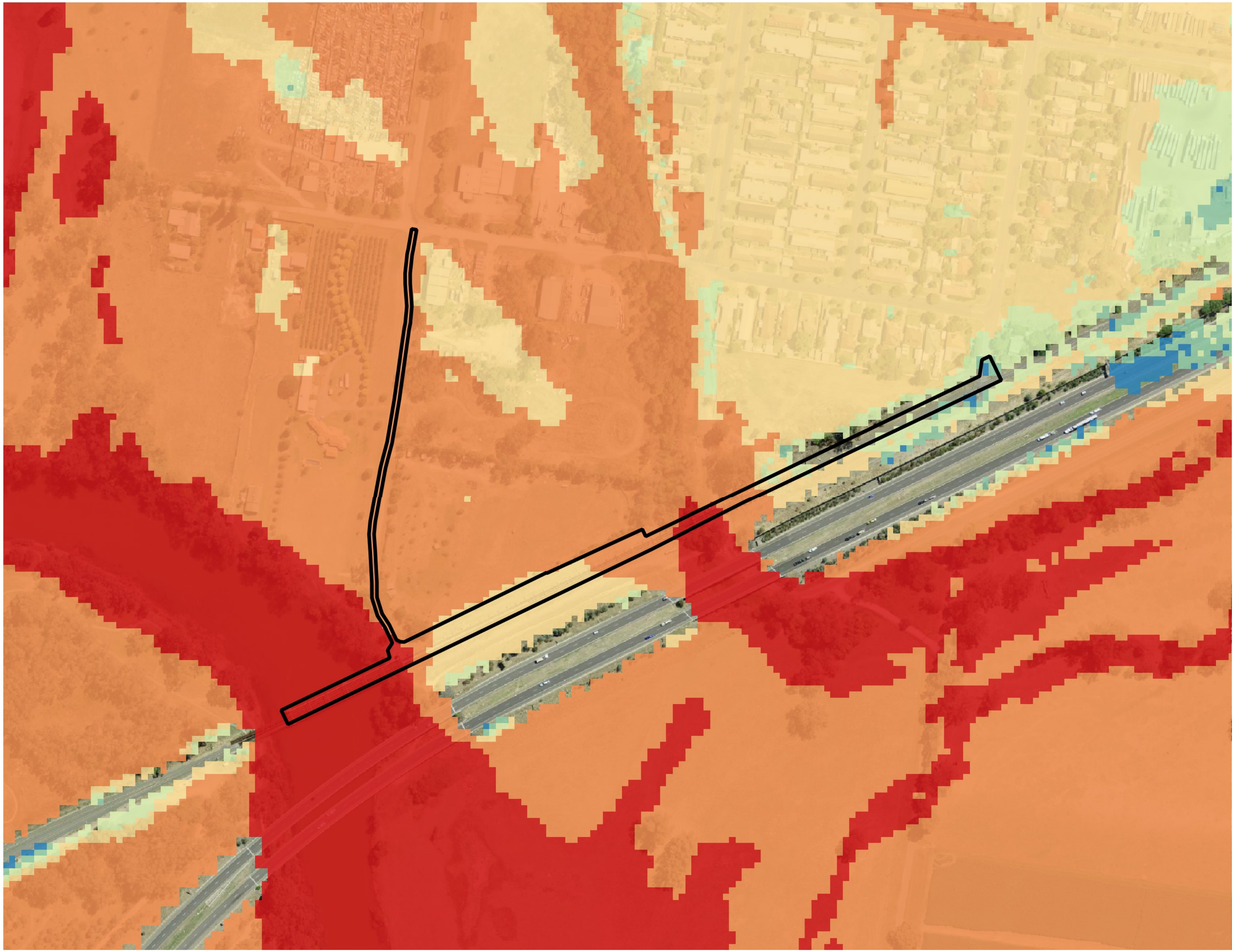
Figure A17 : 1% AEP Peak Flood Hazard (Existing Condition)



25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A18 : 0.5% AEP (Climate Change Scenario 1) Peak Flood Hazard (Existing Condition)



Legend

Project Boundary

Peak Flood Hazard

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

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A19 : 0.2% AEP (Climate Change Scenario 2) Peak Flood Hazard (Existing Condition)

MARTINUS
aurecon
BG&E

Legend

Project Boundary

Peak Flood Hazard

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

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A20 : 0.05% AEP (Bridge Assessment) Peak Flood Hazard (Existing Condition)

MARTINUS

aurecon

BG&E

Legend

Project Boundary

Peak Flood Hazard

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

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A21 : PMF Peak Flood Hazard (Existing Condition)

MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

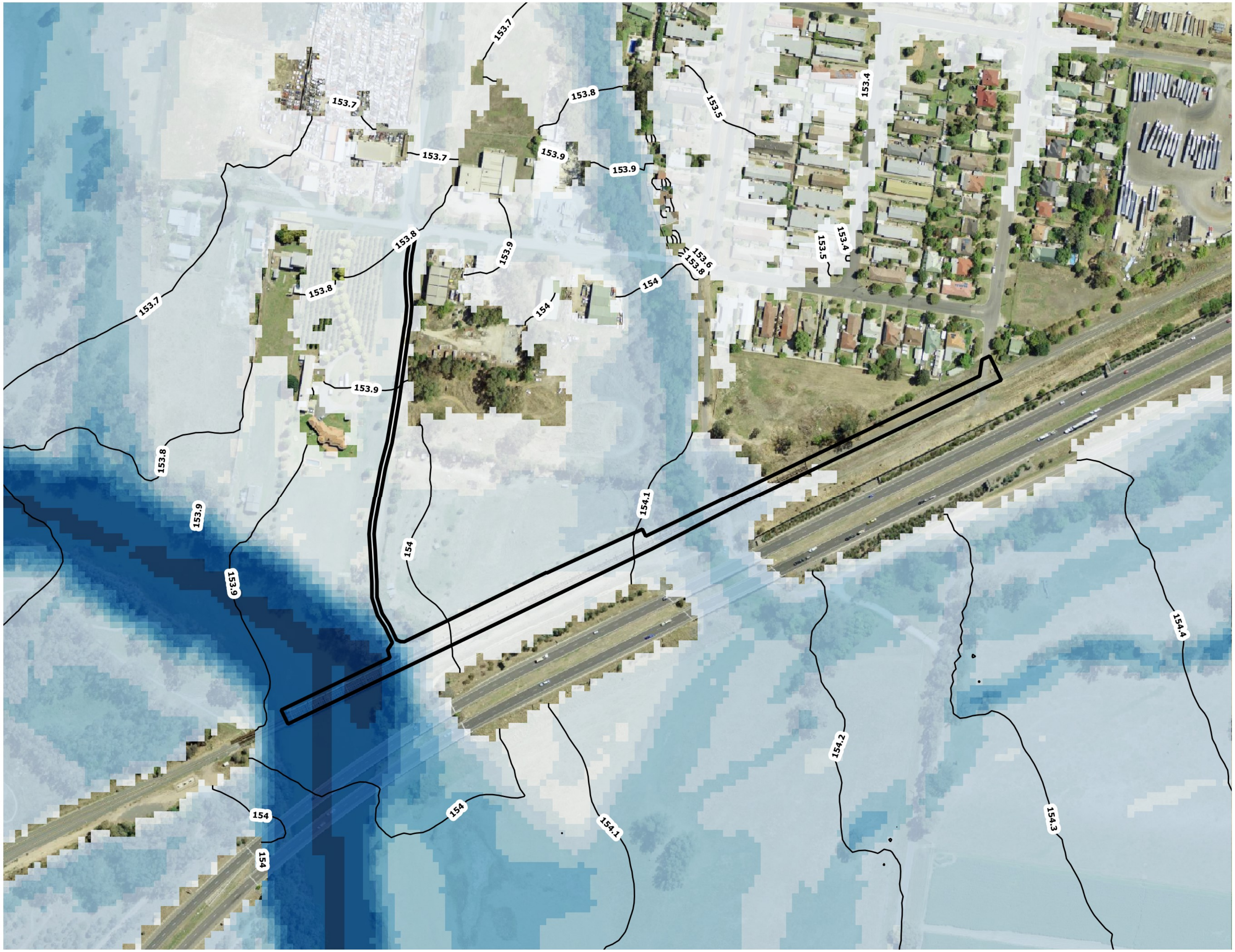
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A22 : 5% AEP Peak Flood Depth and Levels (Design Condition)



Legend

- Project Boundary

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

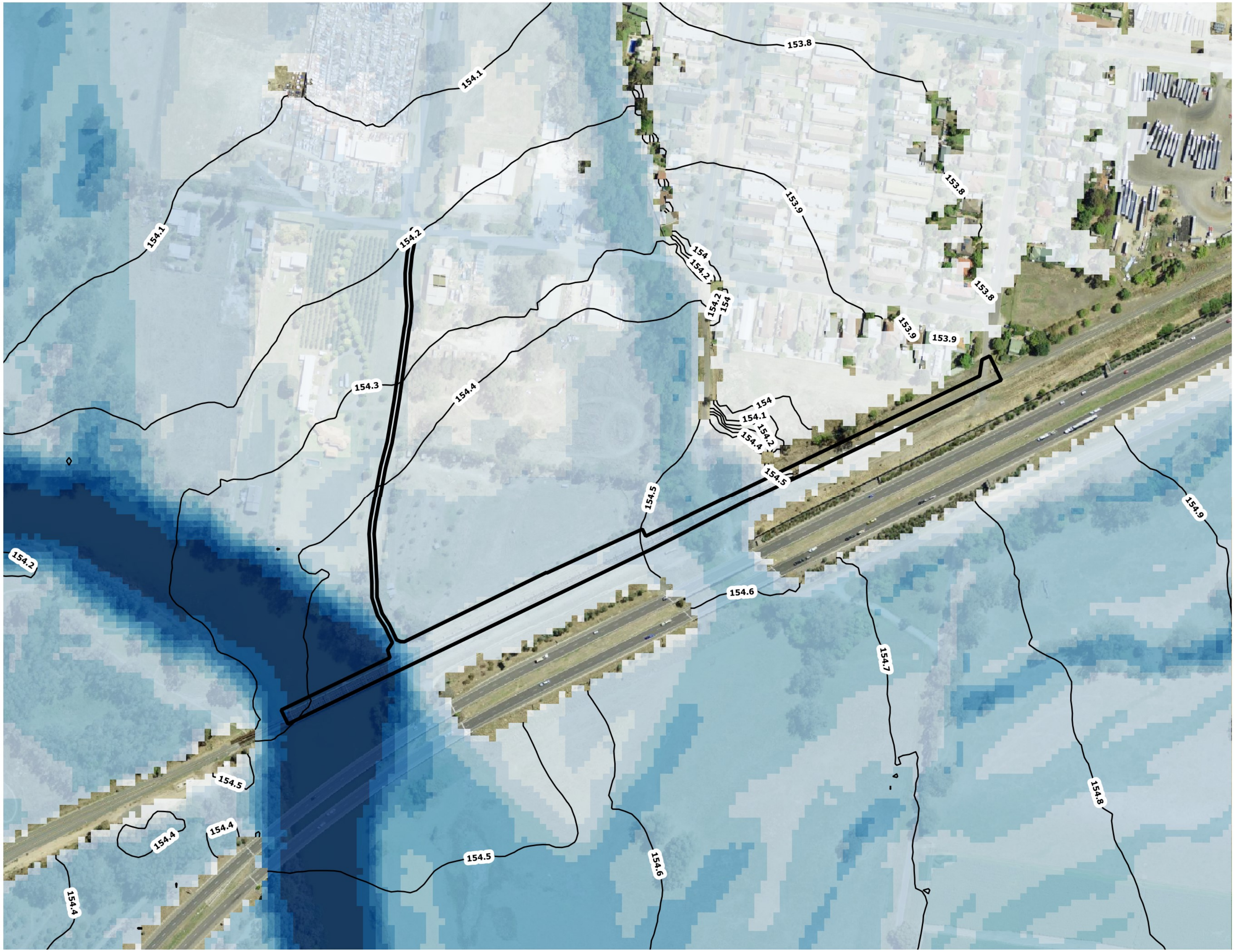
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A23 : 2% AEP Peak Flood Depth and Levels (Design Condition)



MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

0 190 380 m

A3 Scale: 1:5,000

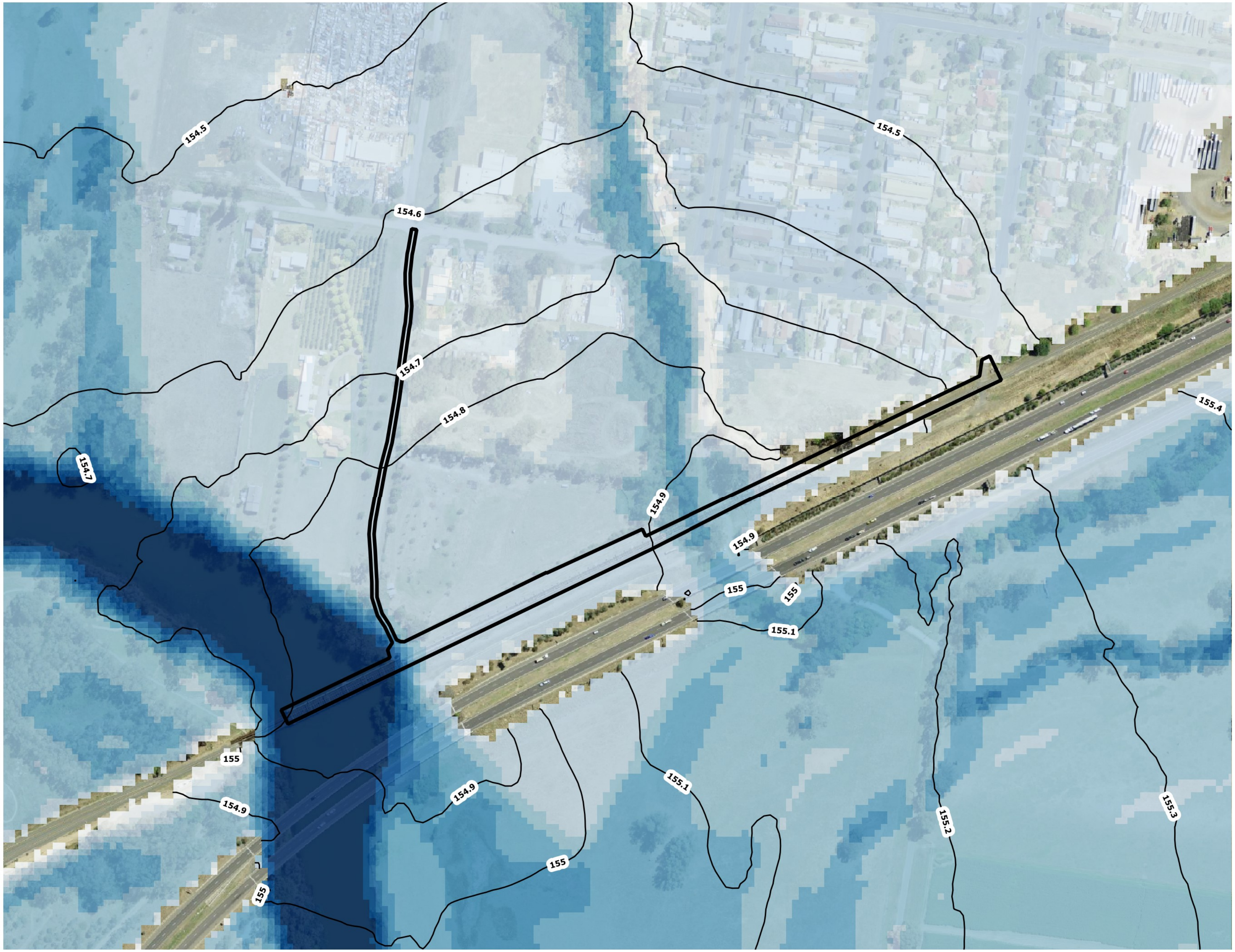
25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A24 : 1% AEP Peak Flood Depth and Levels (Design Condition)

MARTINUS

aurecon BG&E



Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

0 190 380 m

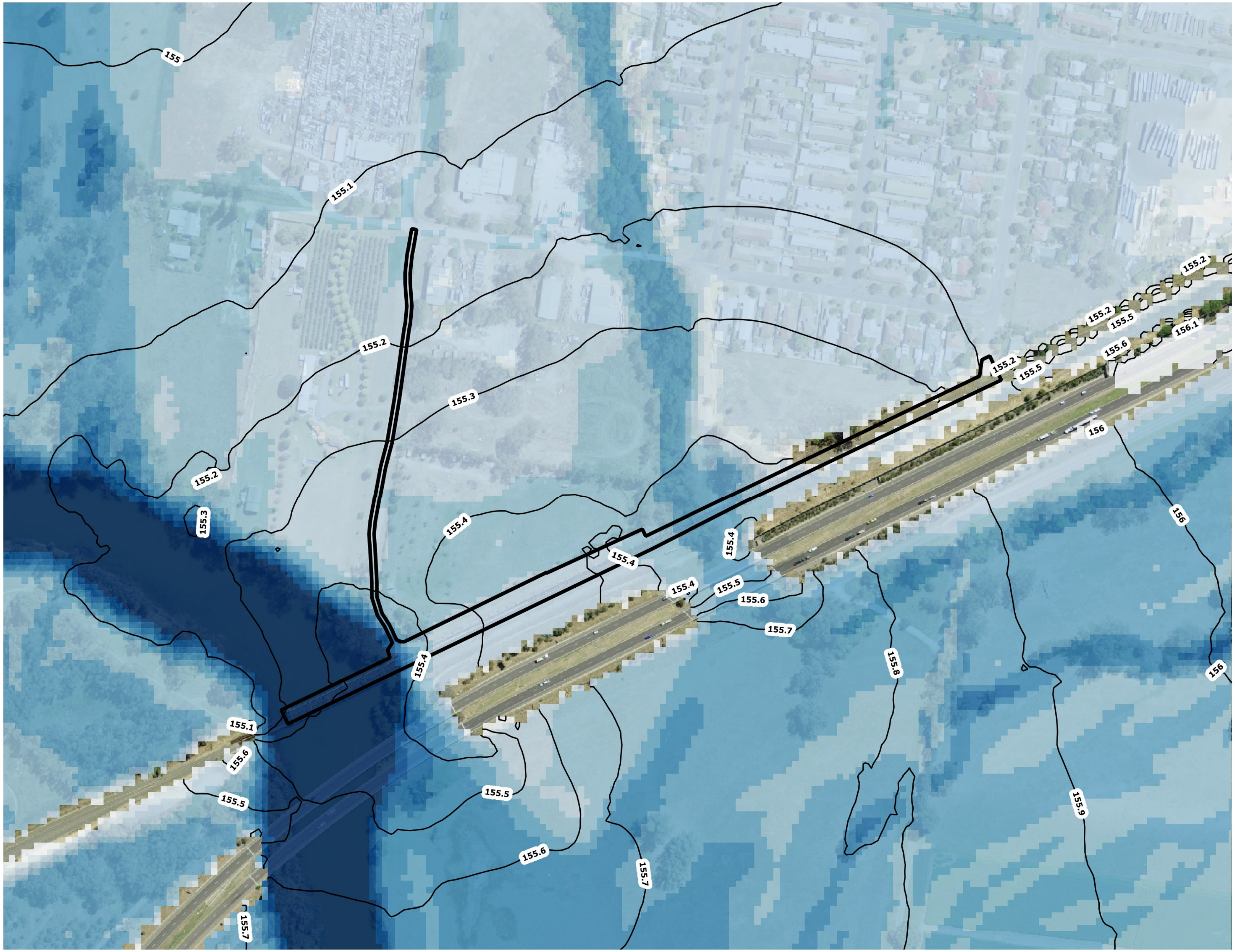
A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A25 : 0.5% AEP (Climate Change Scenario 1) Peak Flood Depth and Levels (Design Condition)

MARTINUS
aurecon
BG&E



Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

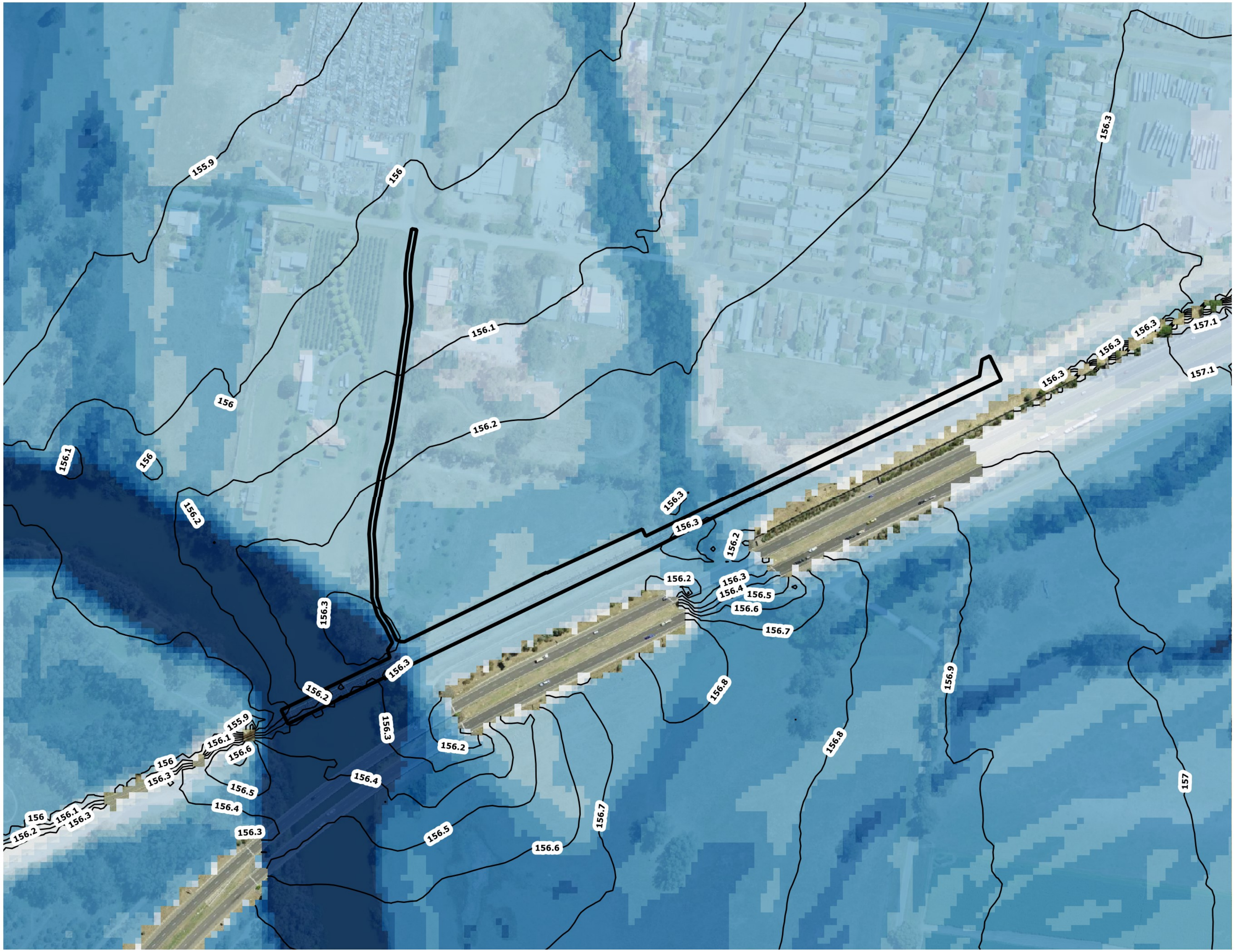
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A26 : 0.2% AEP (Climate Change Scenario 2) Peak Flood Depth and Levels (Design Condition)



MARTINUS
aurecon
BG&E

Legend

Project Boundary
Peak Flood Level (mAHD)
Peak Flood Depth (m)
<= 0.50
0.50 - 1.00
1.00 - 2.00
2.00 - 3.00
3.00 - 4.00
4.00 - 5.00
5.00 - 6.00
6.00 - 7.00
> 7.00

Notes:

DRAFT

Map by: JPE

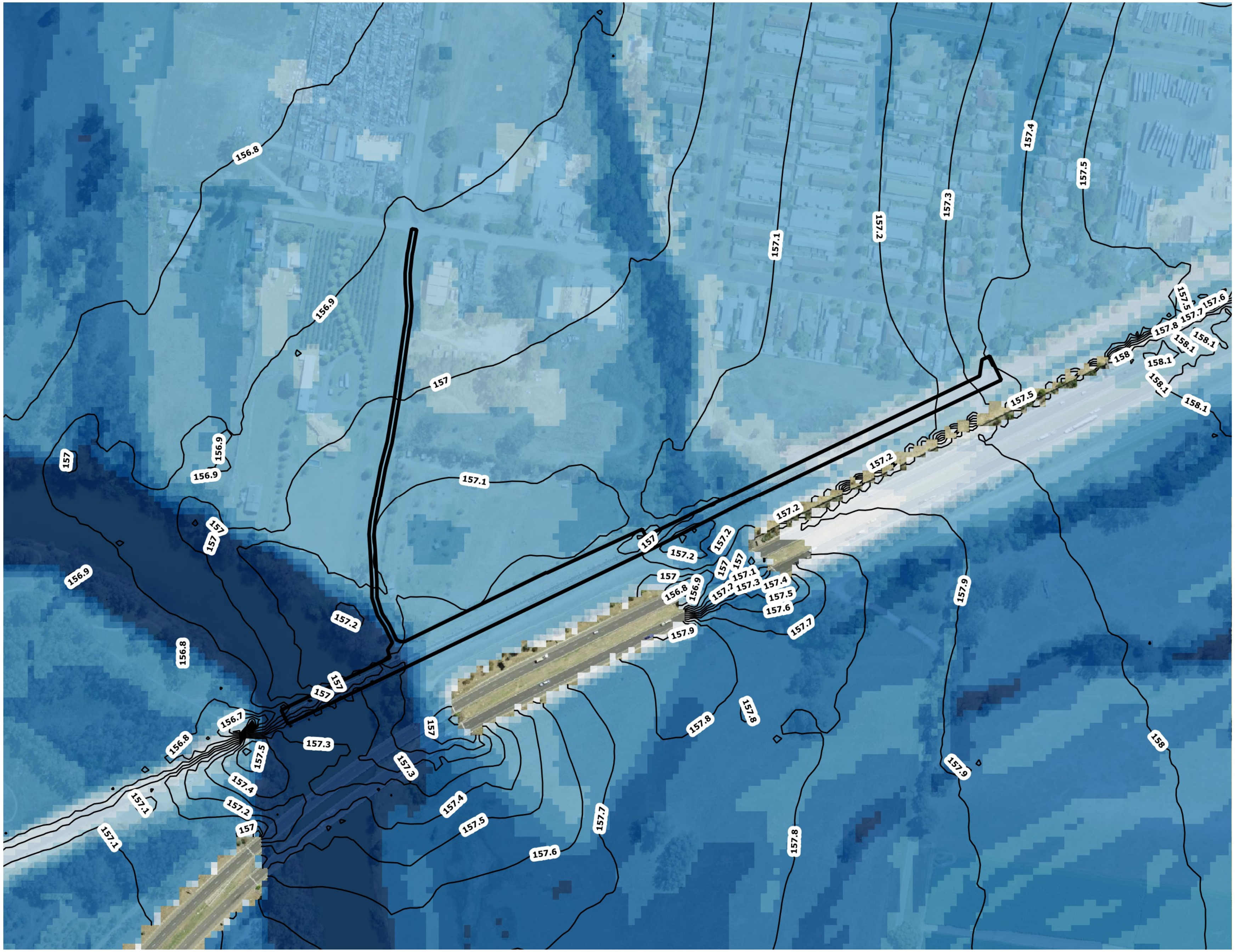
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A27 : 0.05% AEP (Bridge Assessment) Peak Flood Depth and Levels (Design Condition)



MARTINUS

aurecon BG&E

Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

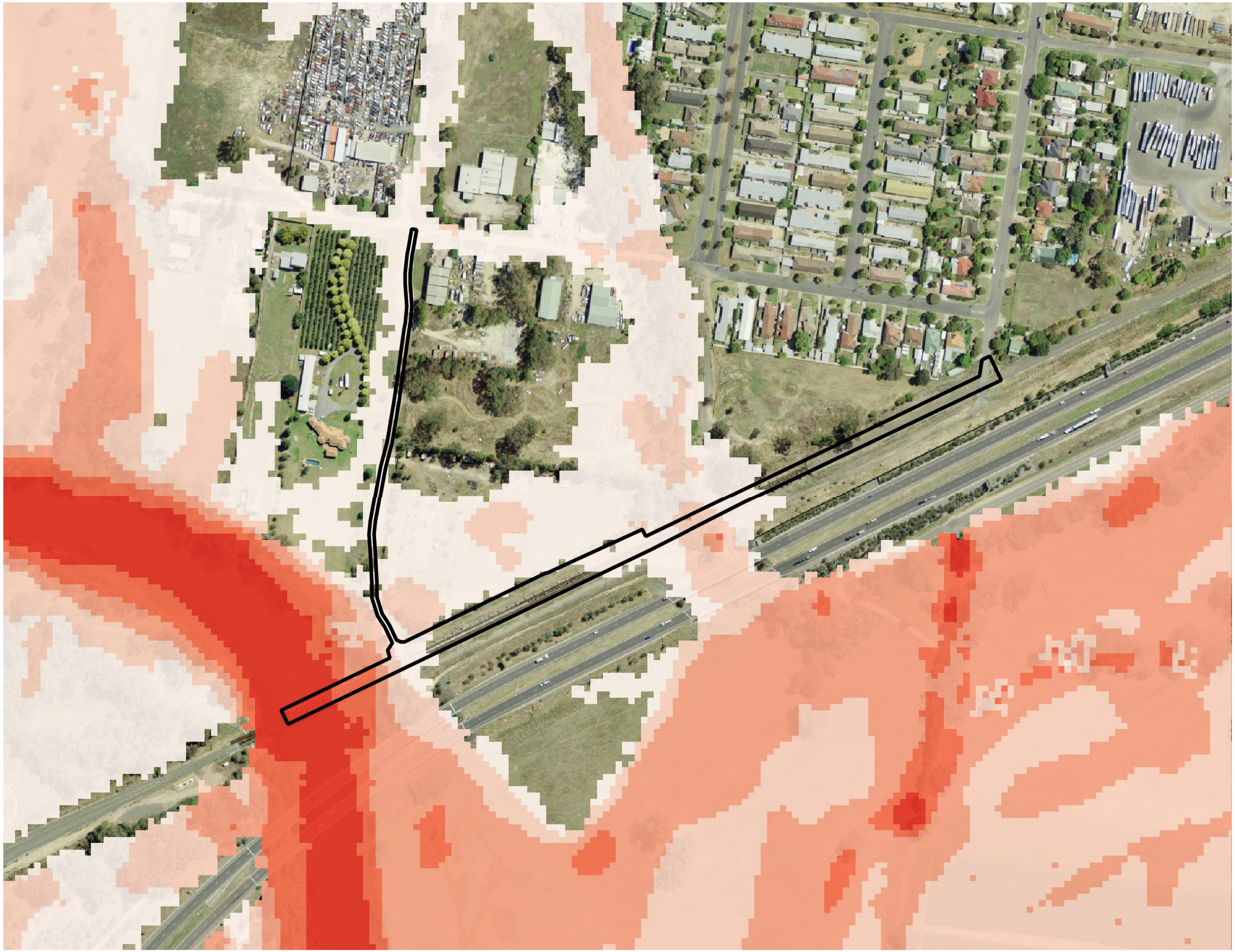
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A28 : PMF Peak Flood Depth and Levels (Design Condition)



Legend

- Project Boundary
- Peak Flood Velocity (m/s)
  - <= 0.25
  - 0.25 - 0.50
  - 0.50 - 0.75
  - 0.75 - 1.00
  - 100 - 1.50
  - 1.50 - 2.00
  - > 2.00

Notes:

DRAFT

Map by: JPE

0 190 380 m

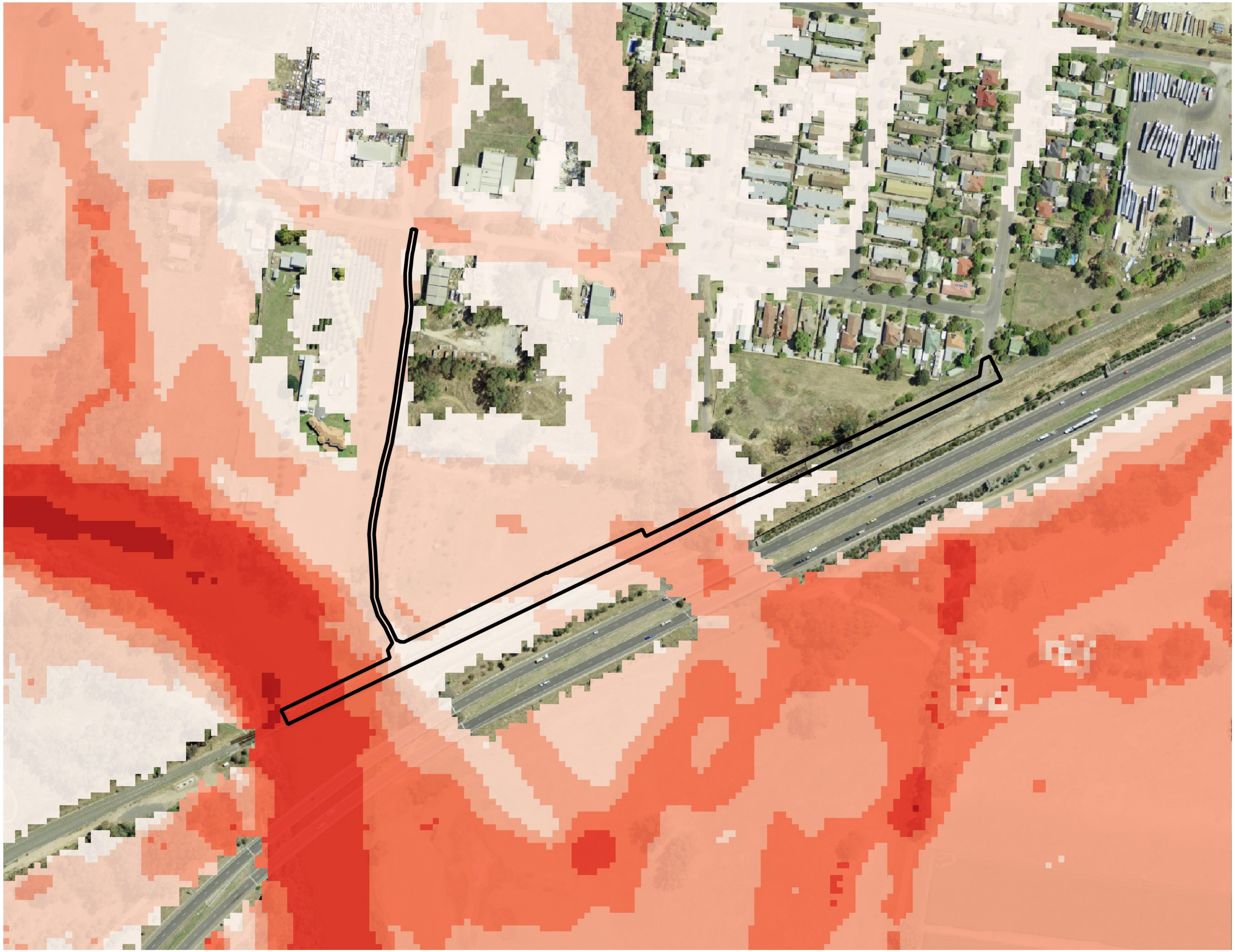
A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A29 : 5% AEP Peak Flood Velocity (Design Condition)

MARTINUS
aurecon BG&E



Legend

- Project Boundary
- Peak Flood Velocity (m/s)
  - <= 0.25
  - 0.25 - 0.50
  - 0.50 - 0.75
  - 0.75 - 1.00
  - 100 - 1.50
  - 1.50 - 2.00
  - > 2.00

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A30 : 2% AEP Peak Flood Velocity (Design Condition)

MARTINUS
aurecon BG&E

Legend

Project Boundary

Peak Flood Velocity (m/s)

- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 100 - 1.50
- 1.50 - 2.00
- > 2.00

Notes:

DRAFT

Map by: JPE

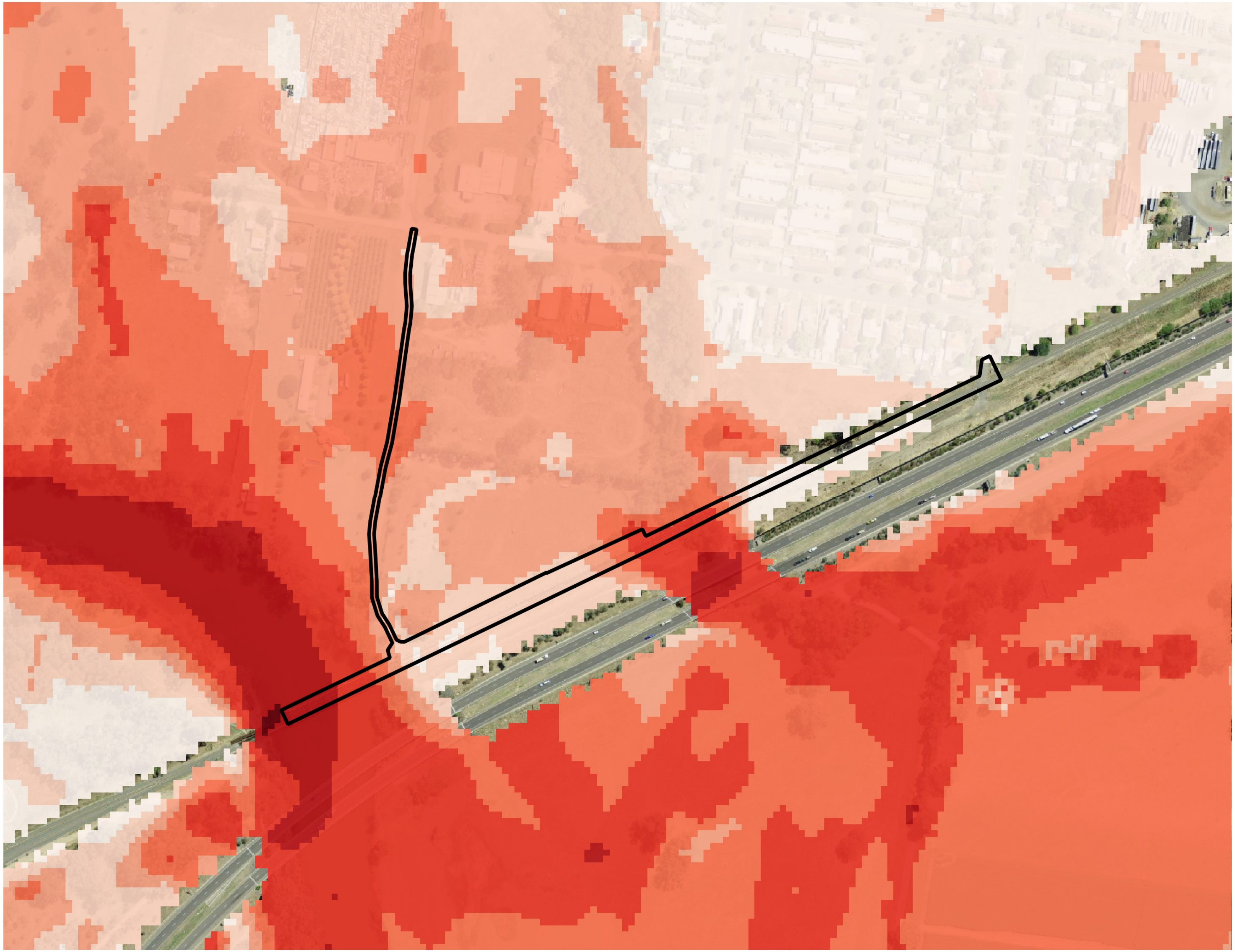
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A31 : 1% AEP Peak Flood Velocity (Design Condition)



Legend

- Project Boundary
- Peak Flood Velocity (m/s)
  - <= 0.25
  - 0.25 - 0.50
  - 0.50 - 0.75
  - 0.75 - 1.00
  - 100 - 1.50
  - 1.50 - 2.00
  - > 2.00

Notes:

DRAFT

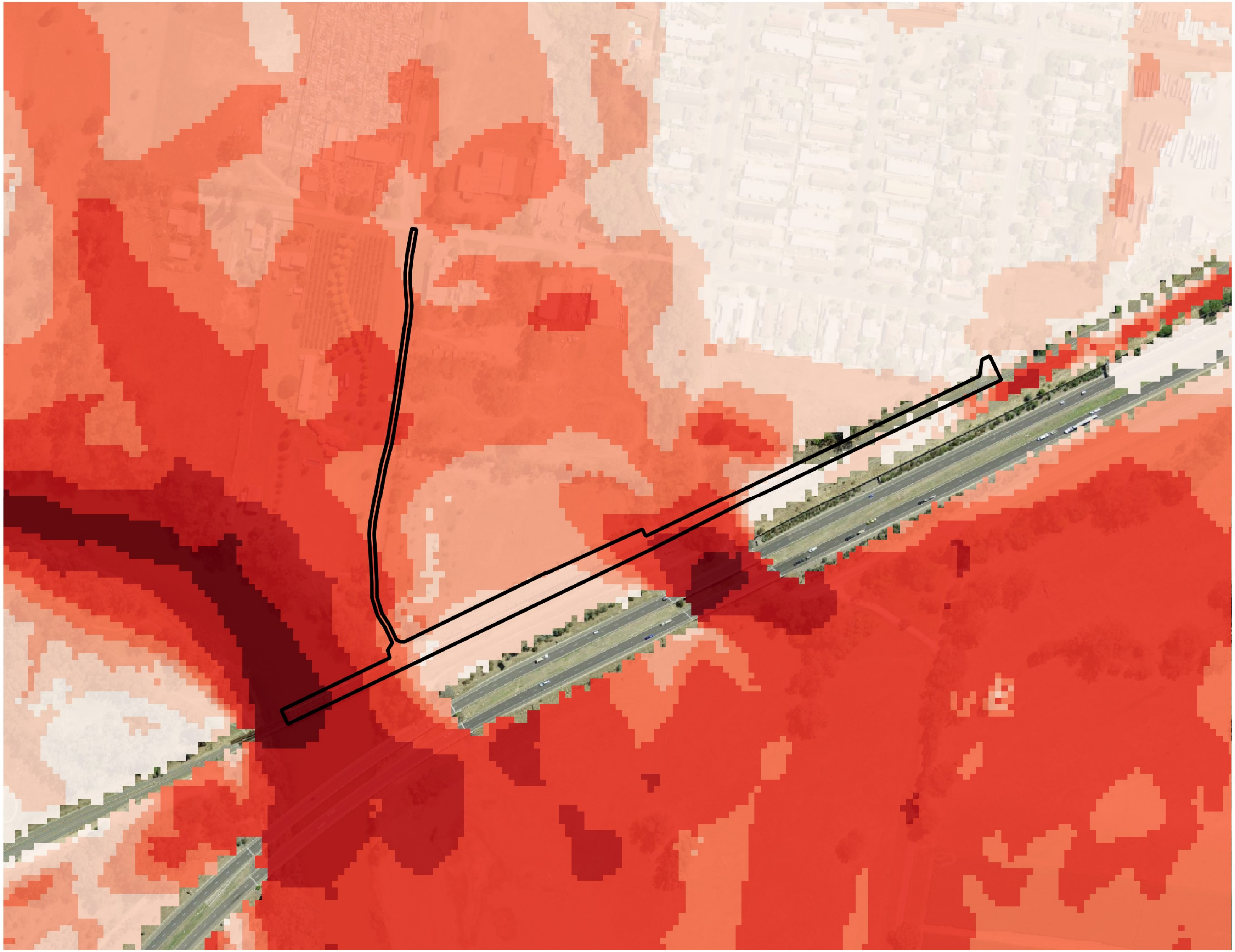
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A32 : 0.5% AEP (Climate Change Scenario 1) Peak Flood Velocity (Design Condition)



MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Peak Flood Velocity (m/s)
  - <= 0.25
  - 0.25 - 0.50
  - 0.50 - 0.75
  - 0.75 - 1.00
  - 100 - 1.50
  - 1.50 - 2.00
  - > 2.00

Notes:

DRAFT

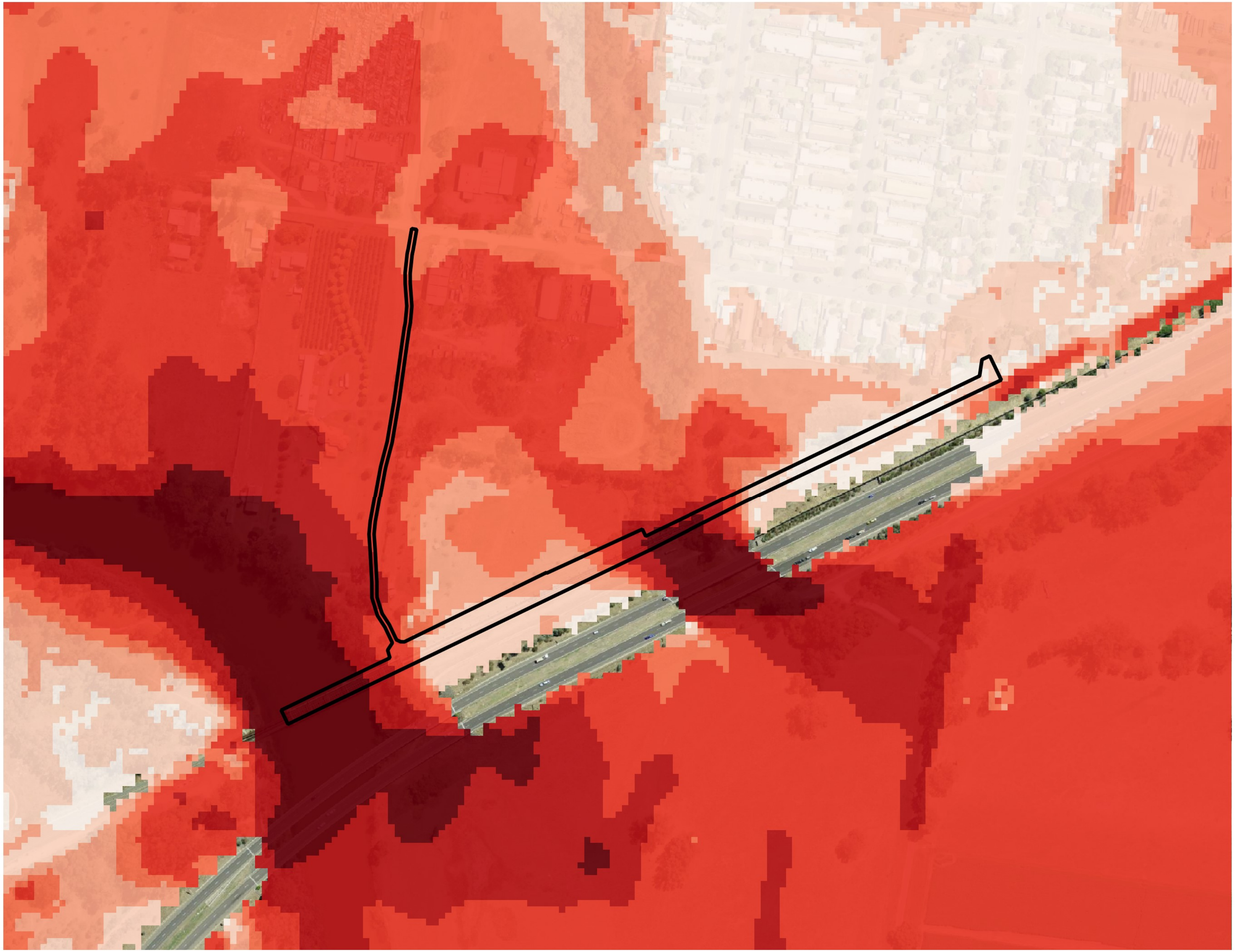
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A33 : 0.2% AEP (Climate Change Scenario 2) Peak Flood Velocity (Design Condition)



Legend

- Project Boundary
- Peak Flood Velocity (m/s)
  - <= 0.25
  - 0.25 - 0.50
  - 0.50 - 0.75
  - 0.75 - 1.00
  - 100 - 1.50
  - 1.50 - 2.00
  - > 2.00

Notes:

DRAFT

Map by: JPE

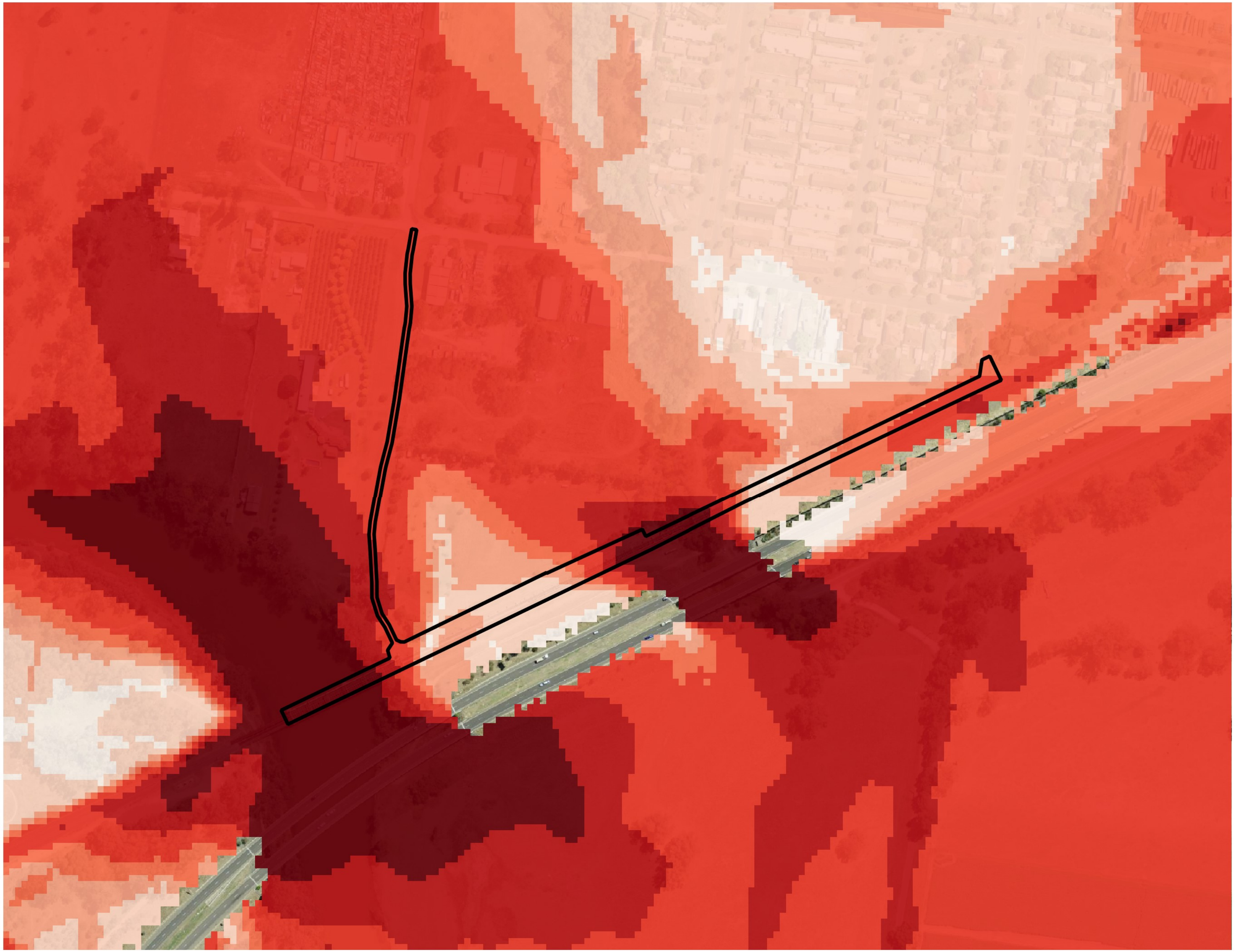
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A34 : 0.05% AEP (Bridge Assessment) Peak Flood Velocity (Design Condition)



MARTINUS
aurecon BG&E

Legend

- Project Boundary
- Peak Flood Velocity (m/s)
  - <= 0.25
  - 0.25 - 0.50
  - 0.50 - 0.75
  - 0.75 - 1.00
  - 100 - 1.50
  - 1.50 - 2.00
  - > 2.00

Notes:

DRAFT

Map by: JPE

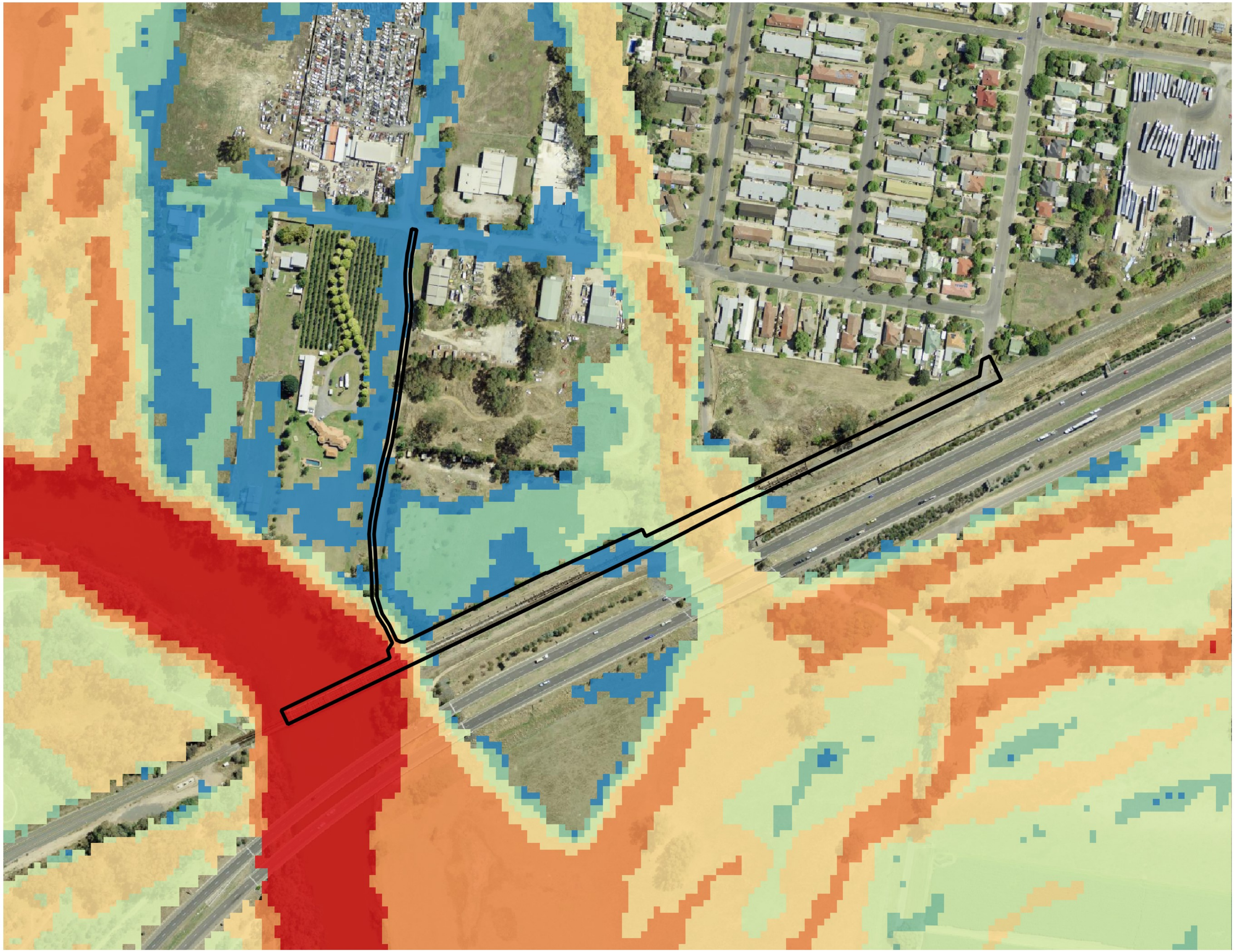
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A35 : PMF Peak Flood Velocity (Design Condition)



MARTINUS
aurecon BG&E

Legend

Project Boundary

Peak Flood Hazard

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

Notes:

DRAFT

Map by: JPE

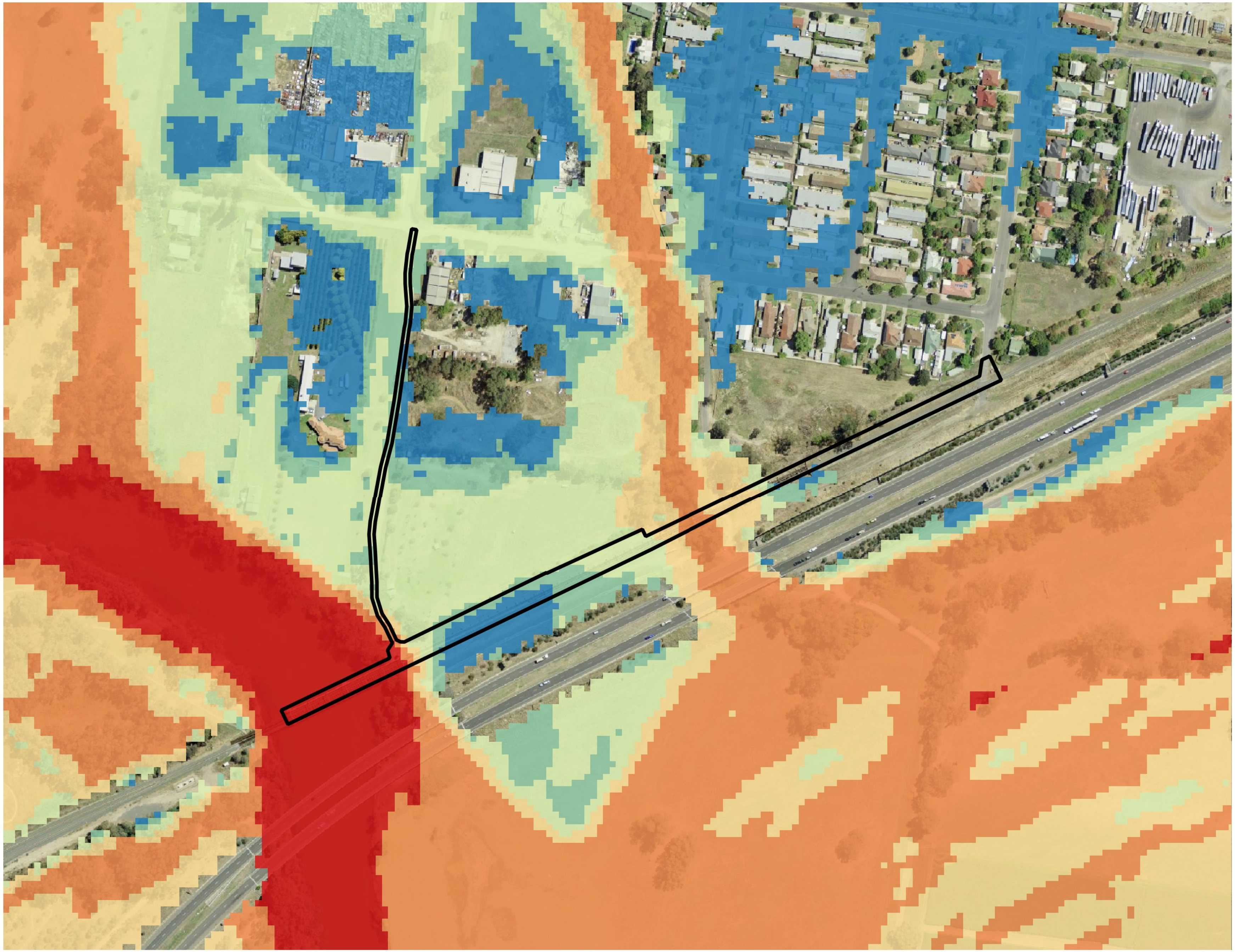
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A36 : 5% AEP Peak Flood Hazard (Design Condition)



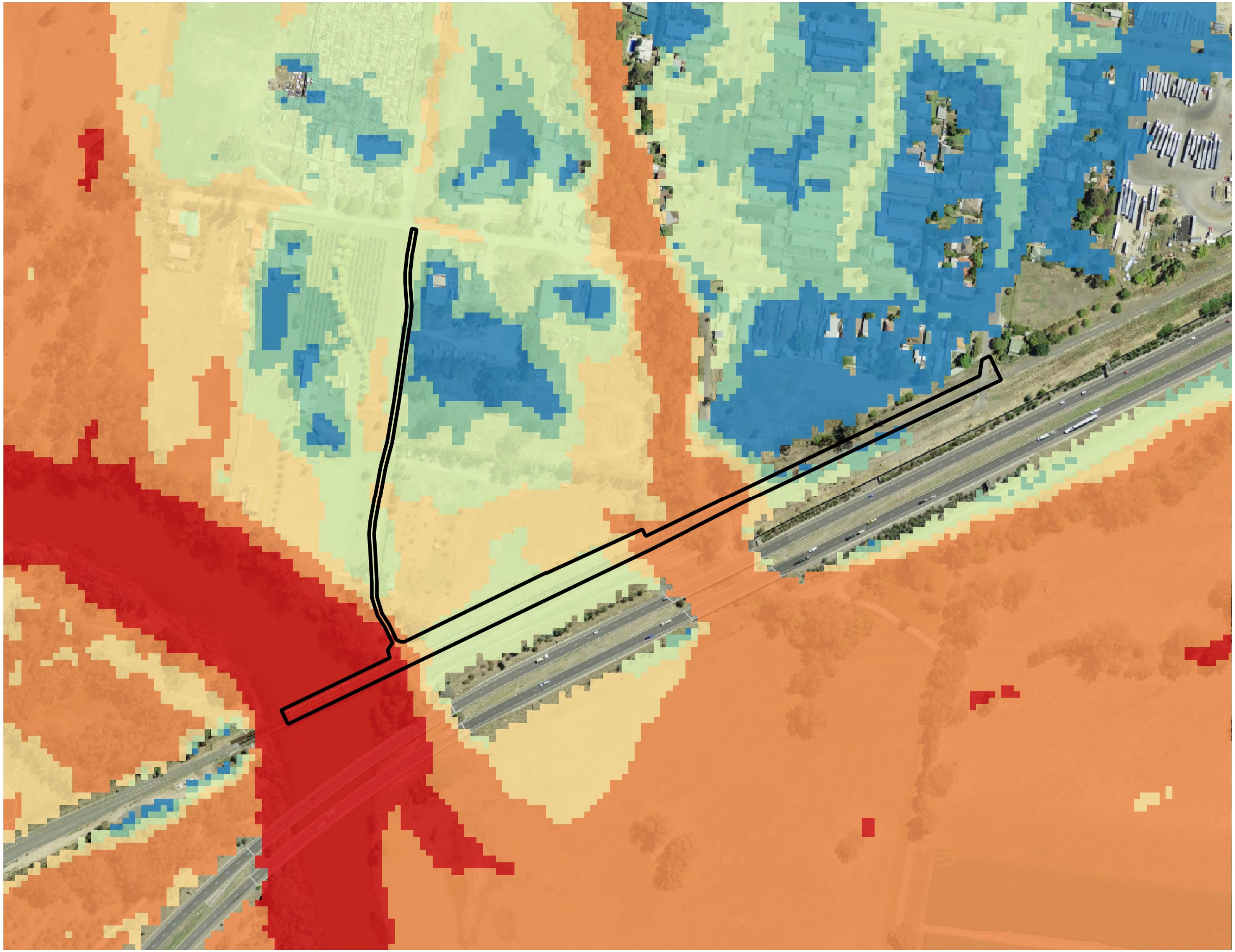
Notes:

DRAFT

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A37 : 2% AEP Peak Flood Hazard (Design Condition)



Legend

Project Boundary

Peak Flood Hazard

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

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A38 : 1% AEP Peak Flood Hazard (Design Condition)

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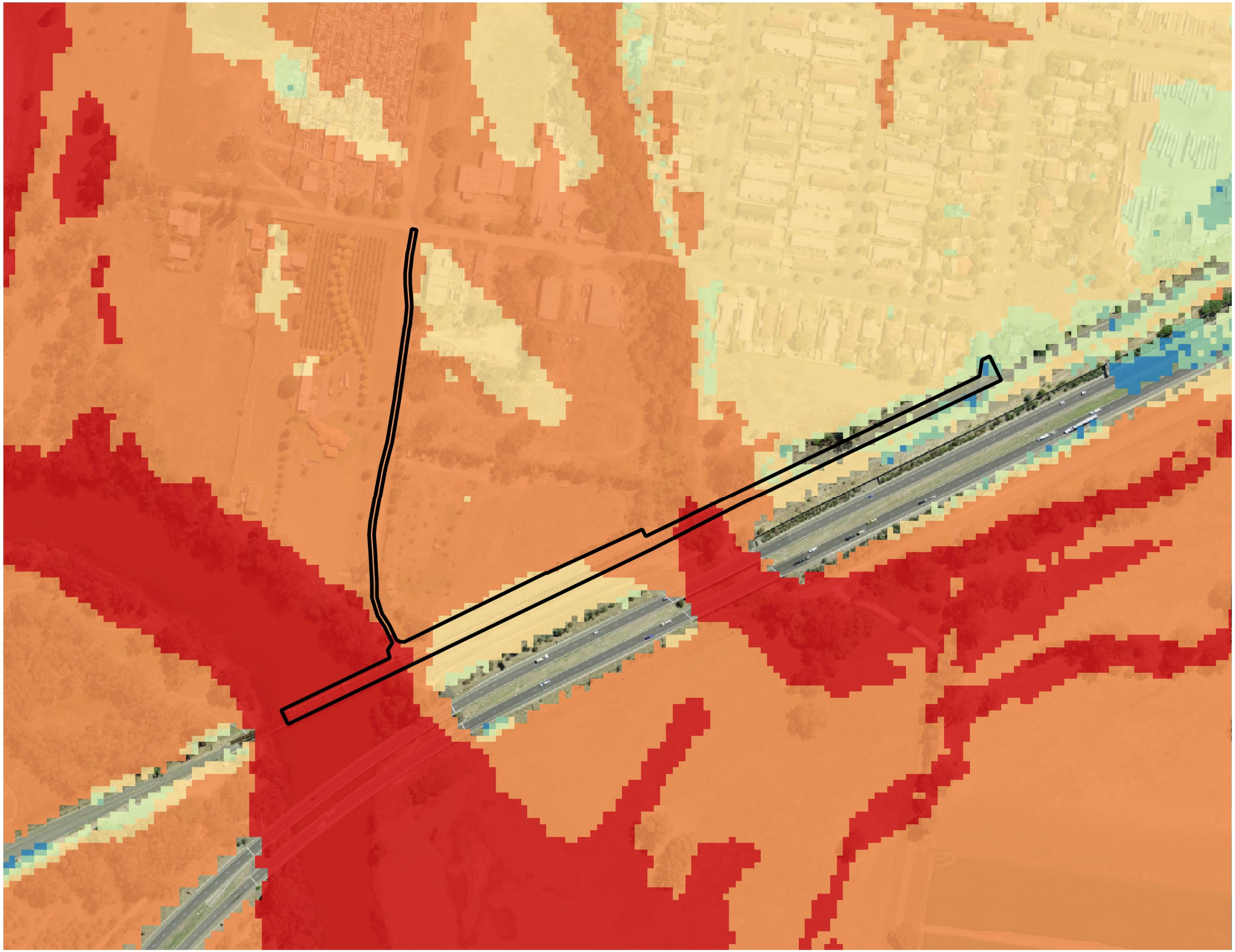
Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A39 : 0.5% AEP (Climate Change Scenario 1) Peak Flood Hazard (Design Condition)



MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Peak Flood Hazard
  - H1
  - H2
  - H3
  - H4
  - H5
  - H6

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A40 : 0.2% AEP (Climate Change Scenario 2) Peak Flood Hazard (Design Condition)

MARTINUS
aurecon
BG&E

Legend

Project Boundary
Peak Flood Hazard
H1
H2
H3
H4
H5
H6

Notes:

DRAFT

Map by: JPE

0 190 380 m
A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A41 : 0.05% AEP (Bridge Assessment) Peak Flood Hazard (Design Condition)

MARTINUS
aurecon
BG&E

Legend

Project Boundary

Peak Flood Hazard

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

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A42 : PMF Peak Flood Hazard (Design Condition)

MARTINUS
aurecon BG&E

Legend

- Project Boundary
- Changes in Peak Flood Level (m)
- Area no longer inundated
- Less than -0.25
- -0.25 to -0.15
- -0.15 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.15
- 0.15 to 0.25
- Greater than 0.25
- New area of inundation
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A43 : 5% AEP Changes in Peak Flood Depth and Levels (Design Condition vs Existing Condition)

MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Changes in Peak Flood Level (m)
  - Area no longer inundated
  - Less than -0.25
  - -0.25 to -0.15
  - -0.15 to -0.05
  - -0.05 to -0.01
  - -0.01 to 0.01
  - 0.01 to 0.05
  - 0.05 to 0.15
  - 0.15 to 0.25
  - Greater than 0.25
  - New area of inundation
  - Was Wet Now Dry
  - Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A44 : 2% AEP Changes in Peak Flood Depth and Levels (Design Condition vs Existing Condition)

MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Changes in Peak Flood Level (m)
- Area no longer inundated
- Less than -0.25
- -0.25 to -0.15
- -0.15 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.15
- 0.15 to 0.25
- Greater than 0.25
- New area of inundation
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A45 : 1% AEP Changes in Peak Flood Depth and Levels (Design Condition vs Existing Condition)

MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Changes in Peak Flood Level (m)
- Area no longer inundated
- Less than -0.25
- -0.25 to -0.15
- -0.15 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.15
- 0.15 to 0.25
- Greater than 0.25
- New area of inundation
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A46 : 0.5% AEP (Climate Change Scenario 1) Changes in Peak Flood Depth and Levels (Design Condition vs Existing Condition)

MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Changes in Peak Flood Level (m)
- Area no longer inundated
- Less than -0.25
- -0.25 to -0.15
- -0.15 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.15
- 0.15 to 0.25
- Greater than 0.25
- New area of inundation
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A47 : 0.2% AEP (Climate Change Scenario 2) Changes in Peak Flood Depth and Levels (Design Condition vs Existing Condition)

MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Changes in Peak Flood Level (m)
- Area no longer inundated
- Less than -0.25
- -0.25 to -0.15
- -0.15 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.15
- 0.15 to 0.25
- Greater than 0.25
- New area of inundation
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A48 : 0.05% AEP (Bridge Assessment) Changes in Peak Flood Depth and Levels (Design Condition vs Existing Condition)

MARTINUS
aurecon
BG&E

Legend

Project Boundary

Changes in Peak Flood Level (m)

- Area no longer inundated
- Less than -0.25
- -0.25 to -0.15
- -0.15 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.15
- 0.15 to 0.25
- Greater than 0.25
- New area of inundation
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A49 : PMF Changes in Peak Flood Depth and Levels (Design Condition vs Existing Condition)

MARTINUS
aurecon
BG&E

Legend

Project Boundary

Changes in Peak Flood Velocity (m/s)

- < -0.5
- -0.5 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- > 0.5
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A50 : 5% AEP Changes in Peak Flood Velocity (Design Condition vs Existing Condition)

Legend

Project Boundary

Changes in Peak Flood Velocity (m/s)

- < -0.5
- -0.5 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- > 0.5
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A51 : 2% AEP Changes in Peak Flood Velocity (Design Condition vs Existing Condition)

Legend

- Project Boundary
- Changes in Peak Flood Velocity (m/s)
  - < -0.5
  - -0.5 - -0.2
  - -0.2 - -0.1
  - -0.1 - 0.1
  - 0.1 - 0.2
  - 0.2 - 0.5
  - > 0.5
  - Was Wet Now Dry
  - Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A52 : 1% AEP Changes in Peak Flood Velocity (Design Condition vs Existing Condition)

Legend

- Project Boundary
- Changes in Peak Flood Velocity (m/s)
- < -0.5
- -0.5 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- > 0.5
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A53 : 0.5% AEP (Climate Change Scenario 1) Changes in Peak Flood Velocity (Design Condition vs Existing Condition)

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A54 : 0.2% AEP (Climate Change Scenario 2) Changes in Peak Flood Velocity (Design Condition vs Existing Condition)

MARTINUS

aurecon

BG&E

Legend

Project Boundary

Changes in Peak Flood Velocity (m/s)

- < -0.5
- -0.5 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- > 0.5
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A55 : 0.05% AEP (Bridge Assessment) Changes in Peak Flood Velocity (Design Condition vs Existing Condition)

MARTINUS aurecon BG&E

Legend

Project Boundary

Changes in Peak Flood Velocity (m/s)

- < -0.5
- -0.5 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- > 0.5
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A56 : PMF Changes in Peak Flood Velocity (Design Condition vs Existing Condition)

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A57 : 5% AEP Changes in Peak Flood Hazard (Design Condition vs Existing Condition)

MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Changes in Peak Flood Hazard
  - Reduced 5 Classes
  - Reduced 4 Classes
  - Reduced 3 Classes
  - Reduced 2 Classes
  - Reduced 1 Class
  - No Change
  - Increased 1 Class
  - Increased 2 Classes
  - Increased 3 Classes
  - Increased 4 Classes
  - Increased 5 Classes
  - Was Wet Now Dry
  - Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A58 : 2% AEP Changes in Peak Flood Hazard (Design Condition vs Existing Condition)

MARTINUS
aurecon BG&E

Legend

- Project Boundary
- Changes in Peak Flood Hazard
  - Reduced 5 Classes
  - Reduced 4 Classes
  - Reduced 3 Classes
  - Reduced 2 Classes
  - Reduced 1 Class
  - No Change
  - Increased 1 Class
  - Increased 2 Classes
  - Increased 3 Classes
  - Increased 4 Classes
  - Increased 5 Classes
  - Was Wet Now Dry
  - Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A59 : 1% AEP Changes in Peak Flood Hazard (Design Condition vs Existing Condition)

Legend

Project Boundary

Changes in Peak Flood Hazard

- Reduced 5 Classes
- Reduced 4 Classes
- Reduced 3 Classes
- Reduced 2 Classes
- Reduced 1 Class
- No Change
- Increased 1 Class
- Increased 2 Classes
- Increased 3 Classes
- Increased 4 Classes
- Increased 5 Classes
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A60 : 0.5% AEP (Climate Change Scenario 1) Changes in Peak Flood Hazard (Design Condition vs Existing Condition)

Legend

- Project Boundary
- Changes in Peak Flood Hazard
  - Reduced 5 Classes
  - Reduced 4 Classes
  - Reduced 3 Classes
  - Reduced 2 Classes
  - Reduced 1 Class
  - No Change
  - Increased 1 Class
  - Increased 2 Classes
  - Increased 3 Classes
  - Increased 4 Classes
  - Increased 5 Classes
  - Was Wet Now Dry
  - Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A61 : 0.2% AEP (Climate Change Scenario 2) Changes in Peak Flood Hazard (Design Condition vs Existing Condition)

Notes:

DRAFT

Map by: JPE

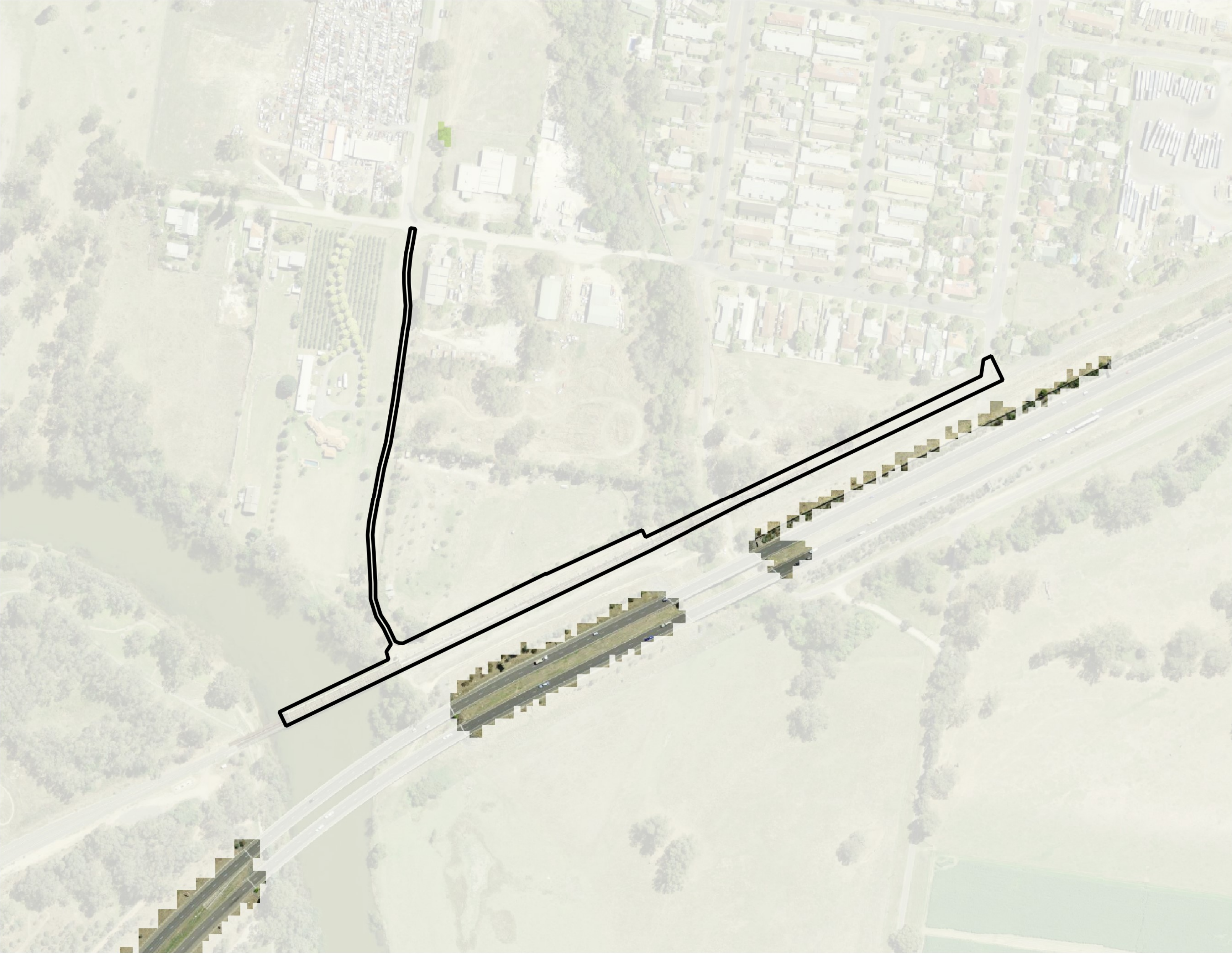
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A62 : 0.05% AEP (Bridge Assessment) Changes in Peak Flood Hazard (Design Condition vs Existing Condition)



Legend

- Project Boundary
- Changes in Peak Flood Hazard
- Reduced 5 Classes
- Reduced 4 Classes
- Reduced 3 Classes
- Reduced 2 Classes
- Reduced 1 Class
- No Change
- Increased 1 Class
- Increased 2 Classes
- Increased 3 Classes
- Increased 4 Classes
- Increased 5 Classes
- Was Wet Now Dry
- Was Dry Now Wet

Notes:

DRAFT

Map by: JPE

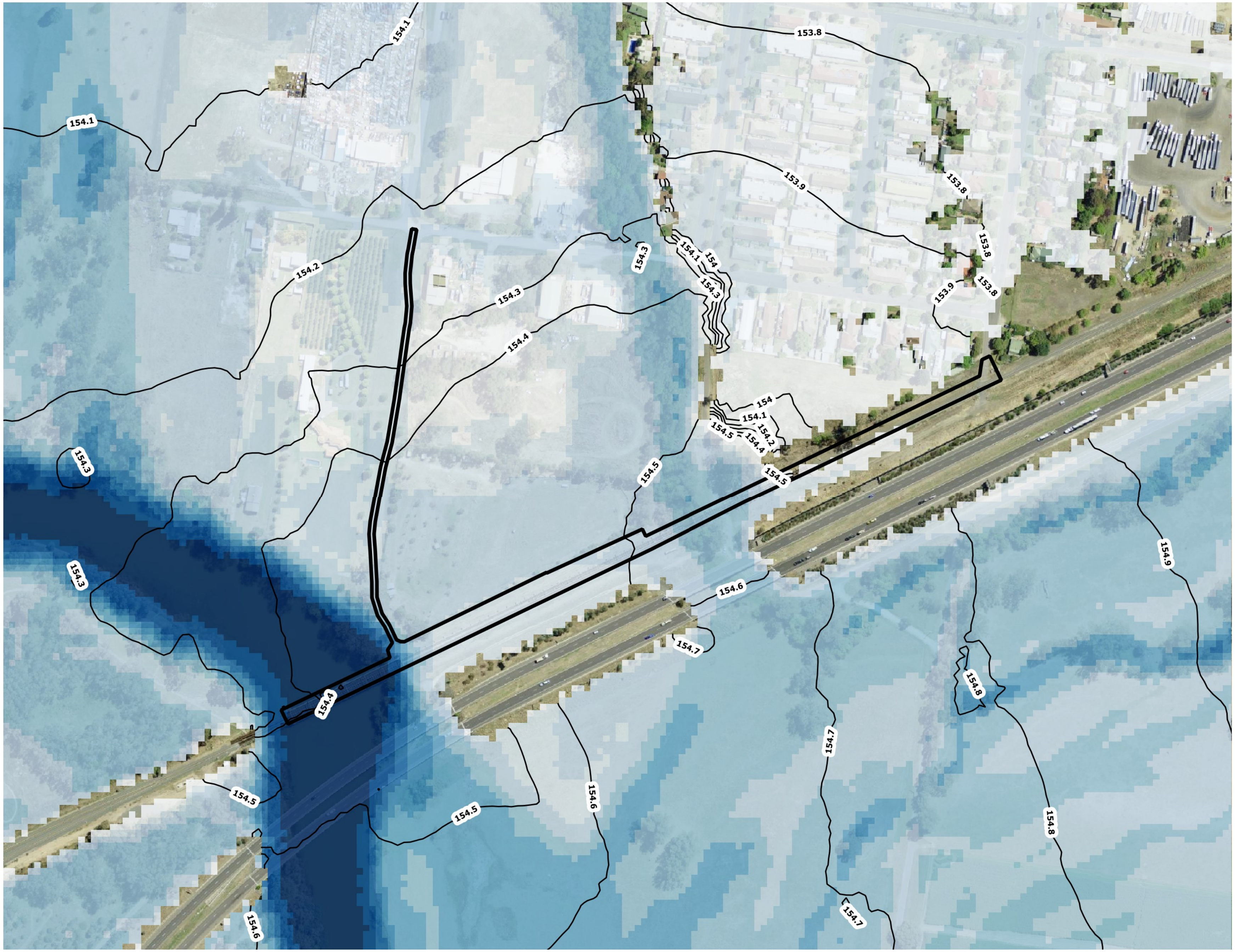
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A63 : PMF Changes in Peak Flood Hazard (Design Condition vs Existing Condition)



MARTINUS
aurecon BG&E

Legend

- Project Boundary
- Peak Flood Level (mAHD)

Peak Flood Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 - 6.00
- 6.00 - 7.00
- > 7.00

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A64 : 1% AEP Peak Flood Depth and Levels (Blockage Assessment)

MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Peak Flood Velocity (m/s)
  - <= 0.25
  - 0.25 - 0.50
  - 0.50 - 0.75
  - 0.75 - 1.00
  - 100 - 1.50
  - 1.50 - 2.00
  - > 2.00

Notes:

DRAFT

Map by: JPE

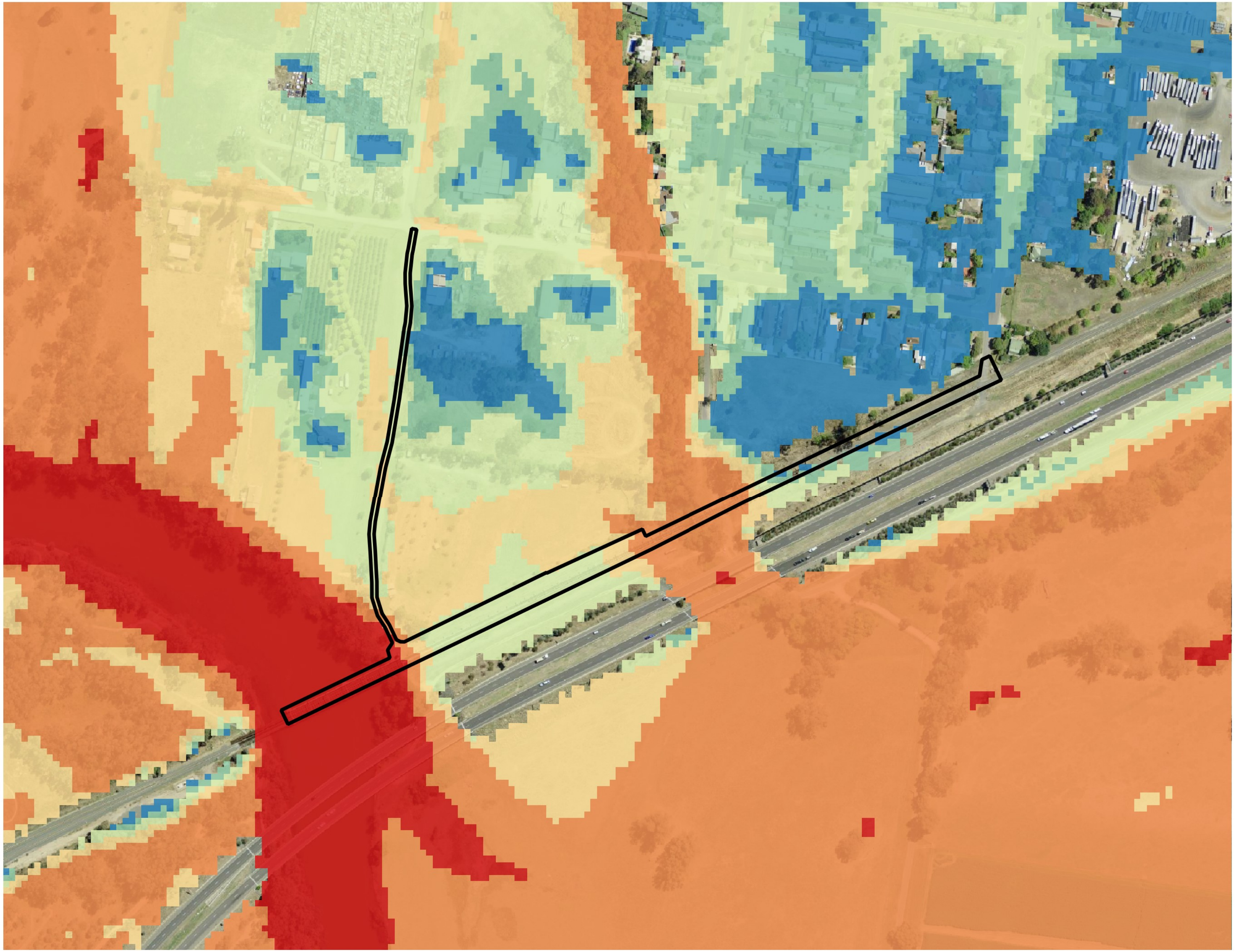
0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A65 : 1% AEP Peak Flood Velocity (Blockage Assessment)



MARTINUS
aurecon BG&E

Legend

Project Boundary

Peak Flood Hazard

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

Notes:

DRAFT

Map by: JPE

0 190 380 m

A3 Scale: 1:5,000

25/10/2024 MGA 55

Murray River Bridge - Inland Rail (A2P) - DDR Stage

Figure A66 : 1% AEP Peak Flood Hazard (Blockage Assessment)

APPENDIX B

PMF Analysis

Estimation of PMF that is in line with ARR2019 procedures

1. Albury Flood Risk Management Study (FRMS) (WMA 2016) adopted a PMF flow of 14,900 m^3/s that is based on a "Hume Weir Study" by MDBA from ANCOLD. However, such publication cannot be identified based on the information available from the FRMS.
2. An ANCOLD paper by Nandakumar et al. (2011) looked at the hydrological risk for Hume Dam and estimated PMF flood based on a number of procedures. The PMF flow estimated ranges from 10,300 m^3/s to 14,900 m^3/s. It is likely that the flow of 14,900 m^3/s is sourced from this paper or at least the approach employed by this paper to estimate PMF.
3. The Option D approach in Nandakumar et al. (2011) yields a PMF peak flow of 14,900 m^3/s. Option PMF is produced based on the following assumptions:
   a. PMP –
      i. The AEP is estimated using a chart by Laurenson and Kuczera (1999) (Table 8.3.1 of ARR2019 BK 8 Ch 3) as 1 in 65 000.
      ii. Rainfall frequency curve was used to extrapolate the rainfall to this 1 in 65 000 AEP.
      iii. This is a reasonable extrapolation, considering the amount of validation provided.
   b. Losses and Pre burst –
      i. IL = 0mm and CL =1 mm/hr.
      ii. Pre- burst has been applied using pre burst developed by Minty & Meighen (1999).
      iii. With the conservative assumption on IL and CL, the application of pre-burst seems overly conservative. Nevertheless, the effect on peak flow is unlikely to be significant considering the size of the catchment, and the critical storm is likely to be a very long-duration storm.
   c. Reservoirs initially at FSL – This is a common assumption
   d. Temporal pattern –
      i. Historical pattern provided by BOM that gives max outflow. Not exactly sure what pattern was used. Table 8.3.3 recommended "GSAM areal rainfall patterns (single and ensemble)" for South Eastern Australia. It is not clear if the pattern used by Green et al. (2011) is the ensemble that are the patterns referred to in ARR2019, but the temporal patterns are chosen from historical patterns provided by BOM. It is likely these temporal patterns are appropriate for the Hume catchment.
4. The PMF was estimated with an approach very similar to the procedures recommended by ARR2019. However, there are the following uncertainties:
   a. PMP – Table 8.2.1 of BK 8 Ch 2 of ARR 2019 recommends using the BOM GSAM procedure, but the estimation of PMP based on AEP is not unseasonable and considered acceptable, especially since extensive validation has been conducted.
   b. Losses- pre-burst is unlikely to have much effect on the peak flow.
   c. Temporal pattern – Using a historical temporal pattern that produced the maximum outflow is considered reasonable and is in line with the ARR2019 approach; the temporal pattern assembly could be different.
5. It is considered that the approach to estimate PMF of 14,900 m^3/s is considered reasonable and in line with the principle adopted by ARR2019. However, there is uncertainty that PMP values and temporal patterns adopted may not be exactly the same as ARR2019 recommendations.

Reference

1. Green, J.H., Walland, D., Nandakumar, N. & Nathan, R. (2005). Temporal Patterns for the Derivation of PMPDF and PMF Estimates in the GTSM Region of Australia. Australian Journal of Water Resources 8(2), pp 111-121.

2. Laurenson, E.M. and Kuczera, G.A. (1999). Annual Exceedance Probability of Probable Maximum Precipitation. Australian Journal of Water Resources 3(2), pp 167-176.
3. Nandakumar, Nanda; Green, Janice; Nathan, Rory; Sih, Kristen & Wilson, Robert (2011) *Assessment of Hydrologic Risk for Hume Dam*, ANCOLD Conf, Session 5B-2.

APPENDIX C

ARTC Review

Document Control Information			
	Contractor DC to update for re-submission	**Submitted Document No. or Transmittal No.:**	Martinus-PTRAN-000832
Project:	2100 - A2I	**Date Submission Received:**	13/01/2025
Comment Sheet Number_Revision:	5-0052-210-IHY-B1-CS-0001_C	**Comment Sheet Title:**	***External Comment Sheet - A2I | Flood Design Report - Murray River Bridge***
Revision Date:	30/01/2025	**Documents related in Aconex** (by IR DC)	Yes

Review Comments (Reviewer)									Responses (Document Owner)					Close-Out			
#	PSR ID No. **or** Compliance Reference Document *(State the fully qualified reference the deliverable is non-compliant with)*	Document / drawing number - Revision Number	Section # / page #	Engineering Assurance Stage	Comment *(for example must be specific on non compliance. Reference mark-ups, if required)*	Comment Type	Full Name	Date	Full Name	Company	Date	Response *(must be specific on how the comment has been addressed. Agreed approach for re-submission)*	Documentation Section # / Figure #	Full Name	Date	Comment Status	Close-Out Comment
Example	*IR-SR-A2I-517* ***or*** *01-3500-PD-P00-DE-0008-A*	*0-0000-900-PEN-00-TE-0020_A*		*CRR*	*Is there sufficient space for a 10m maintenance vehicle to turn around at the end of the RMAR?*	*Non-Compliant*	*Joe Bloggs*	*15/02/2023*	*Fred Bloggs*	*Designer*	*15/03/2023*	*The area has been increased - now possible to turn 12.5m vehicle. The drawings are updated.*	*01-3500-PD-P00-DE-0008-A 01-3500-PD-P00-DE-0015-C*	*Jane Doe*	*27/09/2023*	CLOSED	
1	PSR Annexure B Technical Requirements (item IR-SR-A2I-116)	5-0052-210-IHY-B1-RP-0001_A .p1	Page 11, 5-0052-210-IHY-B1-RP-0001_A, Section 1.11	Draft	1% AEP with climate change scenario has not been simulated which is a limitation of this study. It could be an item of this section.	Opportunity	Ayub Ali	4/12/2024	Yucen Lu	DJV Flood Modeller	13/01/2025	The inflow was determined from FFA at GS409017 (Murray River Flood Study GHD,2012). So the flow for the 1% AEP with predicated climate change was not generated. The 1% AEP with climate change rainfall depth (RCP8.5 Year2090) falls between the 0.5% AEP and 0.2% AEP. Therefore, 0.5% AEP and 0.2% AEP were used to represent climate change. The justification and rainfall depth comparison is included in Section 4.2.3.1. This will be added to the Section 1.11 Limitation.		Ayub Ali	29/01/2025	CLOSED	This item is closed based on a screen shot as evidence of updated report.
2	PSR Annexure B Technical Requirements (item IR-SR-A2I-116)	5-0052-210-IHY-B1-RP-0001_A .p1	Page 18, 5-0052-210-IHY-B1-RP-0001_A, Section 4	Draft	What is SEP? Why two climate change scenarios (0.5% AEP and 0.2% AEP) have been simulated instead of 1% AEP plus predicted climate change? Justification to be included in the report.	Non-Compliant	Ayub Ali	4/12/2024	Yucen Lu	DJV Flood Modeller	13/01/2025	It should be "AEP" instead of "SEP". This will be updated in the next design stage report. The inflow was undertaken from Murray River Flood Study (GHD,2012) and it was determined from FFA at GS409017. The flow for 1% AEP with predicated climate change was not generated. The 1% AEP with climate change rainfall depth (RCP8.5 Year2090) falls between the 0.5% AEP and 0.2% AEP. Therefore, 0.5% AEP and 0.2% AEP were used to represent climate change. The justification and rainfall depth comparison is included in Section 4.2.3.1.		Ayub Ali	29/01/2025	CLOSED	This item is closed based on a screen shot as evidence of updated report.
3	CSSI Conditions of Approval E40	5-0052-210-IHY-B1-RP-0001_A .p1	Page 18, 5-0052-210-IHY-B1-RP-0001_A, Section 4	Draft	What about blockage assessment? Need to mention it here.	Non-Compliant	Ayub Ali	4/12/2024	Yucen Lu	DJV Flood Modeller	13/01/2025	The details of blockage assessment are included in Section 6.5.1 and it will be mentioned in the first paragraph of Section 4.		Ayub Ali	29/01/2025	CLOSED	This item is closed based on a screen shot as evidence of updated report.
4	*CSSI Conditions of Approval E42*	5-0052-210-IHY-B1-RP-0001_A .p1	Page 32, 5-0052-210-IHY-B1-RP-0001_A, Section 6.4	Draft	It is understood that steady state (constant) boundary conditions have been used for hydraulic modelling. However, flow rate and water level time series have been compared for duration of inundation assessment. To my understanding, it does not make any sense. Therefore, clarification/rewriting is recommended.	Non-Compliant	Ayub Ali	4/12/2024	Yucen Lu	DJV Flood Modeller	13/01/2025	The clarification will be included in the next design phase report.		Ayub Ali	29/01/2025	CLOSED	This item is closed based on a screen shot as evidence of updated report.
5		5-0052-210-IHY-B1-RP-0001_A .p1	Page 37, Climate Change Risk Assessment pg 37/113	Draft	The reference to Section 0 should be to Section 4.2. This is a document error	Non-Compliant	Andrew Aitken	20/11/2024	Zoe Cruice / Michal Plesko	Martinus		Noted. This will be corrected.		Andrew Aitken	14/01/2025	CLOSED	response noted.

Non-Compliant:	Non-compliance which requires correction before further design development occurs.
Opportunity:	Comment which identifies an opportunity to save capex, achieve increased quality or operational outcome. Not a non-compliance.

OPEN:	Comment has not been addressed.
CLOSED:	Comment is closed. No further action.
NEXT PHASE:	Comment response has been accepted. Resulting actions have been deferred to the next Phase of the Project (for Doc Control purposes the comment is considered OPEN)
TRANSFERRED:	Response is not acceptable or review has been split and the comment has been transferred to another comment sheet. (for Doc Control purposes comment is considered CLOSED)

APPENDIX D

External Stakeholder Review

Transport for NSW

30 May 2024

SF2024/002449; WST24/00003/011

Mr Stephen Brierley
Design Manager A2I
Level 4, 60 Carrington St
SYDNEY NSW 2000

Dear Mr Brierley,

SSI-10055; Albury to Illabo Inland Rail Project; Australian Rail Track Corporation's 70% design for proposed Murray River bridge enhancement

Thank you for providing the 70% designs for the proposed modifications to the Murray River bridge at Albury.

Transport for NSW has reviewed the proposed works and provides the following comments.

There are two elements to the proposed bridge upgrades to be addressed by the proponent as outlined below:

1. **Construction phase:** The mobilisation of plant and equipment including vessel/s and barge/s, the transport of materials and equipment/components, the movement and parking of construction related vehicles and vessels, the requirement for waterway management such as exclusion zones and/or temporary powered vessel operating restrictions and the appropriate marking of hazards.

   At this stage of design and planning Transport for NSW understands that there will be little to no impact on waterway or waterway users resulting from the upgrades to the existing Murray River rail bridge. The proponent anticipates that the works will be confined to the bridge and adjacent waterside land. However this is yet to be confirmed, including the requirement for aspects such as scaffolding and heavy lifting (craning) over the waterway, which does remain a possibility. The section of the Murray River where this bridge crosses is already subject to 4 knot speed restriction, which assists regarding the waterway management requirements and risk mitigation.

   Any specific NSW Maritime waterway management requirements can only be provided once the scope of works, and construction methodology are finalised and provided for review. The proponent has confirmed with Transport for NSW that it is aware of the requirements in this regard, including the relevant timing thresholds for the supply of required information.

2. **Operational phase:** Any ongoing impacts to vessels navigating in the vicinity of the development, traffic generation due to the operation, maintenance, and servicing of the various elements of the project and any changes to the existing bridge design that may impact on navigation.

   At this stage of design and planning Transport for NSW understands that there will no impact to the waterway, users and navigation from the proposed upgrades to the existing bridge design. The required upgrades are anticipated to be above the existing deck level, and therefore will not reduce the available navigable channel height or width.

Should you require further information in relation to this matter, please contact the undersigned on 0408162261 or email development.inlandrail@transport.nsw.gov.au.

Yours sincerely,

John Zannes

Project Director Inland Rail

Transport for NSW

5-0001-210-PEN-B1-LT-0002-TW

APPENDIX E

Independent Flood Consultant Review and Certificate Confirmation

Project: 2300 **Deliverable:** Murray River Bridge

Comment Sheet Reference: 5-0052-210-IHY-B1-CS-0001-PE_C

Review Comments (Reviewer)										Responses (Document Owner)					Close-Out				
#	Document number / drawing number - Revision Number	Section # / page #	Company	Full Name	Functional Area	Date	Design Gate	Comment (for example must be specific on non compliance. Reference mark-ups, if required)	Comment Type	Full Name	Role	Date	Response (must be specific on how the comment has been addressed)	Where addressed (Section # / Figure #)	Full Name	Company	Date	Comment Outcome	Close-Out Comment
1	5-0052-210-IHY-B1-RP-0001_B	TUFLOW files	Hatch	Sam Drysdale	Flood Assessment	3/01/2025	DDR	The adopted Flood Frequency Estimate shows a poor fit to the rarer historical events, providing higher peak flow estimates in the design report when compered to those of the adopted flood study. As the 1% AEP flood level is below the bridge superstructure, the result of this potential over-estimation of flows does not affect the outcomes of this assessment. However, this modelling should not be adopted for purposes beyond this specific report. The FFA could be reivewed, ensuring that low outliers have been appropriately censored, that the LPIII distribution is adopting the Bayesian inference method, with the GEV distribution adopting the LH moments fit inference method.	Opportunity	Yucen Lu	DJV Flood Modeller	21/01/2025	Noted. The adopted FFA was conducted by using the same sets of data from the flood study (Albury Floodplain Risk Management Study and Plan, WMA Water, 2016) but with the latest ARR2019 method (LPIII Flike 5.0.3). The results show conservative value but still do not affect the design up to 0.05% AEP. The words of "This modelling should not be adopted for purposes beyond this report" will be added into the report.	5-0052-210-IHY-B1-RP-0001 Section 1.11	Darren Lyons	Hatch	31/01/2025	CLOSED	It is understood that the latest version of FLIKE has been used but there are things that need to be done by the software user to ensure that the FFA produced is appropriate, which does not appear to have been done, as the data model does not appear to fit well with the observed data. However, as the flood levels being assessed are below the bridge superstructure, this does not impact the outcome of the assessment and we are happy to close out the comment.
2	5-0052-210-IHY-B1-RP-0001_B	TUFLOW files	Hatch	Sam Drysdale	Flood Assessment	3/01/2025	DDR	Currently within the modelling, no form loss factors have been applied within any of the bridge structures for either the existing or design scenarios. Appropriate form losses associated with the bridge substructure and superstructure components should be applied. However, because the design does not alter the bridge hydraulics the omission of form losses does not affect the outcome of this assessment.	Opportunity	Yucen Lu	DJV Flood Modeller	21/01/2025	Noted. The flood model used for this study was from Albury Floodplain Risk Management Study and Plan (WMA Water, 2016). The bridge modelling method (sub- and super structures) was using blockage instead of form loss factors. The model was well-calibrated and validated. Therefore, the same method was used to keep consistency.		Darren Lyons	Hatch	31/01/2025	CLOSED	The method does not use blockage OR form loss factors, BOTH need to be applied. Just because this is what was done in the FRMS does not mean that it is correct and in this instance the minor impact of applying the form losses may not have been integral to the original model calibration process. Notwithstanding this, the best practice for modelling bridge structures should be applied. However, as the design does not modify the bridge substructure, this does not impact the outcome of the assessment and we are happy to close out the comment.
			Hatch	Daniel Williams	Flood Assessment	31/01/2025	DDR	No further comments.										CLOSED	

Schedule 12 Consultant Certificate

Part A – Consultant's Statement of Conformance for Services

(clause 5.3 (b))

Date:	13 February 2025
Project:	Albury to Parkes Enhancement Project (A2P) (the Project) B1 - Murray River Bridge Modifications - Flood Design Report and Model (IFC)
Consultant:	Hatch Pty Ltd ABN 59 008 630 500
In relation to:	The contract between the Consultant and Martinus Rail Pty Ltd (MR) dated …18 March 2024…….with respect to the Project

1. This Statement of Conformance is given in relation to the Agreement.
2. The Consultant hereby certifies to MR that:
   a. the design calculations and drawings are agreed with the Designer; and
   b. it has provided a full and independent assessment of all factors influencing the final integrity of the specified components of the Works,
   c. it has reviewed the design calculations, models and drawings, and undertaken separate calculations for critical aspects of the Works,
   d. it has undertaken an independent detailed check of the Design Documentation,
   e. it has provided all advice and comment, including calculations, in writing.

Statement 2 above applies to the extent clarified in Section 3 and 4 on the following page.

……………………………………………………… Signature of Authorised Person

……………………………………………… Signature of Witness

Darren Lyons
……………………………………………………… Name of Authorised Person

Daniel Williams
……………………………………………… Name of Witness

Schedule 12 Consultant Certificate

Part A – Consultant's Statement of Conformance for Services

(clause 5.3 (b))

3. This statement of conformance applies to the following work packages only:
   a. B1 - Murray River Bridge - Flood Design Report and Model (IFC)

4. The following documents were supplied to Hatch by Martinus and are the subject of our proof engineering review:
   5-0052-210-IHY-B1-RP-0001, Rev No 0
   5-0052-210-PEN-B1-DR-0002, Rev No 0 and referenced drawing set therein

Zoe Cruice

From: Daniel Williams <dan@torrentconsulting.com.au>
Sent: Tuesday, 1 April 2025 8:25 AM
To: Zoe Cruice; Kerr, Claire
Cc: Mullard, John; Simon Fisher
Subject: RE: TfNSW comments (x2) on Murray River Bridge FDR

Hi Zoe,

That is fine, as the representation of the bridges is something that we commented on ourselves but ultimately does not have any implication for the outcome of the assessment. Therefore, the Proof Engineering assessment carried out on the Rev 0 IFC and associated certification still applies.

Thanks,
Dan

Dan Williams
Director

tel: 0408 023 262
web: www.torrentconsulting.com.au

Torrent CONSULTING

From: Zoe Cruice <zoe.cruice@martinus.com.au>
Sent: Sunday, 30 March 2025 6:54 AM
To: Kerr, Claire <claire.kerr@hatch.com>; Daniel Williams <dan@torrentconsulting.com.au>
Cc: Mullard, John <john.mullard@hatch.com>; Simon Fisher <simon.fisher@martinus.com.au>
Subject: TfNSW comments (x2) on Murray River Bridge FDR

Hi Claire, Daniel,
FYI John,

We have received TfNSW review comments back on the Murray River Bridge **DDR** Flood Design Report.

Owing the time taken for TfNSW to carry out their review we have already up-revved the Murray River Bridge FDR to IFC and issued to IRPL at Rev 0.

To address these 2x TfNSW comments, a single change has been made to the Rev 0 IFC report. An update has been made to Table 4-2 to include the bridge modelling approach. This is snipped below with above and below table rows for context.

The updated Rev 1 report is saved in here: 2503XX_B1 - Murray River Bridge - Flood Design Report IFC Rev 1 - waiting on PE cert update
The TfNSW comments and responses are saved in here: Comment Sheet

May you please confirm either through:

1) Re-issue of PE certificate for Rev 1, or

2) Reply response via email

That the Proof Engineering assessment and certification still stands and that there are no further comments. (or alternatively, advise if re-review is required).

Topography	• 1m and 10m resolutions LiDAR collected in 2001 ▪ 10m and 20m resolutions DTM collected in 2010 ▪ Murray River in-channel cross section collected in 2007 and 1984. ▪ 2006 crest survey of the Albury levee bank ▪ 2005 ALS terrain data covering the whole Albury local government area carried out by AAMHatch. ▪ 2001 photogrammetric survey	▪ 1m and 10m resolutions LiDAR c 2001 ▪ 10m and 20m resolutions DTM c 2010 ▪ Murray River in-channel cross se collected in 2007 and 1984. ▪ 2006 crest survey of the Albury l ▪ 2005 ALS terrain data covering t Albury local government area ca by AAMHatch. ▪ 2001 photogrammetric survey
Bridges	Murray River Rail Bridge: 2d_lfcsh with 4% blockage for pier Spirit of Progress Bridges: 2d_lfcsh with 3% blockage for pier	The bridge modelling parameters are in the same way as per the received Albury Floodplain Risk Management Plan (WMA Water, 2016) (item 1 in T because the model is calibrated and Murray River Rail Bridge: 2d_lfcsh with 4% blockage for pier Spirit of Progress Bridges: 2d_lfcsh with 3% blockage for pier
Roughness	Grass: 0.05 Scattered vegetation: 0.10 Thick vegetation: 0.15 Water/lakes: 0.04 Reduced conveyance through built up areas: 0.30 Calibration of levels upstream of Kiewa confluence: 0.07 Calibration of levels - channel u/s of Keiwa us end of Wodonga Creek: 0.07 Calibration of levels near Haywards	Grass: 0.05 Scattered vegetation: 0.10 Thick vegetation: 0.15 Water/lakes: 0.04 Reduced conveyance through built u areas: 0.30 Calibration of levels upstream of Kie confluence: 0.07 Calibration of levels - channel u/s of end of Wodonga Creek: 0.07 Calibration of levels near Haywards

Cheers

Zoe

I'm sending you this message now because it's a good time for me, but do not expect you to read, respond or action it outside your regular hours.

Zoe Cruice
Head of Engineering & Technology
Growth Team

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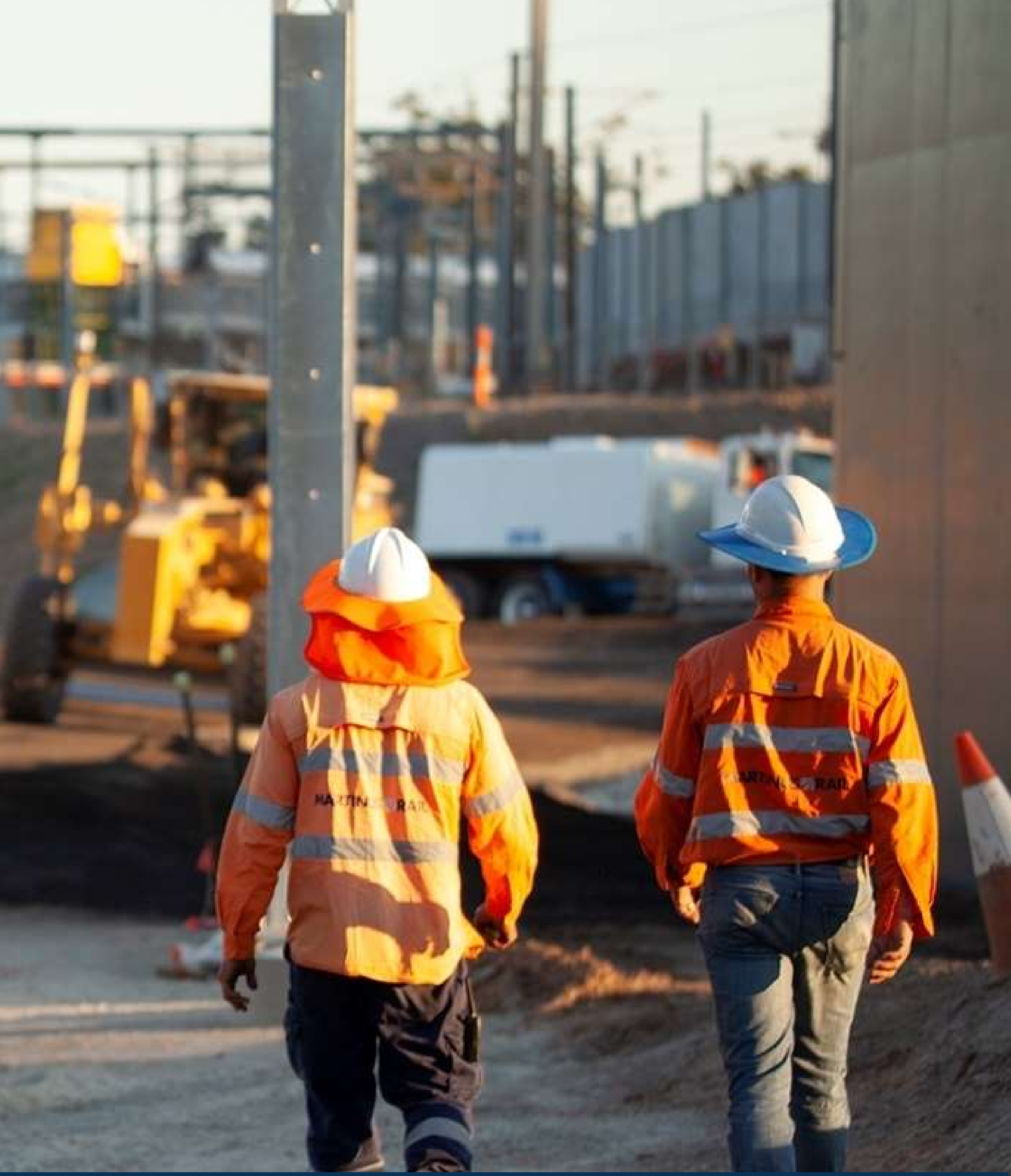
Australia | New Zealand | Chile

in

SAVE CONTACT



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