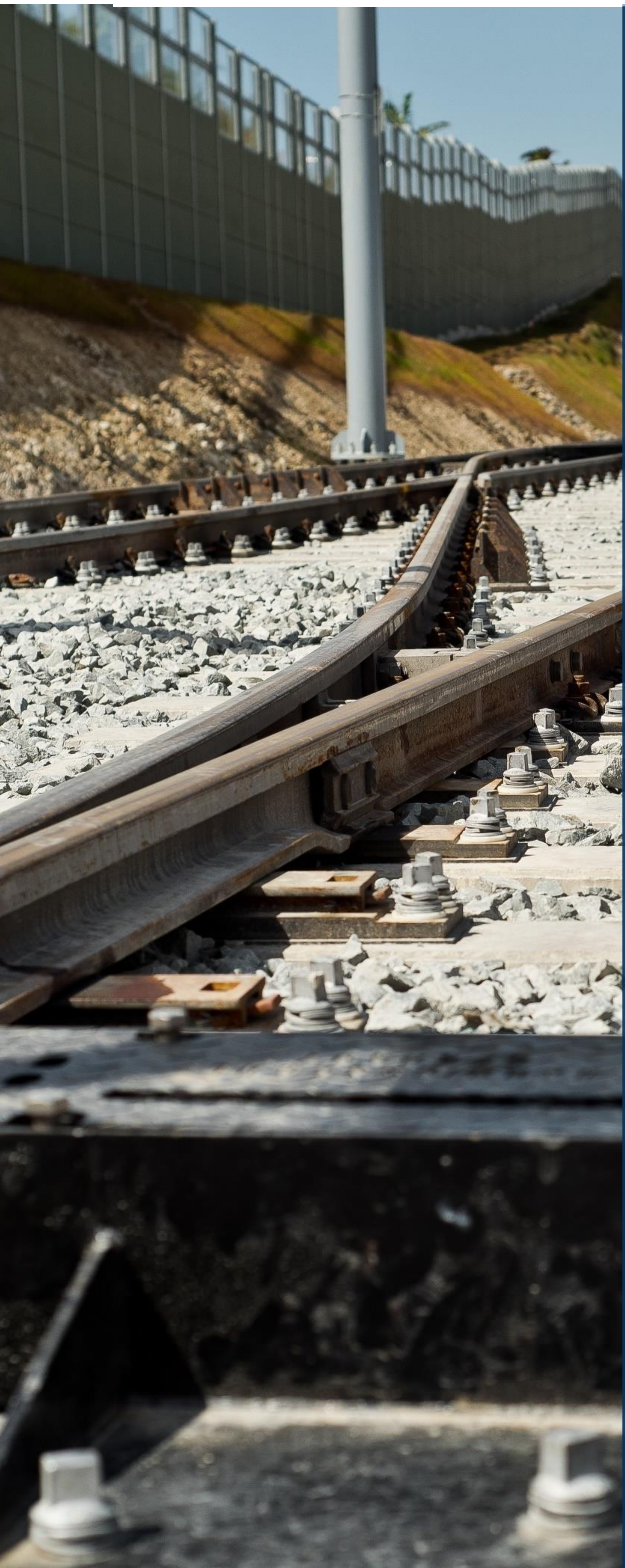
This document is uncontrolled when printed.



FLOOD DESIGN REPORT

A2I | Albury to Illabo

Package: A2I – Junee Yard

CONTRACT NUMBER: 0052

PROJECT DOCUMENT NUMBER:

Document Control

DOCUMENT TITLE:	Flood Design Report – Junee Yard		
DOCUMENT OWNER:	Engineering Manager		
PREPARED BY:	Michael Ren	**TITLE:**	Engineer
REVIEWED BY:	Jasmine Lee	**TITLE:**	Associate Engineer
VERIFIED BY:	Eric Lam	**TITLE:**	Technical Director

Approved by

NAME	TITLE	SIGNATURE	DATE
Zoë Cruice	Engineering Manager		05/08/2025

Revision History

REVISION	REVISION DATE	AMENDMENT	DATE TO CLIENT
A	25/02/2025	DDR issue For Review	25/02/2025
0	05/08/2025	Issued for Construction (IFC) For Use	05/08/2025

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY

Specific terms and acronyms used throughout this plan and sub-plans are listed and described in the table below.

TABLE 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
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

Term	Definition
IR	Inland Rail
ITC	Incentivised Target Cost
IV	Independent Verifier
Km	Kilometres
LPA	Licensed Project Area
MIRDA	Master Inland Rail Development Agreement
NCR	Non-Conformance Report
NLPA	Non-Licensed Project Area
NtP	Notice to Proceed
PDR	Preliminary Design Review
PSR	Project Scope and Requirements
QDL	Quantitative Design Limits
REF	Review of Environmental Factors
RFFE	Regional Flood Frequency Estimation
RORB	Runoff Routing
RFI	Request for Information
S2P	Stockinbingal to Parkes
SAQP	Sampling, Analysis and Quality Plan
SDR	Systems Definition Review
SDRP	State Design Review Panel
SEMP	System Engineering Management Plan
TfNSW	Transport for New South Wales
TWL	Tail Water Level
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 a 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 8 October 2024, and Martinus received the Notice to Proceed from IRPL on 18 October 2024.

Within the A2I section there are twenty (20) locations with twenty-nine (29) Design and Construct (D&C) projects of varying degrees of design gate development:

- Murray River Bridge (Structure modifications)
- Albury Station Yard (Track slews, track reconfigurations)
- Albury Station Yard Track Slews (retained 3-track alignment)
- Albury Station Yard Footbridge (footbridge replacement), both pre- and post- SDRP-response
- 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), both pre- and post- SDRP-response
- Edmondson Street Bridge (stand-alone road bridge)
- Edmondson Street Footbridge (stand-alone road bridge)
- Edmondson Street Bridge and Footbridge (combined Bridge replacement), post- SDRP-response
- Wagga Wagga Station Yard (Track slews)
- Wagga Wagga Footbridge (footbridge replacement), both pre- and post- SDRP-response
- Bomen Yard (Track slews)
- Harefield Yard (Track slews)
- Kemp Street Bridge (stand-alone road bridge)
- Kemp Street Footbridge (stand-along footbridge)
- Kemp Street Bridge and Footbridge (combined 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
- LX605 relocation and LX1472 closure, both 16m and 4m slew options

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

This study conducts a flood assessment for Junee Yard Clearances, as shown in the figure below.

FIGURE 1: SITE LOCATION

The Junee Yard clearances form part of the Albury to Illabo Section works between Chainage (CH) 484.840km to 485.100km (northern section) and 485.928km to 486.155km (southern section). The Junee Station Yard is located between the two clearance locations. The proposed design involves track slews and modification of the Up Main / Middle Road Line (northern section) and Up Platform Road line (southern section). The track slews across both site locations are less than 300mm. The track lifts between 0mm and 59mm have been proposed between CH 484.840km and CH

485.100km for the northern section and the maximum lift is 44mm between CH 485.928km and CH 486.155km for the southern section.

1.4 Objectives

This report has been prepared to support the delivery of the Junee Yard and comply with the CSSI Conditions of Approval (CoA) and Updated Mitigation Measures (UMM) for quantitative flood modelling demonstrating compliance with pre- and post- development criteria. Refer Section 2 for a summary of compliance.

This report provides a flood impact assessment for the Issued for Construction (IFC) stage. 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, especially outside of the project boundary.

This report should be read in conjunction with the Detailed Design Report – Junee Yard (5-0052-210-PEN-J4-RP-0001 Revision D).

1.5 Scopes

The scope of this study includes:

- Carrying out the flood assessment for the designs in the IFC stage for design events of 5%, 2%, 1% AEPs, 1% AEP with Climate Change and PMF (Probable Maximum Flood).
- Checking flood assessment results with the criteria, including flood impacts and flood immunity.
- Proposing any mitigation measures (if required).

1.6 Previous Studies

1.6.1 Flood Studies

The table below summarises all the flood studies associated with the Junee Yard site.

TABLE 2: A SUMMARY OF THE PREVIOUS FLOOD STUDIES

Item No.	Flood Study	Description
1	Lower Butlers Gully Flood Study (Lyall & Associates Consulting Engineers, 2009)	This flood study defined the flood behaviour in the Lower Butlers Gully catchment in Junee. The hydrologic and hydraulic modelling was undertaken in RORB and HEC-RAS (1D only) using the ARR1987 guidelines. There was no historical flood data to calibrate the study.
2	Lower Butlers Gully Floodplain Risk Management Study and Plan (Lyall & Associates Consulting Engineers, 2011)	The flood management study and plan used the findings from the Lower Butlers Gully Flood Study to assess the impacts of flooding, review Council policies and consider options for management of flood affected land.

1.6.2 Reference Design

Reference Design Report:

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

Regional flooding at the Junee Yard was assessed against the Lower Butlers Gully Flood Study (Lyall and Associates, 2009), undertaken for the Junee Shire Council. The flood study indicates there is overland flooding within the rail corridor adjacent to Kemp Street bridge abutments during the 1% and 5% AEP flood events and the flows exit the rail corridor downstream to the Edgar Street Open Channel. To the north, there is an overland flow path on the road parallel to the rail. The Yard was found not to be impacted by flooding. Refer to the figure below extracted from the Reference Design Report.

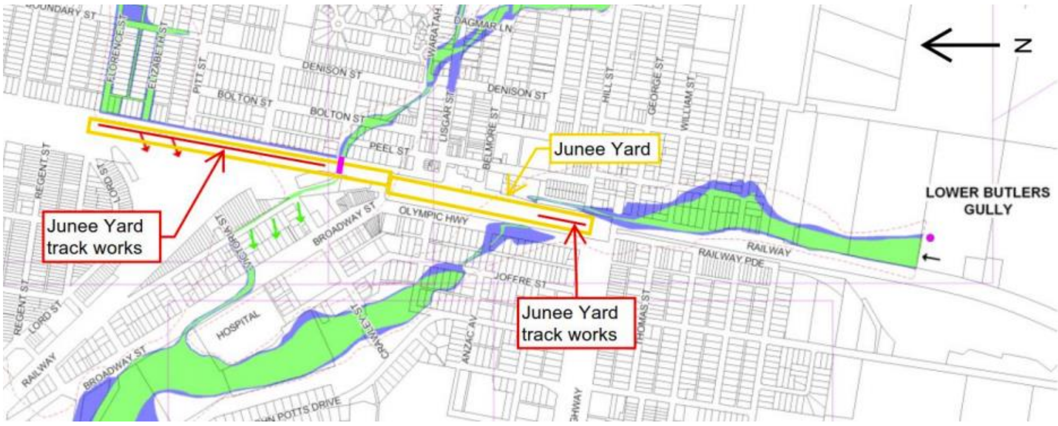


FIGURE 2: 1% AND 5% AEP FLOOD EXTENT AT JUNEE YARD (IMAGE SOURCE: ALBURY TO ILLABO EIS TECHNICAL PAPER 11, FIGURE 4.45 (JULY 2022))

1.6.3 Environmental Impact Statement

An EIS which supports the application for approval of the Proposal under Division 5.2 of the Environmental Planning and Assessment Act 1979 (EP&A Act) has been approved. It addresses the environmental assessment requirements set by the Secretary of the NSW Department of Planning, Industry and Environment, which is commonly referred to as the SEARs. The A2I CSSI Environmental Impact Statement contains the following relevant prior assessment documents:

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

Regional flooding at the Junee Yard was assessed against the Lower Butlers Gully Flood Study (Lyall and Associates, 2009), the flood study was undertaken for the Junee Shire Council. The findings of the Flood Study indicated that there is flood affected land associated with the Lower Butlers Gully surrounding the Junee Yard site, however the site itself is not located within flood prone land. An excerpt of the EIS is shown in the figure below where the Junee Yard works are referred to as the Enhancement Site.

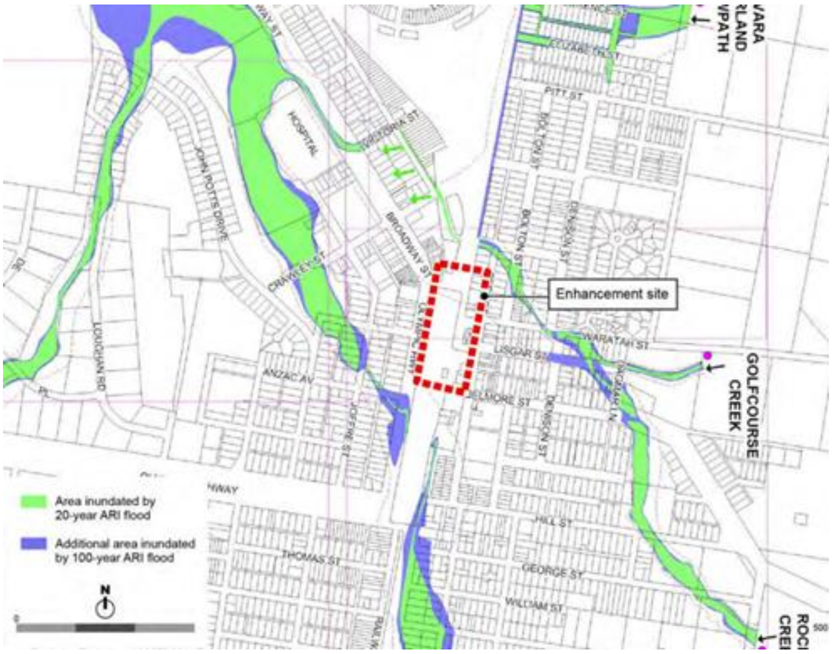


FIGURE 3: 1% AEP AND 5% AEP FLOOD EXTENTS AT JUNEE YARD CLEARANCES (SOURCE: ALBURY TO ILLABO ENVIRONMENTAL IMPACT STATEMENT (EIS) TECHNICAL PAPER 11 – HYDROLOGY, FLOODING AND WATER QUALITY (JULY 2022), FIGURE 4.49)

1.7 Purpose and Requirements

The primary purpose of this flood assessment report is to describe how the design development and the associated review process has been prepared and managed. The report assesses the change to the flood behaviour, and its impact on the rail immunity and on the neighbouring developments.

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 to Appendix C for ARTC review, Appendix D for External Consultation Review, and Appendix E for the Independent Flood Consultant review comments.

1.8 Information Documents

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

- Lower Butlers Gully Floodplain Risk Management Study and Plan (Lyall & Associates Consulting Engineers, 2011). This flood study supersedes the other flood studies listed in Table 2 as it is the most recent flood study.
- Albury to Illabo (A2I) and Stockinbingal to Parkes (S2P) Projects Reference Design Report – Junee Package (June 2022)
- Albury to Illabo Environmental Impact Statement (EIS) Technical Paper 11 – Hydrology, flooding and water quality (July 2022) (currently under planning assessment)

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 V4.1
- Austroads Guide to Bridge Technology – Part 8: Hydraulic Design of Waterway Structures
- Inland Rail Climate Change Risk Assessment Framework

The table below outlines the available information relevant to the site, which is used for flood modelling.

TABLE 3: AVAILABLE INFORMATION

Item	Information / Data Name	Type	Description / Comments
Surveys / General			
1	All Google Maps; NSW Imagery by SIXMAPS; ESRI World Street Map; Open Street Map	WMS	Basemaps linked in QGIS referenced for guidance through the assessment.
2	AAM2015_10cm_210_04_2_KempSt	ECW	Aerial imagery used in Reference Design, dated on 16/08/2023.
3	Urban Stormwater Mains 29 Nov 23 and Urban Stormwater Pits 29 Nov 23	GIS files	GIS files of the urban stormwater within Junee Shire Council, received from Junee Shire Council on 01/12/2023.
4	NSW Landuse 2017 v1.5	GIS files	GIS files of the NSW land zoning by NSW Department of Climate Change, Energy, the Environment and Water, dated on 21/09/2023 and accessed on 20/12/2023.
5	IS2301309 Ortho 35mm MGA2020z55 Junee	ECW	Aerial imagery provided by Martinus, dated on 15/03/2024.
6	Junee201502_Merged_5m_LiDAR	TIF	5m LiDAR captured in 2015 in GDA2020 projection: the data has an accuracy of 0.9m (95% Confidence Interval) vertical and 1.25m (95% Confidence Interval) horizontal, downloaded from Elvis - Elevation and Depth - Foundation Spatial Data (https://elevation.fsdf.org.au/) on 15/07/2024. This LiDAR was used to delineate the hydrological catchments as it was received prior to the 1m LiDAR data.
7	A2P EXT JUN GDA20Z55 RAIL 240719	DXF	Existing rail strings in GDA2020 projection, received from Martinus on 19/07/2024.
8	Merge_1m_2015_GDA2020	TIF	1m LiDAR carried out in 2015 by ARTC (the data for the derived points have an accuracy of 0.15m (68% confidence level)), received from Martinus on 12/11/2024 for the rail corridor.

Item	Information / Data Name	Type	Description / Comments
9	A2P JNK EXT GDA20Z55 COMBINED	TIN, DWG/DXF	Survey of the rail corridor including ground surveys, rails, and drainage infrastructure within the project boundary area, received from Martinus on 18/09/2024 and updated on 04/03/2025.
IFC Designs			
1	TRIA_210_DCW_J2_West_250317	DEM	DEM of the design civil works (to the west of the Kemp Street Bridge), received from the DJV team on 17/03/2025.
2	5-0052-210-SBD-J2-MD-2001-KEMP_STREET_BRIDGE_3D_STRUCTURAL_DESIGN_BRIDGE_MODEL_DWG	DWG	Kemp Street bridge design, received from the DJV design team on 14/05/2025.
3	5-0052-210-CAL-J4-MD-0001-JUNEE_YARD_3D_RAIL_DESIGN_STRINGS	DWG/XML	Design rail 3d strings in GDA2020 projection, received from the DJV team on 06/06/2025.
4	210 DCW J2 RW SKATE CHANNELS 20250613	DEM	DEM of the design civil works (to the east of the Kemp Street Bridge), received from the DJV design team on 13/06/2025.
5	210 DCW J2 RW EDGAR 20250708	DEM	DEM of the design civil works (for channel upgrades near the proposed footbridge and for batters to the east of the Kemp Street Bridge), received from the DJV design team on 08/07/2025.
6	IFC designs from the Olympic Park Underbridge package	TUFLOW files	Design layers in TUFLOW, received from the DJV design team on 08/07/2025.
7	KEMP FOOTBRIDGE 3D	DXF	Kemp Street Footbridge IFC design received from the DJV design team on 15/07/2025.
8	SKATE PARK ACCESS RD 20250717	DEM	DEM of the design civil works (for driveway updates near the proposed footbridge), received from the DJV design team on 17/07/2025.
9	090725 KEMP STREET DRAINAGE DESIGN	12DAZ	Design drainage pits and pipes, received from the DJV design team on 09/07/2025 and updated on 17/07/2025.

1.10 Outputs

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

1.11 Limitations and Assumptions

The following limitations and assumptions are applied to the current study for the IFC stage:

- Existing drainage data for the greater area within Junee Shire Council was adopted based on the supplied GIS files from Junee Shire Council, as well as available survey data from Martinus.
- A blockage assessment was carried out for the 1% AEP design scenario. The estimated blockage as per the ARR2019 guidelines was adopted for the culverts and bridges within the project boundary, and a 20% blockage was adopted for the other culverts, pits and pipes outside the project boundary. The details and results are presented in Section 5.5.2.
- An assessment of temporary works and staging has not been undertaken, as it is out of the flooding scope.

2 COMPLIANCE WITH REQUIREMENTS

2.1 Project Scope and Requirements

The detailed design has been assessed to check if it meets the Project Scope and Requirements (PSRs). This is demonstrated throughout the flood assessment with the table below summarising the Junee Yard Design's Compliance with the PSRs.

TABLE 4: 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 any watercourses environmentally)
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.	Compliant - The existing immunity of the rails (lower than 5% AEP) is lower than the ARTC SMS minimum requirement (1% AEP), which would be maintained under design conditions as per the functional requirements. Refer to Section 5.3.
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.	Compliant - The existing immunity of the rails (lower than 5% AEP) is lower than the ARTC SMS minimum requirement (1% AEP), which would be maintained under design conditions as per the functional requirements. Refer to Section 5.3.
Project Wide	5.4.5	Bridge and culvert hydraulics shall comply with Austroads Guide to Bridge Technology Part 8: Hydraulic Design of Waterway Structures.	N/A (there is no waterway bridge in this package)
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 1% AEP + 2090 RCP 8.5 and identifying that the bridge has low hazards. Refer to Section 5.5.1.
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. Refer to Section 5.3.
A2I Technical Requirements	IR-SR-A2I-350	The Corridor System, where the existing track is lowered, shall maintain the existing flood immunity.	The existing immunity is maintained under design conditions. Refer to Section 5.3.
A2I Technical Requirements	IR-SR-A2I-352	The Corridor System shall prevent damage of the formation due to ponding of water.	The existing immunity and ponding conditions in the rail corridor are maintained. Refer to Sections 5.2 & 5.3.

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.	There is no change to open channels within the corridor system, and the existing conditions are maintained. Refer to Section 5.4.
A2I Technical Requirements	IR-SR-A2I-459	The Corridor System for Enhancement Corridors shall provide mitigation for flood impacts no worse than existing condition.	The existing conditions are maintained. Mitigation is provided for flood impact compliance as per CoA E42. Refer to Section 5.2 & 5.4.
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.	The existing conditions are maintained. No diversion of water is proposed. Refer to Section 5.2 & 5.4.
A2I Technical Requirements	IR-SR-A2I-465	The Corridor System shall minimise changes to the existing or natural flow patterns.	There are no significant changes to the existing or natural flow patterns. Refer to Section 5.2 & 5.4.
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 bridge design in this package)
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. Refer to Section 5.2.
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 5

2.2 Conditions of Approval – Flooding

The Conditions of Approval (CoA) have been provided as part of the CSSI approval and Inland Rail Deed of Variation. The detailed design has been assessed to check if it meets the CoA and the compliance is presented in the table below.

TABLE 5: 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 5.
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 5.
E40	Updated flood modelling of the project's detailed design must be undertaken for the full range of flood events,	Compliant.

Condition	Condition or Criteria	Compliance Evidence Reference
	including blockage of culverts and flowpaths, considered in the documents listed in **Condition A1**. This modelling must include:	Refer to Section 5.
E40	a) Hydrologic and hydraulic assessments consistent with *Australian Rainfall and Runoff – A Guide to Flood Estimation* (Geoscience Australia, 2019);	Compliant. Refer to Section 4.
E40	b) Use of modelling software appropriate to the relevant modelling task;	Compliant. Appropriate software (RORB and TUFLOW) was used. Refer to Section 4.
E40	c) Field survey of the existing rail formation and rail levels, should be included within the models; and	Compliant. The existing rail data was included in the hydraulic models. Refer to Section 1.9 and Section 4.
E40	d) Confirmation of predicted afflux at industrial properties adjacent to Railway Street, Wagga Wagga based on field survey.	N/A - This report relates to the Junee Yard site, which is not related to Wagga Wagga.
E40	Updated flood modelling must be made publicly available in accordance with **Condition B18**.	The Flood design report and independent review of the flood design report has been 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 E38** and **E40** 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 has been undertaken by the Proof Engineer's specialist contractor, to satisfy and comply with the requirements of A16. Consultation with the Council and other stakeholders has been undertaken through formal review of this Flood Design Report. This is shown in Appendices C, D and E.
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:	
E42	(a) a maximum increase in inundation time of one hour, or 10%, whichever is greater;	Compliant. Refer to Section 5.4.4.
E42	(b) a maximum increase of 10 mm in above-floor inundation to habitable rooms where floor levels are currently exceeded;	Compliant. Refer to Section 5.4.1 for discussion of changes in peak flood level.
E42	(c) no above-floor inundation of habitable rooms which are currently not inundated;	
E42	(d) a maximum increase of 50 mm in inundation of land zoned as residential, industrial or commercial;	
E42	(e) a maximum increase of 100 mm in inundation of land zoned as environment zone or public recreation;	

Condition	Condition or Criteria	Compliance Evidence Reference
E42	(f) a maximum increase of 200 mm in inundation of land zoned as rural or primary production, environment zone or public recreation;	
E42	(g) no increase in the flood hazard category or risk to life; and	Compliant. Refer to Section 5.4.3.
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 5.4.2.
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.	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 5.4.
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 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.	Flood information will be provided to the relevant Council, BCS and the SES 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.
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 E43.**	Local drainage flow regime, catchment area and imperviousness remain the same as per the existing condition, there is no additional flow towards the existing Council's stormwater network. The design has not worsened the existing condition. Discharges to the council's

Condition	Condition or Criteria	Compliance Evidence Reference
		stormwater networks have been consulted with Junee Shire Council during the briefing workshops, various stages of design submissions with the Council's comments closed out, details are documented in 5-0052-210-PEN-J4-RP-0001.

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 the table below.

TABLE 6: UPDATED MITIGATION MEASURES COMPLIANCE TABLE – FLOODING

Condition	Condition or Criteria	Compliance Evidence Reference
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 the Council and other relevant authorities will be undertaken through a 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 Junee Yard site, which is not related to Wagga Wagga Yard. Compliant. A quantitative assessment has been undertaken. Refer to Section 5.
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 Junee Yard site, which is not related to the Riverina Highway track lowering site.

* QDL is superseded by CoA E42.

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 was not applicable to this stage.

3.2 SDR to PDR

Flood modelling was not applicable to this stage.

3.3 PDR to DDR

Flood modelling was undertaken for the DDR stage.

Item	Difference	Reason for Change
1	DJV created a new TUFLOW hydraulic model and RORB Hydrologic models to model the area of interest and proposed designs.	The TUFLOW hydraulic model and RORB Hydrologic models were required for the flood assessment for the DDR stage.

3.4 DDR to IFC

Flood assessment was updated for the IFC stage.

Item	Difference	Reason for Change
1	DJV updated the DDR hydraulic and hydrologic models for both the existing conditions and the design conditions.	In addition to including the Junee Yard IFC design, the model was further updated for a cumulative impact assessment, representing the IFC design as part of the Kemp Street Bridge and Footbridge package and the IFC design as part of the Olympic Highway Underbridge package.

4 MODELLING METHODOLOGY

The overall approaches for flood modelling are listed below:

- A 'RORB' runoff routing hydrologic model was developed to calculate flood hydrographs from rainfall and catchment characteristics.
- Based on ARR2019, utilise the hydrological model and generate flow hydrographs for input to the hydraulic model for all events (5% AEP, 2% AEP, 1% AEP, 1% AEP with Climate Change and PMF) to perform critical duration analysis.
- The flood hydrographs generated in the RORB runoff routing model were compared against the Regional Flood Frequency Estimation (RFFE) Model to validate the runoff routing model. There is no stream level gauge within the catchment to calibrate the hydrologic model.
- A hydraulic model was created using the software TUFLOW, which is a 1D/2D hydraulic modelling software for flood assessments. The TUFLOW model was created using the latest available LiDAR and survey, as well as drainage infrastructure information supplied by the Junee Shire Council. This formed the existing model for this study.
- A rainfall-on-grid simulation was undertaken in the created TUFLOW model to assess if local overland flooding or mainstream flooding from Lower Butlers Gully and Rocky Creek was dominant at the site.
- The TUFLOW model was updated from the existing conditions to the design conditions by incorporating the IFC Junee Yard track works, as well as the IFC design works from the Olympic Highway Underbridge package and the Kemp Street Bridge and Footbridge package.
- The cumulative flood impact was assessed for events up to and including the 1% AEP as per the CoA and the flood results are shown within this report.
- A sensitivity assessment for climate change was conducted for the 1% AEP existing and design conditions to inform the potential impacts on the flood immunity of the railway tracks.
- A sensitivity assessment for blockage as per ARR2019 procedures was undertaken for the 1% AEP design conditions to inform the potential impacts of blockage. The methodology used in assessing blockage is described in a separate Technical Memo. Refer to 5-0052-210-IHY-99-ME-0001.

4.1 Hydrologic Modelling

4.1.1 RORB Modelling

A RORB model was developed to generate the flow hydrographs for input to the hydraulic model. The hydrology model covers the Lower Butlers Gully catchment, Rocky Creek catchment, the town of Junee, including the Junee Yard site locations. A figure of the catchment layout of the hydrology model can be seen in the figure below The RORB model was developed with catchment characteristics derived from LiDAR and aerial imagery, following ARR2019 guidelines. The table below lists the parameters used within the model.

TABLE 7: RORB PARAMETERS

Parameters	Descriptions
Hydrology model and version	RORBwin (Version 6.31) using Storm injector HL (V 1.4.0.0).
Events	PMP, 1% AEP + Climate Change, 1% AEP, 2% AEP, 5% AEP
Total catchment area to upstream model boundary for TUFLOW	There are 3 different stream paths that integrate with each other to the Junee Yard site locations. Refer to Figure 4 for the location of these stream paths. Lower Butlers Gully – 16.25 km^2 Rocky Creek – 7.64 km^2 Tributary to the northern site – 1.52 km^2
Design Rainfall	The Bureau of Meteorology (BOM) 2016 Intensity-Frequency-Duration (IFDs) were used for the design rainfall with the rainfall extracted at the centroid of the catchment. This is included in this report in Appendix B. PMP rainfalls were generated using the Generalised Short-Duration Method (GSDM).
Temporal Patterns	ARR2019 ensemble point temporal patterns for the Murray Basin region were used for the durations ranging from 30 minutes to 72 hours for the 5%, 2%, 1%, 1% Climate Change events. The ARR data used for this assessment is included in Appendix B of this report.

Parameters	Descriptions
	The 10 Jordan and 1 BoM (total 11) temporal patterns from 15 minutes to 180 minutes were used for the PMF.
Spatial Varying Rainfall and Areal Reduction Factor (ARF)	Due to the small to medium size of the catchment, spatially varying rainfall was not adopted in this assessment. The ARF for the corresponding catchment area was adopted.
Climate Change Factors	A Climate Change factor of 20.2% was applied from the representative concentration pathway (RCP) 8.5, the Year 2090.
Rainfall Losses	Impervious areas: initial loss 1 mm, continuing loss 0 mm/hr Pervious areas: initial loss - probability neutral burst initial loss, continuing loss 1.84 mm/hr
% Pervious / Impervious	The % pervious / impervious for each catchment was derived using aerial imagery of the catchments. Impervious areas were taken as roads, carparks and rooftops. Inter-connecting-areas (ICA's) were not used as the rooftops of buildings were classified as fully impervious.
Sub-catchments	Sub-catchments were derived from the 2015 LiDAR sourced from Geosciences Australia. Sub-catchments were created so that no sub-catchment was greater than 25% of the total catchment area, and at least 5 sub-catchments were upstream of any reporting locations.
Reach Slopes	The equal area slope was derived for each reach length from the available LiDAR.
Kc Value	Kc values of 4.25, 3.01 and 1.43 were used for tributary catchments, which were derived from the recommended Kc equation for NSW catchments as per ARR2019 Book 7 (Keleemola Equation 7.6.13: Kc=1.18 * A0.46).
Coefficient m	0.8, recommended as per ARR2019

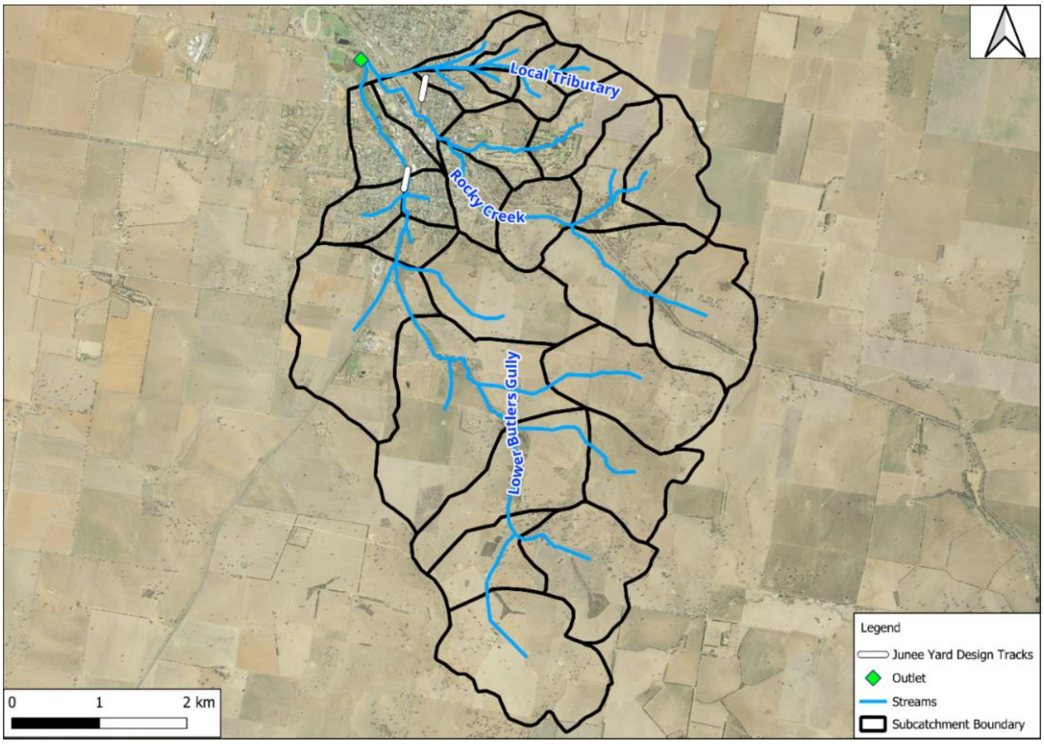


FIGURE 4: RORB MODEL LAYOUT

Storm Injector was used alongside the RORB model to produce the inflow hydrographs for critical duration analysis. Flow hydrographs were generated for input to the hydraulic model for the 5% AEP, 2% AEP, 1% AEP, 1% AEP Climate Change and PMF (Probable Maximum Flood) events. The critical durations and peak flows from the Lower Butlers Gully catchment, from the Rocky Creek catchment, and from the local tributary catchment (towards the northern site) are summarised in the table below respectively. Refer to the Figure 5 for the inflow locations into TUFLOW.

TABLE 8: CRITICAL STORMS AND PEAK FLOWS FROM RORB (FOR TUFLOW INPUTS)

Event	Critical Durations (Minutes) *	Peak Flows (m^3/s) *
5% AEP	180, 120, 60	43.2, 35.7, 15.0
2% AEP	180, 120, 45	59.9, 41.7, 17.0
1% AEP	180, 90, 45	72.7, 51.0, 22.4
1% AEP Climate Change	180, 90, 45	92.3, 65.8, 27.9
PMF	90, 60, 45	824.1, 577.3, 189.1

* XX, YY, ZZ, where "XX" is for Lower Butlers Gully catchment, "YY" is for Rocky Creek catchment, and "ZZ" is for the local tributary catchment, respectively (as illustrated in Figure 4)

4.1.2 RFFE Flow Comparison

The comparison of peak flows was undertaken between RFFE and RORB, for the Lower Butlers Gully catchment and the Rocky Creek catchment, respectively, for validation purposes. The RFFE model 2021 version 2 was used for the regional flow estimation. As shown in the table below, the RORB flows sit within the RFFE confidence limits, and are slightly higher than the expected values. As the events become less frequent, the RORB flows match with the RFFE expected flows better in general. This comparison indicates that the peak flows estimated by RORB are consistent with those by RFFE with some levels of conservativeness.

TABLE 9: FLOW COMPARISON - RORB VS RFFE

Event	RORB Flow (m^3/s) *	RFFE Expected Value (m^3/s) *	RFFE Lower Confidence Limit (5%) (m^3/s) *	RFFE Upper Confidence Limit (95%) (m^3/s) *
5% AEP	43.2, 35.7	29.8, 19.9	6.1, 4.1	123.8, 82.7
2% AEP	59.9, 41.7	49.4, 32.6	8.7, 5.8	227.7, 148.8
1% AEP	72.7, 51.0	67.3, 43.9	10.5, 6.9	349.8, 225.9

* XX, YY, where "XX" is for Lower Butlers Gully catchment and "YY" is for Rocky Creek catchment, respectively (as illustrated in Figure 4)

4.1.3 RORB Kc Sensitivity Assessment

A comparison of the RORB Kc value used in the computation was undertaken to assess if the Kc adopted from ARR2019 Book 7 equation 7.6.13 is appropriate. This method was compared against the Australia wide method Yu (1989), Pearse et. Al. 2002, the Australia wide method Dyer (1994, Pearse et. Al. 2002), and the RORB Manual Equation 2.5. The comparison is shown in the table below. Overall, the ARR2019 Book 7 equation 7.6.13 was chosen as it fit for the purpose for this assessment.

TABLE 10: FLOW COMPARISON - RORB VS RFFE BASED ON DIFFERENT KC METHODS

AEP (%)	RFFE Expected Value (m^3/s) *		ARR2019 Equation 7.6.13 (m^3/s) *		RORB manual, equation 2.5 (m^3/s) *		Dyer (1994, Pearse et. al. 2002) (m^3/s) *		Yu (1989, Pearse et. al. 2002) (m^3/s) *	
	Lower Butlers (XX)	Rocky Creek (YY)	Lower Butlers (XX)	Rocky Creek (YY)	Lower Butlers (XX)	Rocky Creek (YY)	Lower Butlers (XX)	Rocky Creek (YY)	Lower Butlers (XX)	Rocky Creek (YY)
5%	29.8	19.9	43.2	35.7	22.9	17.6	32.5	24.7	37.1	29
2%	49.4	32.6	59.9	41.7	31.8	24.2	45.4	31.7	52.3	36.5
1%	67.3	43.9	72.7	51.0	41.7	29.6	57.7	37.9	61.4	44.0

* XX, YY, where "XX" is for Lower Butlers Gully catchment and "YY" is for Rocky Creek catchment, respectively (as illustrated in Figure 4)

4.1.4 Climate Change

An assessment was conducted to evaluate the influence of climate change on flooding to anticipate any future climate change flood risk(s). The existing RORB model was employed to generate hydrographs for the TUFLOW model for the 1% AEP with climate change. As per the EIS report (Section 3.3.5 of Albury to Illabo Environmental Impact Statement Technical Paper 11) and the agreement between the Contractor and ARTC for the continued use of the prior version of

ARR2019 climate change method (refer to IR2140-RTRFI-000773), the Year 2090 RCP8.5 interim climate change factor sourced from the ARR Data Hub (https://data-legacy.arr-software.org/) was adopted – a 20.2% increase in rainfall.

4.2 Hydraulic Modelling

4.2.1 Existing Model

No existing model was available for the baselining of the assessment, therefore a TUFLOW model for Junee Yard, including the Kemp Street area, was created. For the IFC stage, the model was extended to include the model area from the Olympic Highway Underbridge Package (refer to the Flood Design Report 5-0052-210-IHY-J6-RP-0001 for details), covering a total area of approximately 2.7 km^2 shown in the figure below. A summary of the model parameters is included in the table below.

TABLE 11: MODEL PARAMETERS IN THE TUFLOW MODEL

Parameters	Descriptions
Build	TUFLOW 2023-03-AE HPC
Coordination Reference System (CRS)	GDA2020 MGA 55
Grid Size (see Quadtree extent in Figure 6)	1m within the Quadtree area (for main flow paths within the project boundaries) and 2m outside of the Quadtree area
Hydrology	RORB derived inflows as per ARR2019 guidelines
Inflow type (Figure 5)	2D Flow versus Time (QT) boundaries for mainstream inflows from Lower Butlers Gully, Rocky Creek and the northern tributary. 2D Source over Area (SA) layers for local catchment inflows applied within the major flow paths.
Extent (Figure 5)	Central Junee, covering the Kemp Street site and Junee Yard site, as well as the Olympic Hwy Underbridge site in the north.
Downstream Boundary (Figure 5)	Water level (head) versus flow taken from the slope of the terrain (HQ type)
Timestep	Adaptive timesteps by TUFLOW
Building Representation (Figure 6)	Buildings were modelled as null polygons based on the latest aerial images as listed in Section 1.9. The buildings are the nulled-out areas as shown in Figure 6.
Topography (Figure 6)	1m resolution 2015 LiDAR and site survey/ verified cloud point data, as listed in Section 1.9
Roughness (Figure 7)	Roads: 0.022 Railway: 0.06 Residential and Open Pervious Areas: 0.05
Drainage Network (Figure 8)	As shown in Section 1.9, the drainage data were sourced from the supplied surveys and/or from the supplied drainage GIS layer from Junee Shire Council. Culvert inverts were unavailable from the Council data and were estimated based on the 1m LiDAR data. The drainage network was modelled in 1d domain of TUFLOW. Refer to Section 4.2.1.3 for details.
Design Events (Table 8)	Full ensemble simulations of each duration for the PMF, 1% AEP + Climate Change, 1% AEP, 2% AEP, and 5% AEP events

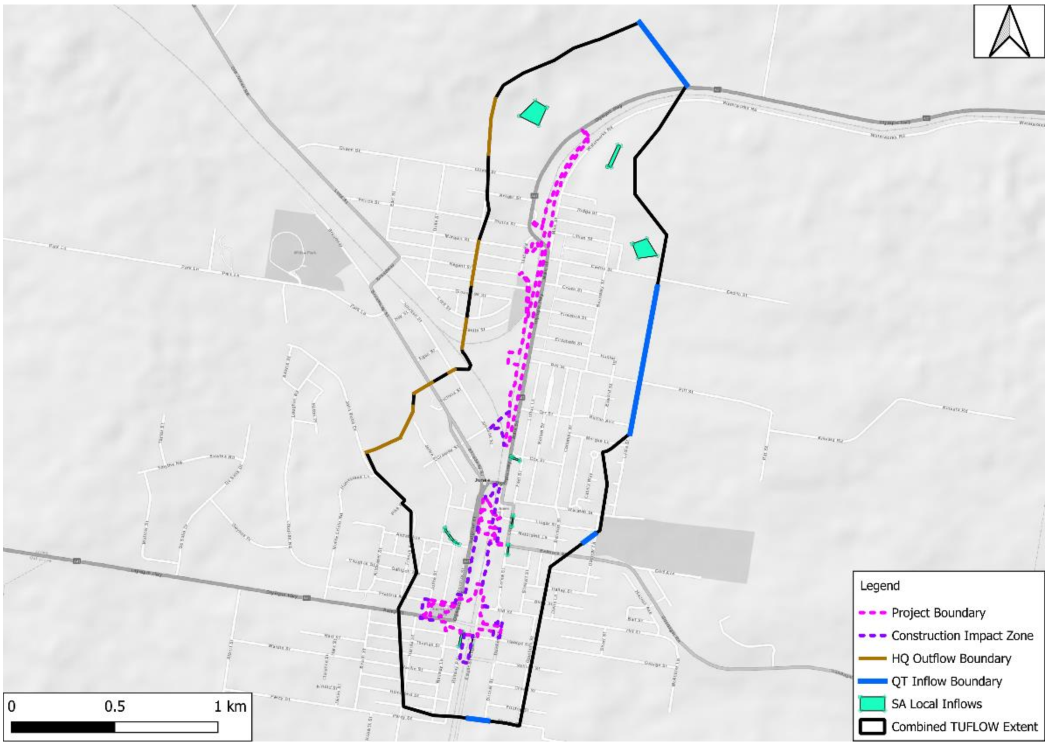


FIGURE 5: TUFLOW MODEL EXTENT AND INFLOW LOCATIONS

4.2.1.1 Topography

As described in Section 1.9, the model base topography was represented by incorporating the 1m LiDAR data and additional survey data on top of it. The digital elevation model (DEM) of the model terrain under the existing conditions is shown in Figure 6. The model sits at approximately 290–340 mAHD. The terrain within the town is largely flat to gently sloping, especially towards the western and southern portions of the model. Surrounding the town to the north and east are low ridges and rolling slopes, rising gradually but with no steep escarpments. The railway corridor runs across a relatively flat bench cut into the local terrain.

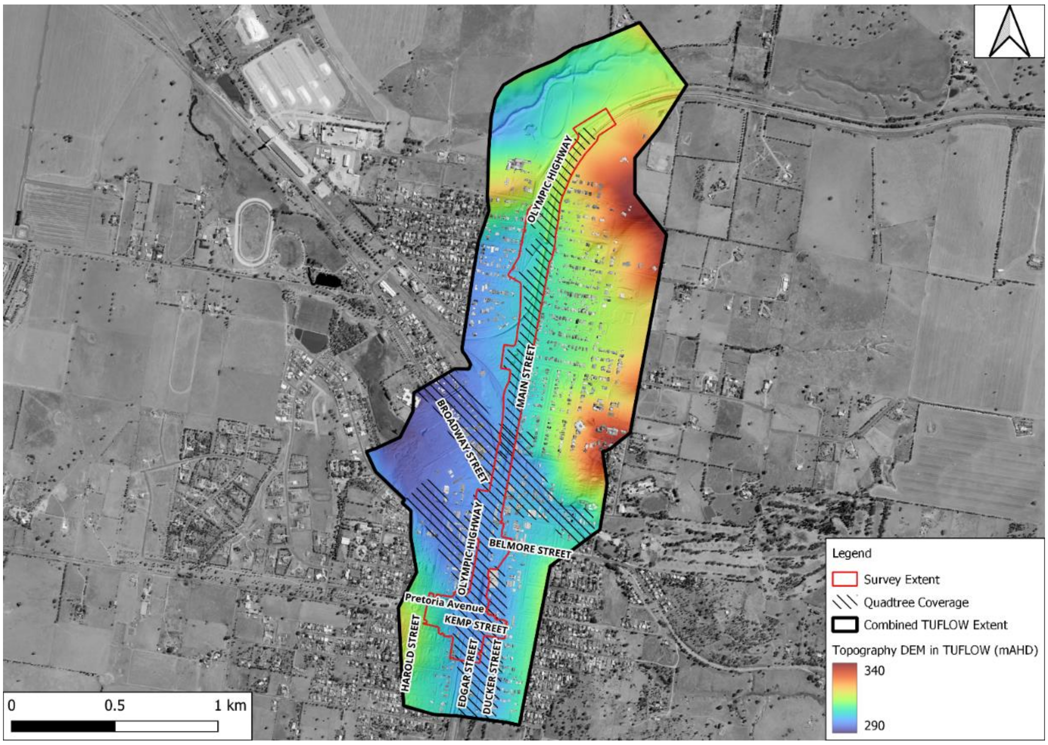


FIGURE 6: BASE TOPOGRAPHY WITH QUADTREE EXTENT AND SURVEY EXTENT IN TUFLOW

4.2.1.2 Hydraulic Roughness

In general, the land zones in TUFLOW were assigned based on the available land zoning data and aerial images as described in Section 1.9. The corresponding hydraulic roughness (Manning's n values) were determined in line with the ARR19 guidelines. The layout of the zones and the hydraulic roughness is shown in the figure below.

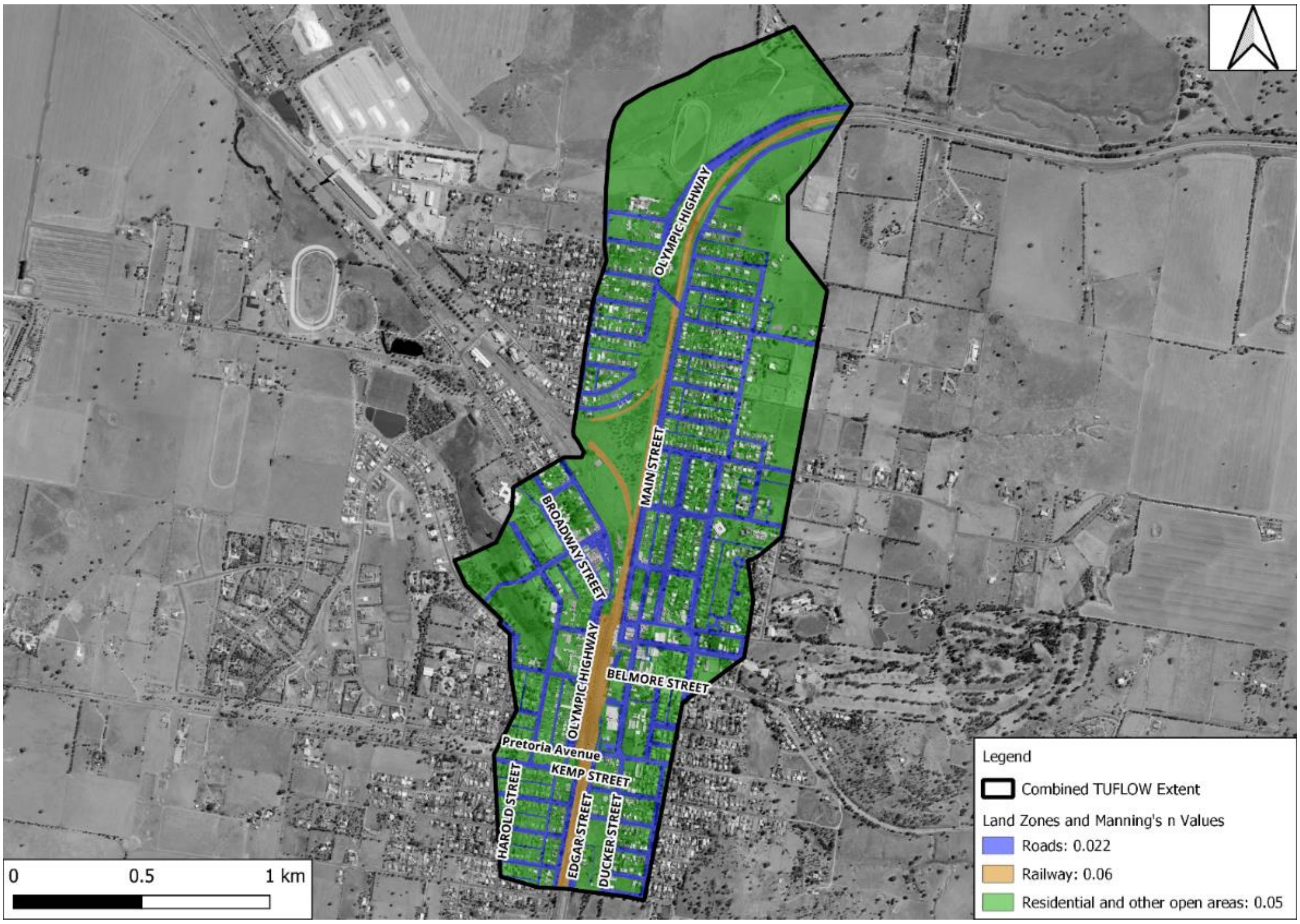


FIGURE 7: ZONING AND MANNING'S N VALUES IN TUFLOW

4.2.1.3 Drainage Network

As shown in Section 1.9, the drainage data were sourced from the supplied detailed surveys and/or from the supplied drainage GIS layer from Junee Shire Council. Where culvert inverts were unavailable from the Council data or surveys, they were estimated based on the 1m LiDAR data. The drainage network was modelled in 1d domain of TUFLOW, as shown in Figure 8. The key drainage data along major flow paths in TUFLOW are summarised in the table below.

TABLE 12: MAJOR EXISTING DRAINAGE NETWORK IN TUFLOW

ID	Type	Dimension (Width x Height or diameter in mm)	Number of Barrels
JY_001	Circular Pipe	525	2
JY_002	Circular Pipe	600	2
JY_003	Box Culvert	1800 x 900	3
JY_004	Box Culvert	1800 x 900	3
JY_005	Box Culvert	1800 x 900	2
JY_006	Box Culvert	2750 x 2100	3
JY_007	Box Culvert	1800 x 1200	6
JY_008	Box Culvert	1800 x 900	2

ID	Type	Dimension (Width x Height or diameter in mm)	Number of Barrels
JY_009	Box Culvert	1800 x 900	2
JY_010	Box Culvert	2400 x 900	2
JY_011	Box Culvert	2400 x 900	2
KS_01	Box Culvert	2500 x 900	3
KS_02	Box Culvert	2400 x 1050	3
KS_03	Box Culvert	1800 x 1200	3
KS_04	Box Culvert	3650 x 2100	5
KS_05	Box Culvert	2100 x 900	2
KS_06	Circular Pipe	750	2
KS_07	Circular Pipe	750	2
KS_010	Circular Pipe	600	2
KS_011	Circular Pipe	600	2

FIGURE 8: MAJOR EXISTING DRAINAGE NETWORK IN TUFLOW

4.2.2 Design Model

The Design Model was updated from the Existing Model by incorporating all relevant Inland Rail Project Works, as listed in Section 1.9 and illustrated in Figures 9 and 10 below, including:

- IFC track works (from Olympic Highway Underbridge package):
  The design rail tracks were represented as 3d breaklines to reinforce the top of rail levels.
- IFC track works (from Junee Station Yard package – this package):
  The design rail tracks were represented as 3d breaklines to reinforce the top of rail levels.
- IFC civil works (from Kemp Street Bridge and Footbridge package):
  The proposed civil works at Kemp Street (MC10), Olympic Highway (MC20), Pretoria Avenue (MC30), Ducker Street (MC40) and for the proposed footbridge were incorporated into the model as DEM TINs.
- IFC structural works (from Kemp Street Bridge and Footbridge package):
  The proposed Kemp Street Bridge (overbridge) and footbridge, including the approaches, were incorporated into the model. The approach slabs, bridge decks, piers and handrails were modelled in 2d_zsh and 2d_lfcsh layers in TUFLOW.
- IFC drainage works (from Kemp Street Bridge and Footbridge package):
  The proposed pit and pipe drainage at Edgar Street and Kemp Street was modelled in the 1D domain of TUFLOW. The proposed open drains were included in the DEM TINs provided by the civil works to the west and the east of the design overbridge. The ARTC culverts under the existing railway line will be retained.

Further details for design disciplines are discussed in the Detailed Design Reports of each interfacing package:

- 5-0052-210-PEN-J2-RP-0001 for Kemp Street Bridge and Footbridge package
- 5-0052-210-PEN-J4-RP-0001 for Junee Station Yard package (this package)
- 5-0052-210-PEN-J6-RP-0001 for Olympic Highway Underbridge package

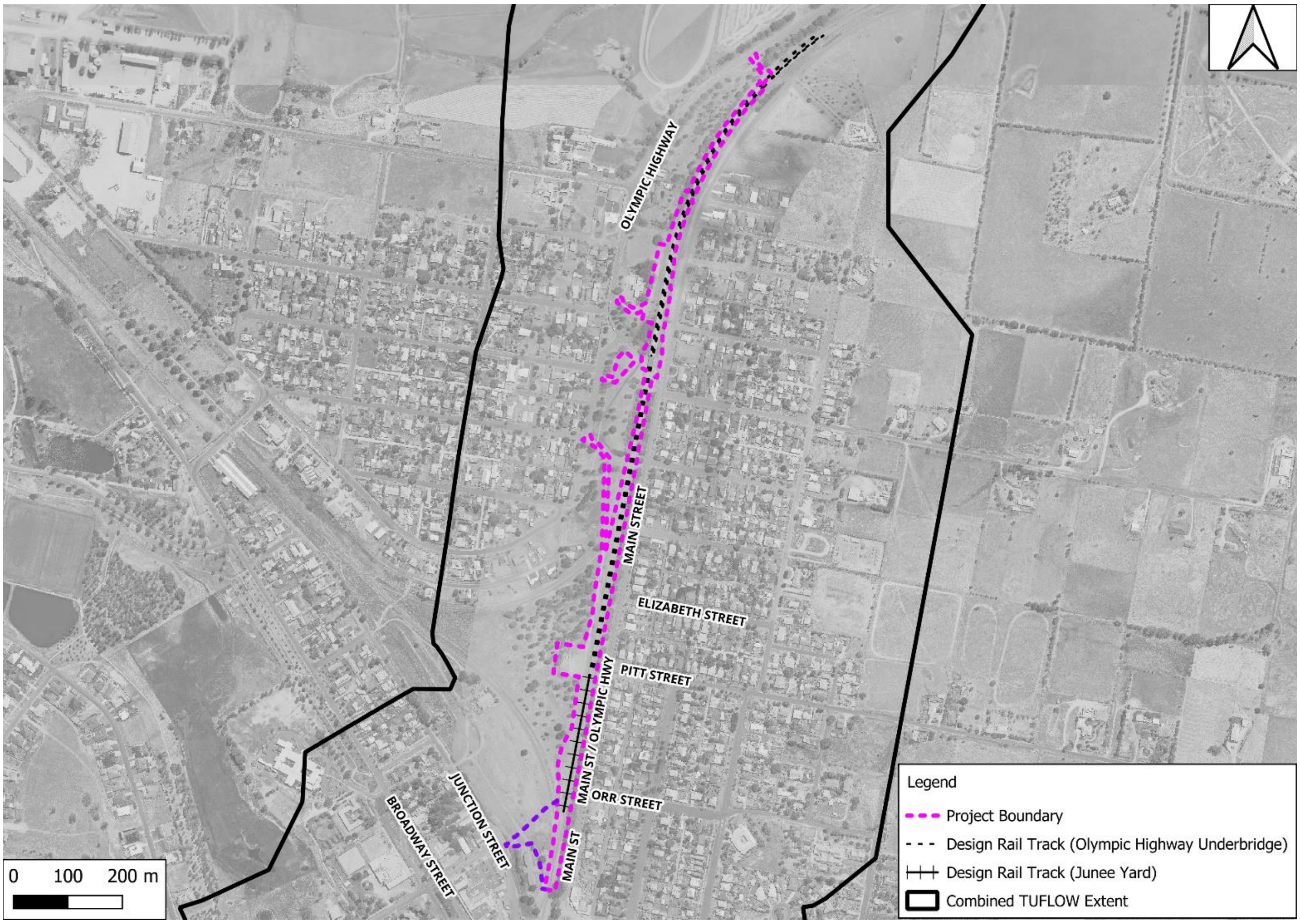


FIGURE 9: DESIGN MODEL KEY FEATURES FOR THE NORTHERN SECTION OF THE PROJECT WORKS

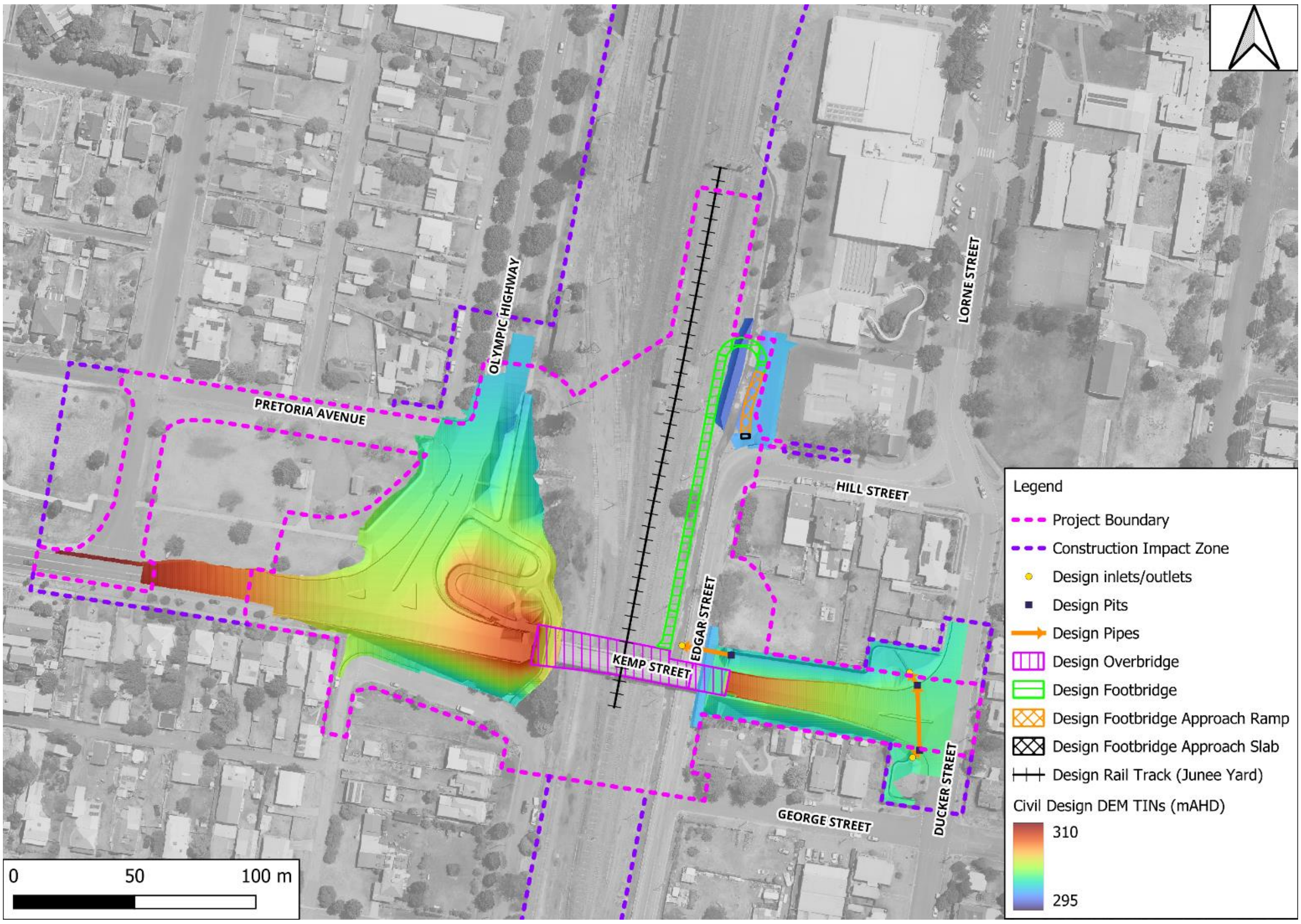


FIGURE 10: DESIGN MODEL KEY FEATURES FOR THE SOUTHERN SECTION OF THE PROJECT WORKS (KEMP STREET AREA)

4.2.3 Design Events

The TUFLOW hydraulic model was run for the 5%, 2%, 1%, 1% AEP + Climate Change and PMF design events to determine the peak flood levels, depths, velocities and hazards under the design conditions. The critical storm durations identified by the RORB modelling, as summarised in Table 8, were adopted in the TUFLOW model simulations. The full ensemble of 11 temporal patterns for PMF and 10 temporal patterns for the other events was run for each critical duration as recommended in ARR2019. The enveloped median results were adopted for all design events except for PMF, while the enveloped maximum results were adopted for the PMF events.

4.2.4 Rainfall-On-Grid Assessment

An assessment of the critical form of flooding was undertaken by assessing the peak flood levels generated from overland flows at the Junee Yard site locations via a rainfall-on-grid assessment. This utilised the IFD rainfall depths and temporal patterns used in the RORB assessment applied via a 2d_rf file, and the same initial and continuing losses were applied directly to the model terrain via a material layer. This assessment was undertaken to ensure the critical forms of flooding at the site locations were from Rocky Creek, Lower Butlers Gully and the local tributary rather from rainfall runoffs from the local catchment. It was found that the mainstream flow paths were the critical form of flooding dominating peak flood levels for the project works.

4.2.5 Comparison to the Previous Study

The hydraulic model from the Lower Butlers Gully Flood Study (Lyall & Associates Consulting Engineers, 2009) (report only) was not made available for this assessment. The Lower Butlers Gully Flood Study was undertaken in 2009 using ARR1987 principles, it used a HEC-RAS 1d model for the hydraulic modelling. HEC-RAS is a hydraulic modelling package developed by the Hydrologic Engineering Centre of the US Army Corps of Engineers. It does not consider areas of floodplain storage within the modelling as it is used when the flow paths are confined to a relatively narrow strip, close to the proximity of the channels and drainage infrastructure.

Results at two locations were compared for the Lower Butlers Gully, upstream of the railway at the entrance to the railway culvert, and within the Edgar Street channel downstream of William Street. Due to the differences in methods between the two studies the results of each assessment are not expected to be directly comparable. The comparison has been undertaken to ensure the estimated flow and flood behaviour in the catchment is appropriate.

Results at two locations under existing conditions were compared for the Lower Butlers Gully Catchment, upstream of the railway at the entrance to the railway culvert KS_04, and within the Edgar Street channel downstream of culvert KS_05 (see culvert locations in Figure 8). Due to the differences in methods between the two studies the results are not expected to be directly comparable. The comparison has been undertaken to ensure the modelled flood behaviour in TUFLOW is reasonably consistent with the HEC-RAS results, which is demonstrated in the table below.

TABLE 13: COMPARISON OF PEAK FLOOD LEVELS IN IFC TUFLOW AND HEC-RAS MODELS

AEP Event	Flood Level at Upstream of KS_04 (mAHD)		Flood Level in the Edgar Street Channel Downstream of KS_05 (mAHD)	
	Lower Butlers Gully Flood Study	IFC TUFLOW	Lower Butlers Gully Flood Study	IFC TUFLOW
1% AEP	298.4	299.0	300.2	300.5
5% AEP	297.5	298.3	299.2	300.3

The peak flood levels from this assessment are reasonably higher than those in the Lower Butlers Gully Flood Study, which is likely due to differences such as:

- The HEC-RAS model conveys flow more efficiently in the 1D system generated by a series of cross sections.
- In TUFLOW, drainage networks were modelled in the 1D domain and transferred through 1D/2D connections.
- There were finer definitions in the TUFLOW model, such as for buildings and for hydraulic roughness (Manning's n).
- The TUFLOW model used 2d terrain data with more recent surveys of the area.
- Different hydrological inflows were applied due to the change in design IFDs from ARR1987 to ARR2019.

5 FLOOD ASSESSMENT

5.1 Existing Conditions

The flood maps under the existing conditions, including peak flood depths, peak velocities, and peak hazards for all flood events, are provided in Appendix A.

For the northern section of the project works under the existing conditions, the floodwaters flow west from the local tributary catchment towards the Olympic Highway/ Main Street and travel south along the existing rail tracks until they overtop the rails near the intersection of Olympic Highway and Elizabeth Street. The overtopping flows travel both to the western open space and to the south within the rail corridor. The corridor is in cut and acts like an open channel. The southward flows eventually join the Rocky Creek near culverts JY_006 and JY_007 (shown in the figure below).

For the southern section of the project works around the Kemp Street area, mainstream floodwaters flow north from Lower Butlers Gully through the Edgar Street channel between Edgar Street and the railway tracks, continue under the Kemp Street overbridge towards the ARTC railway culvert (KS_04 in Figure 11), and eventually discharge to the Junee Urban Wetland. The railway culvert KS_04 acts as a major hydraulic control for its upstream area in a major flood event (i.e. 1% AEP and rarer). Within the rail corridor, the area above this culvert sits generally at the lowest point along the longitudinal alignment.

Figure 11 shows the 1% AEP peak flood depths under the existing conditions with the reporting locations for further discussion below. A description of the reporting locations is listed in the table below.

TABLE 14: REPORTING LOCATION DESCRIPTIONS

Reporting Location	Description
Point 1	On the western side of the rail corridor at approx. CH486.066km in the project boundary
Point 2	Adjacent to the Olympic Highway to the west of the rail corridor at approx. CH485.997km
Point 3	Downstream of Point 1 outside of the project boundary at approx. CH485.997km
Point 4	At Hill Street to the east of the rail line in front of the Locomotive Hotel at approx. CH486.066km
Point 5	In the Edgar Street concrete channel at approx. CH485.997km, within the project boundary
Point 6	On the Down Main Line to the east of the Up Main Line at approx. CH485.073km, within the project boundary
Point 7	To the west of the Up Main Line at approx. CH484.937km, within the project boundary
Point 8	On the Up Main Line at approx. CH484.849km, within the project boundary

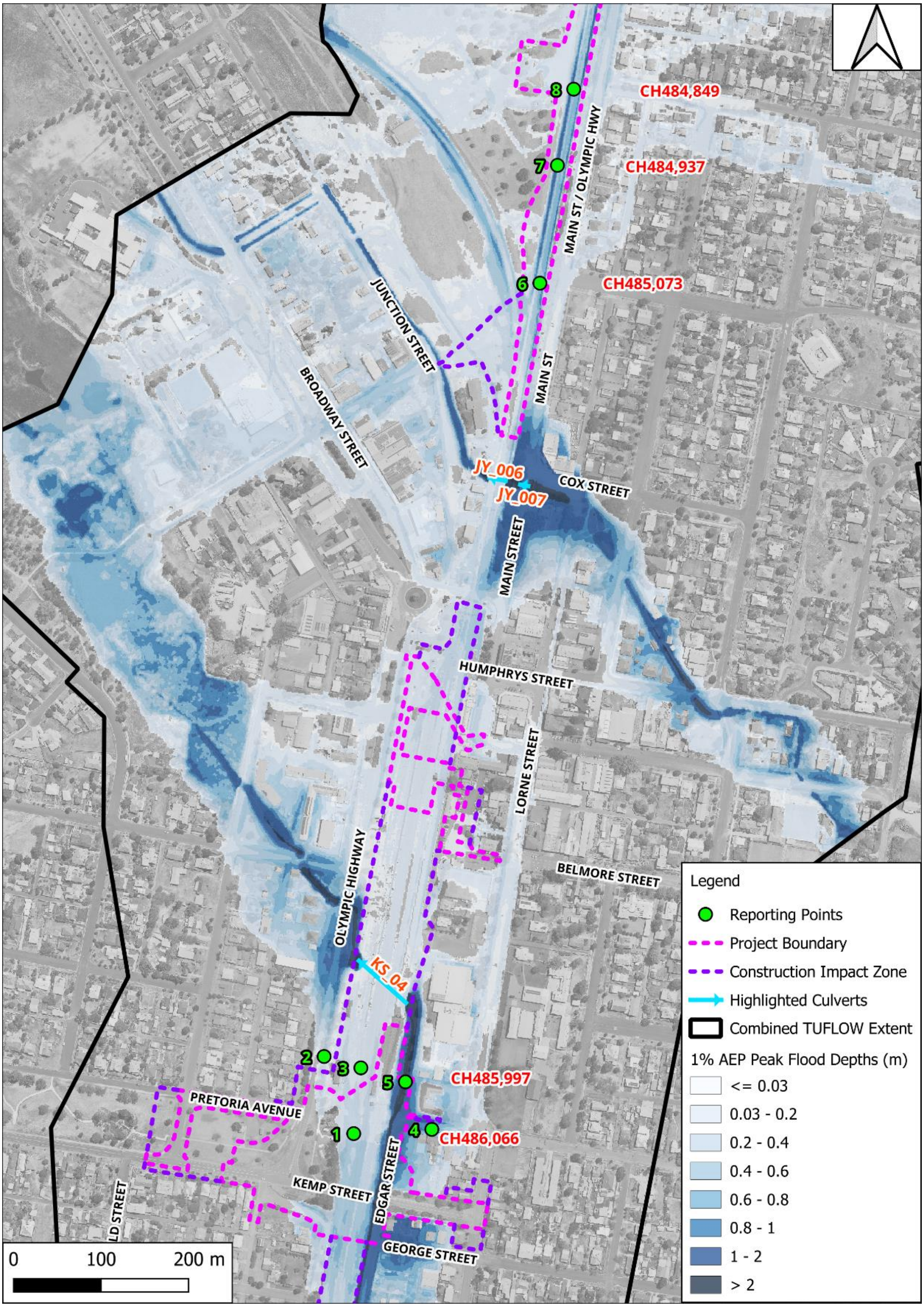


FIGURE 11: 1% AEP EXISTING FLOOD DEPTHS AND REPORTING LOCATIONS

Table 15The table below shows the peak flood depths at the reporting locations in the existing conditions. Point 1, 2 and 3 indicate that the western side of the rail corridor (to the east of the Edgar Street Channel) carries less flow from Lower Butlers Gully than the flow paths along Edgar Street and the Edgar Street Channel. Point 4 at Hill Street suggests that the Locomotive Hotel is flood-prone and likely to be inundated by floodwaters under the existing conditions for the 1% AEP event (and rarer events). Point 5 results in the highest flood depths being located within the Edgar Street Channel, where the surrounding flows concentrate. In the northern section, point 6, 7 and 8 show that the peak flood depths on the railway tracks and along the side drains remain relatively consistent across the range of design flood events except for the PMF, indicating no ponding effects observed within the corridor. The peak flood depth maps are included in Appendix A.

TABLE 15: PEAK FLOOD DEPTHS (M) AT REPORTING LOCATIONS UNDER EXISTING CONDITIONS

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	0.2	0.2	0.3	0.4	2.3
Point 2	0.2	0.2	0.3	0.4	3.0
Point 3	0.1	0.1	0.1	0.2	2.1
Point 4	0.4	0.6	0.8	1.1	3.2
Point 5	2.0	2.3	2.5	2.8	5.0
Point 6	0.5	0.6	0.6	0.7	0.9
Point 7	0.9	0.9	1.0	1.1	1.6
Point 8	0.4	0.4	0.5	0.6	1.5

The table below shows the peak flood velocities at the reporting locations in the existing conditions. At points 1 and 3, the flows are relatively slow at typically less than 1m/s except for the PMF within the rail corridor. The peak velocity at Point 2 is relatively higher as it is within the side drain of Olympic Highway. Velocities at Point 4 are low at generally less than 0.5m/s at the terrain is generally flat in front of the Locomotive Hotel. Within the Edgar Street Channel at Point 5, the velocity is the highest among the reporting locations, consistently at 1.9m/s across all the modelled events except for the PMF. In the northern section, point 6, 7 and 8 show that the peak flood velocities on the railway tracks and along the side drains remain relatively consistent across the range of design flood events except for the PMF. The velocities are typically between 1m/s and 2m/s, indicating the rail corridor acting as an open channel. The peak flood velocity maps are included in Appendix A.

TABLE 16: PEAK FLOOD VELOCITY (M/S) AT REPORTING LOCATIONS UNDER EXISTING CONDITIONS

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	0.4	0.4	0.4	0.6	2.3
Point 2	0.8	0.9	1.0	1.4	2.0
Point 3	0.2	0.2	0.2	0.4	1.4
Point 4	0.1	0.1	0.2	0.2	0.5
Point 5	1.9	1.9	1.9	1.9	2.3
Point 6	1.1	1.1	1.2	1.3	1.7
Point 7	1.4	1.5	1.6	1.6	2.5
Point 8	1.1	1.2	1.2	1.3	2.4

The flood hazard assessment was based on the general flood hazard classification set by the Australian Institute for Disaster Resilience in the Australian Disaster Resilience Handbook Collection - Flood Hazard, 2017. The figure below shows the general flood hazard vulnerability curves and categories.

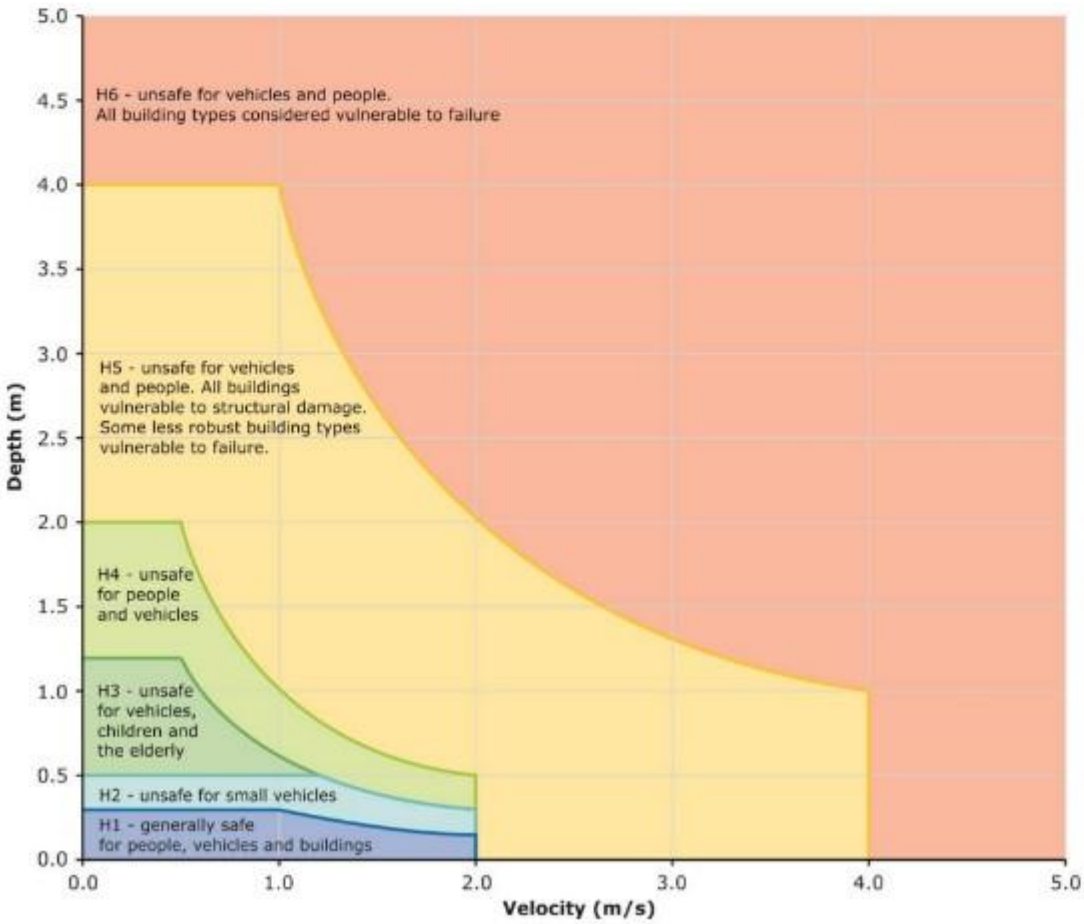


FIGURE 12: GENERAL FLOOD HAZARD VULNERABILITY CURVES AND CATEGORIES

The table below shows the peak flood hazards at the reporting locations in the existing conditions. At Points 1, 2, and 3, it is Category H1 - generally safe for people, vehicles and buildings for the events up to and including 1% AEP, showing typically low hazards within the rail corridor and adjacent to Olympic Highway. At Point 4, peak hazards are all above H1 Category due to the ponding depths in front of the Hotel, further suggesting that it is flood-prone with relatively high existing flood risks at this location. The most hazardous location is at Point 5 within the Edgar Street Channel floodway zone, which reaches Category H5 in the 5% AEP events. In the northern section, it shows medium to high hazards (all above Category H2) at Points 6, 7 and 8 within the rail corridor due to its channelling effect. The peak flood hazard maps are included in Appendix A.

TABLE 17: PEAK FLOOD HAZARDS AT REPORTING LOCATIONS UNDER EXISTING CONDITIONS

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate change	PMF
Point 1	H1	H1	H1	H2	H6
Point 2	H1	H1	H1	H2	H6
Point 3	H1	H1	H1	H1	H5
Point 4	H2	H3	H3	H3	H5
Point 5	H5	H6	H6	H6	H6
Point 6	H3	H4	H4	H4	H5
Point 7	H5	H5	H5	H5	H6
Point 8	H3	H3	H4	H4	H5

5.2 Design Conditions

For the northern section of the project works under the design conditions, the track lifts by up to 59mm have been proposed as part of the Junee Yard track designs. It generally causes only localised changes in flood behaviour as the rail corridor is in cut and acts like a channel for the floodwaters spilling over from the Olympic Highway to travel west and south. Refer to key design features in Figure 9

For the southern section of the project works under the design conditions, the maximum lift is approximately 44mm and the maximum lowering is approximately 30mm. It generally causes minimal changes in flood behaviour as the flow across the proposed rail track is much less than that flows in parallel to the track. Refer to key design features in Figure 10.

The figure below shows the 1% AEP peak flood depths under the design conditions, with the reporting locations, for further discussion below. A description of the reporting locations was listed in Table 14.

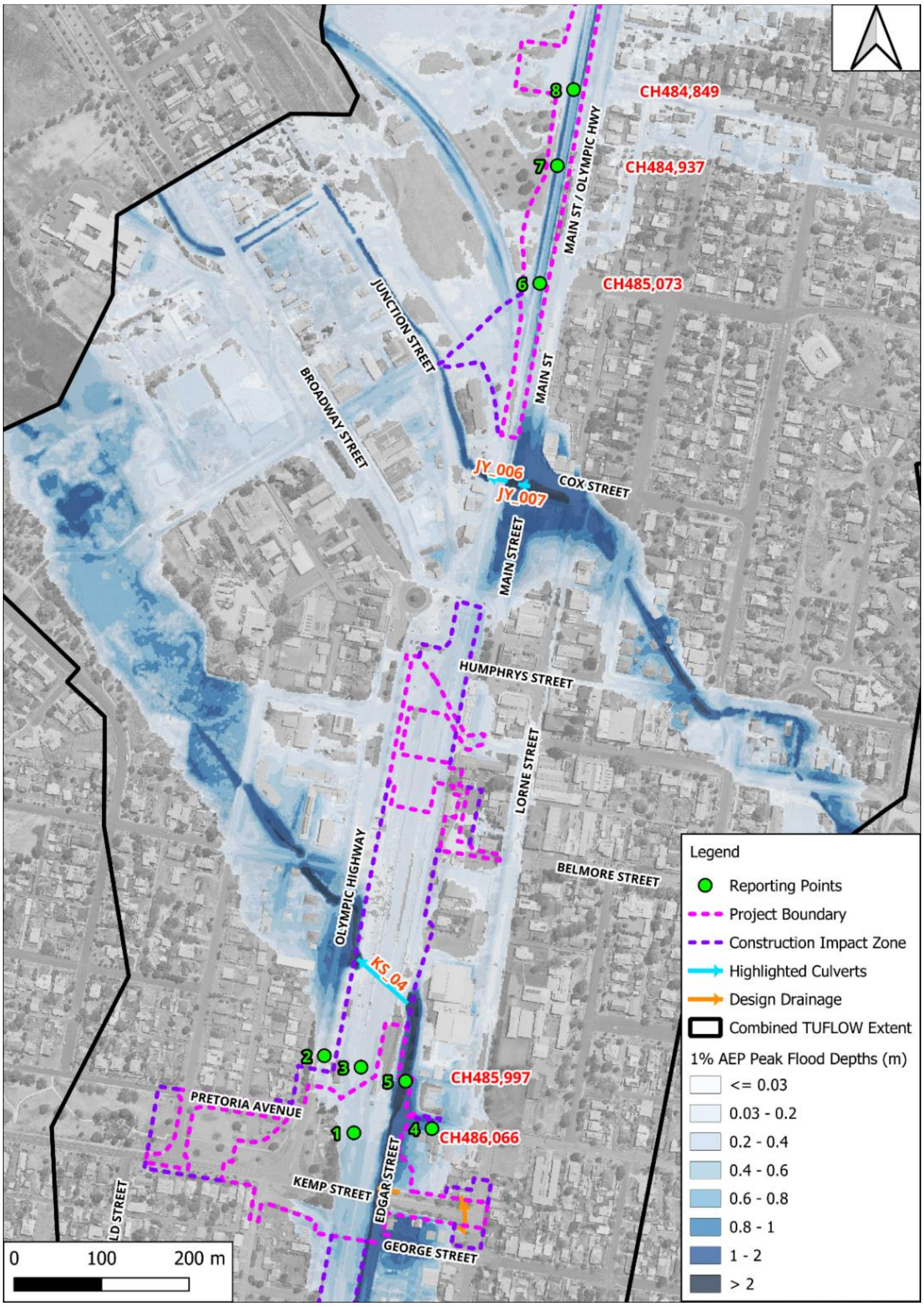


FIGURE 13: 1% AEP DESIGN FLOOD DEPTHS AND REPORTING LOCATIONS

The table below shows the peak flood depths at the reporting locations in the design condition. The peak flood depths in the design conditions have minimal changes to those in the existing condition. For a detailed discussion on changes, refer to Section 5.4. The peak flood depth maps are included in Appendix A.

TABLE 18: PEAK FLOOD DEPTHS (M) AT REPORTING LOCATIONS UNDER DESIGN CONDITIONS

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	0.2	0.2	0.3	0.4	2.4
Point 2	0.2	0.2	0.3	0.4	3.0
Point 3	0.1	0.1	0.1	0.2	2.1
Point 4	0.4	0.6	0.8	1.1	3.3
Point 5	2.0	2.3	2.5	2.8	5.0
Point 6	0.5	0.6	0.6	0.7	0.9
Point 7	0.9	1.0	1.0	1.1	1.7
Point 8	0.4	0.4	0.5	0.6	1.5

The table below shows the peak flood velocities at the reporting locations in the design conditions. The velocities remain consistent with the existing conditions, with the maximum velocities occurring at Point 5 in the Edgar Street Channel and with the relatively high velocities occurring across Points 6, 7, and 8, where the rail corridor acts like a channel. For a detailed discussion on changes, refer to Section 5.4. The peak flood velocity maps are included in Appendix A.

TABLE 19: PEAK FLOOD VELOCITY (M/S) AT REPORTING LOCATIONS UNDER DESIGN CONDITIONS

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	0.3	0.4	0.4	0.6	2.4
Point 2	0.8	0.9	1.0	1.3	1.8
Point 3	0.2	0.2	0.2	0.4	1.5
Point 4	0.1	0.1	0.2	0.2	0.5
Point 5	1.6	1.6	1.6	1.6	2.5
Point 6	1.1	1.1	1.2	1.3	1.7
Point 7	1.5	1.5	1.6	1.7	2.6
Point 8	1.1	1.1	1.2	1.3	2.3

The table below shows the peak flood hazards at the reporting locations in the design conditions. The flood hazards remain consistent with the existing conditions, with the peak flood hazards occurring at Point 5 within the Edgar Street Channel. For a detailed discussion on changes, refer to Section 5.4. The peak flood hazard maps are included in Appendix A.

TABLE 20: PEAK FLOOD HAZARDS AT REPORTING LOCATIONS UNDER DESIGN CONDITIONS

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	H1	H1	H1	H2	H6
Point 2	H1	H1	H1	H2	H6
Point 3	H1	H1	H1	H1	H5
Point 4	H2	H3	H3	H3	H5
Point 5	H5	H5	H6	H6	H6

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 6	H3	H4	H4	H4	H5
Point 7	H5	H5	H5	H5	H6
Point 8	H3	H3	H4	H4	H5

5.3 Flood Immunity and Scour Protection

The flood immunity of the rail tracks in the existing and design conditions is discussed in the table below. There has been no change in flood immunity due to the proposed designs. Refer to Table 15 and 18 for peak flood depths at the reporting locations in the existing and design conditions. The peak flood depth maps are included in Appendix A for illustration of inundation extents.

TABLE 21: RAIL IMMUNITY – EXISTING CONDITIONS AND DESIGN CONDITIONS

Design Events	Overtopping Descriptions
5% AEP	▪ Floodwaters overtop the existing rail tracks except for the section from CH485.180km to CH485.280km in the northern section of the track works. ▪ Floodwaters overtop the existing rail tracks except for the section from CH485.880km to CH486.000km in the southern section of the track works. ▪ Overtopping extents are maintained for both sections of the track works under the design conditions.
2% AEP	▪ Floodwaters overtop the existing rail tracks except for the section from CH485.180km to CH485.250km in the northern section of the track works. ▪ Floodwaters overtop the existing rail tracks except for the section from CH485.880km to CH486.000km in the southern section of the track works. ▪ Overtopping extents are maintained for both sections of the track works under the design conditions.
1% AEP	▪ Floodwaters overtop the existing rail tracks except for the section from CH485.190km to CH485.250km in the northern section of the track works. ▪ Floodwaters overtop the existing rail tracks except for the section from CH485.915km to CH485.997km in the southern section of the track works. ▪ Overtopping extents are maintained for both sections of the track works under the design conditions.

The table below compares the flood immunity at CH484.892km where the rail has been lifted the most, by approximately 59mm which shows minimal change to the flood levels.

TABLE 22: COMPARISON OF FLOOD IMMUNITY AT CH484.892KM

Level (mAHD)	Existing Conditions	Design Conditions
Top of Rail Level	303.37	303.43
Top of Formation Level*	302.70	302.77
5% AEP Flood Level	303.78	303.79
2% AEP Flood Level	303.82	303.83
1% AEP Flood Level	303.90	303.92

*Note top of formation level has been assumed to be 667mm below the existing top of rail level, assuming a 167mm depth 53kg/m rail, 10mm rail pad, 250mm sleeper depth and 250mm ballast depth below sleeper.

Based on the results above, the existing flood immunity of the rails is lower than the 5% AEP event. The proposed track lifts would improve the existing immunity. As per the functional requirements. the existing immunity of the rails is lower than the ARTC SMS minimum requirement (1% AEP), which would be maintained under the design conditions. The rail formation has not been affected as part of the designs. This complies with the criteria in PSRs and the CoA flood immunity criteria.

Furthermore, in the design conditions, the flood velocities outside the project boundary comply with the CoA Scour/Erosion potential criteria (less than 10% increase or less than 0.5m/s changes in velocity) (refer to CoA E42 (h) in Table 5) up to and including the 1% AEP storm event. Hence, there is no need for scour protection measures outside the project boundary. Refer to Section 5.4.2 for more details on changes in flood velocity by the designs.

5.4 Flood Impact Assessment

As per CoA E42, the flood impact assessment was conducted. The results are summarised for events up to and including the 1% AEP event and are discussed for the northern section of the Project Works (refer to Figure 9) and for the southern section of the Project Works (refer to Figure 10) respectively. The discussion focuses on the flood impacts outside the project boundary (and the construction impact zone) for compliance. The flood impact maps are included in Appendix A for illustration of the project areas, which are recommended to be read with the discussion below.

5.4.1 Changes in Peak Flood Level

The changes in peak flood level are summarised and discussed in the table below.

TABLE 23: SUMMARY OF IMPACTS ON PEAK FLOOD LEVEL

Design Events	Changes in Peak Flood Level
5% AEP	▪ For the northern section of the Project Works, the changes are generally within ±10mm outside the project boundary. No properties are adversely affected by the project works. To the west of the design tracks within the downstream open space, the peak levels have minimal changes of ±25mm due to the track lifts. These are compliant within the 100mm limit as per the CoA E42(e) for the public recreation zone. ▪ For the southern section of the Project Works, the changes are generally within ±10mm outside the project boundary. No properties are adversely affected by the project works. Due to the proposed footbridge and associated civil designs, the peak levels are typically increased by 10-50mm downstream of the footbridge within the Edgar Street Channel. To its east within the Junee Recreation and Aquatic Centre complex, the affected building appears to be a non-habitable storage structure. The increases are compliant within the 100mm limit as per the CoA E42(e) for the public recreation zone. ▪ Adjacent to the intersection of Pretoria Avenue and Olympic Highway, there are increases in peak flood level and newly wet areas within the approved Construction Impact Zone, which are due to the increases in design level from the civil works. The impacts are generally observed in the corridor area on the eastern side of the Highway. These changes are compliant as per the CoA E42(d). ▪ The 'newly wet' grids outside the project boundary are varied between 0 to 50 mm in the road/ rail corridors, and below 100mm in the public recreation zones. There is no inundation of habitable properties which are currently not inundated. These are within the limits as per CoA E42. Refer to the maps showing the peak flood depths under the design conditions in Appendix A for details.
2% AEP	▪ For the northern section of the Project Works, the changes are consistent to the 5% AEP above. ▪ For the southern section of the Project Works, the changes are consistent to the 5% AEP above. The peak levels are typically increased by 10-40mm downstream of the footbridge within the Edgar Street Channel and to its east, which causes less impact than the 5% AEP at this location.
1% AEP	▪ For the northern section of the Project Works, the changes are consistent to the events above. ▪ For the southern section of the Project Works, the changes are consistent to the events above. The peak levels are typically increased by 10-20mm downstream of the footbridge within the Edgar Street Channel and to its east, which causes further less impact than the 2% AEP at this location.

The change in flood levels at the reporting locations in Figure 11 are shown below in the table below. The reduction in peak flood levels at Point 4 is due to improvement of flow conveyance by the civil design works around the proposed footbridge, which allows for the constrictions by the bridge abutment, piers, decks and handrails. The maximum increases occurring at Point 5 are due to the flow constrictions by the presence of the proposed footbridge. The increases in Points 6, 7 and 8 are caused by the proposed track lifts along the Up Main Line.

TABLE 24: CHANGES IN PEAK FLOOD LEVEL (MM) AT REPORTING LOCATIONS (DESIGN MINUS EXISTING)

Locations	5% AEP	2% AEP	1% AEP
Point 1 (within the project boundary)	0	0	0
Point 2 (outside the project boundary)	2	2	2
Point 3 (outside the project boundary)	0	1	2
Point 4 (outside the project boundary)	-15	-8	-4
Point 5 (within the project boundary)	28	21	11
Point 6 (within the project boundary)	8	8	7
Point 7 (within the project boundary)	6	8	11
Point 8 (within the project boundary)	19	19	21

As discussed, the changes in peak flood level outside the project boundary comply with the PSR and CoA requirements.

5.4.2 Changes in Peak Flood Velocity

For the events up to and including the 1% AEP, the changes in peak flood velocity outside the project boundary are less than 0.5m/s. The newly wet grids outside the project boundary have velocities less than 0.5m/s. Refer to the peak flood velocity maps and flood impact maps in Appendix A for demonstration. Within the project boundary, the changes are localised, generally due to the proposed footbridge across the Edgar Street Channel and the associated piers.

The changes in flood velocity at the reporting locations in Figure 11 are shown in the table below, which are insignificant in general. The reduction of the velocities at Point 5 is due to the flow constrictions by the presence of the proposed footbridge.

TABLE 25: CHANGES IN PEAK FLOOD VELOCITY (M/S) AT REPORTING LOCATIONS (DESIGN MINUS EXISTING)

Locations	5% AEP	2% AEP	1% AEP
Point 1 (within the project boundary)	-0.01	0.00	-0.01
Point 2 (outside the project boundary)	0.02	0.01	0.01
Point 3 (outside the project boundary)	0.00	0.00	0.00
Point 4 (outside the project boundary)	0.00	0.00	0.00
Point 5 (within the project boundary)	-0.35	-0.32	-0.32
Point 6 (within the project boundary)	0.01	0.01	0.01
Point 7 (within the project boundary)	0.02	0.02	0.02
Point 8 (within the project boundary)	-0.02	-0.02	-0.01

As discussed, the changes in peak flood velocity outside the project boundary comply with the PSR and CoA requirements.

5.4.3 Changes in Peak Flood Hazard

For the events up to and including the 1% AEP, there is no increase in flood hazard or risk to life outside the project boundary. Where there are scattered individual cells showing an increase by 1 category, velocities, depths and V × D were inspected and reviewed at these locations. The changes in V × D at the scattered cells are within ±0.01 m^2/s, showing no real change in hazard category or risk to life, according to the combined hazard curves thresholds in Figure 12. The inaccuracies are likely due to the output configurations in TUFLOW assigning values for the peak flood hazards. According to the TUFLOW Classic/HPC User Manual (2025.0), Section 11.2.3.1, grid map output hazard categories are output as integer grids (i.e. values are rounded to the nearest integer when a grid output cell centre is located at a change in category).

The changes in peak flood hazard at the reporting locations in Figure 11 are shown in the table below. There is generally no change at these locations, except for Point 4 in the 2% AEP event, where the hazard is lowered due to the velocity reductions by the footbridge as flow constrictions.

TABLE 26: CHANGES IN FLOOD HAZARD AT REPORTING LOCATIONS (DESIGN MINUS EXISTING)

Locations	5% AEP	2% AEP	1% AEP
Point 1 (within the project boundary)	No change	No change	No change
Point 2 (outside the project boundary)	No change	No change	No change
Point 3 (outside the project boundary)	No change	No change	No change
Point 4 (outside the project boundary)	No change	No change	No change
Point 5 (within the project boundary)	No change	Lowered from Category H6 to Category H5	No change
Point 6 (within the project boundary)	No change	No change	No change
Point 7 (within the project boundary)	No change	No change	No change
Point 8 (within the project boundary)	No change	No change	No change

As discussed, the changes in peak flood hazard outside the project boundary comply with the PSR and CoA requirements.

5.4.4 Changes in Duration of Inundation

The analysis around the changes in the duration of inundation was undertaken by comparing the time series of flood level between the existing and design conditions at selected locations. The typical locations were selected in the vicinity of the project works outside the project boundary, which are the key locations for concern in terms of the flood impacts, as shown in Figure 14. The diagrams are shown in Figure 15. The comparison of the flood level vs time for the 1%, 2% and 5% AEP events indicates that there are minimal changes to the duration of inundation, thereby complying with the maximum increase in inundation time of one hour, or 10%, whichever is greater as per the CoA E42(a).

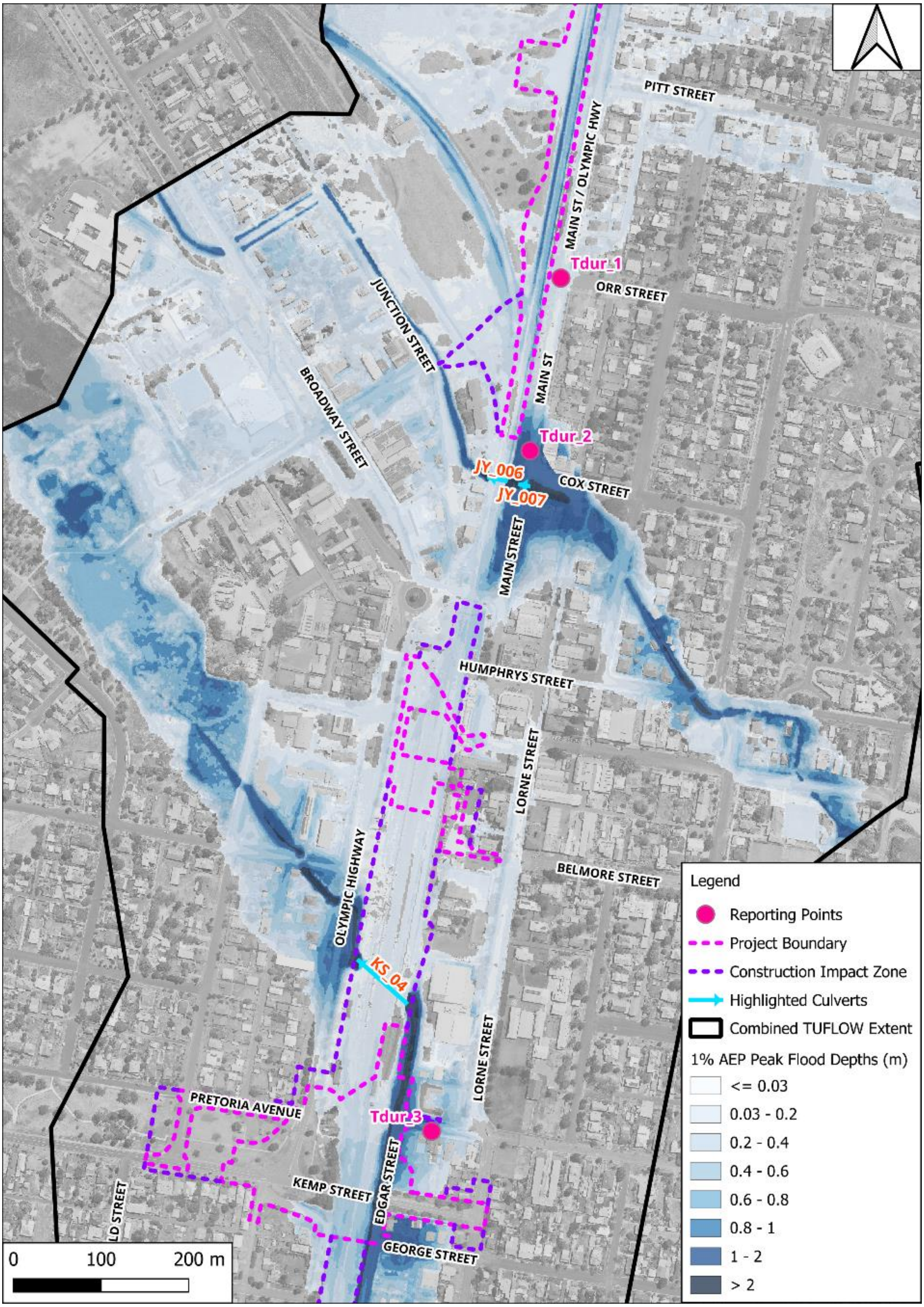


FIGURE 14: REPORTING LOCATIONS (TDUR_X) FOR THE CHANGES IN DURATION OF INUNDATION WITH EXISTING 1% AEP FLOOD DEPTHS

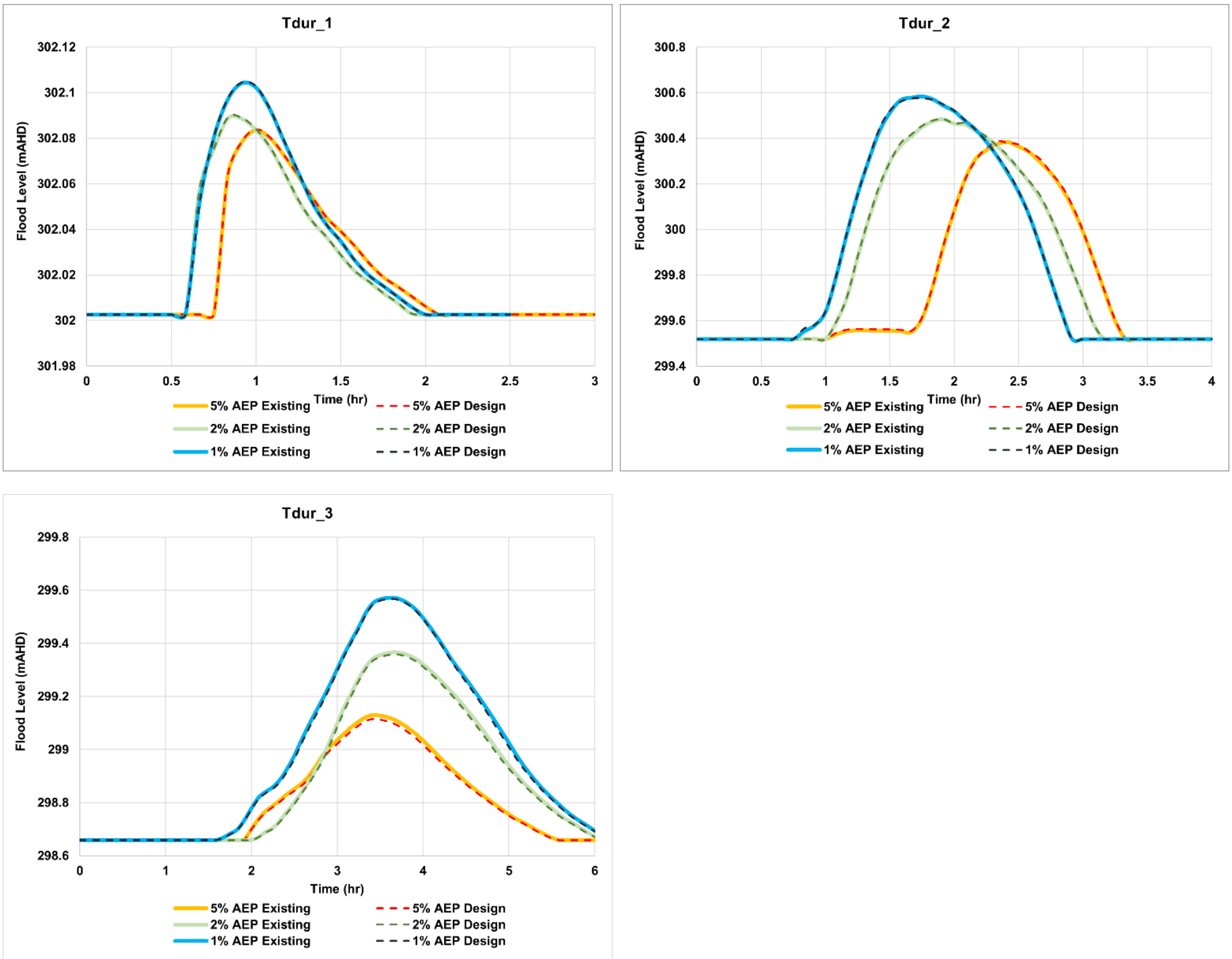


FIGURE 15 COMPARISON FOR CHANGES IN DURATION OF INUNDATION AT KEY LOCATIONS

5.4.5 Cumulative impact

As stated in Section 4 under “Modelling Methodology”, the design condition incorporated the Olympic Highway Underbridge design (5-0052-210-PEN-J6-RP-0001) and Kemp Street Bridge and Footbridge design (5-0052-210-PEN-J2-RP-0001) to understand an overall cumulative impact on the site. Those cumulative impacts have been reflected in Section 5.4.1 to Section 5.4.4, indicating that there are no non-compliances on Junee Yard caused by the Olympic Highway Underbridge design, and the Kemp Street Bridge and Footbridge design for all events up to 1% AEP.

5.5 Sensitivity Test

5.5.1 Climate Change Risk Assessment

Climate Change risk assessment was carried out by running the 1% AEP with 2090 RCP8.5 interim climate change factor (refer to Section 4.1.4 for details of methodology). The results of peak flood depths, flood velocities and flood hazards are shown in Sections 5.1 and 5.2. The corresponding flood maps are included in Appendix A.

As discussed in Section 5.3 for flood immunity, the railway tracks would be overtopped in both the existing and design conditions in the 1% AEP event + Climate Change event. The depth of overtopping is slightly higher due to the increased rainfall.

5.5.2 Blockage Assessment

A hydraulic blockage assessment was carried out for the 1% AEP design scenario. A 20% blockage was adopted for all the other culverts, pits and pipes outside the project boundary. Within the project boundary, blockage of culverts and bridges was assessed based on the ARR2019 guidelines. The assessment involved assessing the site area for debris availability, mobility and transportability. The adopted blockage factors are shown in the table below.

TABLE 27: BLOCKAGE ASSESSMENT FOR THE STRUCTURES WITHIN THE PROJECT BOUNDARY

Structures	Debris Availability	Debris Mobility	Debris Transportability	AEP Adjusted Debris Potential	Blockage
Culverts	Low	Low	Medium	Low	25%
Kemp Street overbridge	Medium	Medium	Medium	Medium	10%
Kemp Street footbridge	Medium	High	High	High	20%

For the northern section of works, there are minimal changes with the blockage applied as there is a minor drainage network in this area and the floodwaters are relatively shallow overland flows. Downstream of the design tracks near the Rocky Creek (between Humphry's Street and Main Street) results in a typical 10-20mm increase by blockage. For the southern section, the impacts of blockage on the flood behaviour are more prominent due to the presence of major culverts, the proposed bridge and footbridge around the Kemp Street area, as well as the mainstream flooding mechanism. The increases are up to 160mm between the proposed footbridge and the ARTC rail culvert (KS_04 shown in Figure 8) and are approximately 44mm along Hill Street. The change in peak flood levels for the 1% AEP design conditions is shown in Figure 16 The culverts are highlighted as the key hydraulic controls adjacent to the project works, upstream of which are most sensitive to the potential blockage.

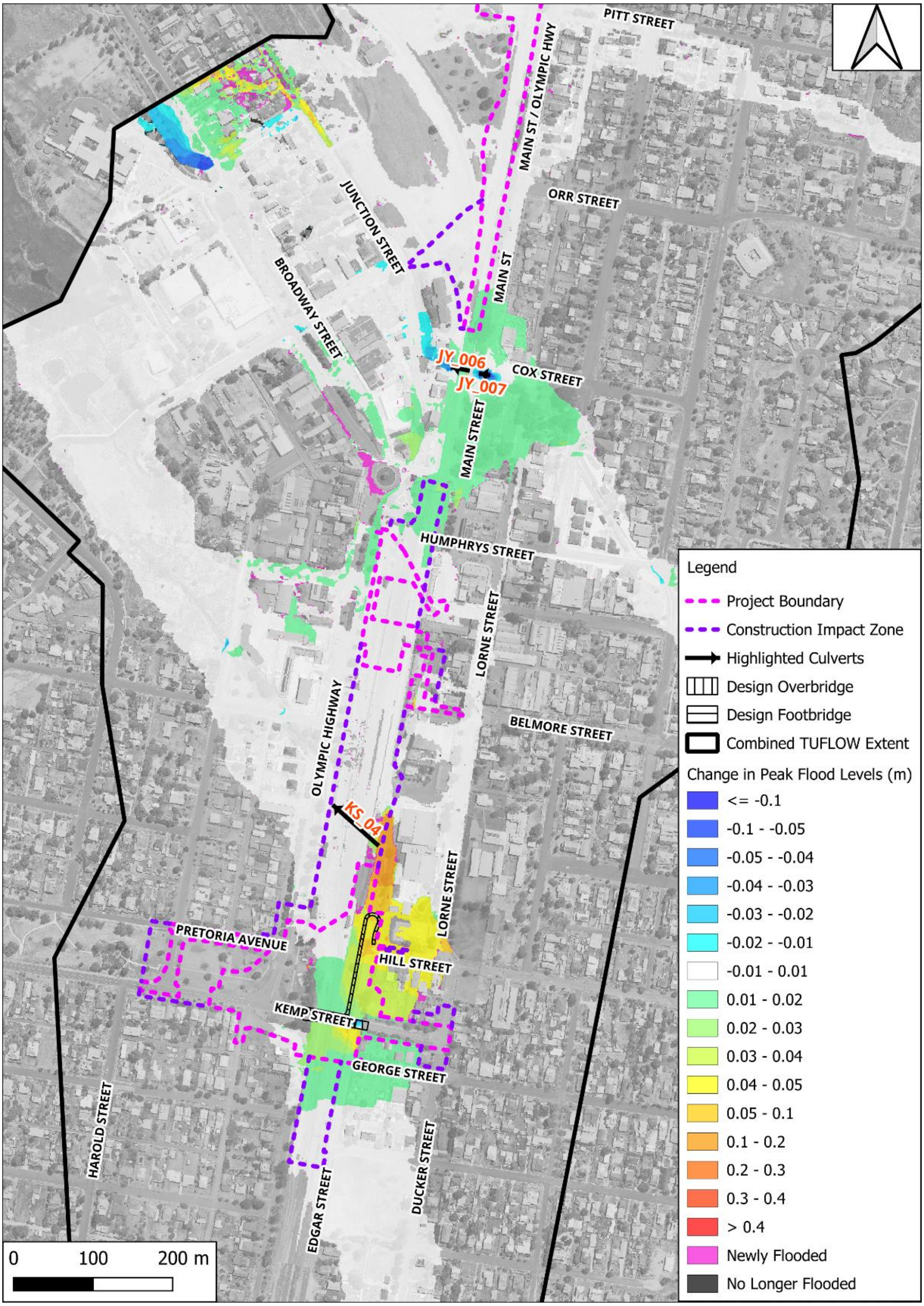


FIGURE 16: CHANGES IN PEAK FLOOD LEVELS FOR THE 1% AEP DESIGN CONDITIONS (BLOCKAGE VS NO BLOCKAGE)

6 MITIGATION MEASURES

No instances of non-compliance in terms of flood impact were documented. Therefore, no additional mitigation measures are necessary unless the design changes.

7 RECOMMENDATIONS

This is the IFC stage of the report, and the following 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.

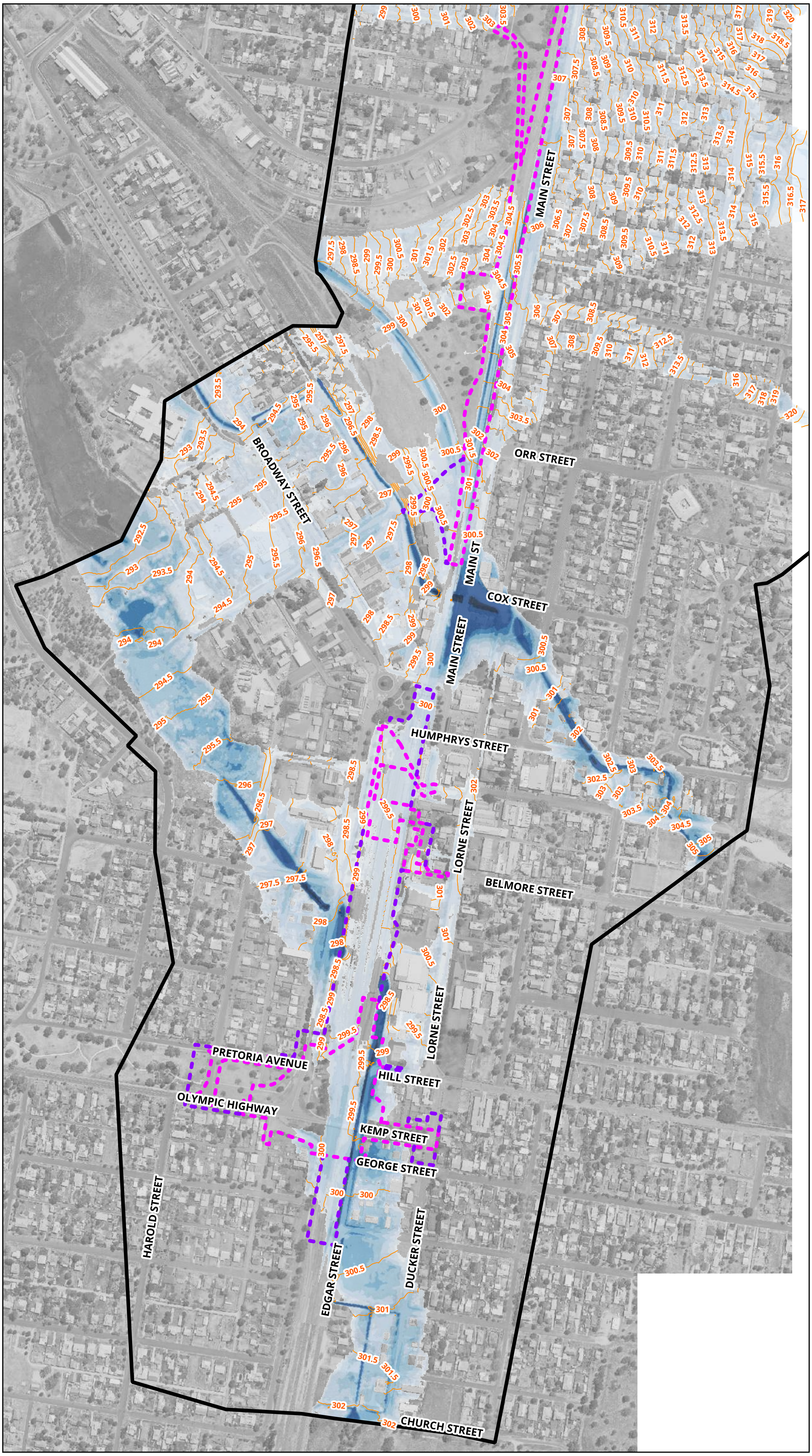
APPENDIX A

Flood Maps

TABLE A- 1 LIST OF FIGURES

Figure Number	Figure Name
Figure A33	(Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 1% AEP Changes in Peak Flood Level
Figure A34	(Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 5% AEP Changes in Peak Flood Velocity
Figure A35	(Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 2% AEP Changes in Peak Flood Velocity
Figure A36	(Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 1% AEP Changes in Peak Flood Velocity
Figure A37	(Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 5% AEP Changes in Peak Flood Hazard
Figure A38	(Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 2% AEP Changes in Peak Flood Hazard
Figure A39	(Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 1% AEP Changes in Peak Flood Hazard
Figure A40	(Overall Extent) Flood Impacts (Design Blockage Conditions vs Design Conditions) - 1% AEP Changes in Peak Flood Level
Figure A41	(Overall Extent) Flood Impacts (Design Blockage Conditions vs Design Conditions) - 1% AEP Changes in Peak Flood Velocity
Figure A42	(Overall Extent) Flood Impacts (Design Blockage Conditions vs Design Conditions) - 1% AEP Changes in Peak Flood Hazard
Figure A43	(Northern Extent) Existing Conditions - 5% AEP Peak Flood Depths and Flood Level Contours
Figure A44	(Northern Extent) Existing Conditions - 2% AEP Peak Flood Depths and Flood Level Contours
Figure A45	(Northern Extent) Existing Conditions - 1% AEP Peak Flood Depths and Flood Level Contours
Figure A46	(Northern Extent) Existing Conditions - 1% AEP + Climate Change Peak Flood Depths and Flood Level Contours
Figure A47	(Northern Extent) Existing Conditions - PMF Event Peak Flood Depths and Flood Level Contours
Figure A48	(Northern Extent) Existing Conditions - 5% AEP Peak Flood Velocities
Figure A49	(Northern Extent) Existing Conditions - 2% AEP Peak Flood Velocities
Figure A50	(Northern Extent) Existing Conditions - 1% AEP Peak Flood Velocities
Figure A51	(Northern Extent) Existing Conditions - 1% AEP + Climate Change Peak Flood Velocities
Figure A52	(Northern Extent) Existing Conditions - PMF Event Peak Flood Velocities
Figure A53	(Northern Extent) Existing Conditions - 5% AEP Peak Flood Hazards
Figure A54	(Northern Extent) Existing Conditions - 2% AEP Peak Flood Hazards
Figure A55	(Northern Extent) Existing Conditions - 1% AEP Peak Flood Hazards
Figure A56	(Northern Extent) Existing Conditions - 1% AEP + Climate Change Peak Flood Hazards
Figure A57	(Northern Extent) Existing Conditions - PMF Event Peak Flood Hazards
Figure A58	(Northern Extent) Design Conditions - 5% AEP Peak Flood Depths and Flood Level Contours
Figure A59	(Northern Extent) Design Conditions - 2% AEP Peak Flood Depths and Flood Level Contours
Figure A60	(Northern Extent) Design Conditions - 1% AEP Peak Flood Depths and Flood Level Contours
Figure A61	(Northern Extent) Design Conditions - 1% AEP + Climate Change Peak Flood Depths and Flood Level Contours
Figure A62	(Northern Extent) Design Conditions - PMF Event Peak Flood Depths and Flood Level Contours

Figure Number	Figure Name
Figure A63	(Northern Extent) Design Conditions - 5% AEP Peak Flood Velocities
Figure A64	(Northern Extent) Design Conditions - 2% AEP Peak Flood Velocities
Figure A65	(Northern Extent) Design Conditions - 1% AEP Peak Flood Velocities
Figure A66	(Northern Extent) Design Conditions - 1% AEP + Climate Change Peak Flood Velocities
Figure A67	(Northern Extent) Design Conditions - PMF Event Peak Flood Velocities
Figure A68	(Northern Extent) Design Conditions - 5% AEP Peak Flood Hazards
Figure A69	(Northern Extent) Design Conditions - 2% AEP Peak Flood Hazards
Figure A70	(Northern Extent) Design Conditions - 1% AEP Peak Flood Hazards
Figure A71	(Northern Extent) Design Conditions - 1% AEP + Climate Change Peak Flood Hazards
Figure A72	(Northern Extent) Design Conditions - PMF Event Peak Flood Hazards
Figure A73	(Northern Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 5% AEP Changes in Peak Flood Level
Figure A74	(Northern Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 2% AEP Changes in Peak Flood Level
Figure A75	(Northern Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 1% AEP Changes in Peak Flood Level
Figure A76	(Northern Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 5% AEP Changes in Peak Flood Velocity
Figure A77	(Northern Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 2% AEP Changes in Peak Flood Velocity
Figure A78	(Northern Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 1% AEP Changes in Peak Flood Velocity
Figure A79	(Northern Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 5% AEP Changes in Peak Flood Hazard
Figure A80	(Northern Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 2% AEP Changes in Peak Flood Hazard
Figure A81	(Northern Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 1% AEP Changes in Peak Flood Hazard
Figure A82	(Northern Extent) Flood Impacts (Design Blockage Conditions vs Design Conditions) - 1% AEP Changes in Peak Flood Level
Figure A83	(Northern Extent) Flood Impacts (Design Blockage Conditions vs Design Conditions) - 1% AEP Changes in Peak Flood Velocity
Figure A84	(Northern Extent) Flood Impacts (Design Blockage Conditions vs Design Conditions) - 1% AEP Changes in Peak Flood Hazard
Figure A85	(Southern Extent) Existing Conditions - 5% AEP Peak Flood Depths and Flood Level Contours
Figure A86	(Southern Extent) Existing Conditions - 2% AEP Peak Flood Depths and Flood Level Contours
Figure A87	(Southern Extent) Existing Conditions - 1% AEP Peak Flood Depths and Flood Level Contours
Figure A88	(Southern Extent) Existing Conditions - 1% AEP + Climate Change Peak Flood Depths and Flood Level Contours
Figure A89	(Southern Extent) Existing Conditions - PMF Event Peak Flood Depths and Flood Level Contours
Figure A90	(Southern Extent) Existing Conditions - 5% AEP Peak Flood Velocities
Figure A91	(Southern Extent) Existing Conditions - 2% AEP Peak Flood Velocities



MARTINUS

aurecon

BG&E

Legend

- Peak Flood Level Contours (0.5m Intervals)
- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Depths (m)

- <= 0.03
- 0.03 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 2
- > 2

0 100 200 m

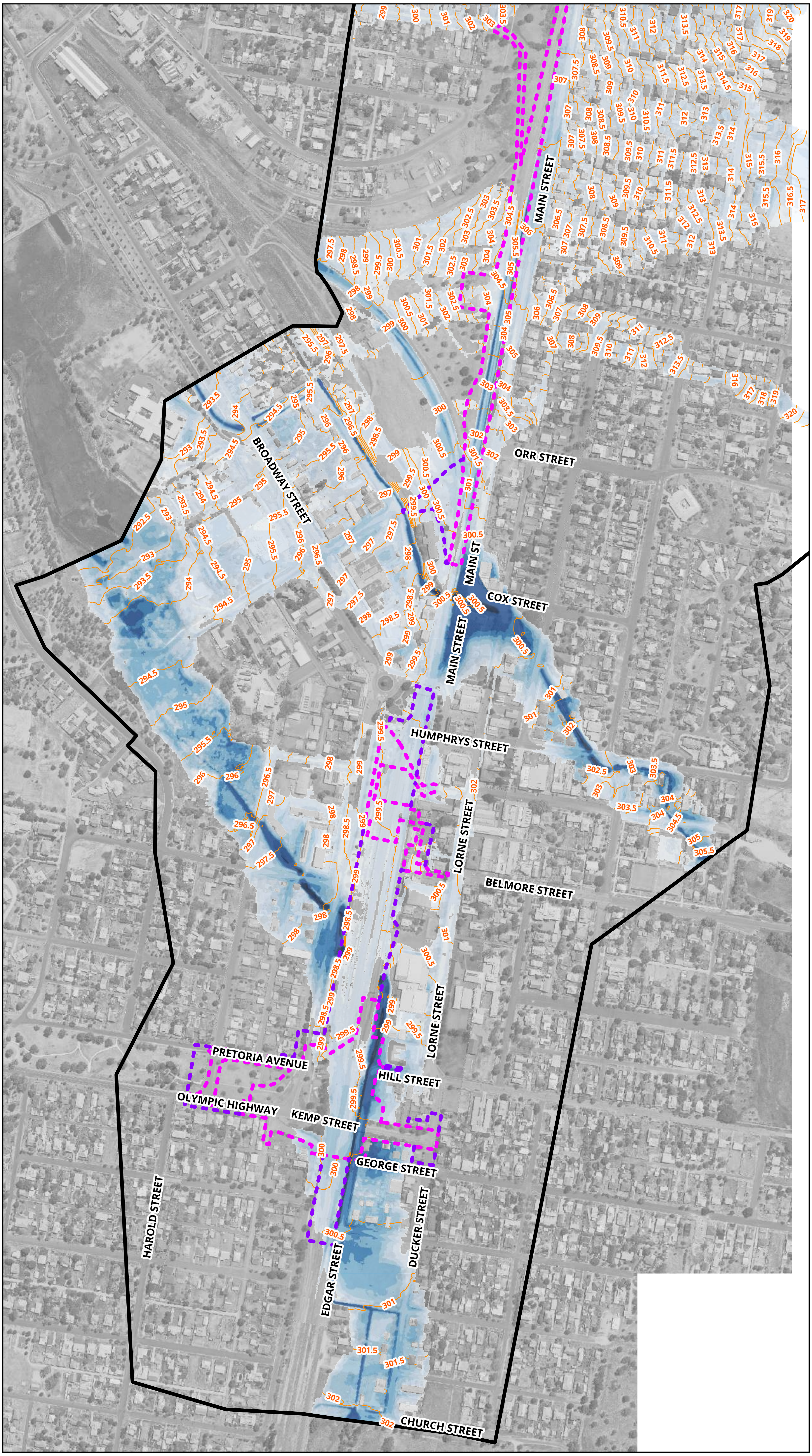
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A1: (Overall Extent) Existing Conditions - 5% AEP Peak Flood Depths and Flood Level Contours



MARTINUS

aurecon

BG&E

Legend

- Peak Flood Level Contours (0.5m Intervals)
- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Depths (m)

- <= 0.03
- 0.03 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 2
- > 2

0 100 200 m

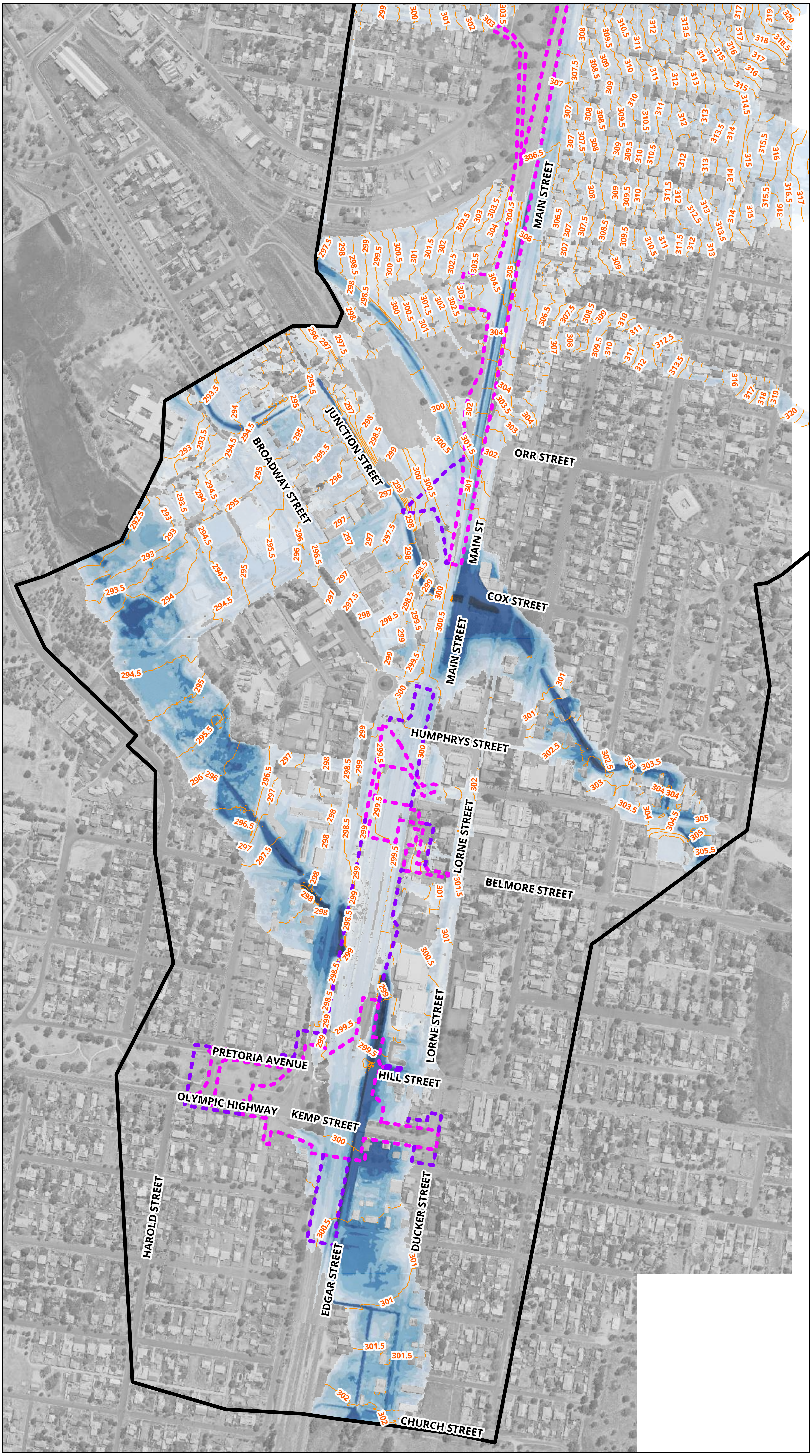
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A2: (Overall Extent) Existing Conditions - 2% AEP Peak Flood Depths and Flood Level Contours



MARTINUS

aurecon

BG&E

Legend

- Peak Flood Level Contours (0.5m Intervals)
- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Depths (m)

- <= 0.03
- 0.03 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 2
- > 2

0 100 200 m

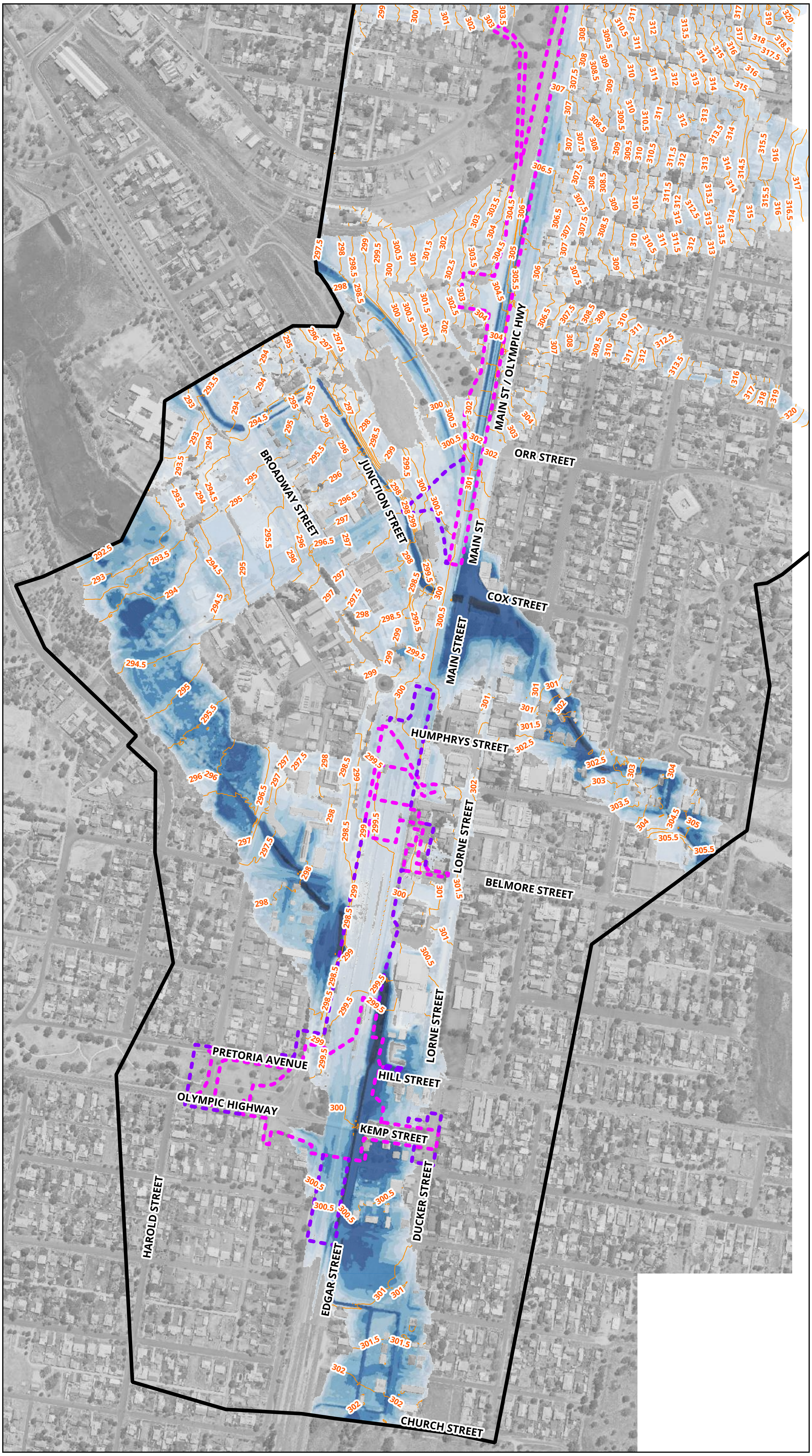
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A3: (Overall Extent) Existing Conditions - 1% AEP Peak Flood Depths and Flood Level Contours



MARTINUS

aurecon BG&E

Legend

- Peak Flood Level Contours (0.5m Intervals)
- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Depths (m)

- <= 0.03
- 0.03 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 2
- > 2

0 100 200 m

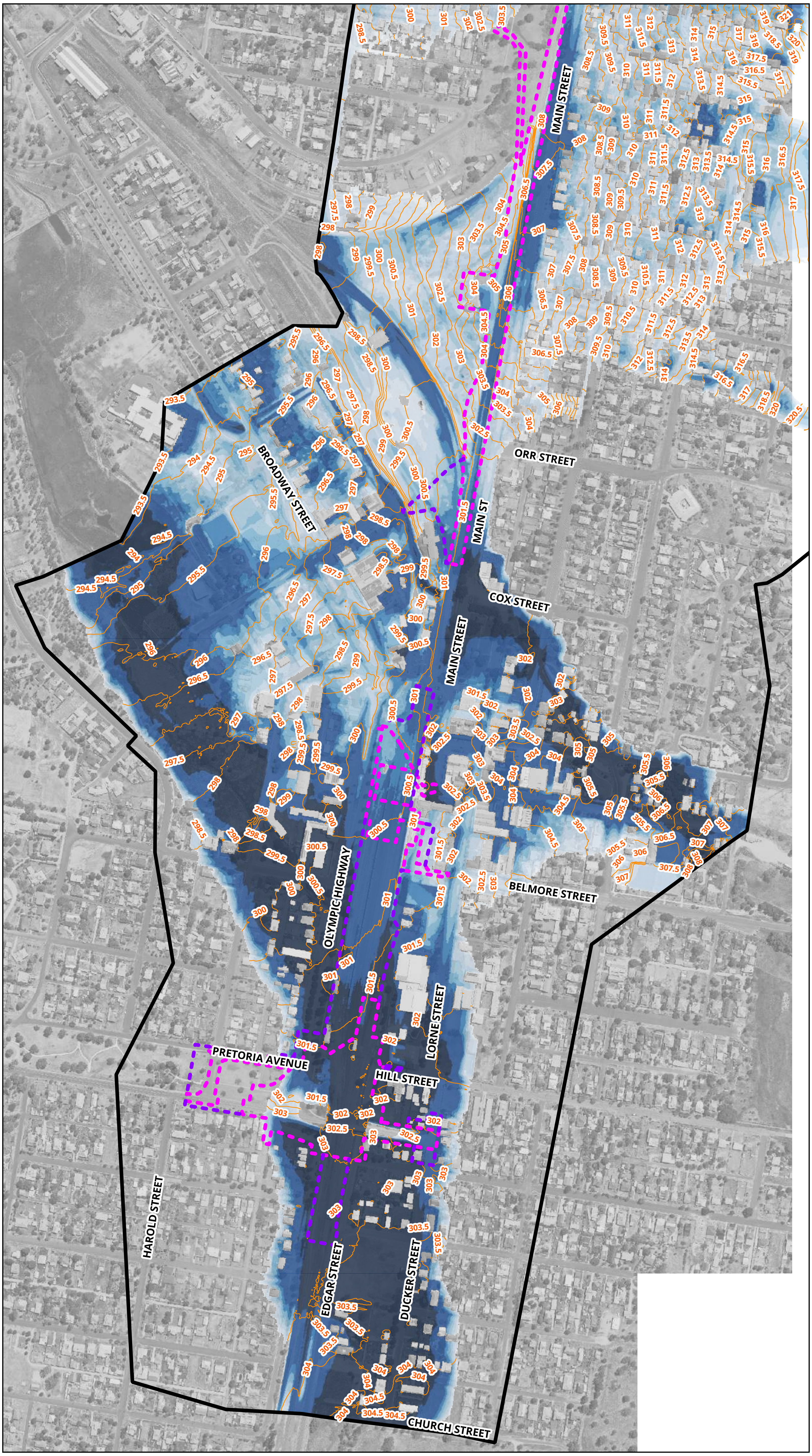
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A4: (Overall Extent) Existing Conditions - 1% AEP + Climate Change Peak Flood Depths and Flood Level Contours



Legend

- Peak Flood Level Contours (0.5m Intervals)
- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Depths (m)

- <= 0.03
- 0.03 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 2
- \> 2

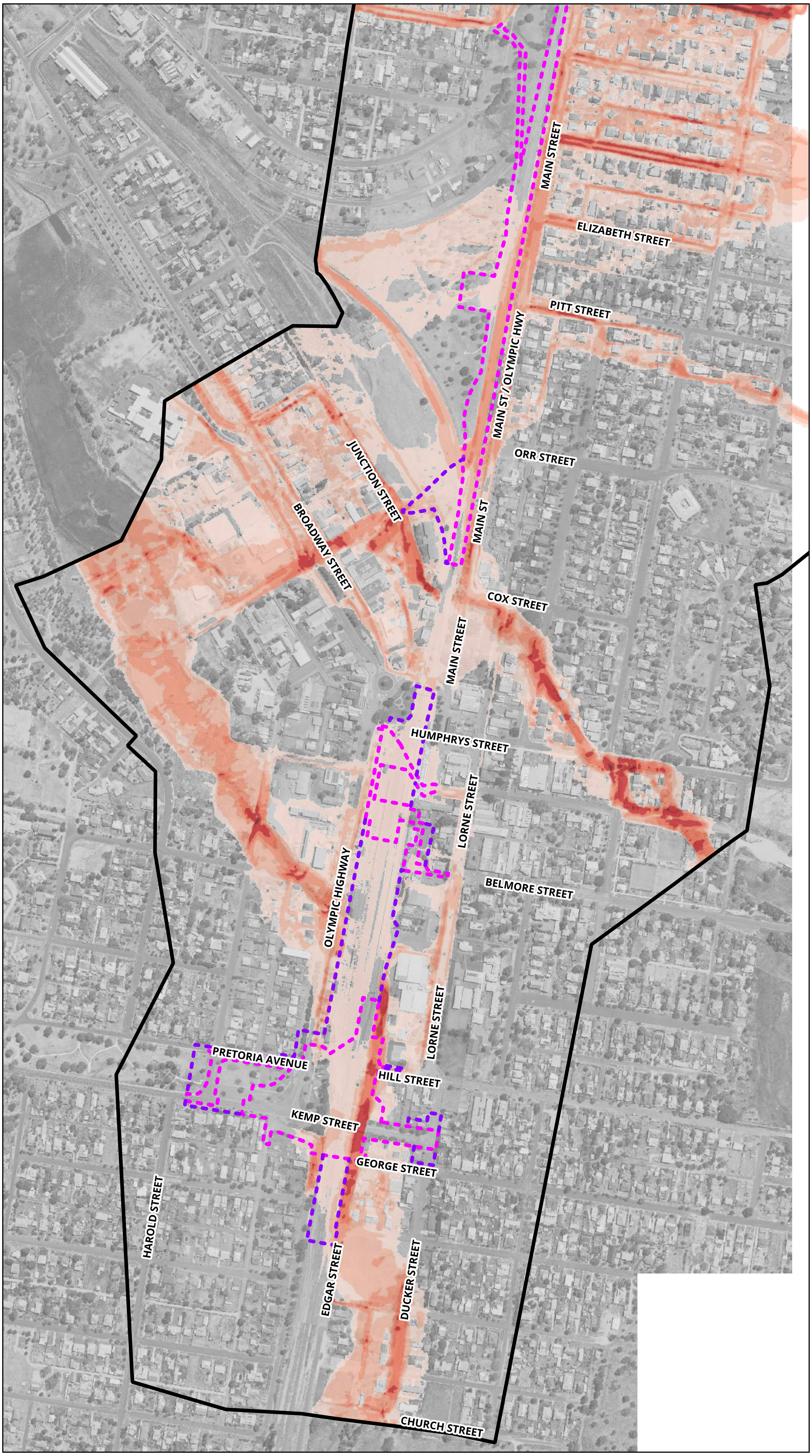
0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A5: (Overall Extent) Existing Conditions - PMF Event Peak Flood Depths and Flood Level Contours



MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Velocities (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 3.00
- > 3.00

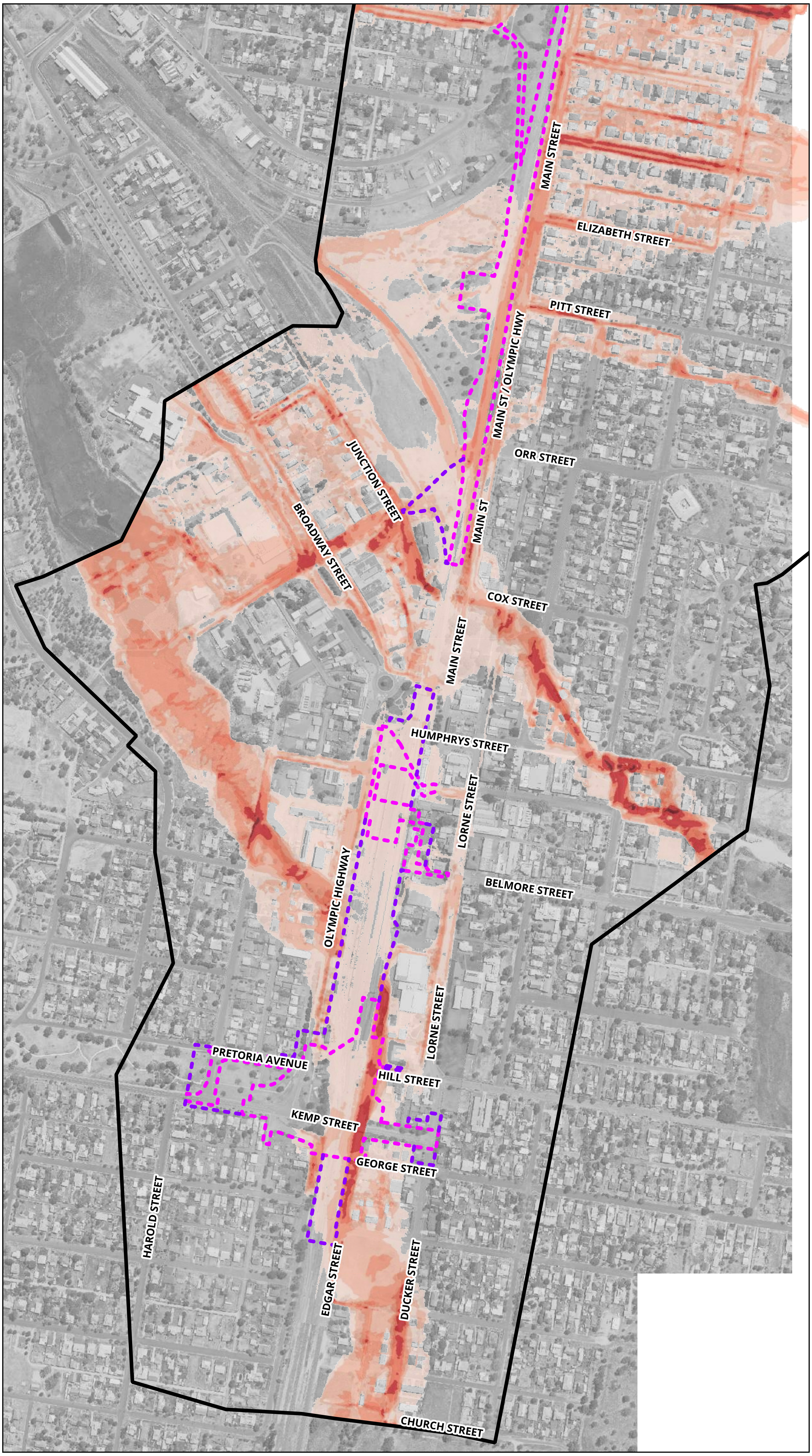
0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A6: (Overall Extent) Existing Conditions - 5% AEP Peak Flood Velocities



MARTINUS

aurecon BG&E

Legend

Project Boundary
Construction Impact Zone
TUFLOW Model Extent

Peak Flood Velocities (m/s)

<= 0.50
0.50 - 1.00
1.00 - 1.50
1.50 - 2.00
2.00 - 3.00
> 3.00

0 100 200 m

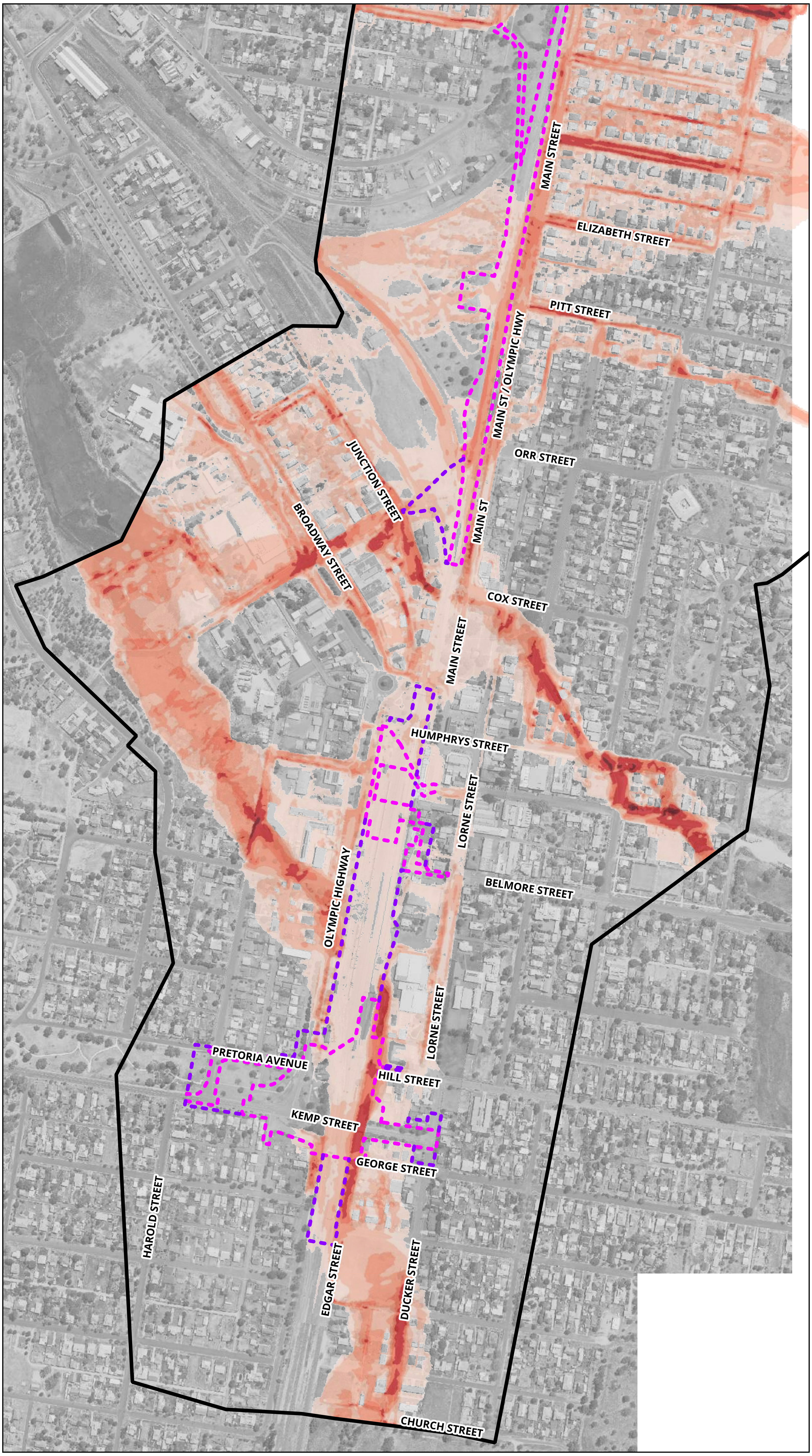
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A7: (Overall Extent) Existing Conditions - 2% AEP Peak Flood Velocities



MARTINUS

aurecon

BG&E

Legend

Project Boundary

Construction Impact Zone

TUFLOW Model Extent

Peak Flood Velocities (m/s)

<= 0.50

0.50 - 1.00

1.00 - 1.50

1.50 - 2.00

2.00 - 3.00

> 3.00

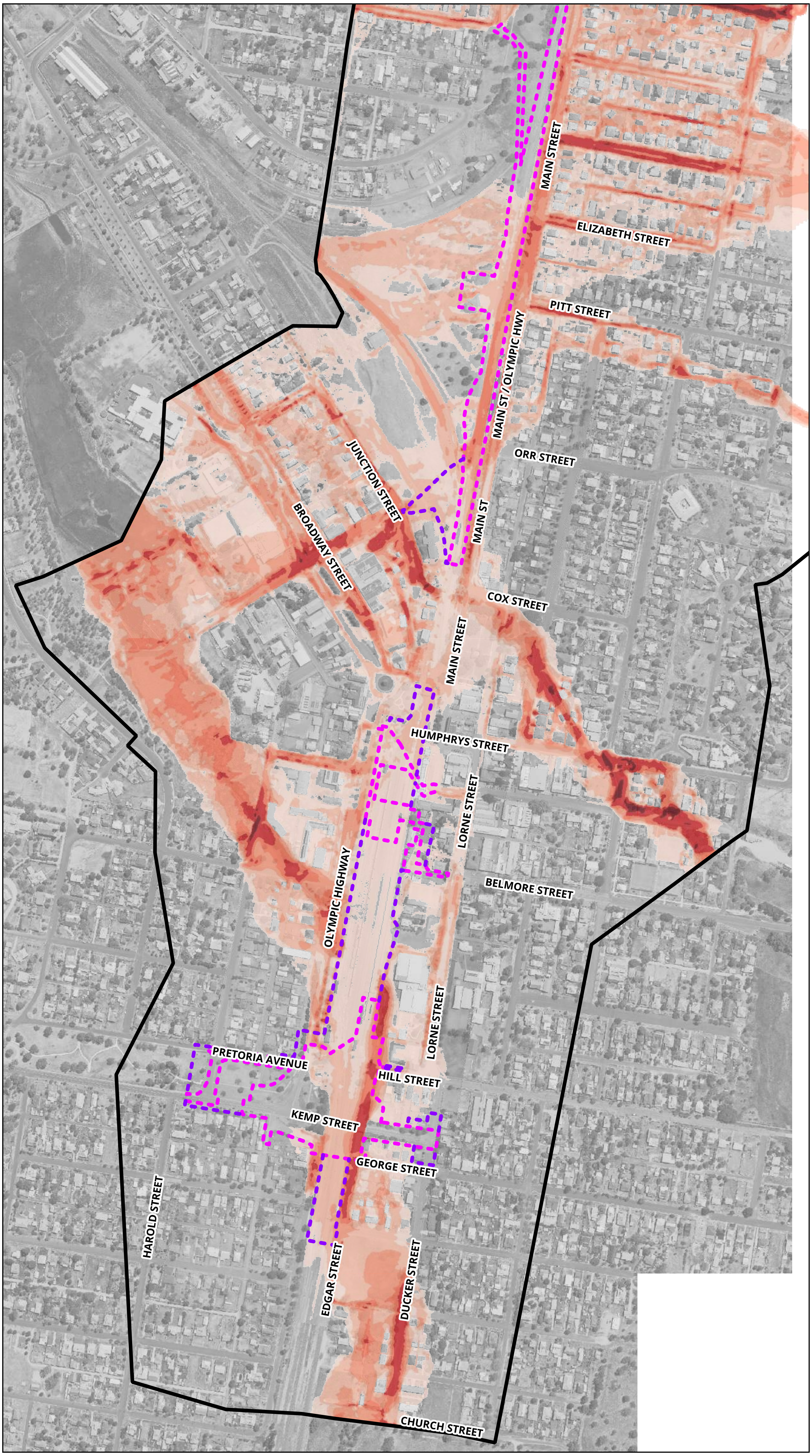
0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A8: (Overall Extent) Existing Conditions - 1% AEP Peak Flood Velocities



MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Velocities (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 3.00
- > 3.00

0 100 200 m

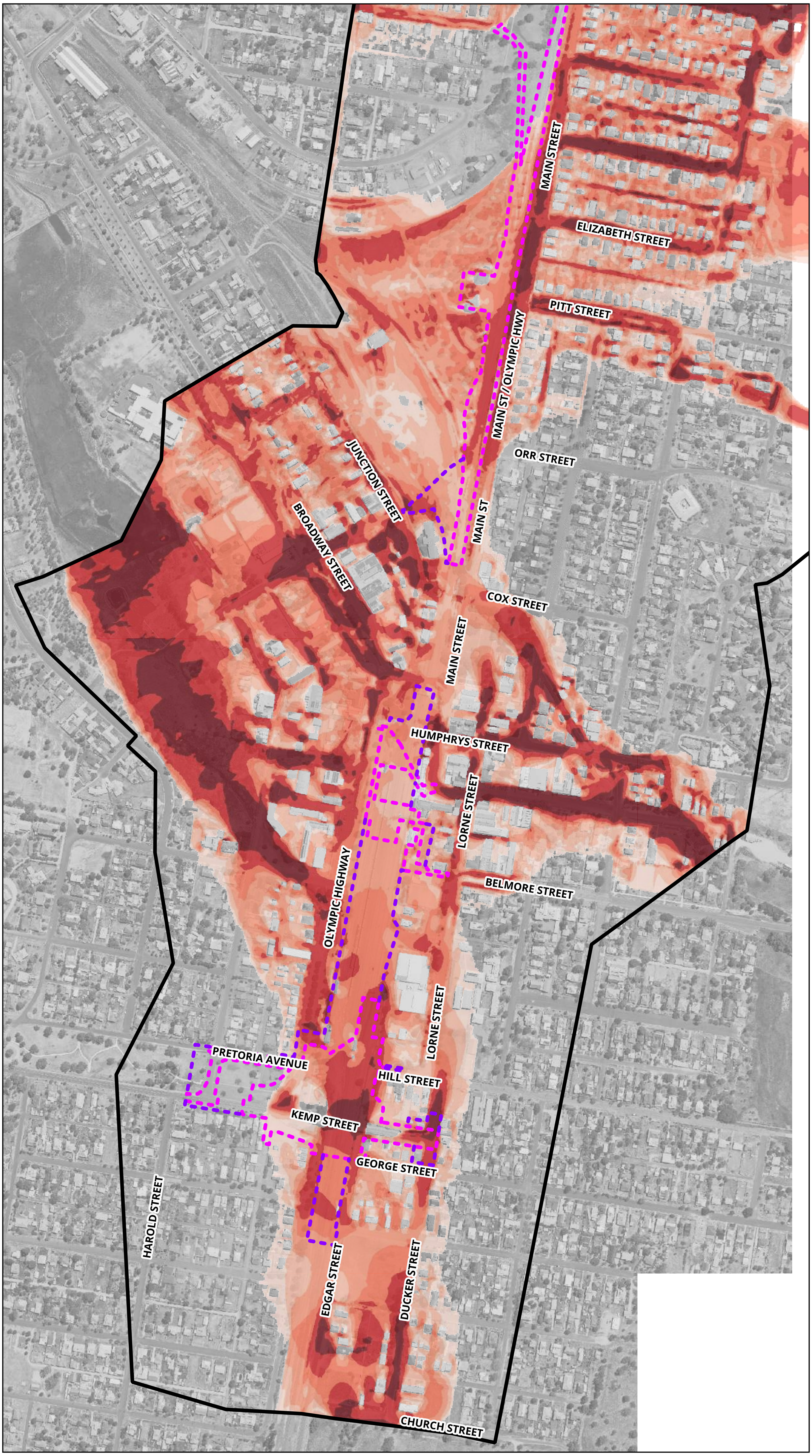
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A9: (Overall Extent) Existing Conditions - 1% AEP + Climate Change Peak Flood Velocities



MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Velocities (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 3.00
- > 3.00

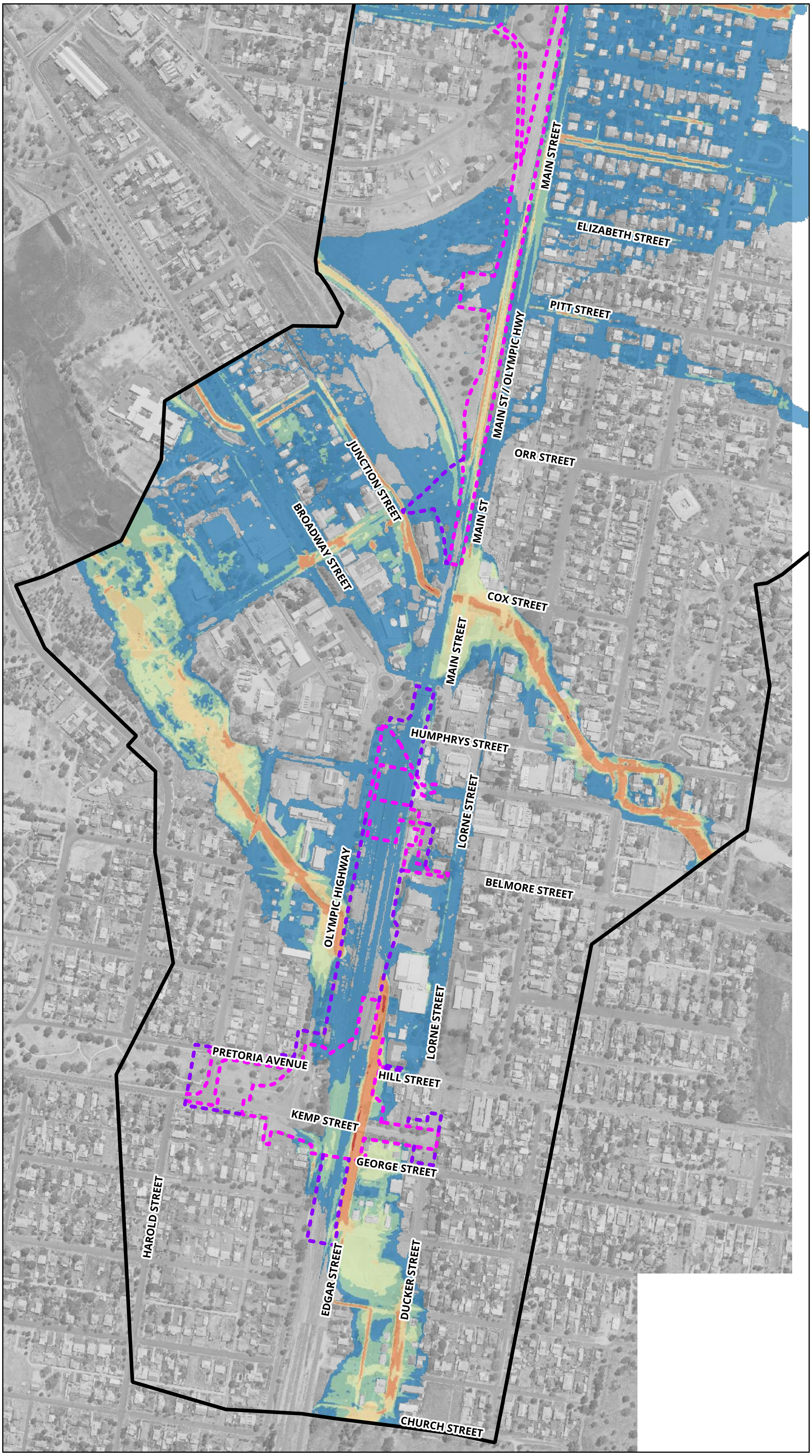
0 100 200 m
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A10: (Overall Extent) Existing Conditions - PMF Event Peak Flood Velocities



Legend

- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Hazards

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

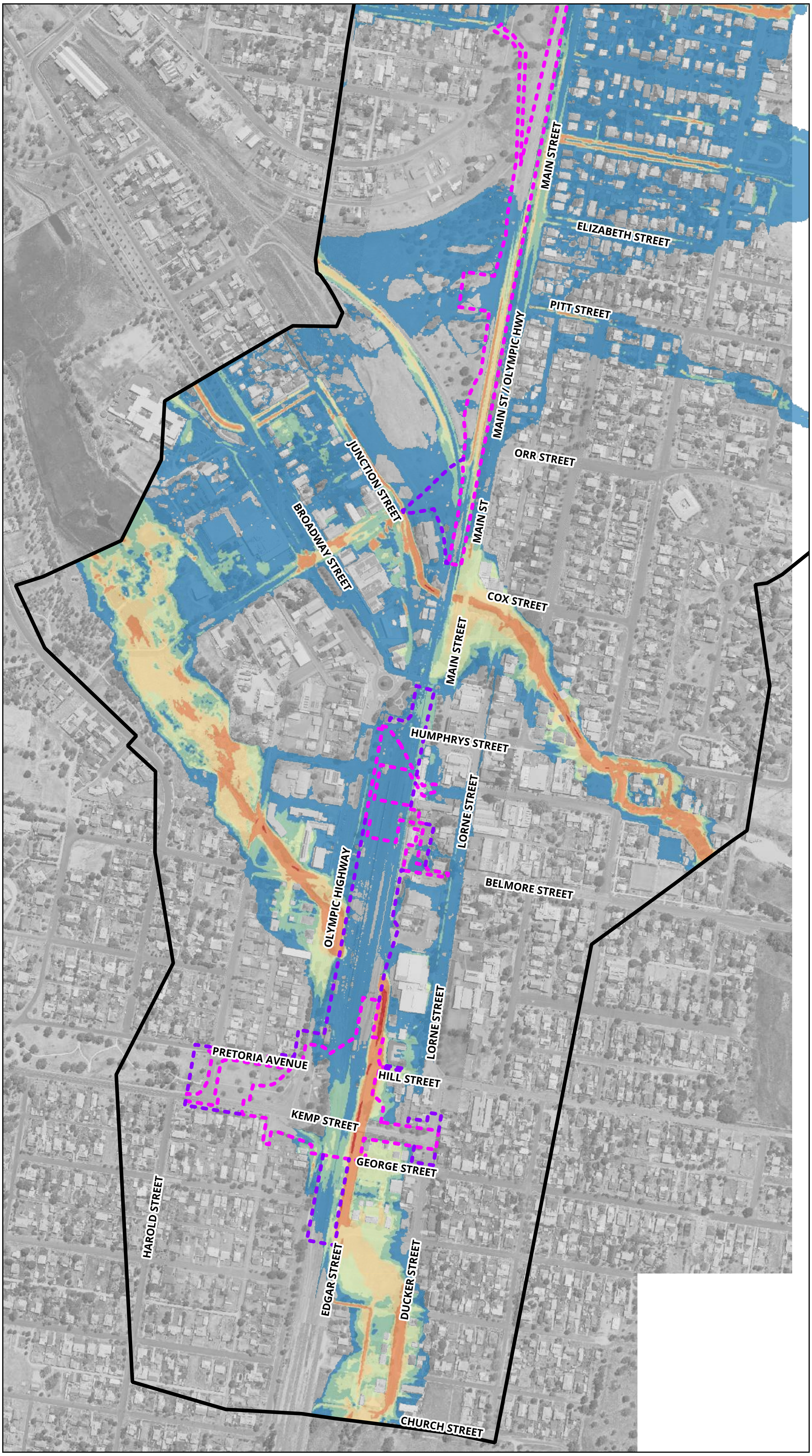
0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A11: (Overall Extent) Existing Conditions - 5% AEP Peak Flood Hazards



MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Hazards

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

0 100 200 m

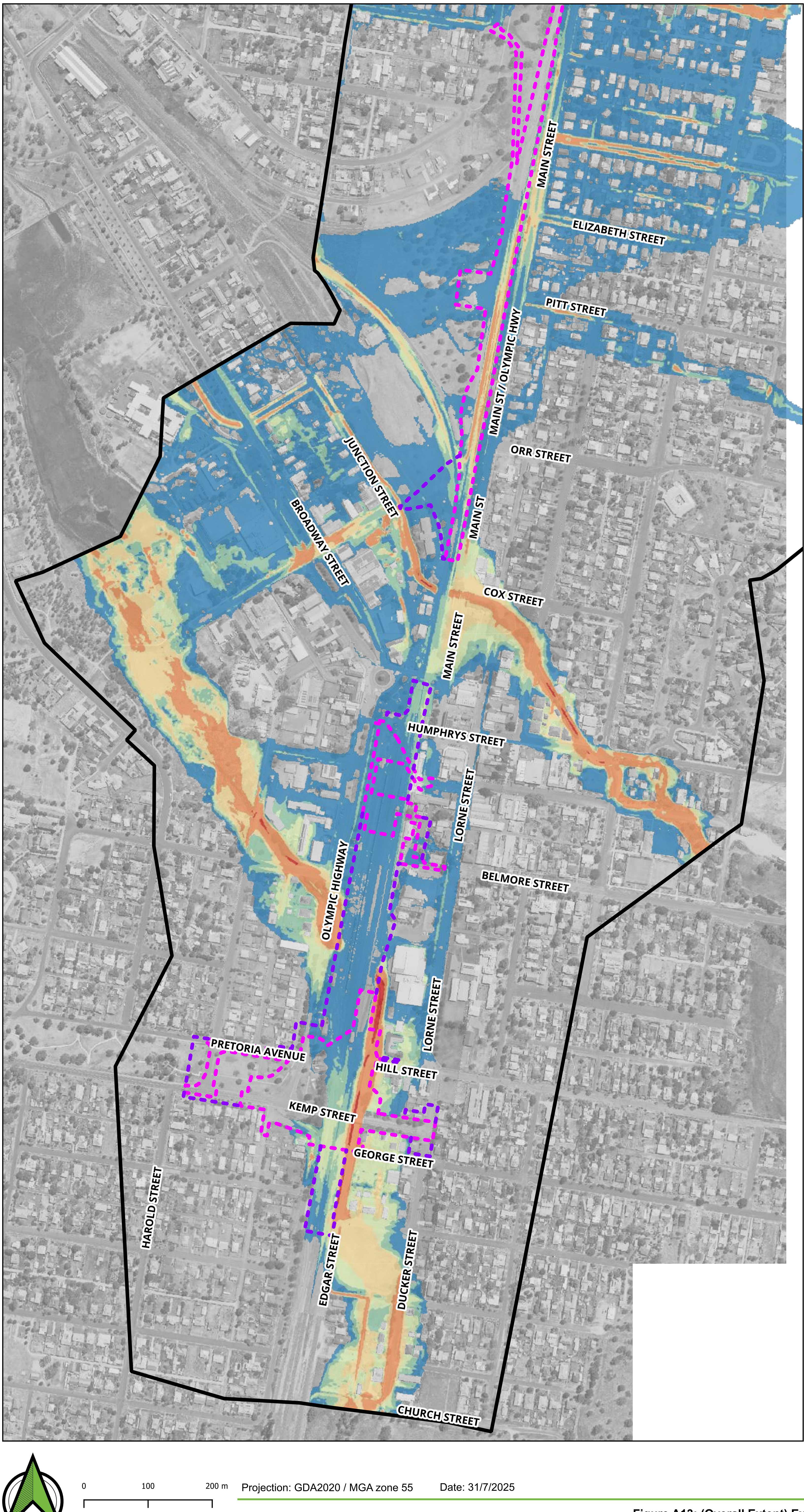
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A12: (Overall Extent) Existing Conditions - 2% AEP Peak Flood Hazards



MARTINUS aurecon BG&E

Legend

- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

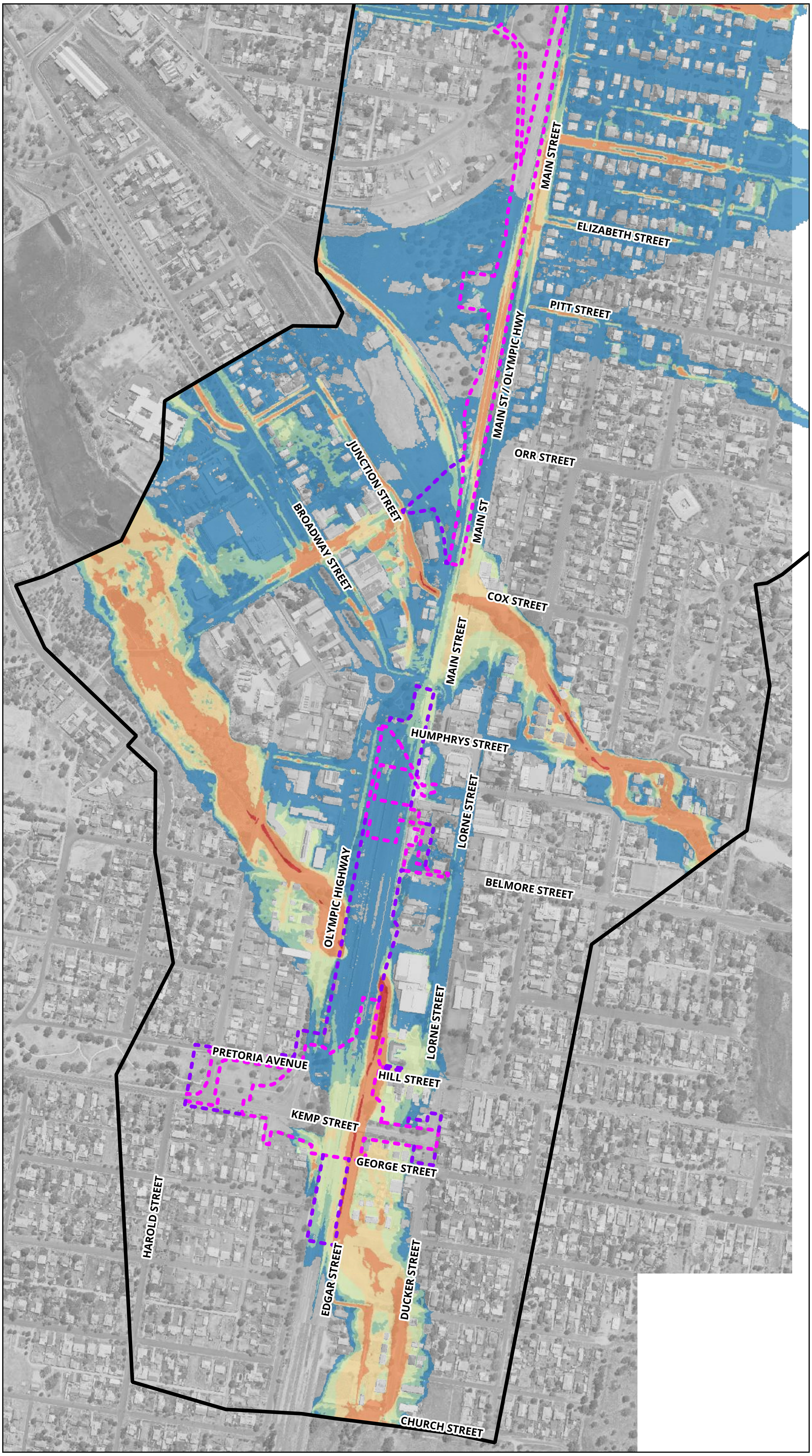
Peak Flood Hazards

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A13: (Overall Extent) Existing Conditions - 1% AEP Peak Flood Hazards



MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Hazards

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

0 100 200 m

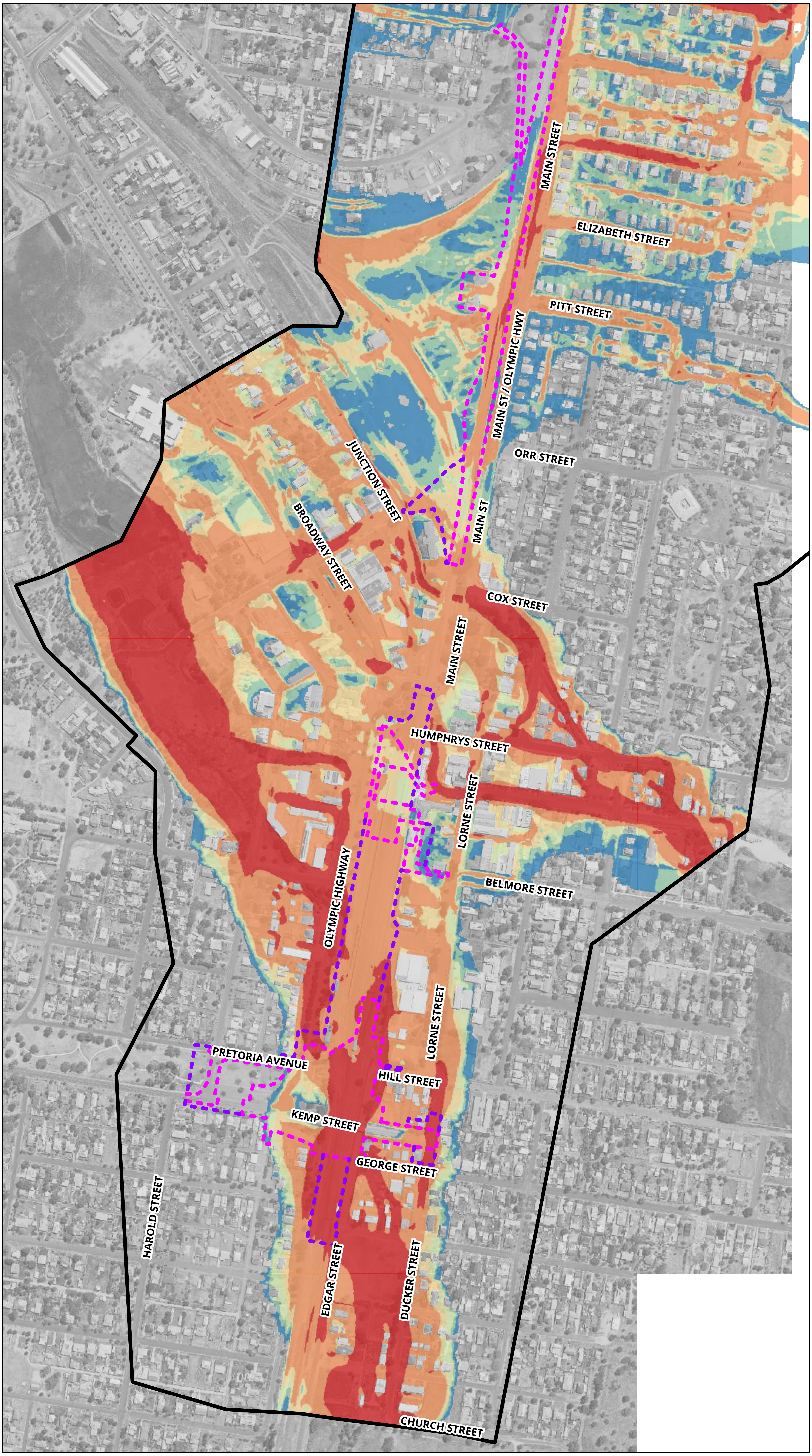
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A14: (Overall Extent) Existing Conditions - 1% AEP + Climate Change Peak Flood Hazards



MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Hazards

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

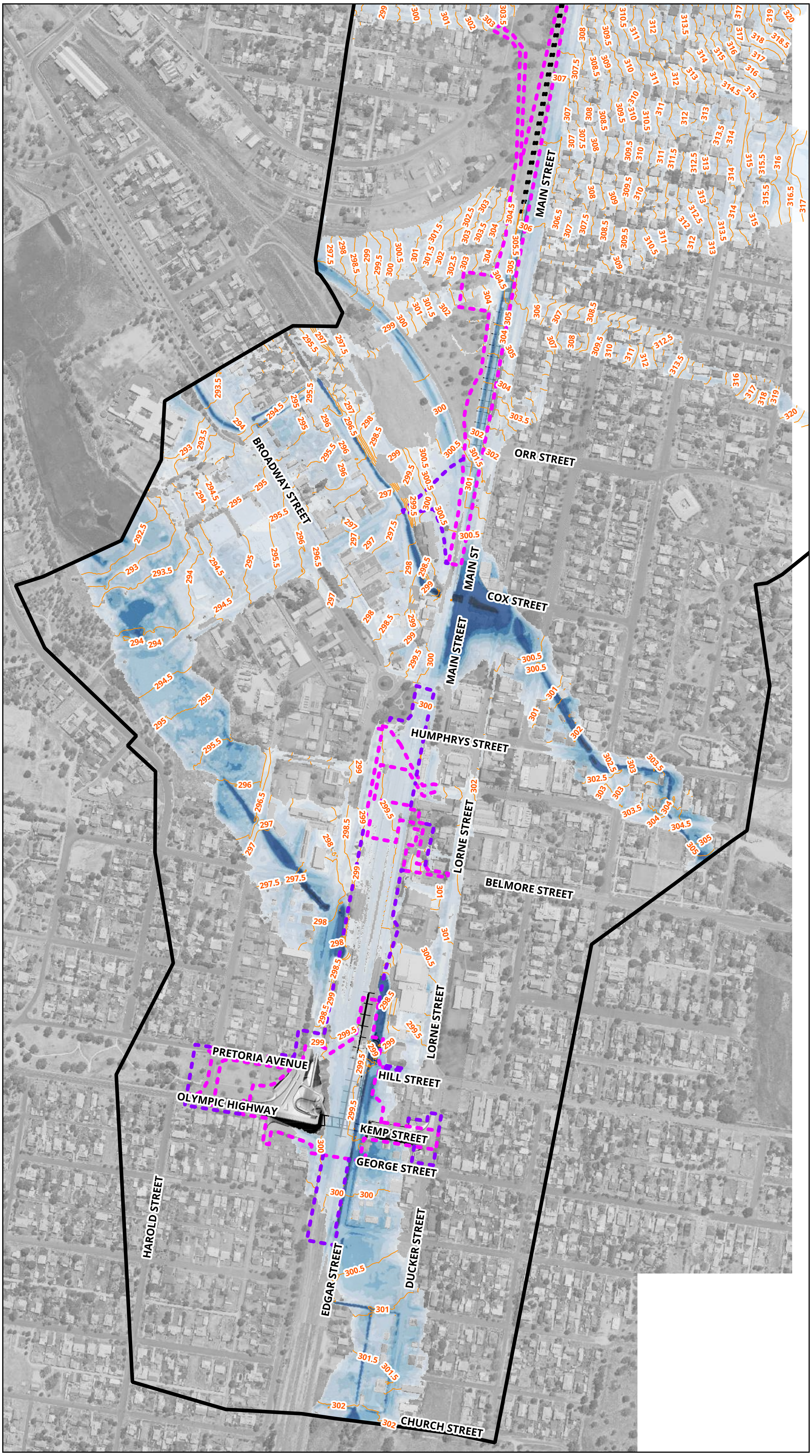
Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A15: (Overall Extent) Existing Conditions - PMF Event Peak Flood Hazards

MARTINUS

aurecon BG&E



Legend

- Peak Flood Level Contours (0.5m Intervals)
- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Peak Flood Depths (m)

- <= 0.03
- 0.03 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 2
- > 2

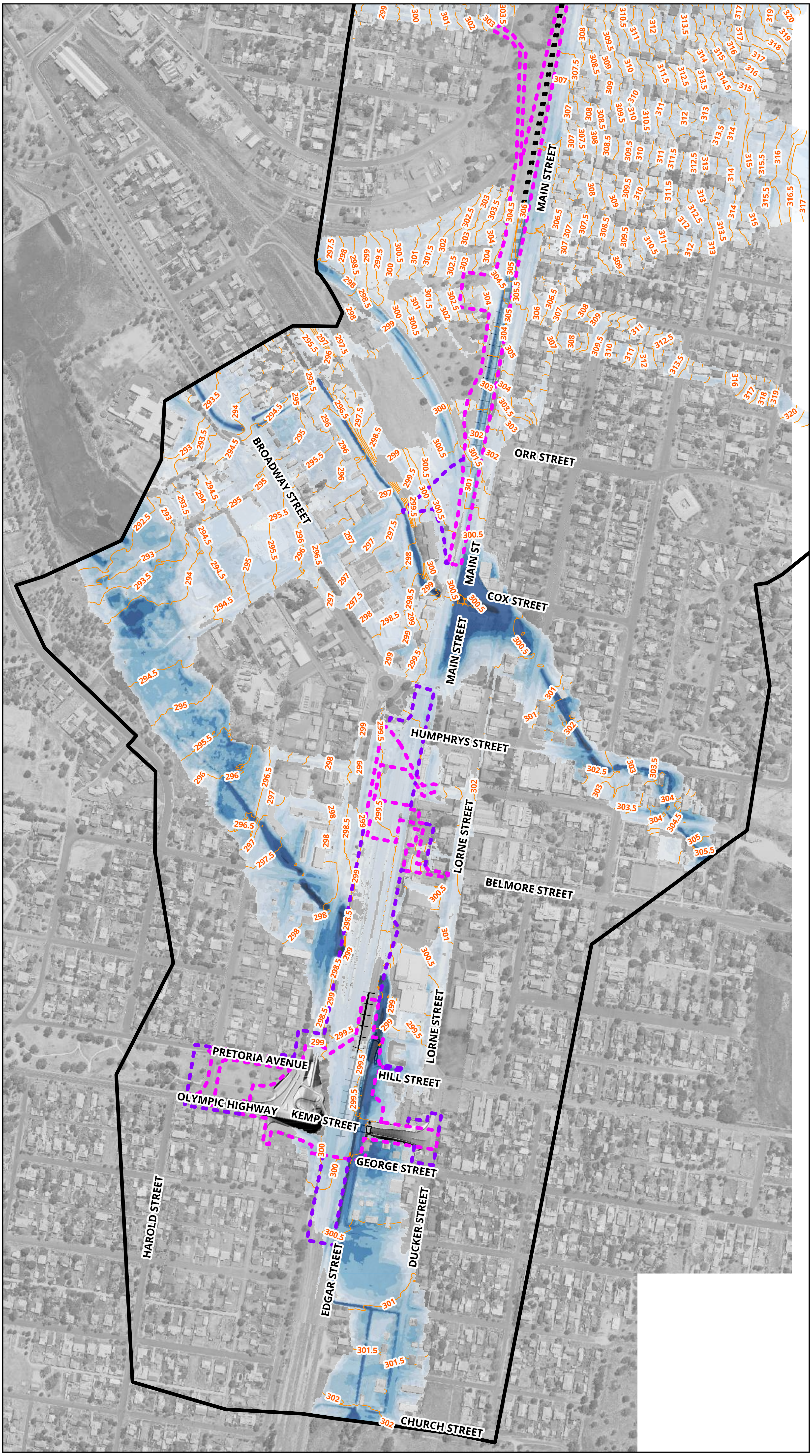
0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A16: (Overall Extent) Design Conditions - 5% AEP Peak Flood Depths and Flood Level Contours



Legend

- Peak Flood Level Contours (0.5m Intervals)
- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Peak Flood Depths (m)

- <= 0.03
- 0.03 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 2
- > 2

0 100 200 m

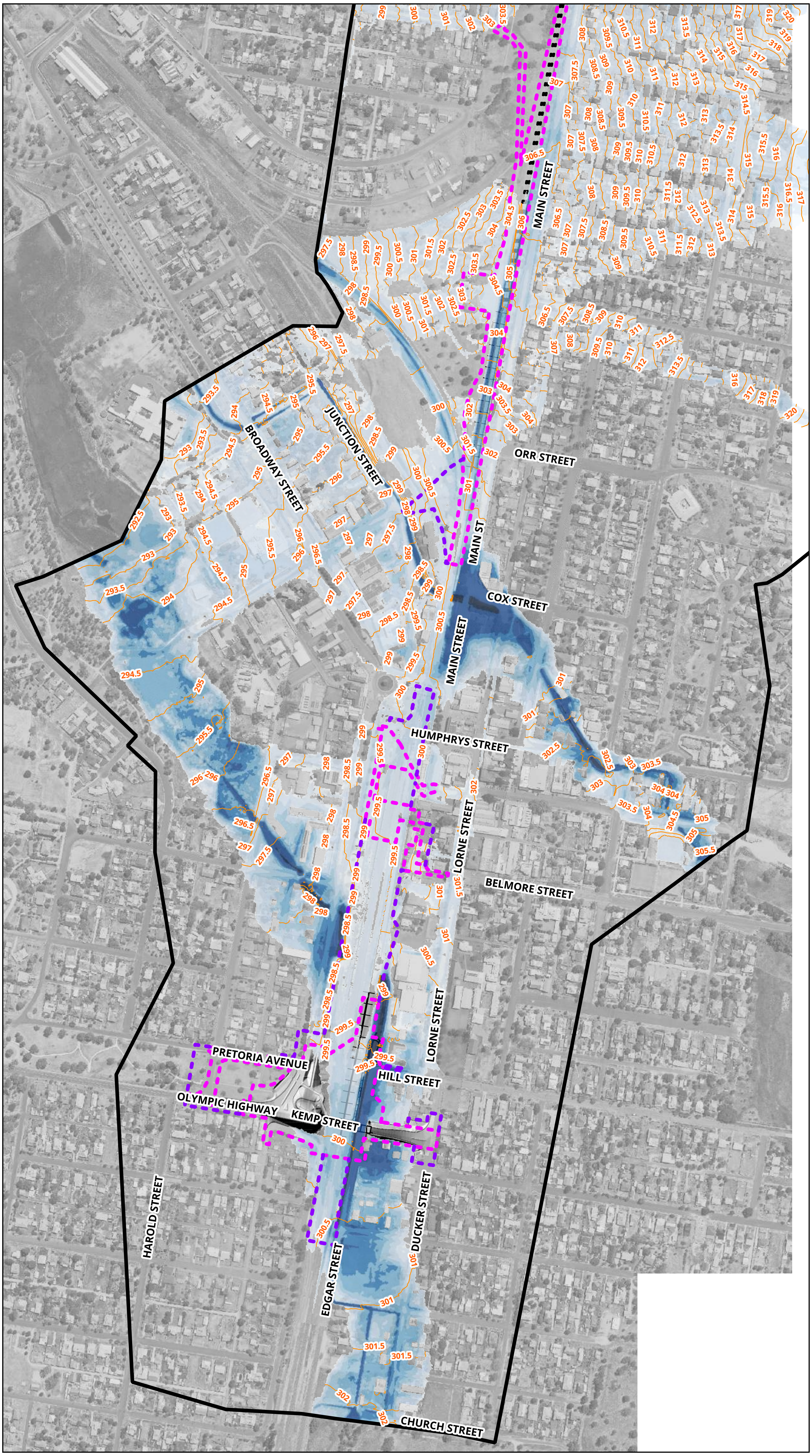
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A17: (Overall Extent) Design Conditions - 2% AEP Peak Flood Depths and Flood Level Contours



MARTINUS

aurecon BG&E

Legend

- Peak Flood Level Contours (0.5m Intervals)
- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Peak Flood Depths (m)

- <= 0.03
- 0.03 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 2
- > 2

0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

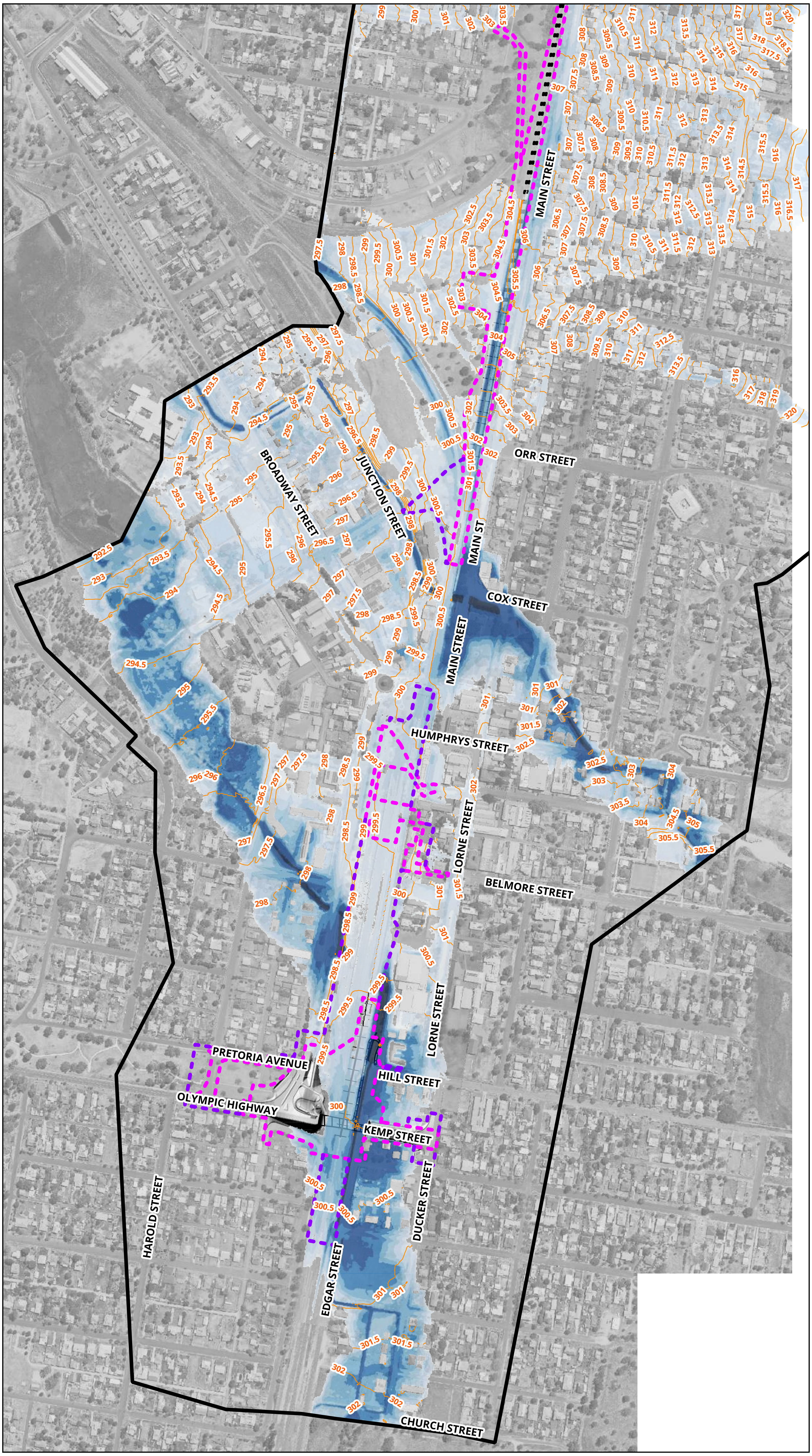
A2I – Junee Yard IFC Stage

Figure A18: (Overall Extent) Design Conditions - 1% AEP Peak Flood Depths and Flood Level Contours

MARTINUS

aurecon

BG&E



Legend

- Peak Flood Level Contours (0.5m Intervals)
- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Peak Flood Depths (m)

- <= 0.03
- 0.03 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 2
- > 2

0 100 200 m

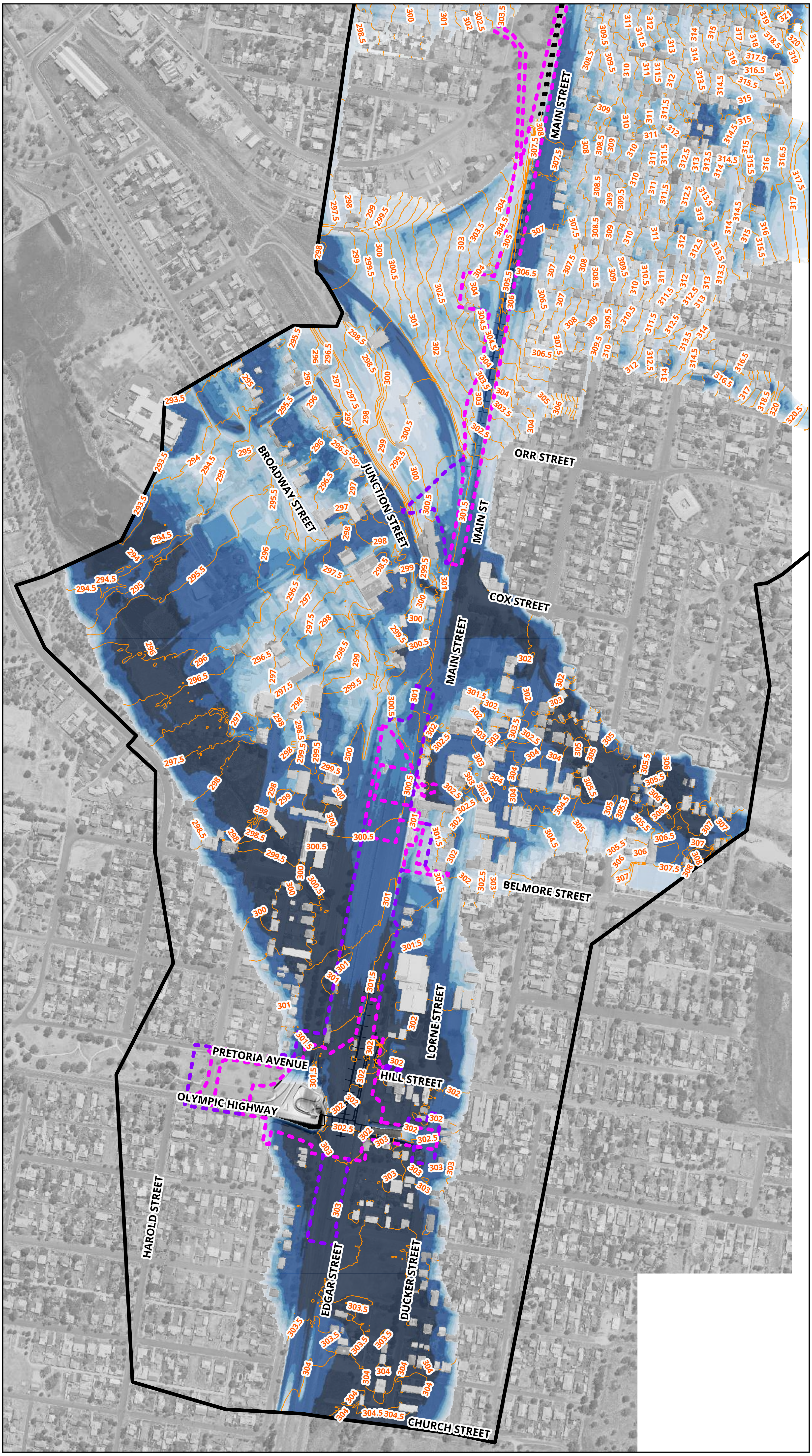
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A19: (Overall Extent) Design Conditions - 1% AEP + Climate Change Peak Flood Depths and Flood Level Contours



MARTINUS

aurecon BG&E

Legend

- Peak Flood Level Contours (0.5m Intervals)
- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Peak Flood Depths (m)

- <= 0.03
- 0.03 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 2
- > 2

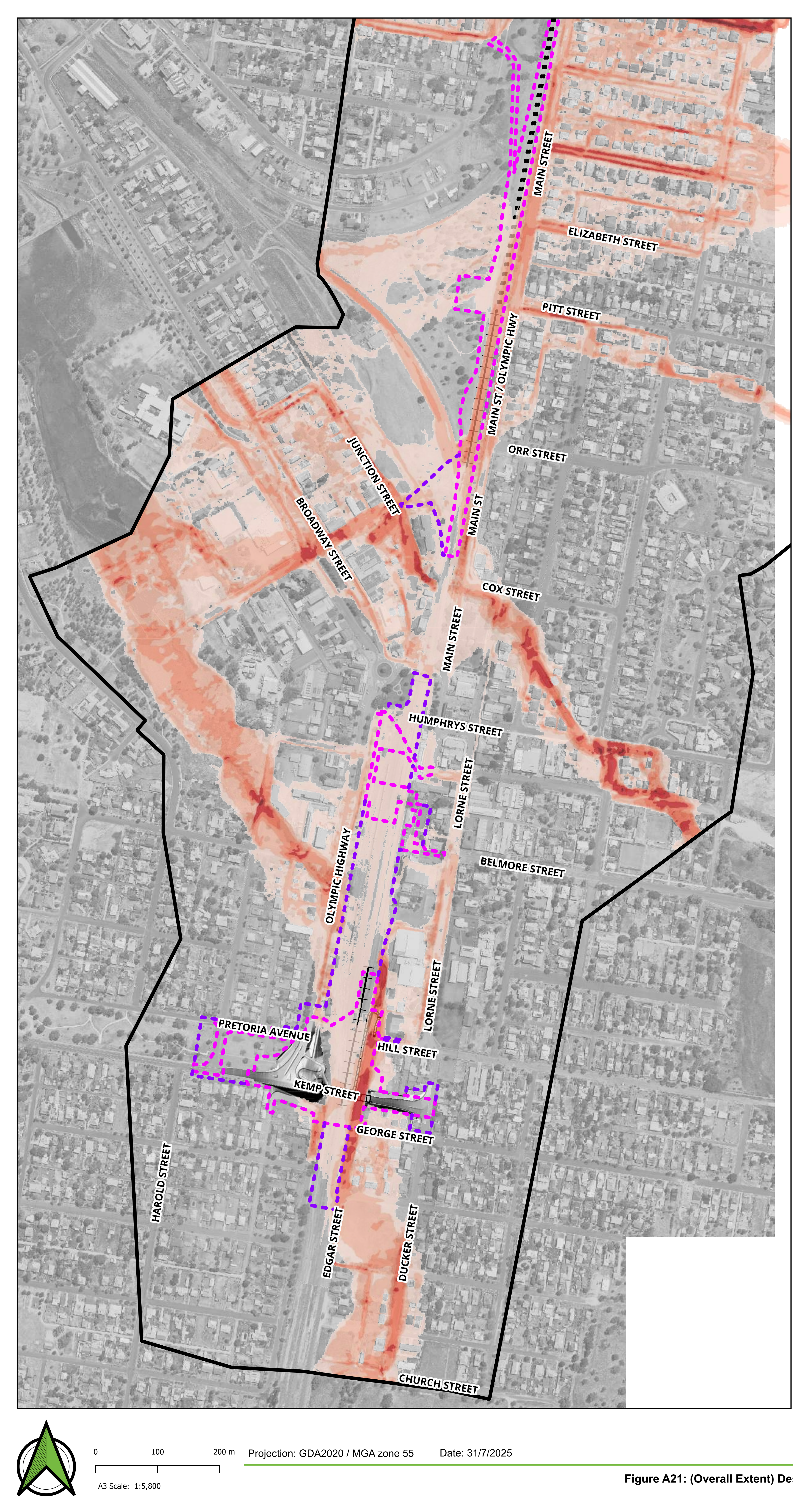
0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A20: (Overall Extent) Design Conditions - PMF Event Peak Flood Depths and Flood Level Contours



MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

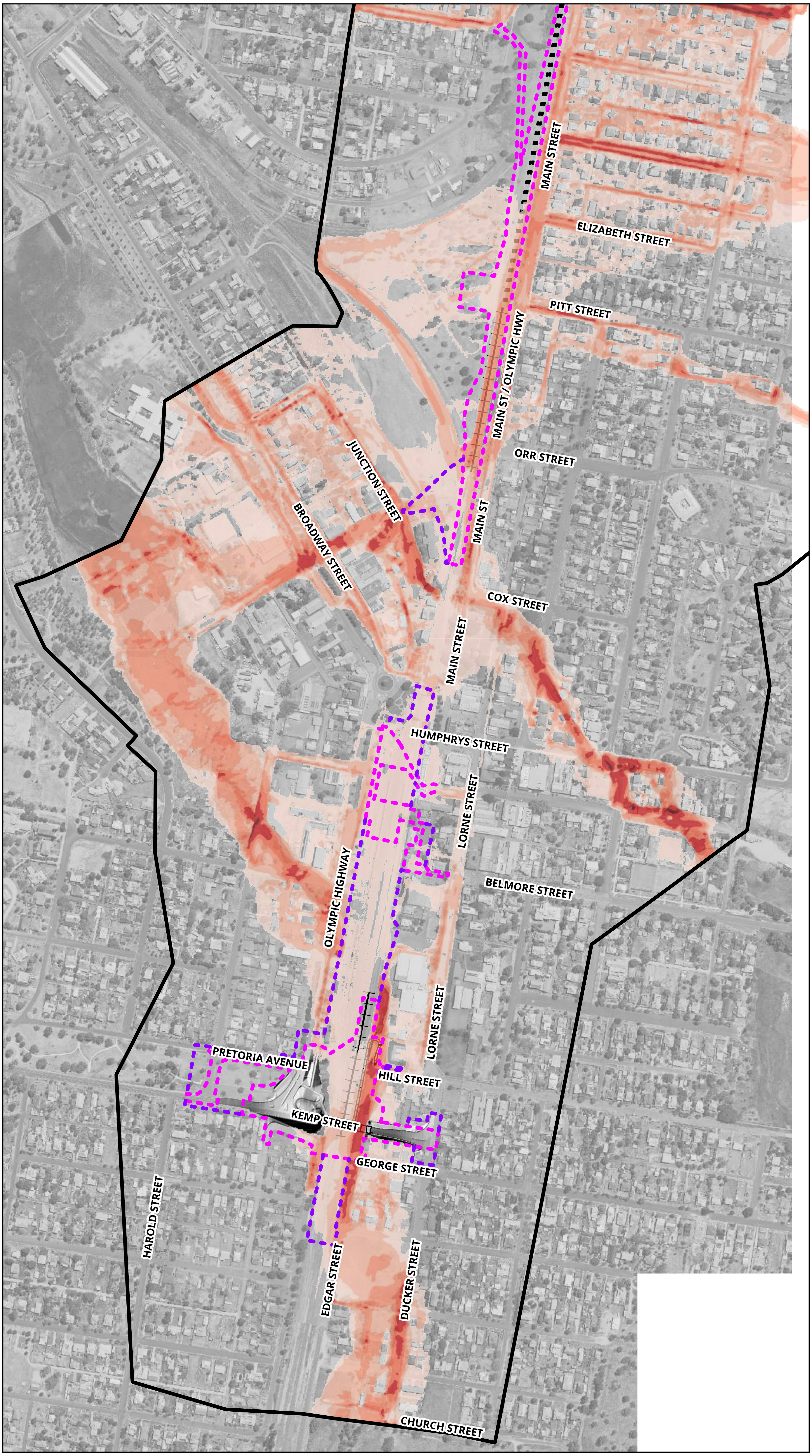
Peak Flood Velocities (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 3.00
- > 3.00

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A21: (Overall Extent) Design Conditions - 5% AEP Peak Flood Velocities



Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Peak Flood Velocities (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 3.00
- > 3.00

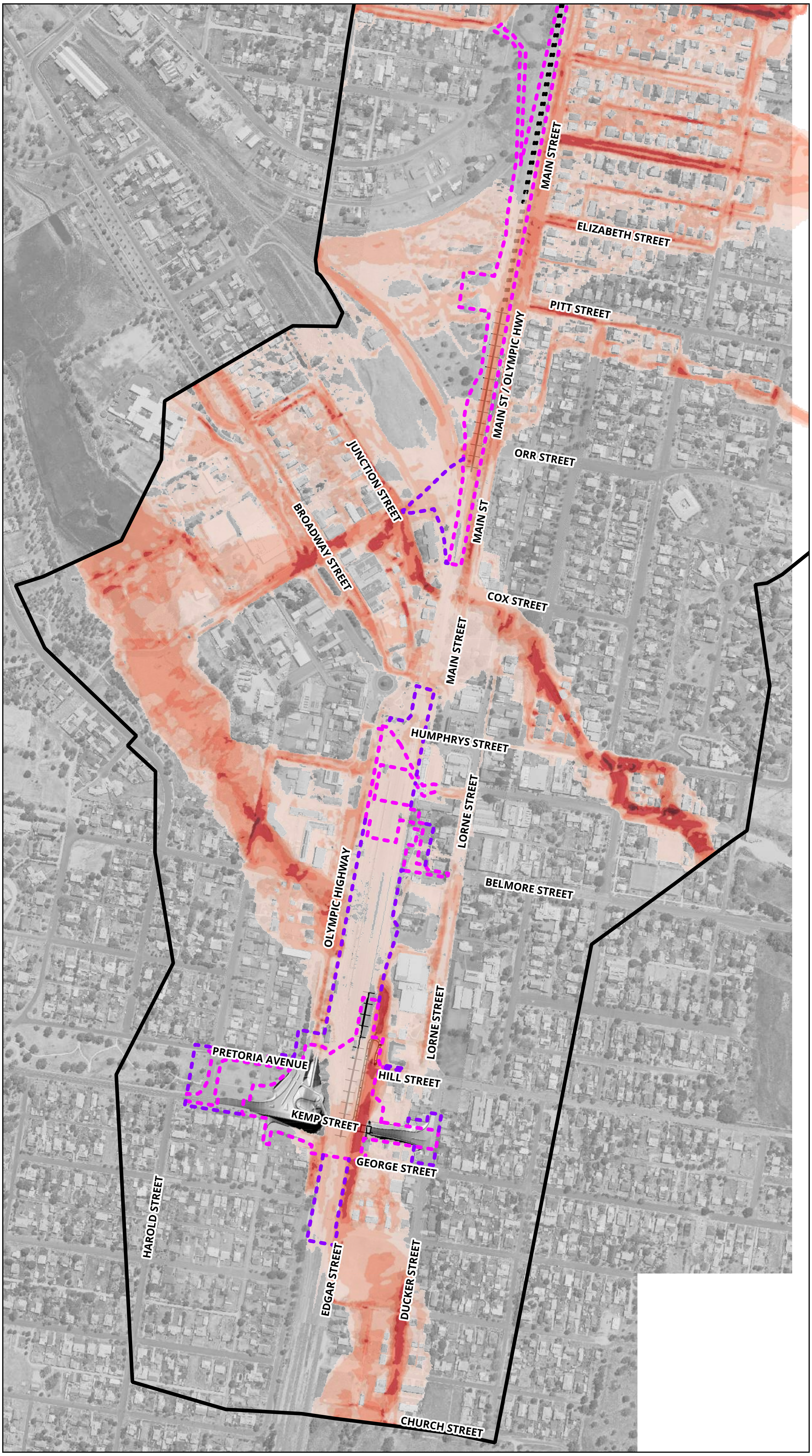
0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A22: (Overall Extent) Design Conditions - 2% AEP Peak Flood Velocities



MARTINUS

aurecon BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Peak Flood Velocities (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 3.00
- > 3.00

0 100 200 m

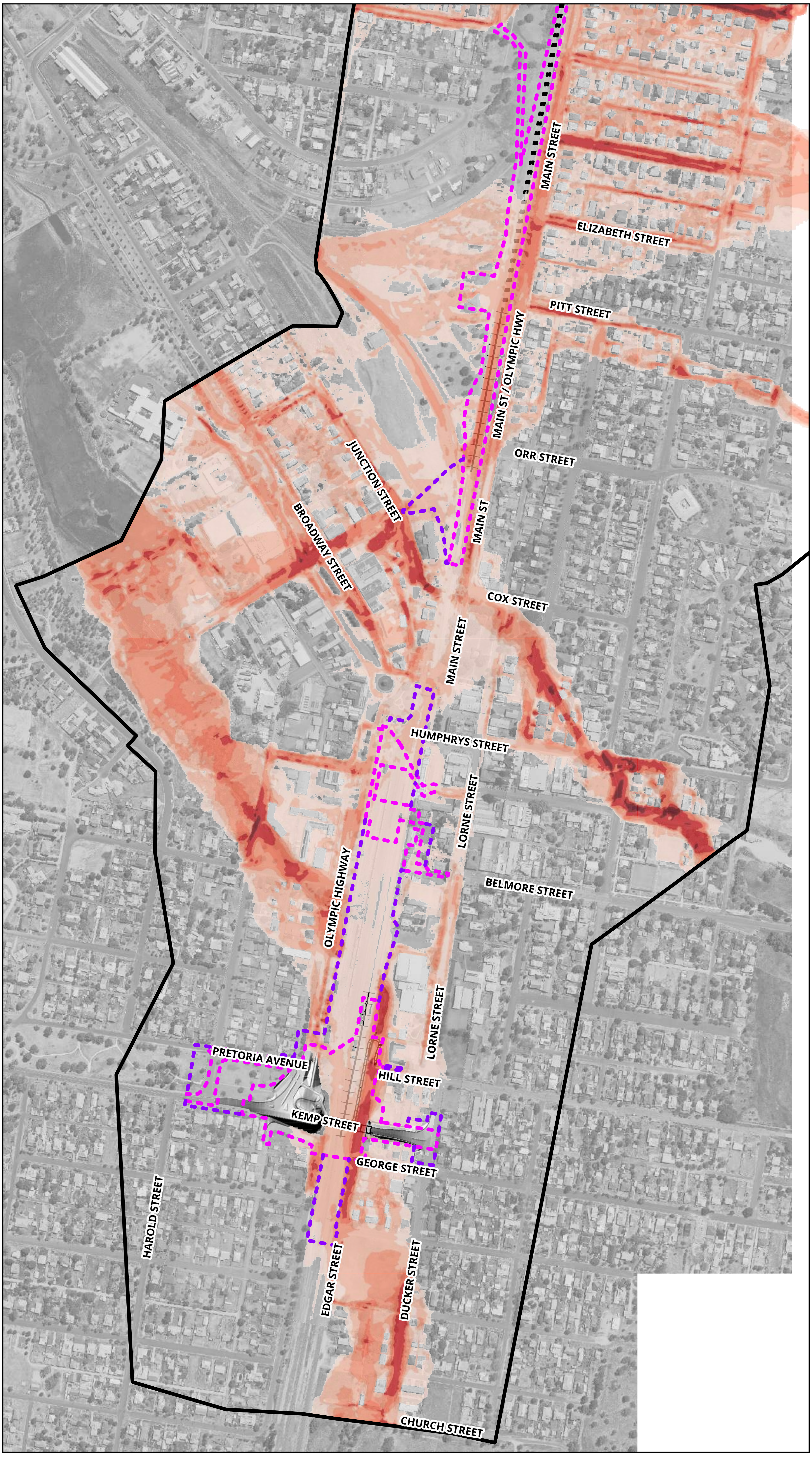
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A23: (Overall Extent) Design Conditions - 1% AEP Peak Flood Velocities



MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Peak Flood Velocities (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 3.00
- > 3.00

0 100 200 m

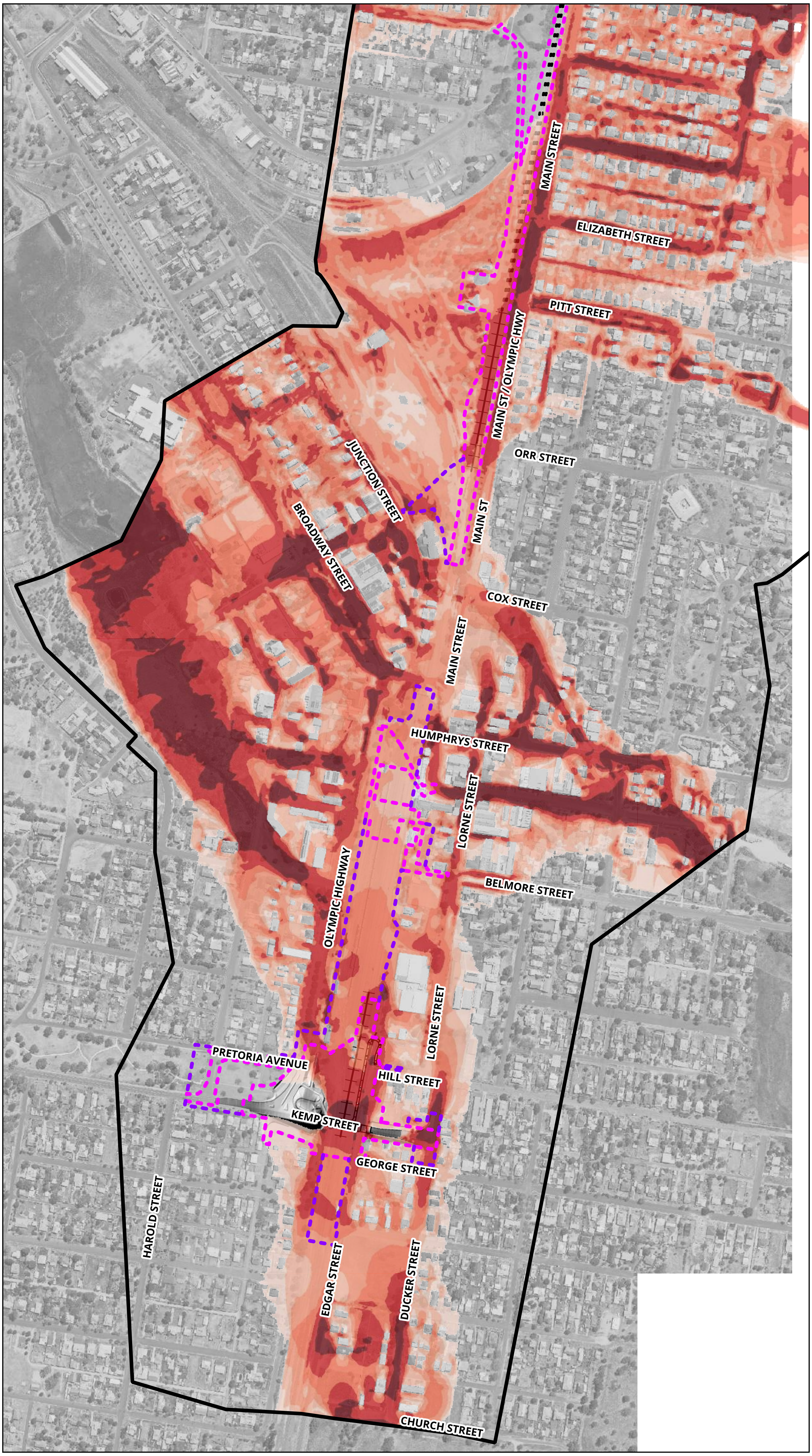
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A24: (Overall Extent) Design Conditions - 1% AEP + Climate Change Peak Flood Velocities



MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Peak Flood Velocities (m/s)

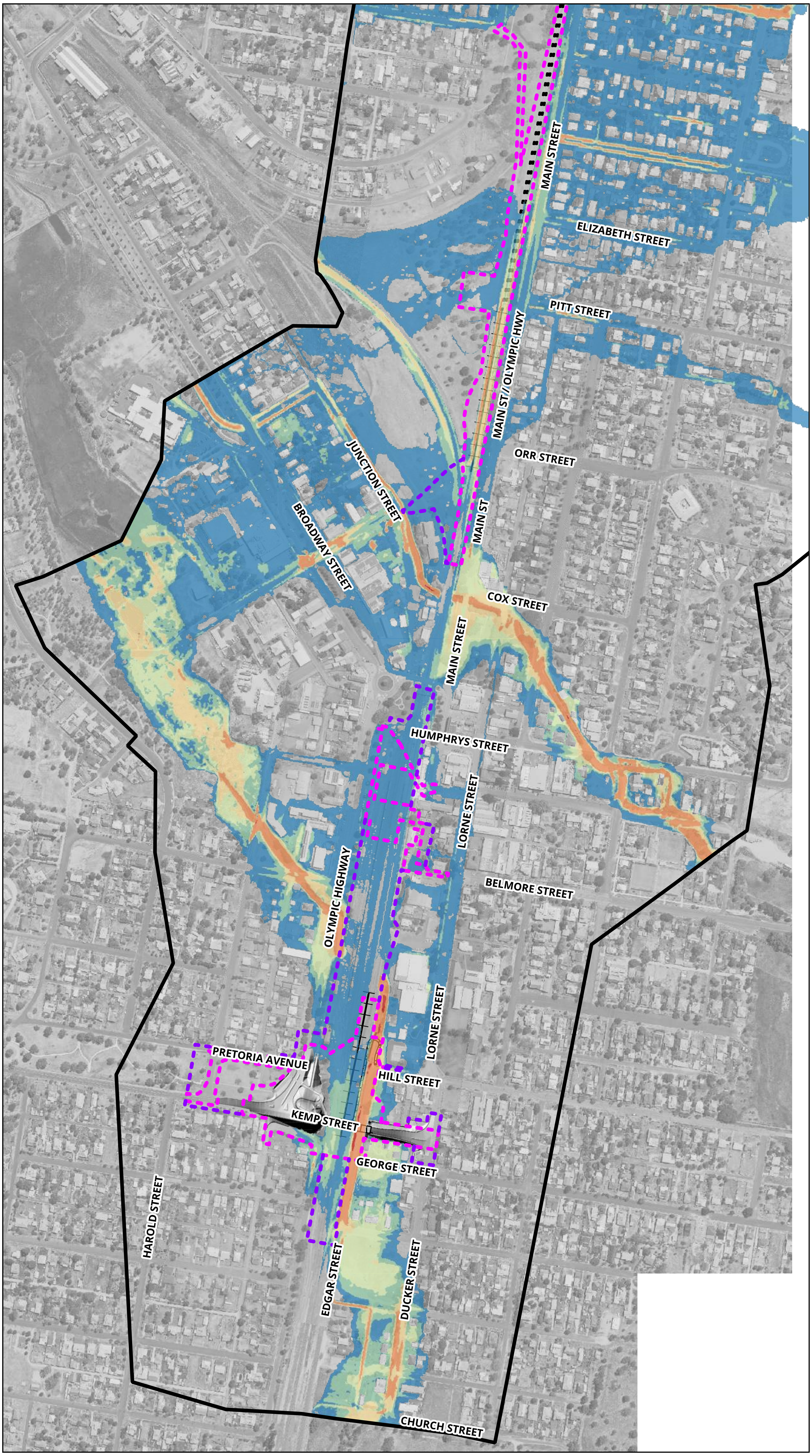
- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 3.00
- > 3.00

0 100 200 m
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A25: (Overall Extent) Design Conditions - PMF Event Peak Flood Velocities



MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Peak Flood Hazards

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

0 100 200 m

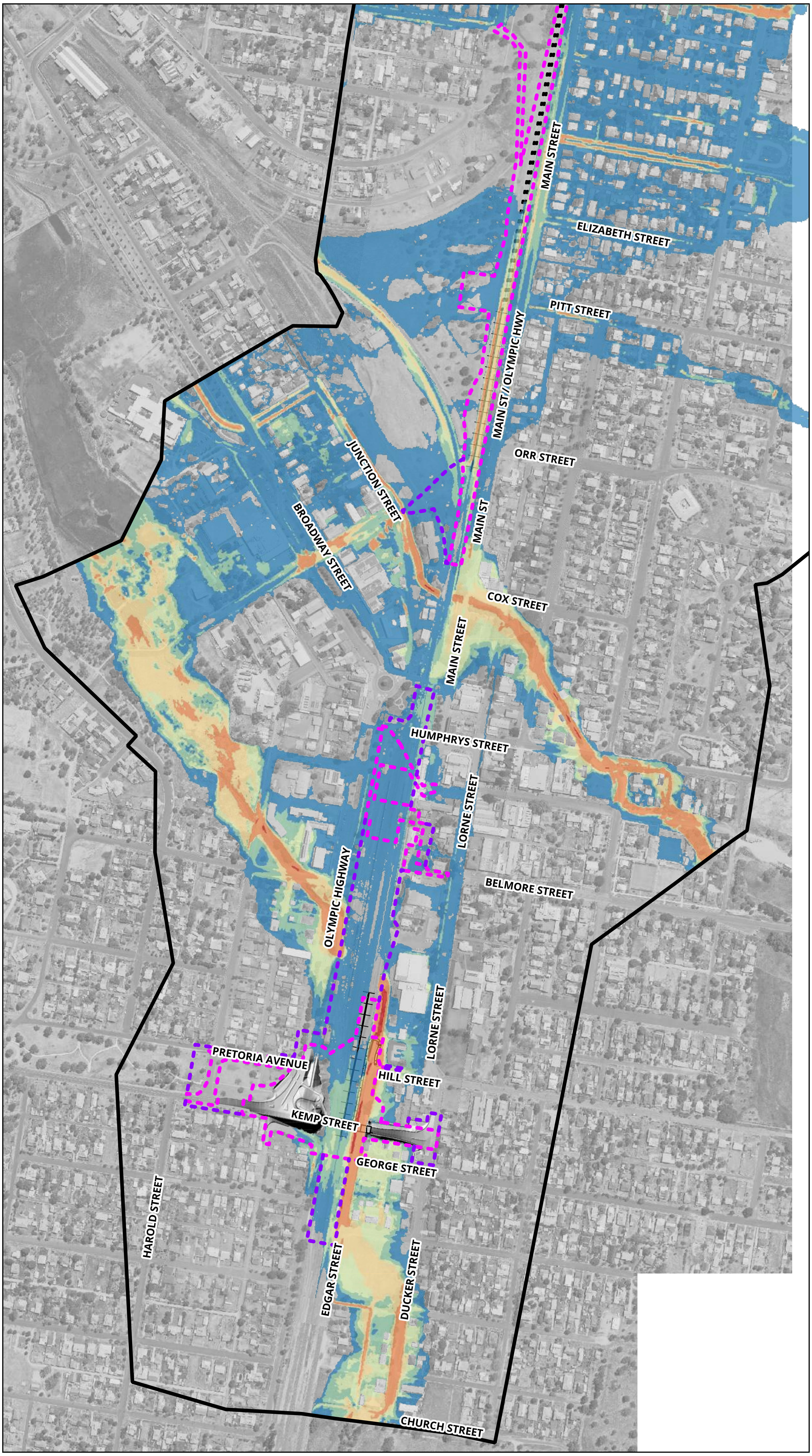
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A26: (Overall Extent) Design Conditions - 5% AEP Peak Flood Hazards



MARTINUS aurecon BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

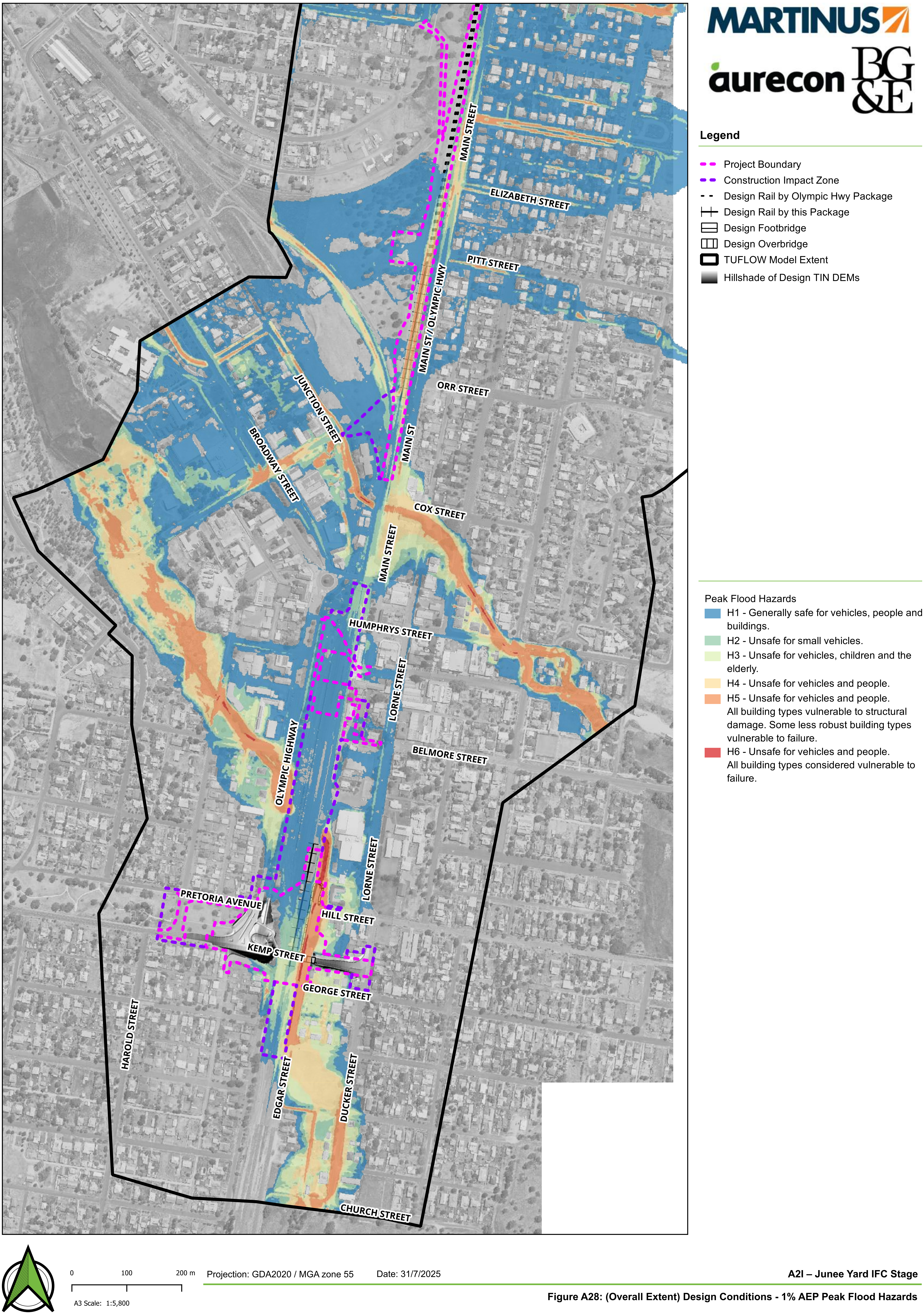
Peak Flood Hazards

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

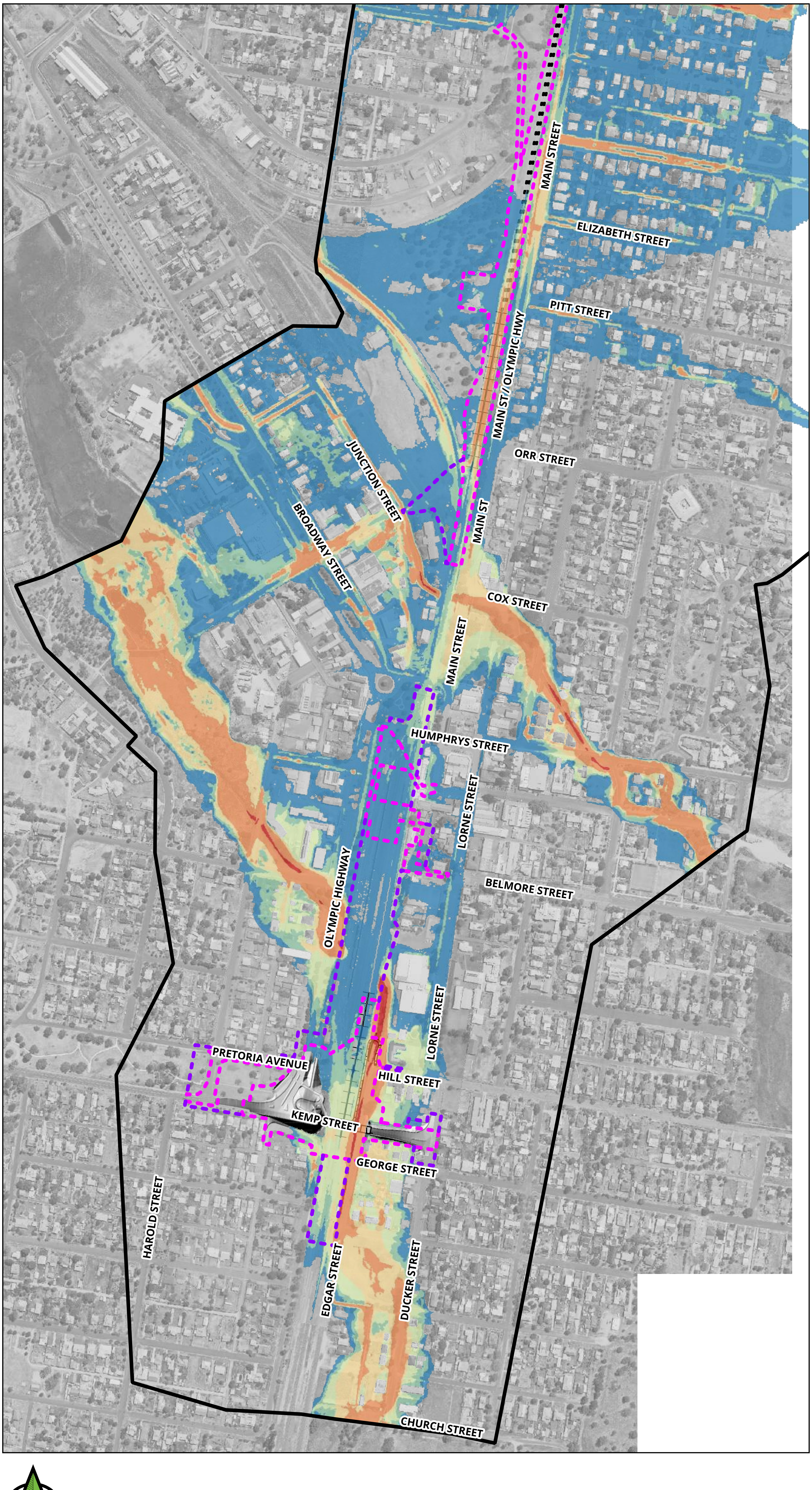
Figure A27: (Overall Extent) Design Conditions - 2% AEP Peak Flood Hazards



Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A28: (Overall Extent) Design Conditions - 1% AEP Peak Flood Hazards



MARTINUS
aurecon
BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Peak Flood Hazards

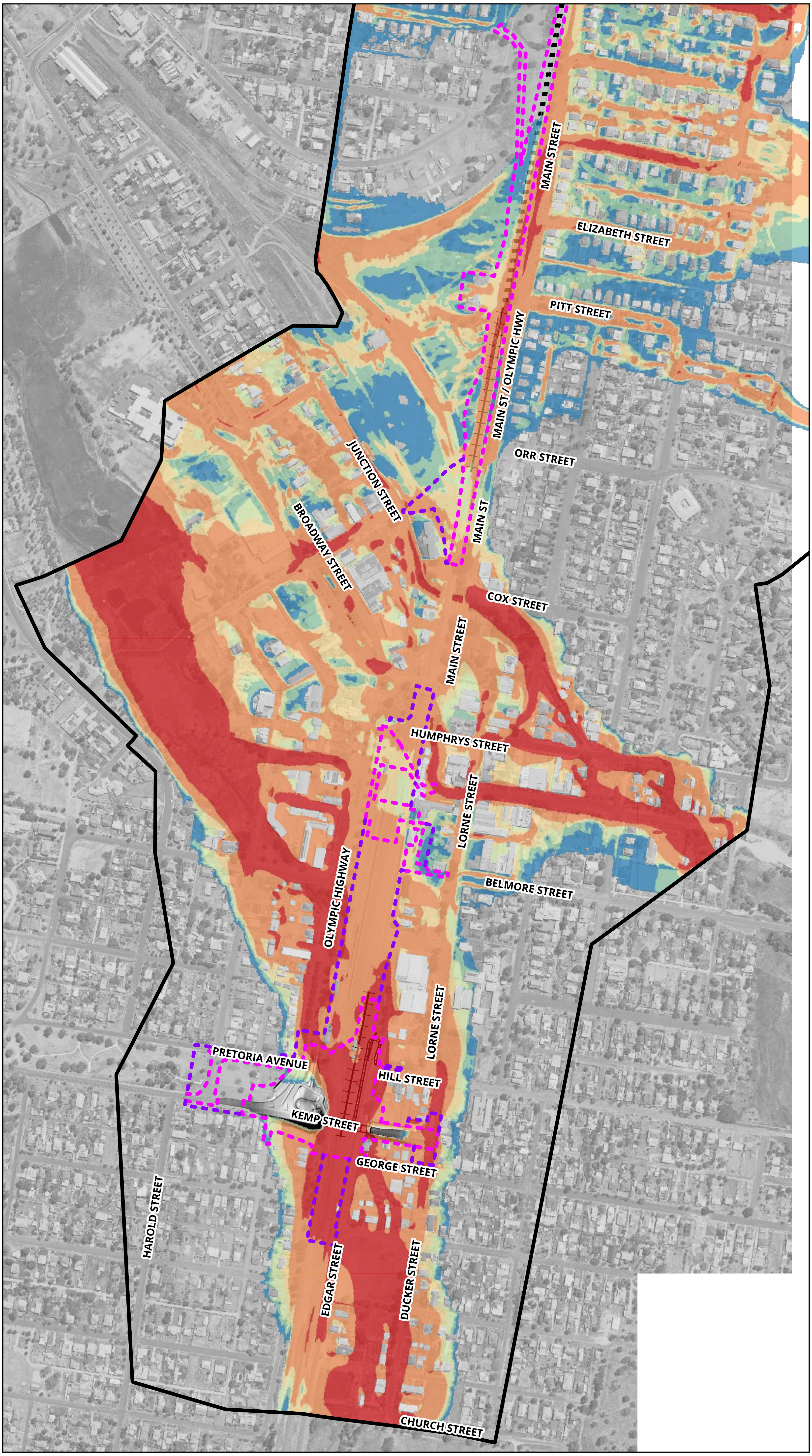
- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A29: (Overall Extent) Design Conditions - 1% AEP + Climate Change Peak Flood Hazards

MARTINUS
aurecon BG&E



Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Peak Flood Hazards

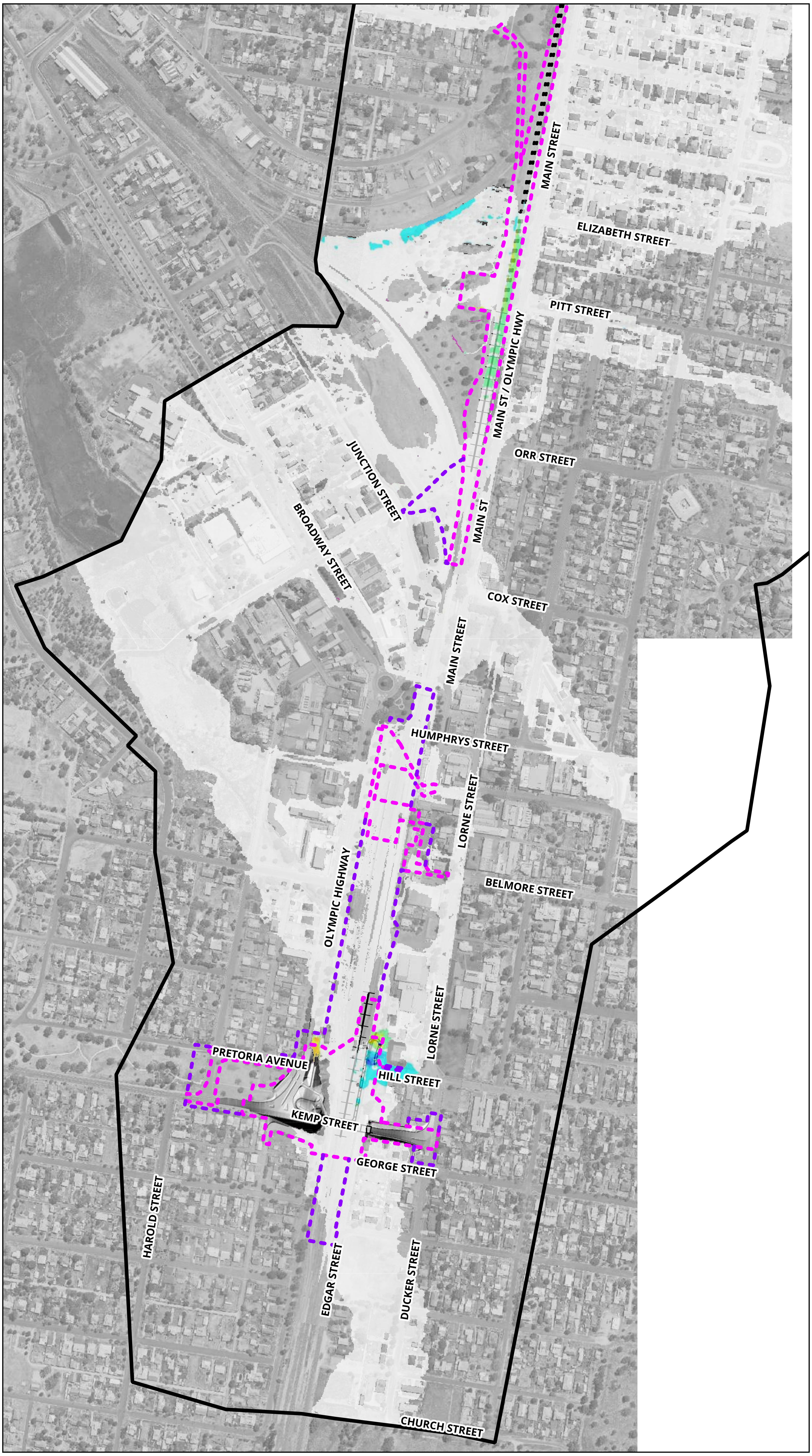
- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

0 100 200 m
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A30: (Overall Extent) Design Conditions - PMF Event Peak Flood Hazards



MARTINUS

aurecon BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Change in Peak Flood Levels (m)

- <= -0.1
- -0.1 - -0.05
- -0.05 - -0.04
- -0.04 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.04
- 0.04 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- > 0.4
- Newly Flooded
- No Longer Flooded

0 100 200 m

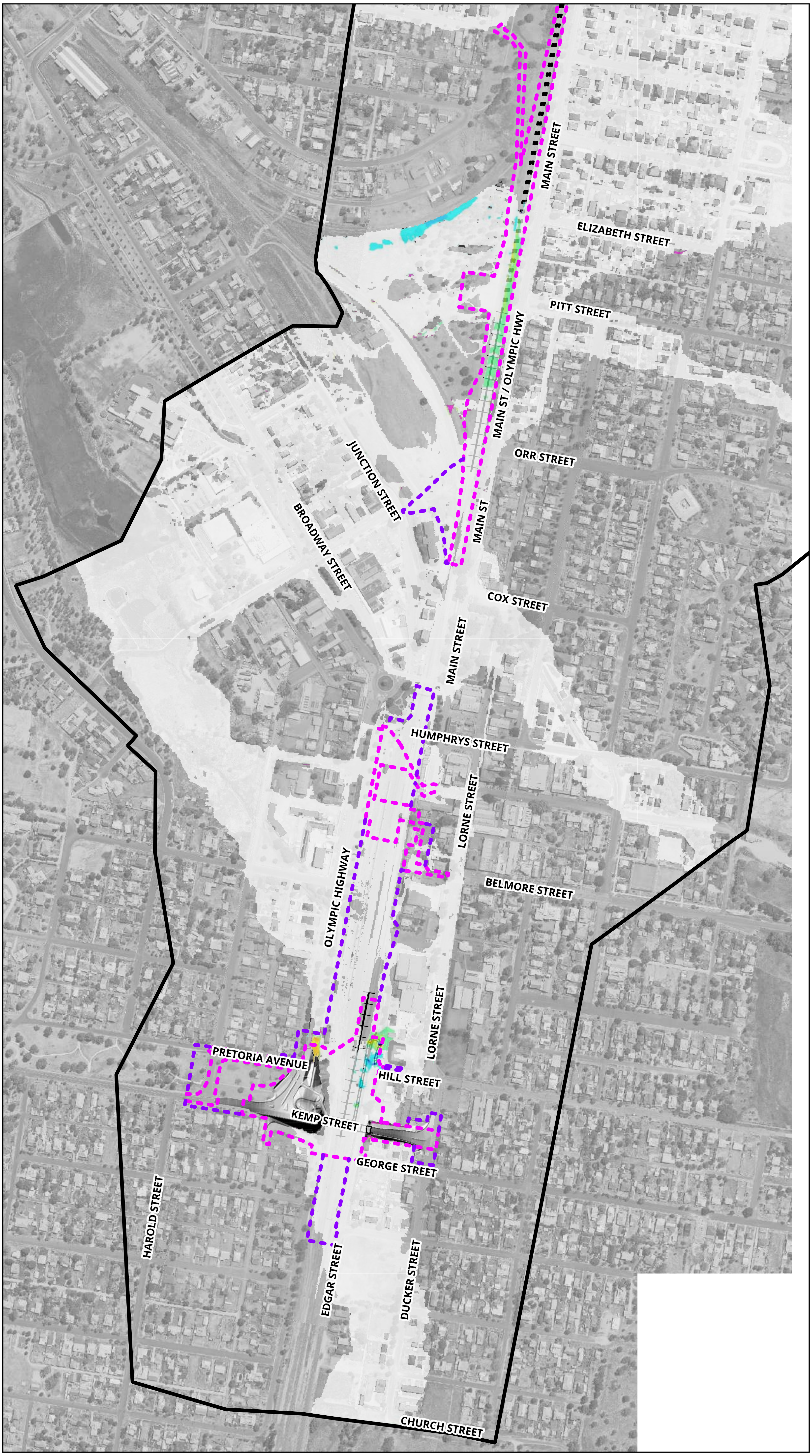
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A31: (Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 5% AEP Changes in Peak Flood Level



MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Change in Peak Flood Levels (m)

- <= -0.1
- -0.1 - -0.05
- -0.05 - -0.04
- -0.04 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.04
- 0.04 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- > 0.4
- Newly Flooded
- No Longer Flooded

0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

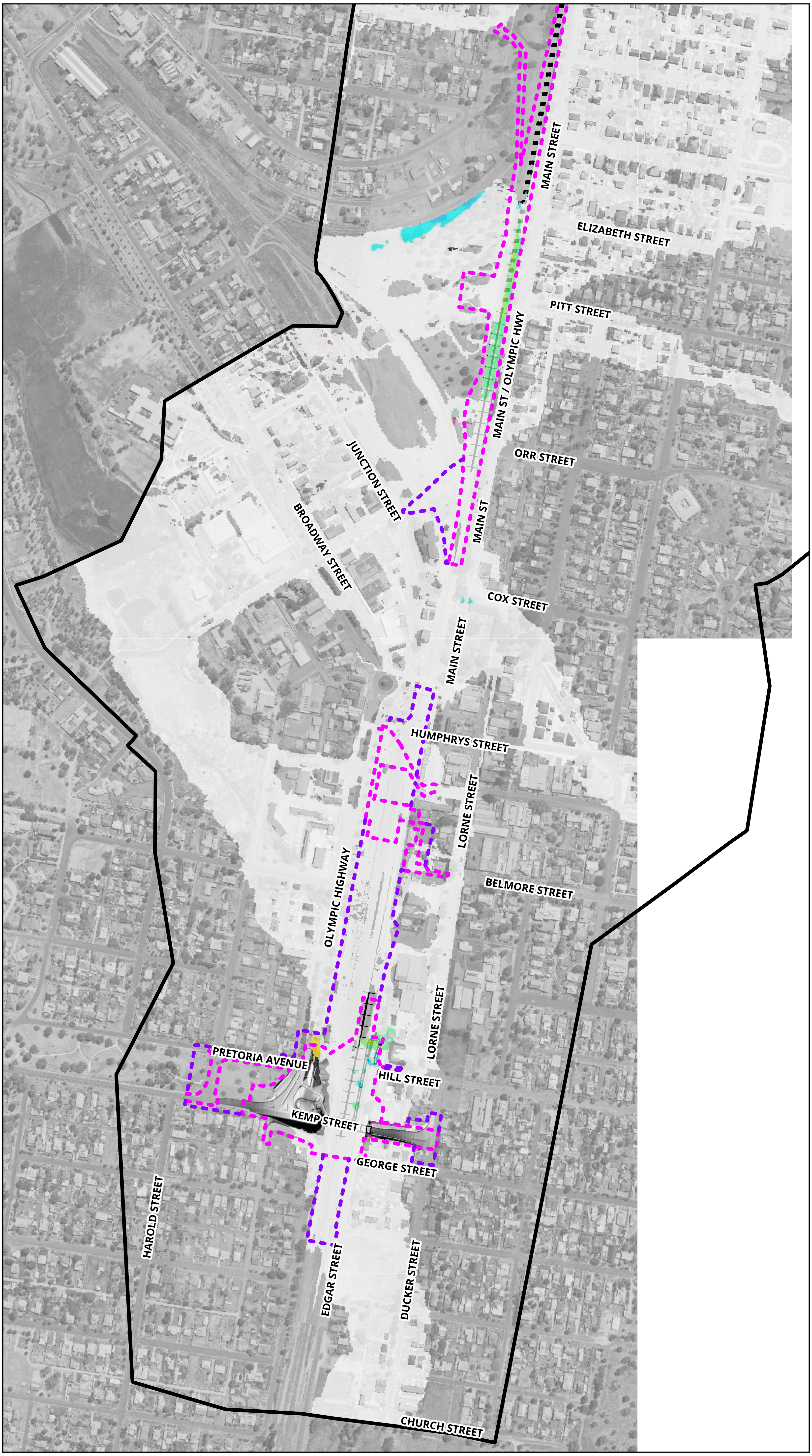
A2I – Junee Yard IFC Stage

Figure A32: (Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 2% AEP Changes in Peak Flood Level

MARTINUS

aurecon

BG&E



Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Change in Peak Flood Levels (m)

- <= -0.1
- -0.1 - -0.05
- -0.05 - -0.04
- -0.04 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.04
- 0.04 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- > 0.4
- Newly Flooded
- No Longer Flooded

0 100 200 m

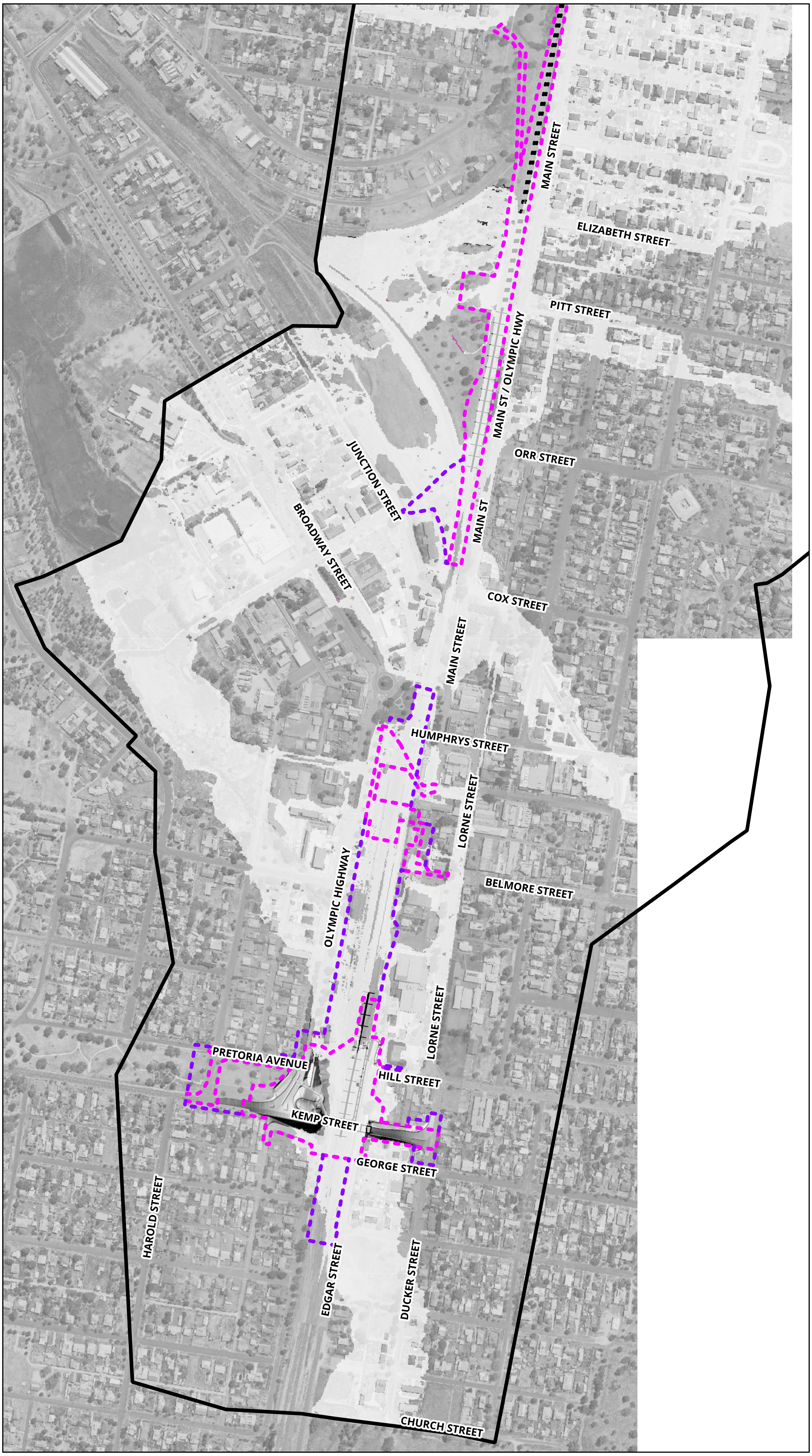
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A33: (Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 1% AEP Changes in Peak Flood Level



MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Change in Peak Flood Velocities (m/s)

- <= 0.50
- > 0.50
- Newly Flooded
- No Longer Flooded

0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

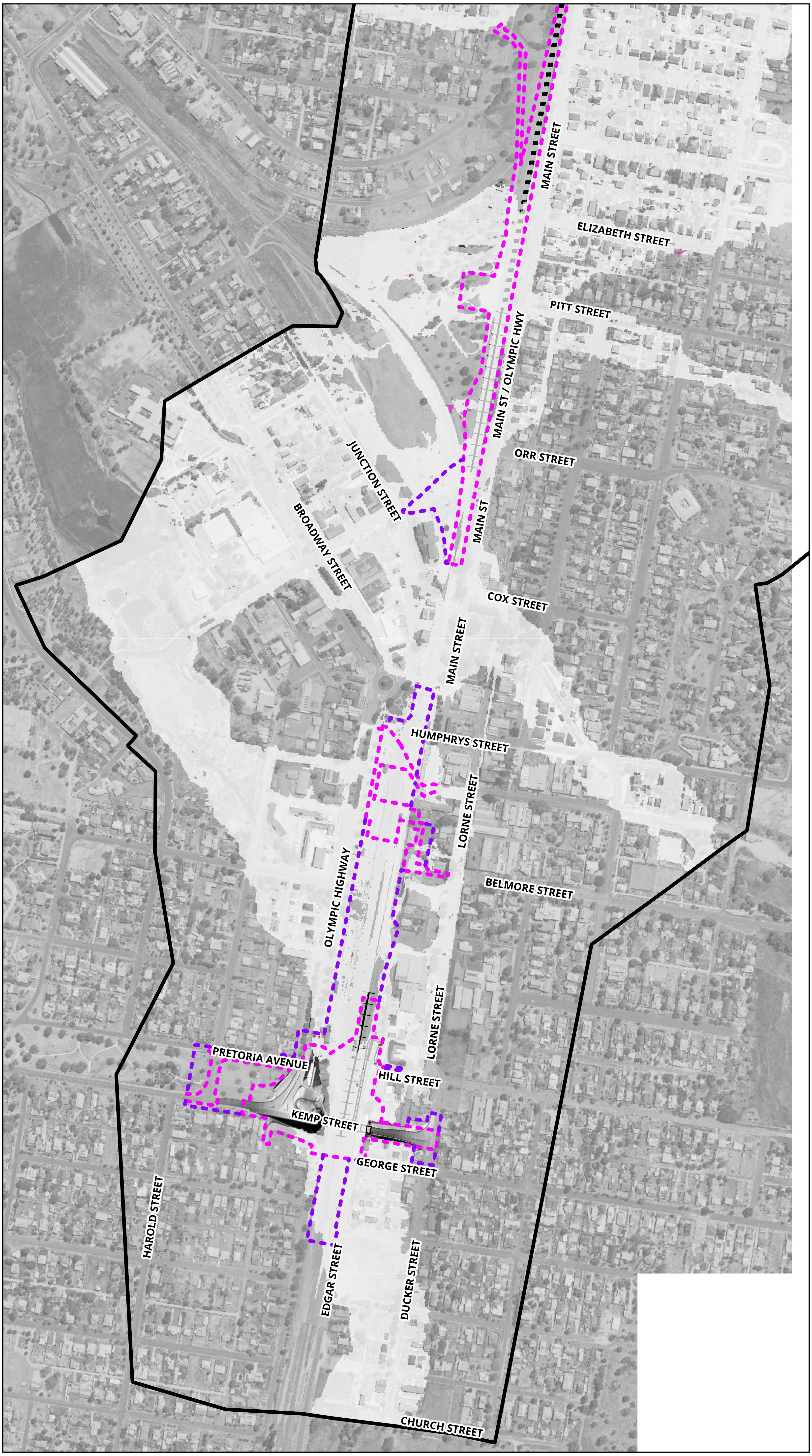
Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A34: (Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 5% AEP Changes in Peak Flood Velocity

MARTINUS

aurecon BG&E



Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Change in Peak Flood Velocities (m/s)

- <= 0.50
- > 0.50
- Newly Flooded
- No Longer Flooded

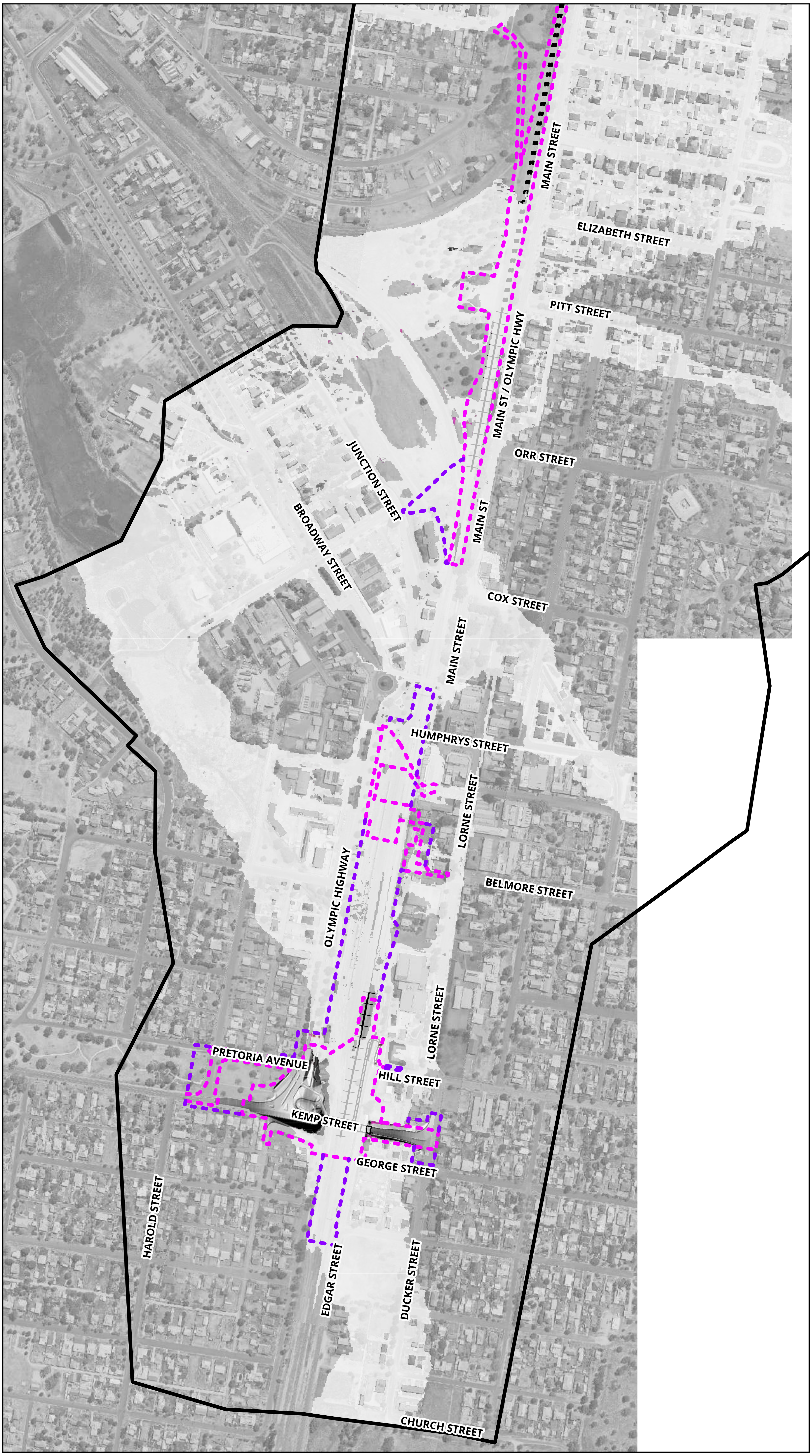
0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A35: (Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 2% AEP Changes in Peak Flood Velocity



MARTINUS aurecon BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Change in Peak Flood Velocities (m/s)

- <= 0.50
- > 0.50
- Newly Flooded
- No Longer Flooded

0 100 200 m

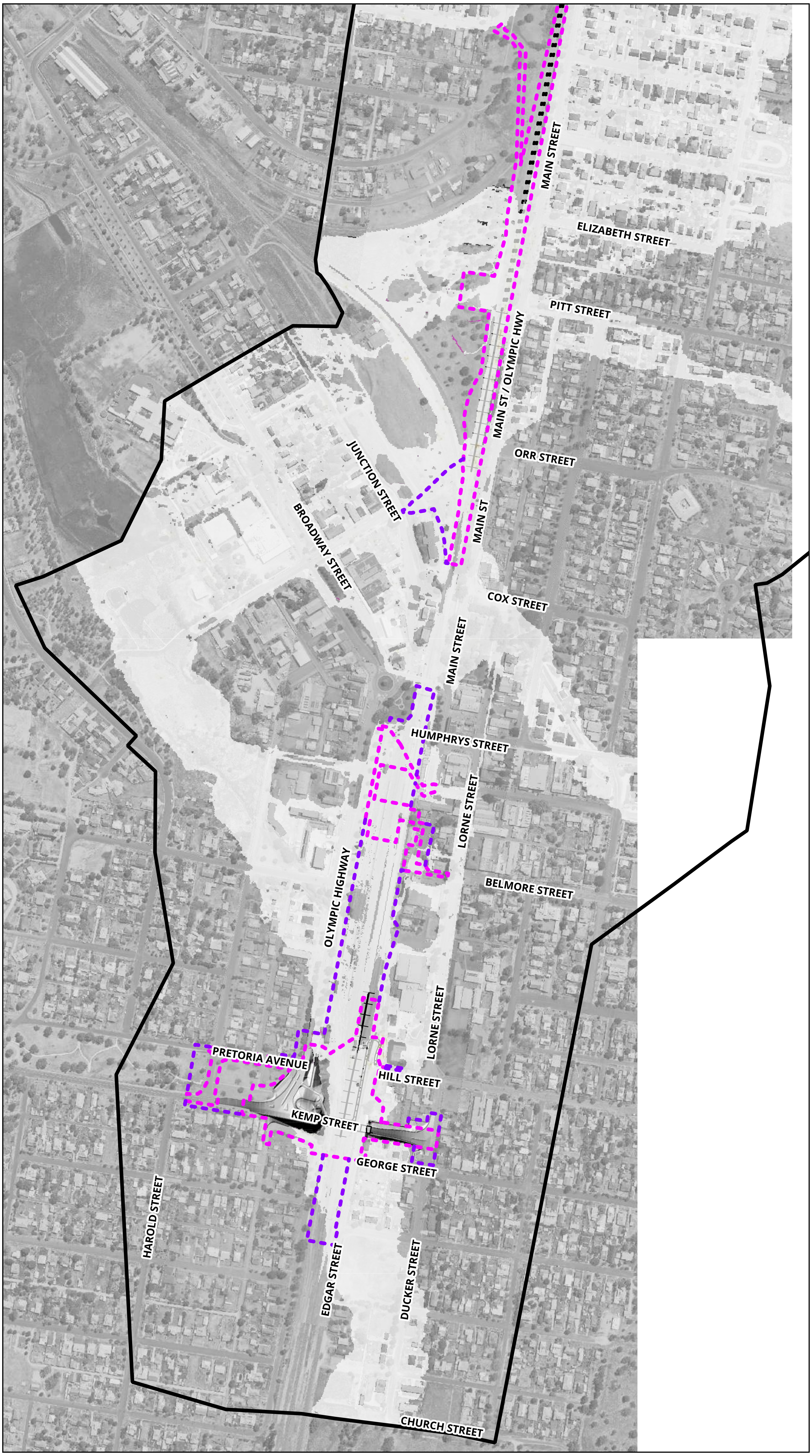
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A36: (Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 1% AEP Changes in Peak Flood Velocity



MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Change in Peak Flood Hazards

- -4 Class lower
- -3 Class lower
- -2 Class lower
- -1 Class lower
- No change
- 1 Class higher
- 2 Class higher
- 3 Class higher
- 4 Class higher
- Newly Flooded
- No Longer Flooded

0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

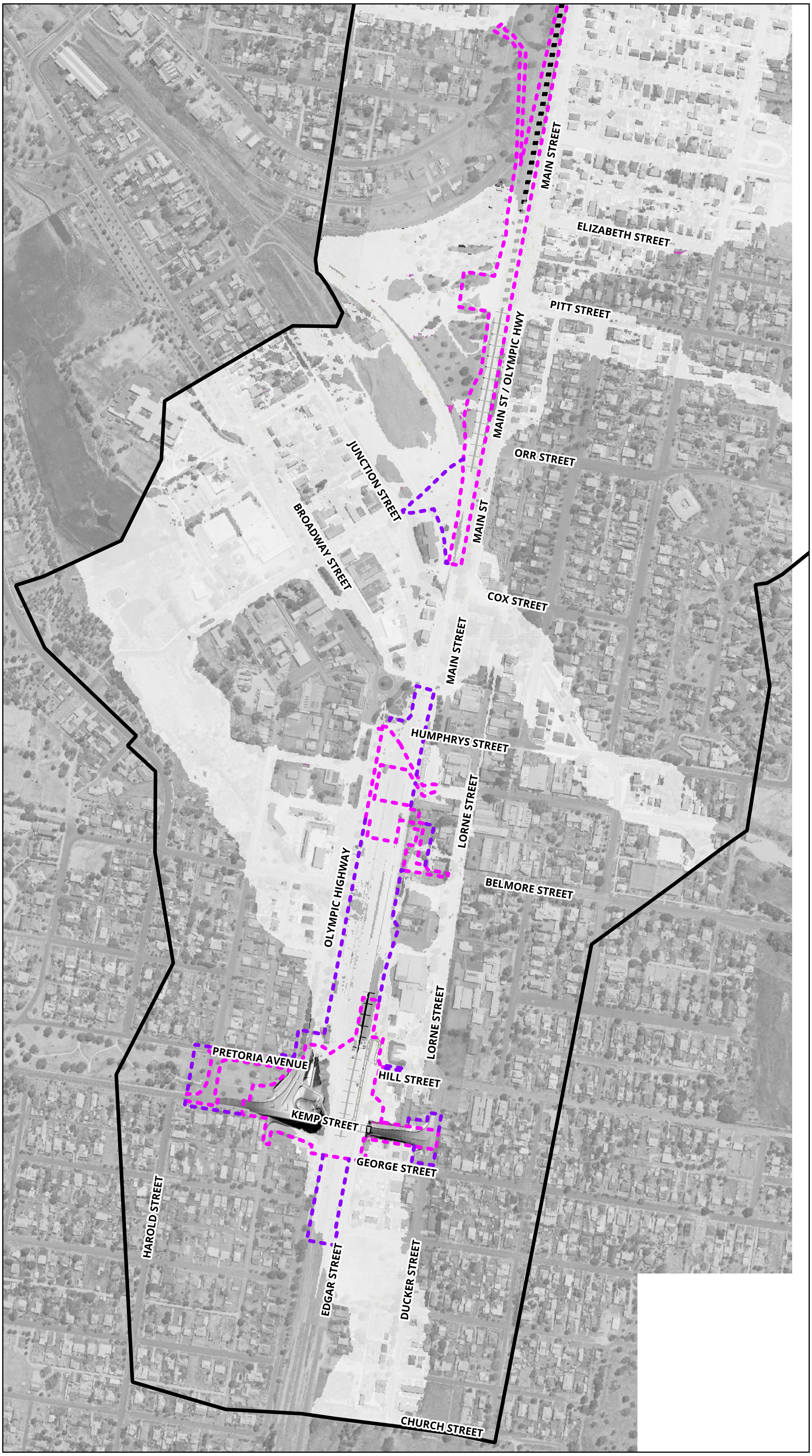
Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A37: (Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 5% AEP Changes in Peak Flood Hazard

MARTINUS

aurecon BG&E



Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Change in Peak Flood Hazards

- -4 Class lower
- -3 Class lower
- -2 Class lower
- -1 Class lower
- No change
- 1 Class higher
- 2 Class higher
- 3 Class higher
- 4 Class higher
- Newly Flooded
- No Longer Flooded

0 100 200 m

A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A38: (Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 2% AEP Changes in Peak Flood Hazard

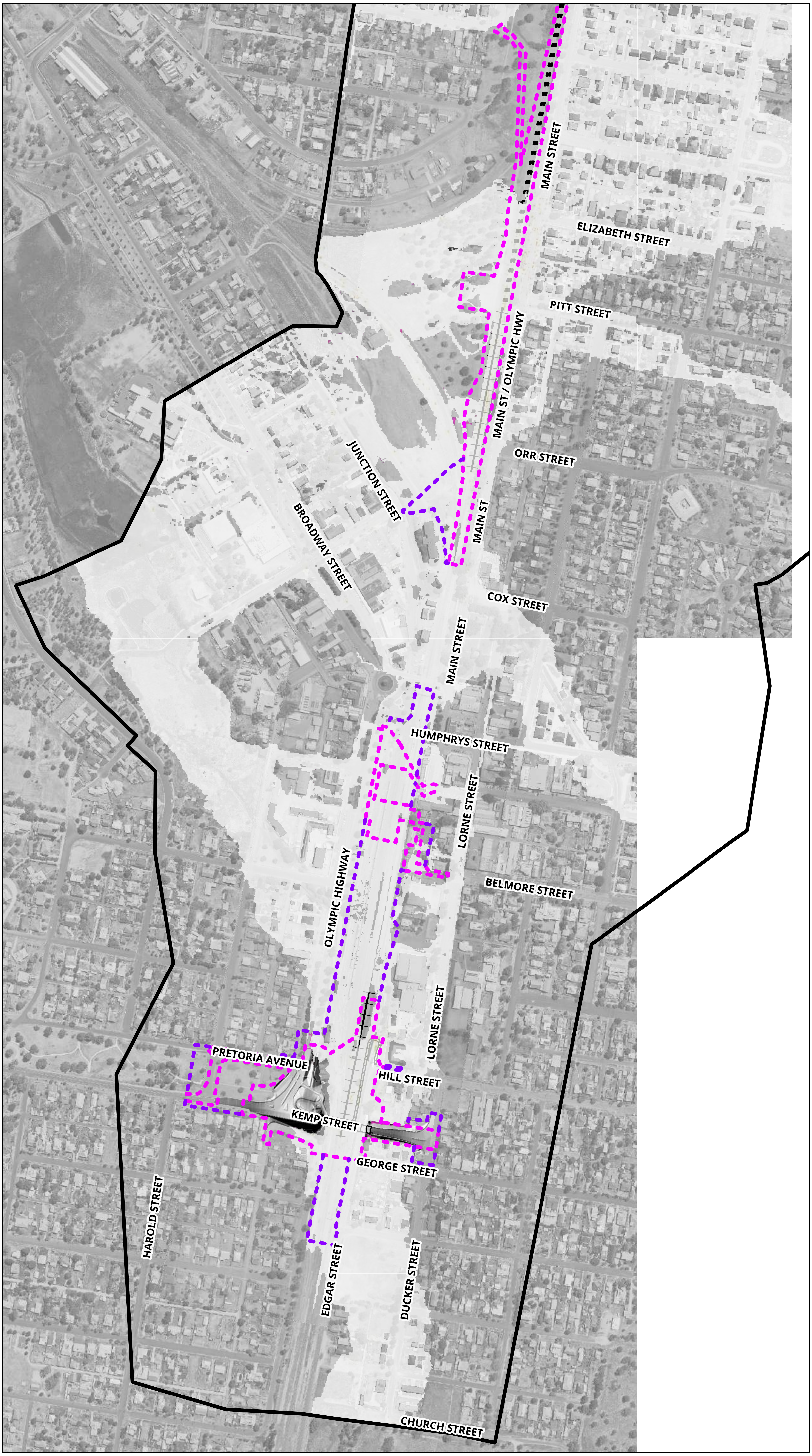
MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs



Change in Peak Flood Hazards

- -4 Class lower
- -3 Class lower
- -2 Class lower
- -1 Class lower
- No change
- 1 Class higher
- 2 Class higher
- 3 Class higher
- 4 Class higher
- Newly Flooded
- No Longer Flooded

0 100 200 m

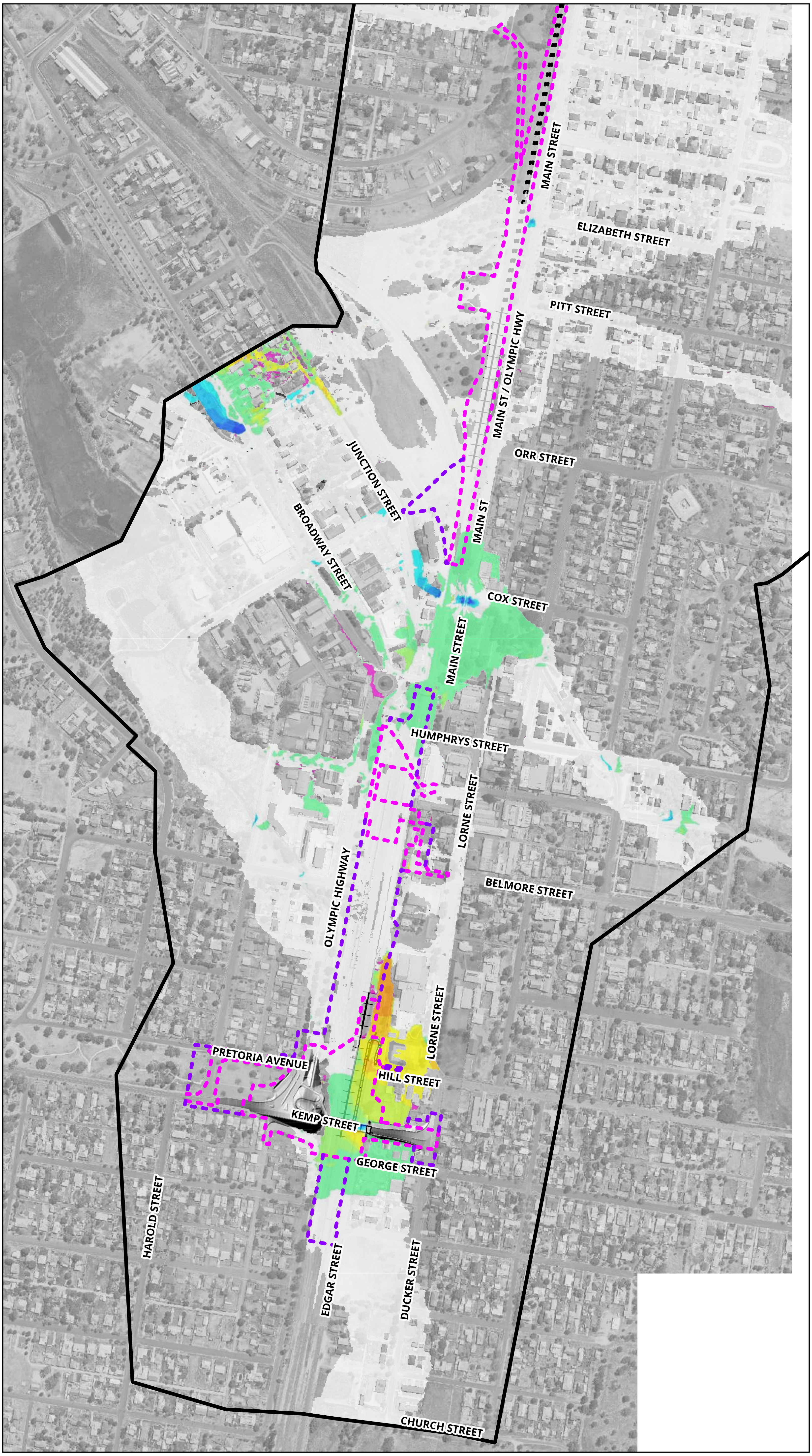
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A39: (Overall Extent) Flood Impacts (Design Conditions vs Existing Conditions) - 1% AEP Changes in Peak Flood Hazard



MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Change in Peak Flood Levels (m)

- <= -0.1
- -0.1 - -0.05
- -0.05 - -0.04
- -0.04 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.04
- 0.04 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- > 0.4
- Newly Flooded
- No Longer Flooded

0 100 200 m

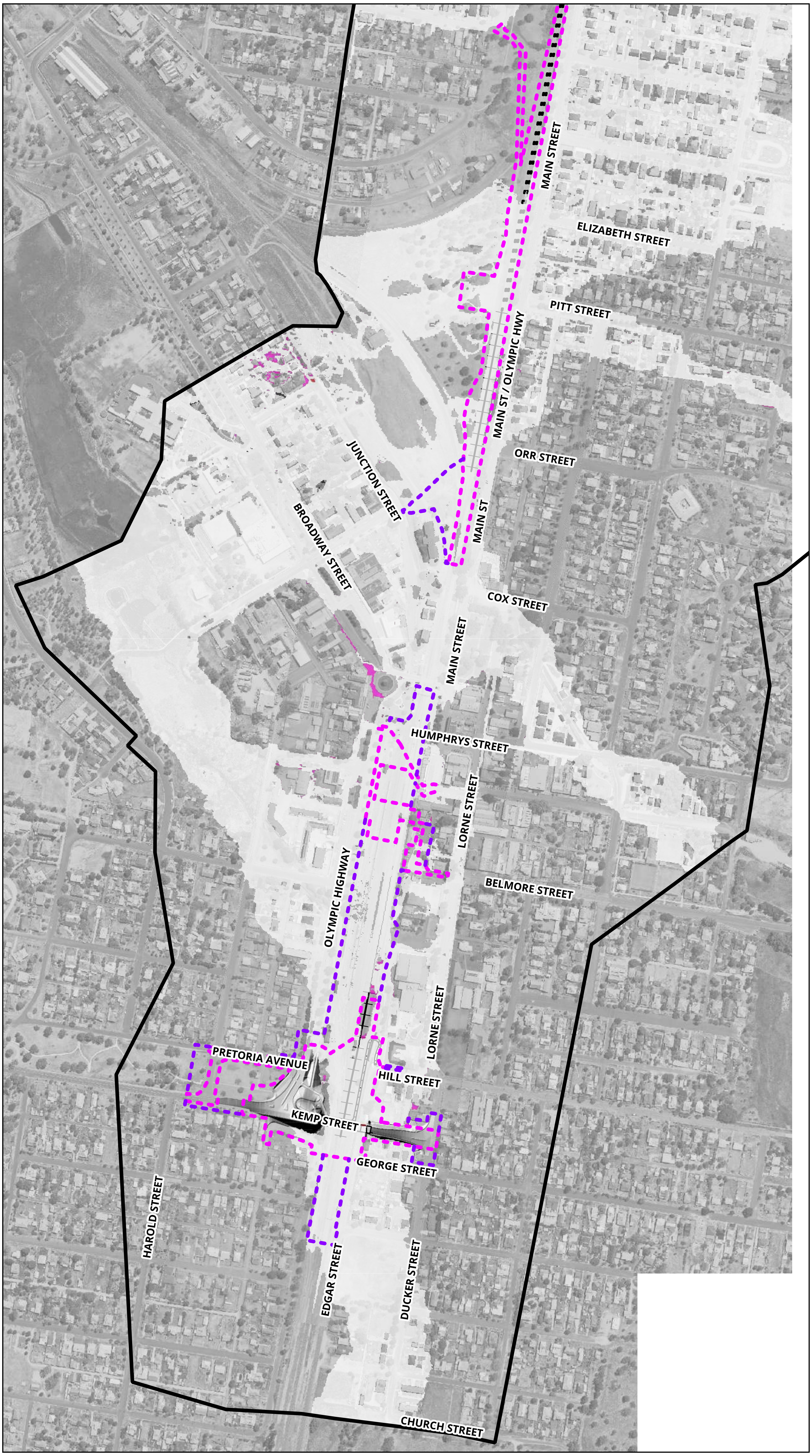
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A40: (Overall Extent) Flood Impacts (Design Blockage Conditions vs Design Conditions) - 1% AEP Changes in Peak Flood Level



MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Change in Peak Flood Velocities (m/s)

- <= 0.50
- > 0.50
- Newly Flooded
- No Longer Flooded

0 100 200 m

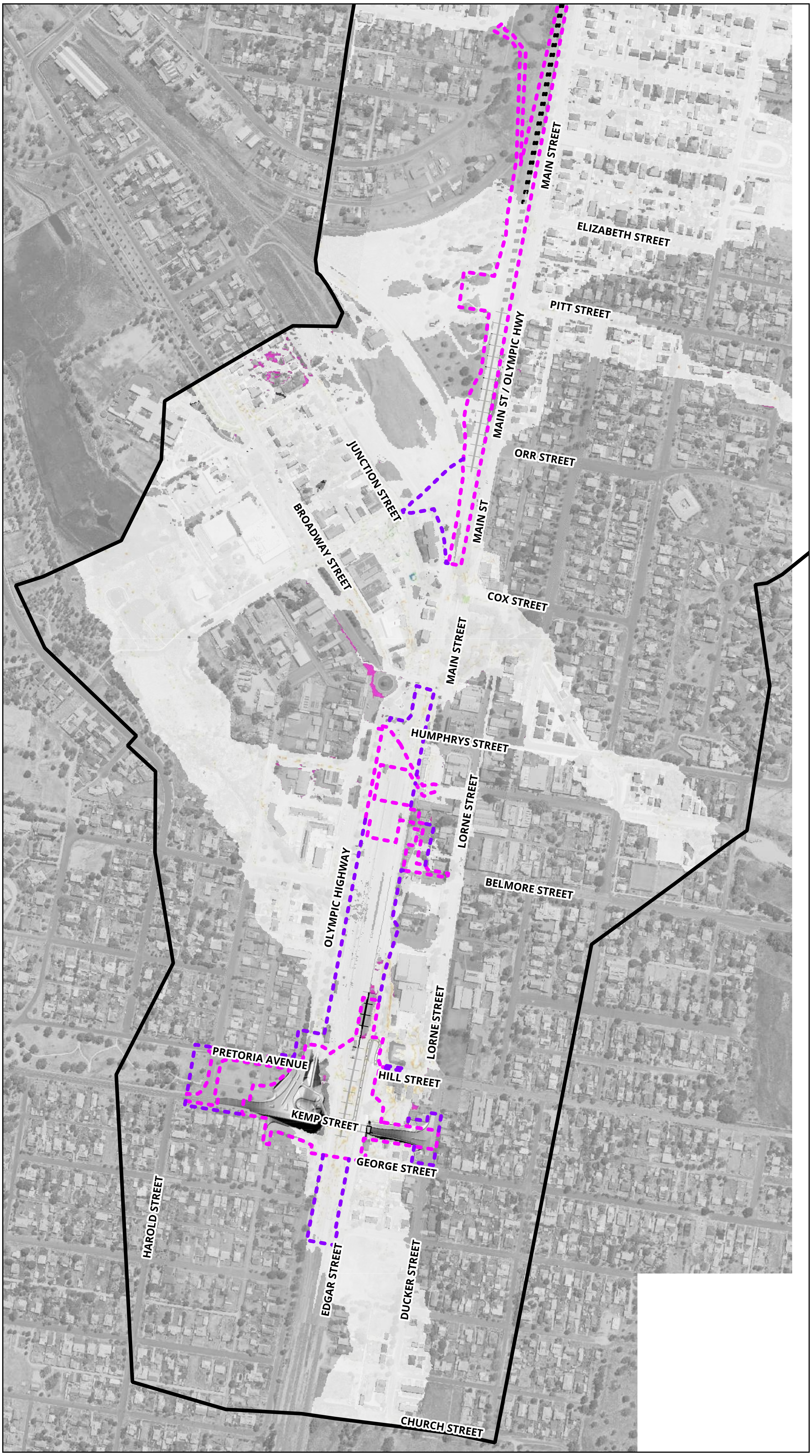
A3 Scale: 1:5,800

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A41: (Overall Extent) Flood Impacts (Design Blockage Conditions vs Design Conditions) - 1% AEP Changes in Peak Flood Velocity



MARTINUS

aurecon

BG&E

Legend

- Project Boundary
- Construction Impact Zone
- Design Rail by Olympic Hwy Package
- Design Rail by this Package
- Design Footbridge
- Design Overbridge
- TUFLOW Model Extent
- Hillshade of Design TIN DEMs

Change in Peak Flood Hazards

- -4 Class lower
- -3 Class lower
- -2 Class lower
- -1 Class lower
- No change
- 1 Class higher
- 2 Class higher
- 3 Class higher
- 4 Class higher
- Newly Flooded
- No Longer Flooded

0 100 200 m

A3 Scale: 1:5,800

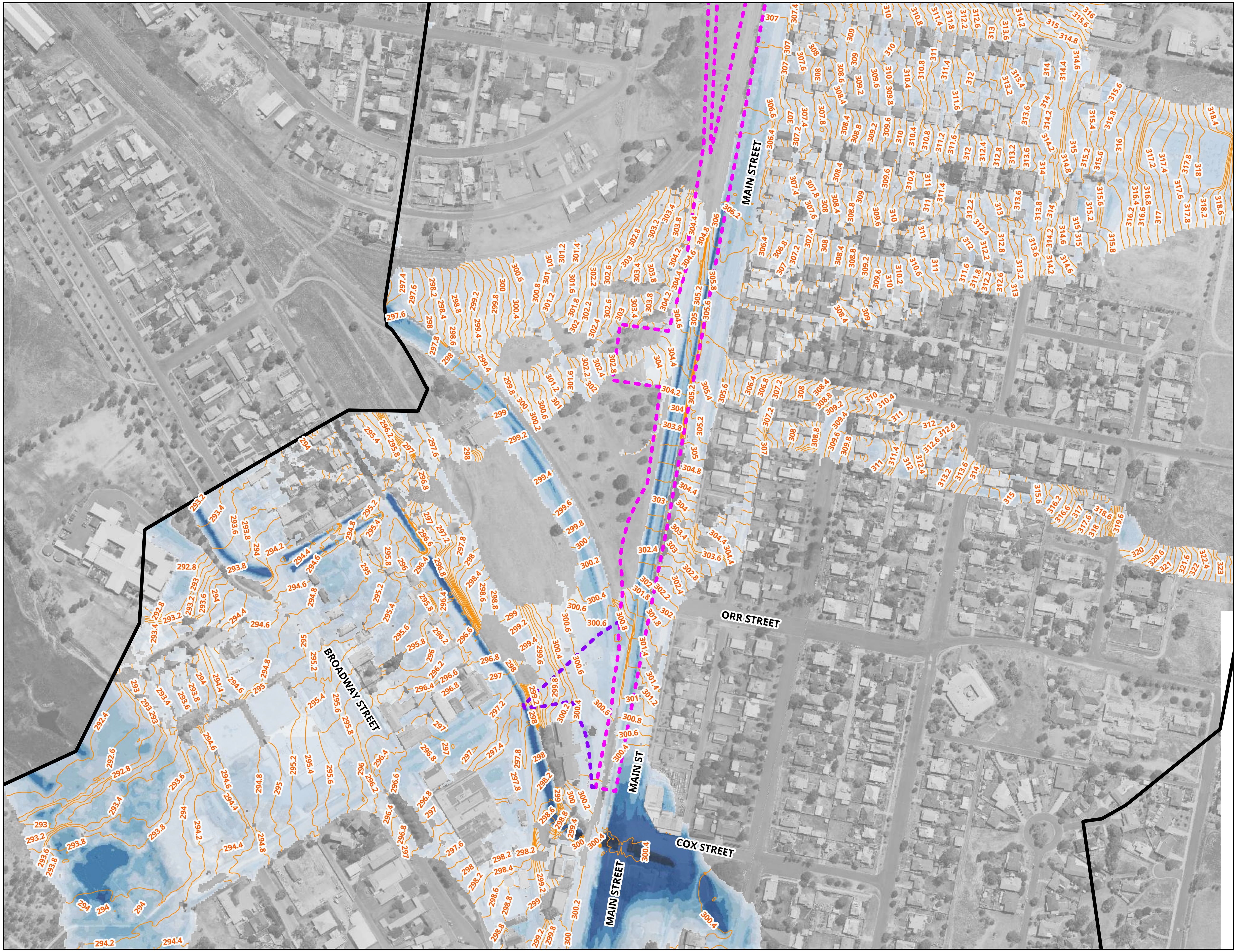
Projection: GDA2020 / MGA zone 55 Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A42: (Overall Extent) Flood Impacts (Design Blockage Conditions vs Design Conditions) - 1% AEP Changes in Peak Flood Hazard

MARTINUS

aurecon BG&E



Legend

- Peak Flood Level Contours (0.2m Intervals)
- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Depths (m)

- <= 0.03
- 0.03 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 2
- > 2

0 100 200 m

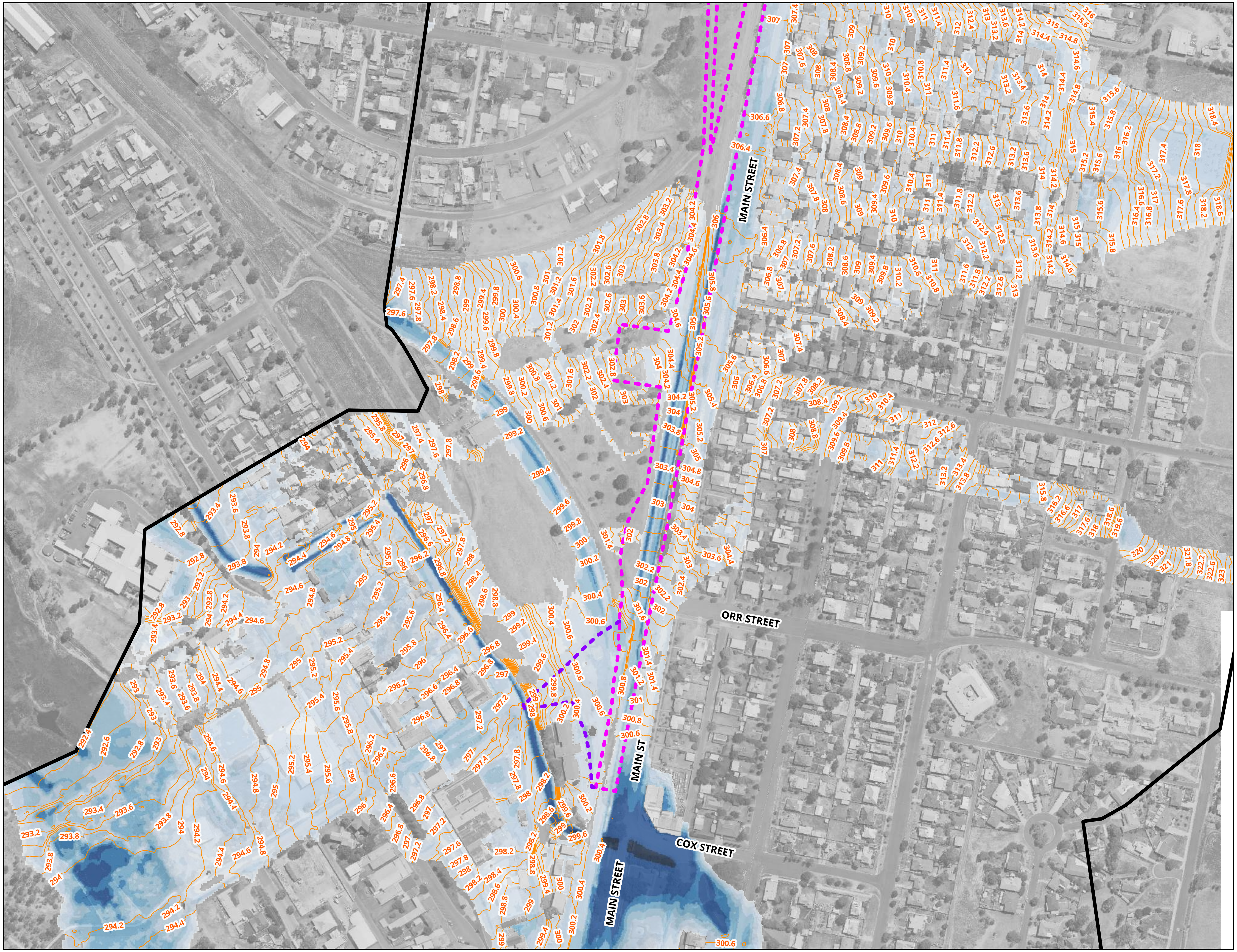
A3 Scale: 1:3,500

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A43: (Northern Extent) Existing Conditions - 5% AEP Peak Flood Depths and Flood Level Contours



MARTINUS

aurecon

BG&E

Legend

- Peak Flood Level Contours (0.2m Intervals)
- Project Boundary
- Construction Impact Zone
- TUFLOW Model Extent

Peak Flood Depths (m)

- <= 0.03
- 0.03 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1 - 2
- > 2

0 100 200 m

A3 Scale: 1:3,500

Projection: GDA2020 / MGA zone 55

Date: 31/7/2025

A2I – Junee Yard IFC Stage

Figure A44: (Northern Extent) Existing Conditions - 2% AEP Peak Flood Depths and Flood Level Contours