



This document is uncontrolled
when printed.



A21 | Albury to Illabo

FLOOD DESIGN REPORT

Olympic Highway Underbridge

CONTRACT NUMBER: 0052


PROJECT DOCUMENT NUMBER:

5-0052-210-IHY-J6-RP-0001

Document Control

DOCUMENT TITLE:	Flood Design Report – Olympic Highway Underbridge		
DOCUMENT OWNER:	Engineering Manager		
PREPARED BY:	Malinda Gunasekera	TITLE:	Water Engineer
	Yucen Lu	TITLE:	Senior Water Resources Engineer
REVIEWED BY:	Jasmine Lee	TITLE:	Associate Water Resources Engineer
VERIFIED BY:	Eric Lam	TITLE:	Technical Director

Approved by

NAME	TITLE	SIGNATURE	DATE
Zoe Cruice	Engineering Manager		11/08/2025

Revision History

REVISION	REVISION DATE	AMENDMENT	DATE TO CLIENT
A	15/05/2025	DDR Issue for review	15/05/2025
0	11/08/2025	Issued for Use	11/08/2025

Disclaimer: This document has been prepared by Martinus. Use of this document shall be subject to the terms of the relevant contract with Martinus. The electronic file of this current revision is the controlled copy. This file is stored on Martinus' server located at Head Office, Unit 1, 23-27 Waratah St, Kirrawee, NSW.

This document is the property of and contains proprietary information owned by Martinus. No permission is granted to publish, reproduce, transmit or disclose to another party, any information contained in this document, in whole or in part, without prior written permission from the issuing authority.

For the purpose of this document, Martinus refers to the Martinus Group of companies.

This document is uncontrolled when printed.

TABLE OF CONTENTS

GLOSSARY	4
1. A2P PROJECT INTRODUCTION.....	6
1.1. Albury to Parkes (A2P).....	6
1.2. Project Scope.....	6
1.3. Site Description.....	7
1.4. Objectives.....	8
1.5. Scope.....	8
1.6. Previous Studies.....	8
1.7. Purpose and Requirements.....	9
1.8. Information Documents.....	10
1.9. Inputs.....	10
1.10. Outputs.....	10
1.11. Limitations and Assumptions.....	11
2. COMPLIANCE WITH REQUIREMENTS.....	12
2.1. Project Scope and Requirements.....	12
2.2. Conditions of Approval - Flooding.....	13
2.3. Updated Mitigation Measures - Flooding.....	16
3. CHANGE MANAGEMENT.....	18
3.1. Concept Design to SDR.....	18
3.2. SDR to PDR.....	18
3.3. PDR to DDR.....	18
3.4. DDR to IFC.....	18
4. MODELLING METHODOLOGY.....	19
4.1. Hydrology Modelling.....	19
4.2. Hydraulic Modelling.....	23
4.3. Hydraulic Model Comparison.....	27
4.4. Design Events.....	28
5. FLOOD ASSESSMENT.....	29
5.1. Existing Conditions.....	29
5.2. Design Conditions.....	32
5.3. Flood Immunity and Scour Protection.....	34
5.4. Flood Impact Assessment.....	34
5.5. Sensitivity Test.....	39
6. MITIGATION MEASURES.....	42
7. RECOMMENDATIONS.....	43
APPENDICES.....	44
APPENDIX A.....	45
APPENDIX B.....	48
APPENDIX C.....	49
APPENDIX D.....	50
APPENDIX D1.....	51
APPENDIX D.....	52
APPENDIX E.....	53

LIST OF TABLES

Table 0-1: Definitions.....	4
Table 1-1: Summary of Previous Flood Studies.....	8
Table 1-2: Available Information	10
Table 2-1: Flooding Criteria within PSR Annexure B Technical Requirements.....	12
Table 2-2: Conditions of Approval Compliance Table	13
Table 2-3: Updated Mitigation Measures Compliance Table - Flooding	16
Table 3-1: Design Differences between Concept Design and SDR.....	18
Table 3-2: Design Differences Between SDR and PDR	18
Table 3-3: Design Differences Between PDR and DDR	18
Table 3-4: Design Differences Between DDR and IFC	18
Table 4-1: RORB Parameters.....	19
Table 4-2: Critical Storms and Peak Flows.....	21
Table 4-3: Kc Parameter Comparison – Lower Butlers Creek	21
Table 4-4: Flow Comparison – RORB vs RFFE – Lower Butlers Creek	21
Table 4-5: Kc Parameter Comparison – Northern Catchment	22
Table 4-6: Flow Comparison – RORB vs RFFE – Northern Catchment	22
Table 4-7: Model Parameters in the TUFLOW Model.....	24
Table 4-8 Hydraulic Model Comparison.....	28
Table 4-9: TUFLOW Modelled Durations and Temporal Patterns	28
Table 5-1: Points of Interest.....	29
Table 5-2: Rail Immunity – Existing Conditions.....	30
Table 5-3: Points of Interest Data – Peak Flood Levels (mAHD) – Existing Conditions.....	30
Table 5-4: Points of Interest Data – Peak Flood Velocity (m/s) – Existing Conditions	30
Table 5-5: Points of Interest Data – Peak Flood Hazard Category – Existing Conditions	31
Table 5-6: Rail Immunity – Design Conditions.....	32
Table 5-7: Points of Interest Data – Peak Flood Levels (mAHD) – Design Conditions	33
Table 5-8: Points of Interest Data – Peak Flood Velocities (m/s) – Design Conditions.....	33
Table 5-9: Points of Interest Data – Peak Flood Hazard Category– Design Conditions	33
Table 5-10: Overtopping Details at CH483 + 690km and CH484+850km	34
Table 5-11: Points of Interest Data – Changes in Flood Level (m)	34
Table 5-12: Points of Interest Data – Changes in Flood Velocity (m/s).....	35
Table 5-13: Points of Interest Data – Changes in Flood Hazard.....	35
Table 5-14: Culvert Blockage Percentage	40
Table 5-15: Culvert Blockage Parameters	40

LIST OF FIGURES

Figure 1-1: Site Boundary.....	7
Figure 1-2: 1% AEP and 5% AEP Flood Extents at Olympic Highway Underbridge (Image source: Albury to Illabo EIS Technical Paper 11 Figure 4.51 (July 2022)).....	9
Figure 4-1: Hydrologic Model Sub-Catchment Extents (Combined Model).....	20
Figure 4-2: Kc Sensitivity Testing – Lower Butlers Creek	22
Figure 4-3: Kc Sensitivity Testing – Northern Catchment	22
Figure 4-4: TUFLOW Model Extent – Junee Combined Model.....	23
Figure 4-5: Survey Extent	25
Figure 4-6: Drainage Infrastructure within TUFLOW Model.....	26
Figure 4-7: Extent of Olympic Highway Design Works	27
Figure 4-8: Comparison Location (Figure 6.6 Lower Butlers Gully Flood Study)	28
Figure 5-1: Existing Conditions Flood Extent – 1% AEP Event.....	29
Figure 5-2: Hazard Category Classification	31
Figure 5-3: Design Conditions Flood Extent – 1% AEP Event.....	32
Figure 5-4: Duration of Inundation Reporting Location	36
Figure 5-5: 1% AEP Duration of Inundation– Location A.....	36
Figure 5-6: 1% AEP Duration of Inundation– Location B.....	37
Figure 5-7: 2% AEP Duration of Inundation– Location A.....	37
Figure 5-8: 2% AEP Duration of Inundation– Location B.....	38
Figure 5-9: 5% AEP Duration of Inundation– Location A.....	38
Figure 5-10: 5% AEP Duration of Inundation– Location B.....	39
Figure 5-11: Culvert Blockage Setup.....	40
Figure 5-12: 1% AEP Blockage – Flood Level Difference.....	41

GLOSSARY

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

Table 0-1: Definitions

Term	Definition
A2I	Albury to Illabo
A2P	Albury to Parkes Enhancement Project
AEP	Annual Exceedance Probability
ADC	Assumptions, Dependencies and Constraints
AHD	Australian Height Datum
ALCAM	Australian Level Crossing Assessment Model
ARF	Areal Reduction Factor
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
ARTC	Australian Railway Track Corporation
BoD	Basis of Design
BoM	Bureau of Meteorology
CIZ	Construction Impact Zone
CO	Construct Only
CoA	Conditions of Approval
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
IR	Inland Rail
ITC	Incentivised Target Cost
IV	Independent Verifier
Km	Kilometers
LPA	Licensed Project Area
LiDAR	Light Detection and Ranging
MGA	Map Grid of Australia
MIRDA	Master Inland Rail Development Agreement
NCR	Non-Conformance Report
NLPA	Non-Licensed Project Area
NtP	Notice to Proceed
PDR	Preliminary Design Review
PSR	Project Scope and Requirements
QDL	Quantitative Design Limits
RCP	Representative Concentration Pathways
RFFE	Regional Flood Frequency Analysis
REF	Review of Environmental Factors
RFI	Request for Information
S2P	Stockinbingal to Parkes
SAQP	Sampling, Analysis and Quality Plan
SDR	Systems Definition Review
SEMP	System Engineering Management Plan
TfNSW	Transport for New South Wales
TWL	Tail Water Level
UMM	Updated Mitigation Measure
V & V	Verification and Validation
WAD	Works Authorisation Deed
WAE	Work-as-Executed

1. A2P PROJECT INTRODUCTION

1.1. Albury to Parkes (A2P)

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

1.2. Project Scope

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

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

- Daroobalgie New Loop
- Wyndham Avenue (track lowering)

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

- 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 Structure Outline D H F2 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 the Olympic Highway Underbridge. Refer to Figure 1-1 indicating the site location. The background and previous studies for each site are listed below.



Figure 1-1: Site Boundary

1.3.1. Background

The Olympic Highway design package forms part of the Albury to Illabo (A2I) section of works, with the proposed track slews located approximately between Chainage (CH) 483.680km and CH484.840km to provide sufficient clearance for Inland Rail rollingstock. This package interfaces with the Junee Yard Clearances package J4 at CH484.850km.

This package includes the track, civil, geotechnical, structural and utilities design for the proposed track slews. Refer to Section 1.5 for the specific design discipline scope of works.

1.4. Objectives

This report has been prepared to support the delivery of the Olympic Highway Underbridge package and provide a flood impact assessment for the IFC stage. The flood assessment for the site aims to estimate the flood behaviour and assess the potential flood impacts as a result of the design. The assessment also includes a cumulative assessment of the works occurring within the Junee Station Yard (track slews) Package (J4) as these works occur in the same area of Junee.

This report should be read in conjunction with the IFC Design Report– Olympic Highway Underbridge – (5-0052-210-PEN-J6-RP-0001_0).

1.5. Scope

The scope of this study includes:

- Carrying out the flood assessment for the design in the IFC stage for design events of 5%, 2%, and 1% Annual Exceedance Probability (AEP) events, the 1% AEP with Climate Change applied, and the Probable Maximum Flood (PMF).
- Checking flood assessment results against the Conditions of Approval criteria and PSR technical requirements.
- Proposing any mitigation measures if required.

This IFC flood assessment is based on the latest Olympic Highway Underbridge design as documented in the IFC Design Report– Olympic Highway Underbridge – (5-0052-210-PEN-J6-RP-0001_C).

1.6. Previous Studies

1.6.1. Flood Studies

Table 1-1 summarises all the flood studies associated with the Junee area. Neither hydrologic nor hydraulic models from the flood study and floodplain risk management study and plan, were provided for this assessment.

Table 1-1: Summary of Previous Flood Studies

Item No.	Flood Study	Description
1	Lower Butlers Gully Flood Study (Lyll & 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 (Lyll & 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

A high-level assessment using the Council floods studies was undertaken for the Olympic Highway Underbridge site during Reference Design (by Others), as outlined in the following reports:

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

Regional flooding at the Olympic Highway Underbridge site was assessed against the Lower Butlers Gully Flood Study (Lyll and Associates, 2009). The flood study was undertaken for the Junee Shire Council. The findings of the Flood Study indicated that there is overland flooding adjacent to the rail corridor in the 1% and 5% AEP flood events, however the rail corridor and underbridge site are not impacted.

1.6.3. Detailed Design

Flooding assessment for the Olympic Highway Underbridge was included as a variation to the A2I Detailed Design works, as it was not originally included in the Reference Design stage. During tender, the draft EIS assessment and draft

Conditions of Approval were used to form the position that qualitative and drainage assessment only would be required for the site. However, upon CSSI project approval, the conditions of approval required quantitative assessment. Refer Section 1.6.4 below.

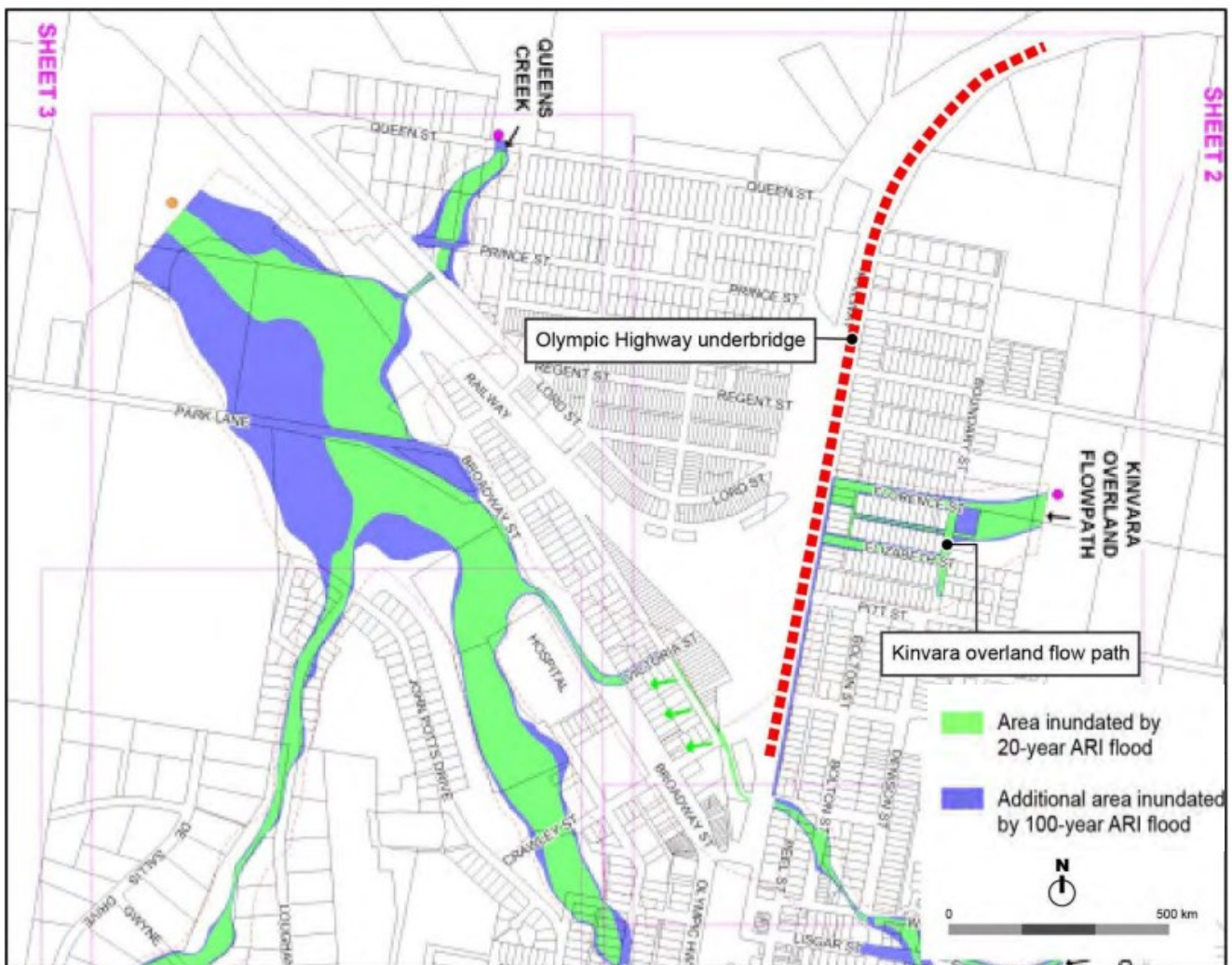
1.6.4. Environmental Impact Statement

The below document, produced by WSP for the Environment Impact Statement, has been used to inform the flood assessment:

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

A qualitative assessment of the Olympic Highway Underbridge works was undertaken in the EIS using the Lower Butlers Gully Flood Study (Lyll and Associates, 2009). This shows that the site is not affected by flooding by either Rock Creek or Lower Butlers Gully that are south of the site. Further, it said that the site is not located within an area affected by river flooding and a review of the flood data available shows that the site is not affected by overland flooding up to and including the 1 per cent AEP flood event.

As noted above in Section 1.6.3, the Olympic Highway Underbridge flooding assessment is a variation and was not originally included in the EIS.



Source: The Lower Butlers Gully flood study (Lyll & Associates, 2009)

Figure 1-2: 1% AEP and 5% AEP Flood Extents at Olympic Highway Underbridge (Image source: Albury to Illabo EIS Technical Paper 11 Figure 4.51 (July 2022))

1.7. Purpose and Requirements

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

A series of tasks and activities that the design development and design reporting processes need to address and include is described in the set of requirements within the Condition of Approval (CoA), PSR Annexure F, and Inland Rail’s Design Management Specification.

1.8. Information Documents

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

- Albury to Illabo (A2I) and Stockinbingal to Parkes (S2P) Projects Reference Design Report – Albury (WSP, June 2022), 2-0008-210-PEN-01-RP-0002
- Albury to Illabo Environmental Impact Statement (EIS) Technical Paper 11 – Hydrology, flooding and water quality (WSP, July 2022), 2-0008-210-EAP-00-RP-0010 (under 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
- Austrroads Guide to Bridge Technology – Part 8: Hydraulic Design of Waterway Structures
- Inland Rail Climate Change Risk Assessment Framework

1.9.1. Input Data

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

Table 1-2: Available Information

Item	Information	Type	Description / Comments
1	GIS files of the urban stormwater within Junee Shire Council.	GIS files	Received from Junee Shire Council on 01/12/2023.
2	A2P JNK EXT GDA20Z55 COMBINED	DEM, DWG	Survey of the rail corridor including drainage infrastructure within the project boundary area, received on 04/03/2025.
3	LiDAR 2015 and High-Resolution Aerial Imagery. The data derived points have an accuracy of 0.15m (68% confidence interval) ARTC LiDAR	TIF format in 1m resolution in GDA94	The existing 1m LiDAR (provided by ARTC) was received from Martinus on 12/11/2024.
4	LiDAR 2015 The data used to create this DEM has an accuracy of 0.9m (95% Confidence Interval) vertical and 1.25m (95% Confidence Interval) horizontal	TIF format in 5m resolution in GDA2020 projection	Downloaded from https://elevation.fsdf.org.au/ on 15/07/2024
5	Survey DTM 21 J6 ISV Survey DTM 21 J4 ISV	DEM	DEM surface survey of Olympic Highway Underbridge site area received from Martinus 04/04/2025
6	CAPPING 21 J6 CCW 1m.dem BALLAST TIN 21 J6 CCW 1m.dem COMBINED TIN 21 J6 CCW 1m.dem	DEM	DEM surface of Olympic Highway DDR design Ballast and Capping layers received from the DJV design team on 30/04/2025 This did not change for IFC stage.
7	5-0052-210-CAL-J6-MD-0001-OLYMPIC_HIGHWAY_3D_RAIL_DESIGN_STRING_DWG	DWG	DWG of IFC top of rail design strings. Received from DJV design team on 04/07/2025

1.10. Outputs

A list of prepared flood maps with the flood maps is included in Appendix A.

1.11. Limitations and Assumptions

The following limitations and assumptions apply to the flood assessment for this IFC stage.

- An assessment of temporary works and staging has not been undertaken.
- Details for the culvert under the rail outside the project boundary at CH 480+650km were not available either through the provided council GIS files or survey, so the details for the culvert were assumed. This existing culvert helps to convey flows to the north and therefore results in less flow within the rail corridor and so will not have a material negative impact on compliance.
- Flood immunity is in accordance with Clause 5.4.2 and Clause 5.4.3 of Annexure B of PSR (see Table 2-1).
- Blockage assessment is carried out for the 1% AEP design scenario as per the guidance set out in ARR2019 for the culverts within the project boundary, while 20% blockage is adopted for all the other culverts, pits and pipes outside the project boundary.

2. COMPLIANCE WITH REQUIREMENTS

2.1. Project Scope and Requirements

The preliminary design has been assessed to check if it meets the Project Scope and Requirements (PSRs). This is demonstrated throughout the flood assessment with Table 2-1 below summarising the Olympic Highway Underbridge - Design Compliance with the PSRs.

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

Requirement	Identifier	A2P Technical Requirements Description	Compliance Evidence Reference
Project Wide	5.4.10	Without limiting the environmental management requirements in Annexure F, section 6.1.1, all D&C Works in watercourses shall comply with the NSW Department of Primary Industries Standards: Policy and Guidelines for Fish Friendly Waterway Crossings; Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings; and Policy and Guidelines for Fish Habitat Conservation and Management Update.	N/A (structure modifications do not affect any watercourses)
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 rail immunity is less than 5% in both existing and design conditions. 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 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 as there is no bridge design
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.	Compliant Climate change assessment was carried out by using RCP 8.5 Year 2090, Refer 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.	Compliant 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.	N/A, there is no track lowering as part of this package Refer to Section 5.3

Requirement	Identifier	A2P Technical Requirements Description	Compliance Evidence Reference
A2I Technical Requirements*	IR-SR-A2I-352	The Corridor System shall prevent damage of the formation due to ponding of water.	Compliant. No damage to the formation due to ponding of water. Existing condition is maintained Refer to Section 5.4
A2I Technical Requirements*	IR-SR-A2I-458	The Corridor System shall prevent ponding in longitudinal open channels.	Compliant. Existing condition is 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.	Compliant Refer Section 5.4.1.
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.	Compliant Refer Section 5.4.1
A2I Technical Requirements*	IR-SR-A2I-465	The Corridor System shall minimise changes to the existing or natural flow patterns.	Compliant Refer Section 5.4.1
A2I Technical Requirements*	IR-SR-A2I-541	The Structures System's new underbridges shall withstand the 0.05% annual exceedance probability design flood event.	N/A as there is no new underbridge design
A2I Technical Requirements*	IR-SR-A2I-735	The Third-Party System private roads shall have flood immunity no worse than existing.	Compliant Refer Section 5.4.1
A2I (Annexure F)	6.1.1	Without limiting clauses 8 and 14 of the Deed, the Contractor shall ensure that the Contractor's Activities and the Works comply with the following for A2I, the Conditions of Approval and the environmental assessment reports available on: https://www.planningportal.nsw.gov.au/major-projects/projects/inland-rail-albury-illabo "	Refer to Table 2-2

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 Table 2-2 below.

Table 2-2: Conditions of Approval Compliance Table

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 river banks or watercourses.	N/A - no natural watercourses within the scope of works

Condition	Condition or Criteria	Compliance Evidence Reference
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 5.4
E40	Updated flood modelling of the project's detailed design must be undertaken for the full range of flood events, including blockage of culverts and flowpaths, considered in the documents listed in Condition A1 . This modelling must include:	Compliant Refer to Sections 4 and 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 for the methodology that shows that ARR2019 guidelines were used for this assessment.
E40	b) Use of modelling software appropriate to the relevant modelling task;	Compliant. Section 4 shows that the appropriate software (TUFLOW) was used
E40	c) Field survey of the existing rail formation and rail levels, should be included within the models; and	Compliant. Section 1.9.1 shows that existing field survey and rail levels were used in the models
E40	d) Confirmation of predicted afflux at industrial properties adjacent to Railway Street, Wagga Wagga based on field survey.	N/A – Railway Street in Wagga Wagga is not relevant to this site.
E40	Updated flood modelling must be made publicly available in accordance with Condition B18 .	Flood design report and independent review of flood design report shall be provided to IR, through this submission, for IR to upload on the IR website, as per CoA B18 responsibility allocation.
E41	The Proponent's response to the requirements of Conditions 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, who satisfies and complies with the requirements of A16. Consultation with Council will be undertaken through a formal review of this Flood Design Report. Consultation with other stakeholders will occur prior to finalisation of the report. This is shown in Appendices C, D and E.

Condition	Condition or Criteria	Compliance Evidence Reference
E42	The CSSI must be designed and constructed to limit impacts on flooding characteristics in areas outside the project boundary during any flood event up to and including the 1% AEP flood event, to the following:	See E42 items below
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 10mm in above-floor inundation to habitable rooms where floor levels are currently exceeded;	Compliant Refer Section 5.4.1
E42	(c) no above-floor inundation of habitable rooms which are currently not inundated;	Compliant Refer Section 5.4.1
E42	(d) a maximum increase of 50 mm in inundation of land zoned as residential, industrial or commercial;	Compliant Refer Section 5.4.1
E42	(e) a maximum increase of 100 mm in inundation of land zoned as environment zone or public recreation;	Compliant. No increases of more than 100mm on land zoned as environment or public recreation Refer Section 5.4.1
E42	(f) a maximum increase of 200 mm in inundation of land zoned as rural or primary production, environment zone or public recreation;	Compliant. No increases of more than 200mm on land zoned as rural or primary production. Refer Section 5.4.1
E42	(g) no increase in the flood hazard category or risk to life; and	Compliant Refer 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 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.	N/A
E43	A Flood Design Report confirming the:	
E43	a) final design of the CSSI meets the requirements of Condition E42; and	Compliant
E43	b) the results of consultation with the relevant council in accordance with Condition E46	Refer to E46 below
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	This report will be submitted to the Planning Secretary for approval prior to

Condition	Condition or Criteria	Compliance Evidence Reference
	works that may impact on flooding or the relevant council's stormwater network.	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, in order to assist in preparing relevant documents and to reflect changes in flood behaviour as a result of the CSSI in accordance with the requirements of CoA E45
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 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 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-J6-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 Table 2-3 below.

Table 2-3: Updated Mitigation Measures Compliance Table - Flooding

Condition	Condition or Criteria	Compliance Evidence Reference
HFQ3	Further consultation will be undertaken with local councils and other relevant authorities to identify opportunities to coordinate the proposal with flood mitigation works committed to as part of the council's flood management plans, or other strategies.	Consultation with Council and other relevant authorities has been undertaken through a formal review of this Flood Design Report.
HFQ4	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	This report relates to the Olympic Highway Underbridge site, and so is not relevant to Wagga Wagga Yard.

Condition	Condition or Criteria	Compliance Evidence Reference
	<p>Street and compliance with the Quantitative Design Limits for Inland Rail.</p> <p>This would be informed by topographic and building floor surveys and a review of localised drainage structures (as required).</p> <p>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</p>	<p>Compliant. Refer to Section 5.</p>
HFWQ5	<p>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.</p>	<p>This report relates to the Olympic Highway Underbridge Site and so is not relevant to the Riverina Highway track lowering site.</p>

* 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.

Table 3-1: Design Differences between Concept Design and SDR

Item	Difference	Reason for Change
N/A	N/A	N/A

3.2. SDR to PDR

Flood modelling was not applicable to this stage

Table 3-2: Design Differences Between SDR and PDR

Item	Difference	Reason for Difference
N/A	N/A	N/A

3.3. PDR to DDR

Table 3-3: Design Differences Between PDR and DDR

Item	Difference	Reason for Difference
1	DJV created a new TUFLOW hydraulic model to model the area of interest and proposed design	No TUFLOW hydraulic model was available for the PDR stage or earlier.

3.4. DDR to IFC

Table 3-4: Design Differences Between DDR and IFC

Item	Difference	Reason for Difference
1	Update Flood Model to include IFC Track design	To undertake an assessment for IFC design
2	Update Flood Model to include existing culvert at CH 483 + 660km	To address Proof Engineer review comments
3	Update Flood Model to include shift in location of the inflow boundary and flood model extent at the eastern edge of the flood model east of Boundary Street (between around CH484+450km and CH485+000km)	To better represent the inflow with respect to topography and delineation of the relevant sub catchment and to keep consistency with other sites within Junee town (Junee Yard and Kemp Street) for the combined flood model.

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 (for both Lower Buttlers Creek/Rock Creek and the Northern catchment) were compared against the Regional Flood Frequency Estimation (RFFE) Model to validate the runoff routing models. There is no stream level gauge within the catchments 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.
- The flood impact assessment carried out included a cumulative assessment including the design works for Olympic Highway Underbridge as well as the Junee Station Yard (track slews) IFC package as these works occur in the same area of Junee. Refer to the IFC Flood Design Report - Junee Yard (5-0052-210-IHY-J4-RP-0001_0) for the IFC design for these packages.
- The TUFLOW model was updated from the existing conditions to the design condition model by incorporating the proposed Olympic Highway Underbridge track and civil design into the existing model as well as the designs associated with Junee Station Yard.
- The flood impact was assessed up to the 1% AEP and the flood results are shown within this report.
- A climate change sensitivity assessment was conducted for the 1% AEP to inform the potential impact on the railway track flood immunity.
- Conducting a blockage assessment on hydraulic structures as per ARR2019 procedures for the 1% AEP event design scenario to inform the potential impact on the railway track flood immunity

4.1. Hydrology Modelling

4.1.1. RORB Modelling

Two separate RORB models were developed to generate the flow hydrographs for input to the hydraulic model. The hydrology models cover the Lower Buttlers Gully catchment, Rock Creek catchment, the town of Junee, as well as the catchment to the north of Junee town. A figure of the catchment layouts of the hydrology model can be seen in Figure 4-1. The RORB model was developed with catchment characteristics derived from LiDAR and aerial imagery, following ARR2019 guidelines. Table 4-1 lists the parameters used within the model.

Table 4-1: RORB Parameters

Parameters	Adopted Hydrology Model
Hydrology model and version	RORBwin (Version 6.31) using Storm injector HL(V 1.3.9.0).
Events	PMP, 1% AEP + Climate Change, 1%AEP, 2% AEP, 5% AEP
Total catchment area to Project Boundary	Lower Buttlers Creek - 16.245 km ² Northern Catchment – 6.473 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 (GDSM) Method.
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% and 1% Climate Change events. The 10 Jordan and 1 BoM (total 11) temporal patterns from 15 minutes to 180 minutes were used for the PMF.

Parameters	Adopted Hydrology Model
Climate Change Factors	A Climate Change factor of 20.2% was applied from the representative concentration pathway (RCP) 8.5, the Year 2090. See Section 4.1.3.
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. Imperious 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 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	Lower Buttlers Creek – 4.43 Northern Catchment – 2.79
m	0.8

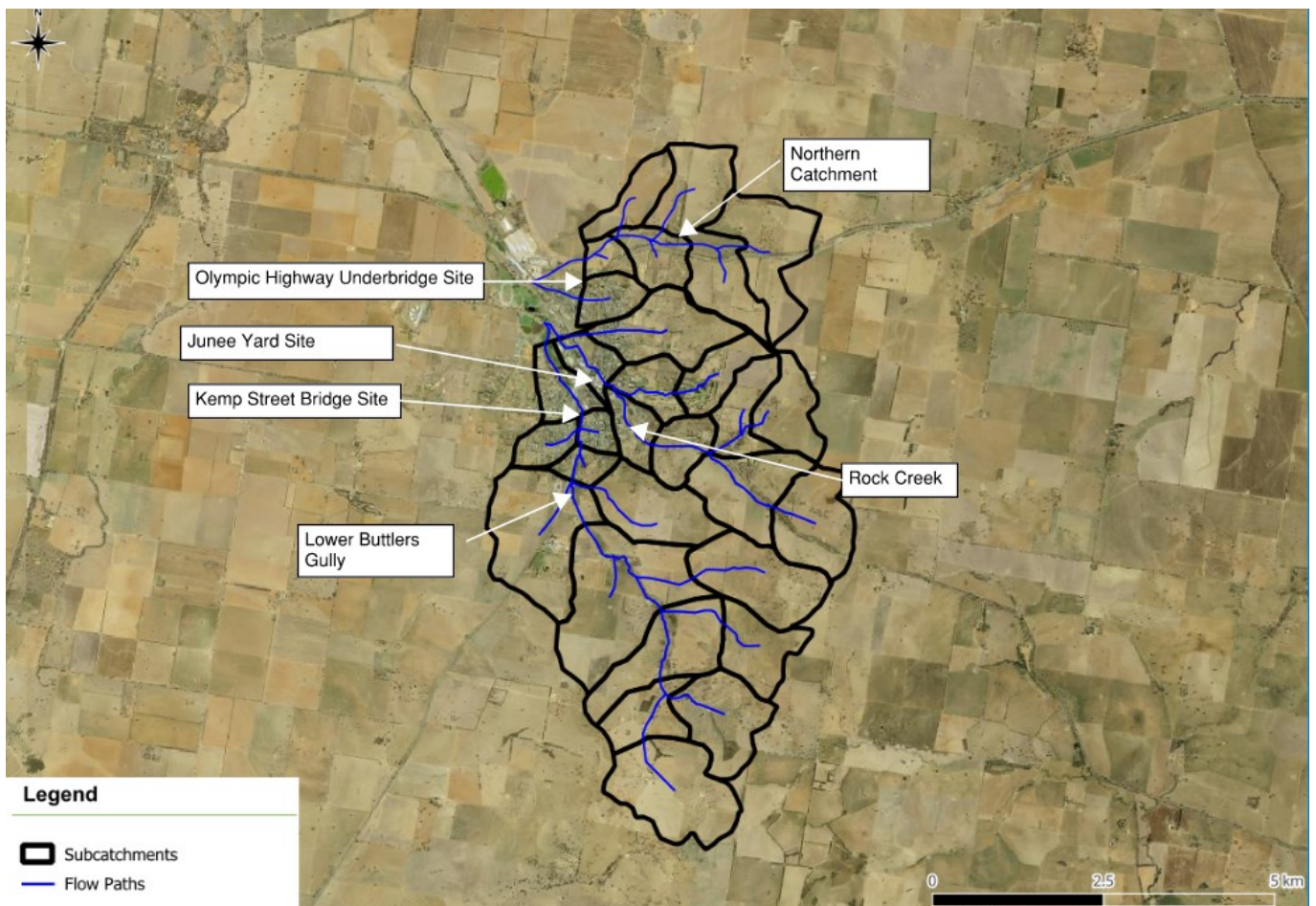


Figure 4-1: Hydrologic Model Sub-Catchment Extents (Combined Model)

Storm Injector HL (V 1.3.9.0) 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 events and PMP (Probable Maximum Precipitation). The critical durations and temporal patterns are listed in Table 4-2.

Table 4-2: Critical Storms and Peak Flows

Event	Duration	Temporal Pattern
5% AEP	30min,90min,120min	All 10 temporal patterns for each duration
2% AEP	30min,90min,120min	All 10 temporal patterns for each duration
1% AEP	30min,60min,90min	All 10 temporal patterns for each duration
1% AEP + Climate Change	30min,60min,90min	All 10 temporal patterns for each duration
PMF	15min,60min	All 11 temporal patterns for each duration

4.1.2. RFFE Flow Comparison

RFFE flow estimates were undertaken for both the Lower Butlers Creek catchment and the Northern catchment to validate the flows generated from the RORB hydrologic modelling analysis. The RFFE model 2021 version 2 was used for this estimation. Specifically, a comparison was undertaken by changing the Kc routing parameter by utilising 4 separate equations that are used to derive this parameter Table 4-4 compares the flows from the RFFE and RORB modelling.

Table 4-3: Kc Parameter Comparison – Lower Butlers Creek

Kc Value	Equation
4.43	ARR2019 Equation 7.6.13
9.27	RORB manual, equation 2.5
6.03	Dyer (1994, Pearse et. al. 2002)
5.07	Yu (1989, Pearse et. al. 2002)

Table 4-4: Flow Comparison – RORB vs RFFE – Lower Butlers Creek

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)
5%	29.8	41.6	22.9	32.5	37.1
2%	49.4	57.9	31.8	45.4	52.3
1%	67.3	70.4	41.7	57.7	61.4

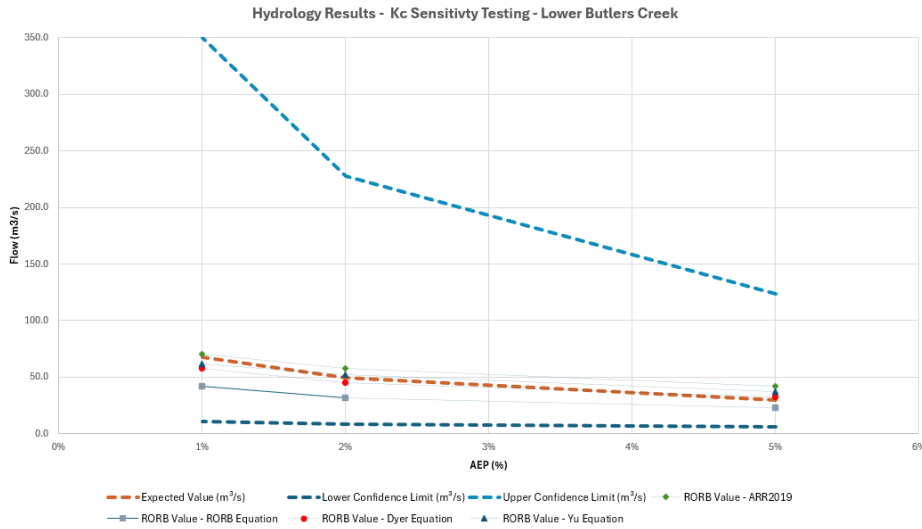


Figure 4-2: Kc Sensitivity Testing – Lower Butlers Creek

For the Lower Butlers Creek catchment model, the Kc parameter derived through the ARR2019 equation 7.6.13 was used as it gave the most reasonable fit when compared to the RFFE generated flows as shown in the above tables and figures.

Table 4-5: Kc Parameter Comparison – Northern Catchment

Kc Value	Equation
2.78	ARR2019 Equation 7.6.13
5.59	RORB manual, equation 2.5
1.67	Dyer (1994, Pearse et. al. 2002)
1.40	Yu (1989, Pearse et. al. 2002)

Table 4-6: Flow Comparison – RORB vs RFFE – Northern Catchment

AEP (%)	RFFE Expected Value (m³/s)	ARR2019 Equation 7.6.13 (m³/s)	RORB manual, equation 2.5(m³/s)	Dyer (1994, Pearse et. al. 2002) (m³/s)	Yu (1989, Pearse et. al. 2002) (m³/s)
5%	9	23	12	36	39
2%	14	28	17	41	47
1%	17	34	21	51	58

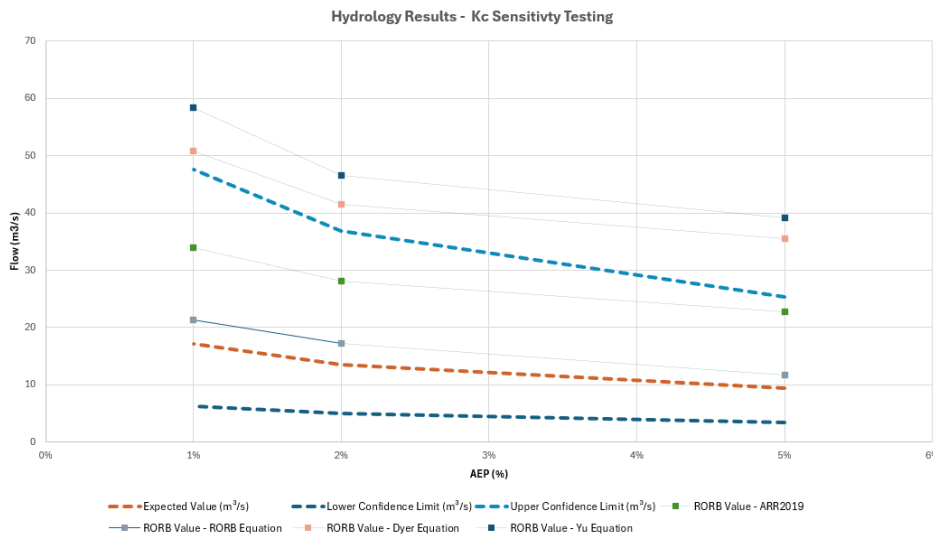


Figure 4-3: Kc Sensitivity Testing – Northern Catchment

For the Northern catchment model, the Kc parameter derived through the RORB Manual equation 2.5 was used as it gave the most reasonable fit when compared to the RFFE generated flows as shown in the above tables and figures

4.1.3. 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 (Refer to Section 1.11 for assumptions). 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.

As per the EIS report (Section 3.3.5 of Albury to Illabo Environmental Impact Statement Technical Paper 11), the Year 2090 RCP8.5 interim climate change factor sourced from the ARR Data Hub (<https://data.arr-software.org/>) and the associated 20.2% increase in rainfall was adopted.

4.2. Hydraulic Modelling

4.2.1. Existing Model

No existing model was available as part of the assessment, therefore a TUFLOW model for Junee was created that includes the site areas for Olympic Highway Underbridge and Junee Yard. A summary of the model parameters can be found in Table 4-7. The model extent encompasses Rock Creek, Lower Butlers Gully, as well as the northern part of Junee town, spanning an area of approximately 2.75 km². Refer to **Figure 4-4**.

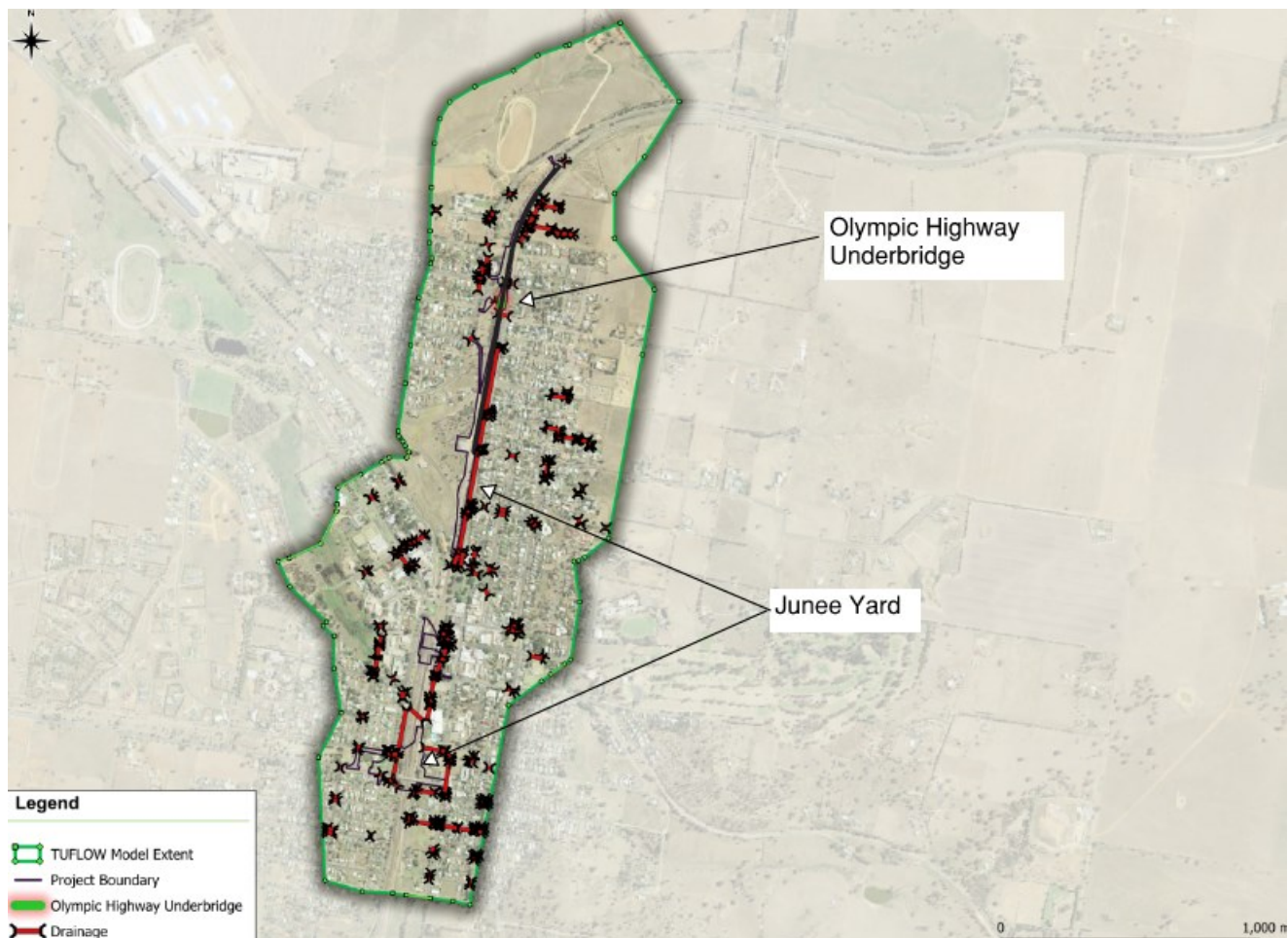


Figure 4-4: TUFLOW Model Extent – Junee Combined Model

Table 4-7: Model Parameters in the TUFLOW Model

Parameters	TUFLOW Model
Build	TUFLOW 2023-03-AE HPC
Coordination System (CRS) Reference	GDA2020 MGA 55
Grid Size	1 m within the quadtree area (around major drains and project boundaries) and 2m outside of the quadtree area
Hydrology	RORB ARR2019 derived inflows
Inflow type	2D Boundary for mainstream inflows for Rock Creek and Lower Butlers Gully, 2D SA RF layers for local catchment inflows applied within the major flow paths.
Extent	Central Junee, both Rock Creek and Lower Butlers Gully flow paths cover the Junee rail yard area.
Downstream Boundary	Water level (head) versus flow taken from the slope of the terrain.
Timestep	Dynamic
Building Representation	Null polygon
Topography	<ul style="list-style-type: none"> ▪ 1m resolution LiDAR collected in 2015 as described in Section 1.9.1. ▪ Site survey and verified cloud point data A figure of the survey extent can be seen in Figure 4-5.
Roughness	Roads: 0.022 Railway: 0.06 Residential: 0.05 Open Pervious Areas (Parks): 0.05 Design Bridge Piers: 0.1
1D Network (Stormwater Infrastructure)	The drainage infrastructure along the Rock Creek and Upper Gully within Junee were surveyed to provide the dimensions and invert levels, for other infrastructure culvert sizes were taken from the supplied drainage infrastructure layer from Junee Shire Council. Culvert inverts were not supplied as part of the data from Junee Shire Council and were taken from the 1m LiDAR.
Bridges	Bridge decks, piers and handrails were modelled as 2d_lfcsh layers.
Design Events	PMF, 1% AEP + Climate Change, 1% AEP, 2% AEP, 5% AEP

4.2.2. Topography

The model topography was updated by incorporating the 2020 LiDAR into site areas. The adopted survey extents are shown in Figure 4-5, all other model areas outside of the survey extent were filled with 1m LiDAR.

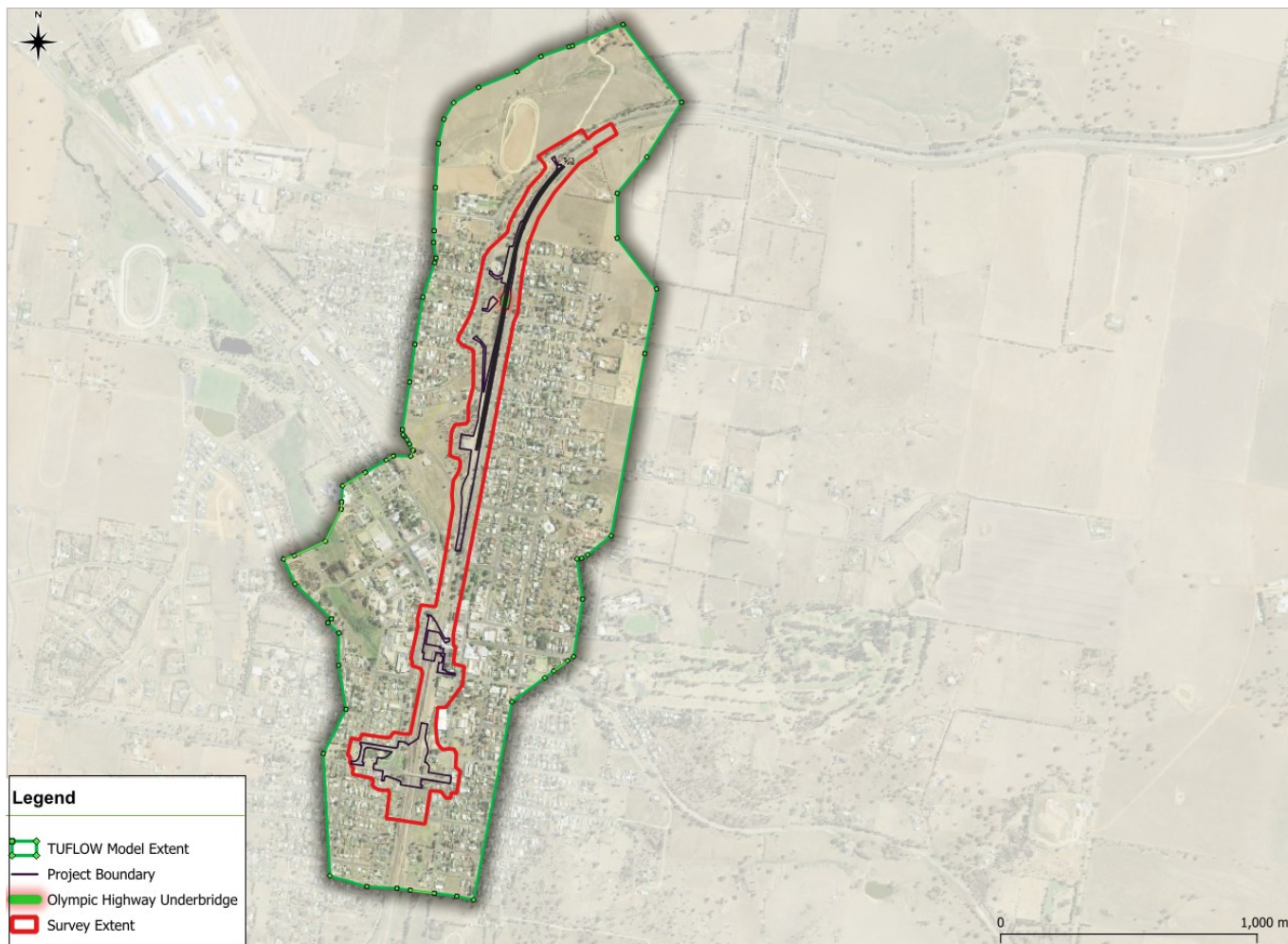


Figure 4-5: Survey Extent

4.2.3. Drainage Network

The drainage network was modelled as per the drainage survey, as well as the provided Junee Shire Council GIS file received on 01/12/2023 as per Table 1-2.

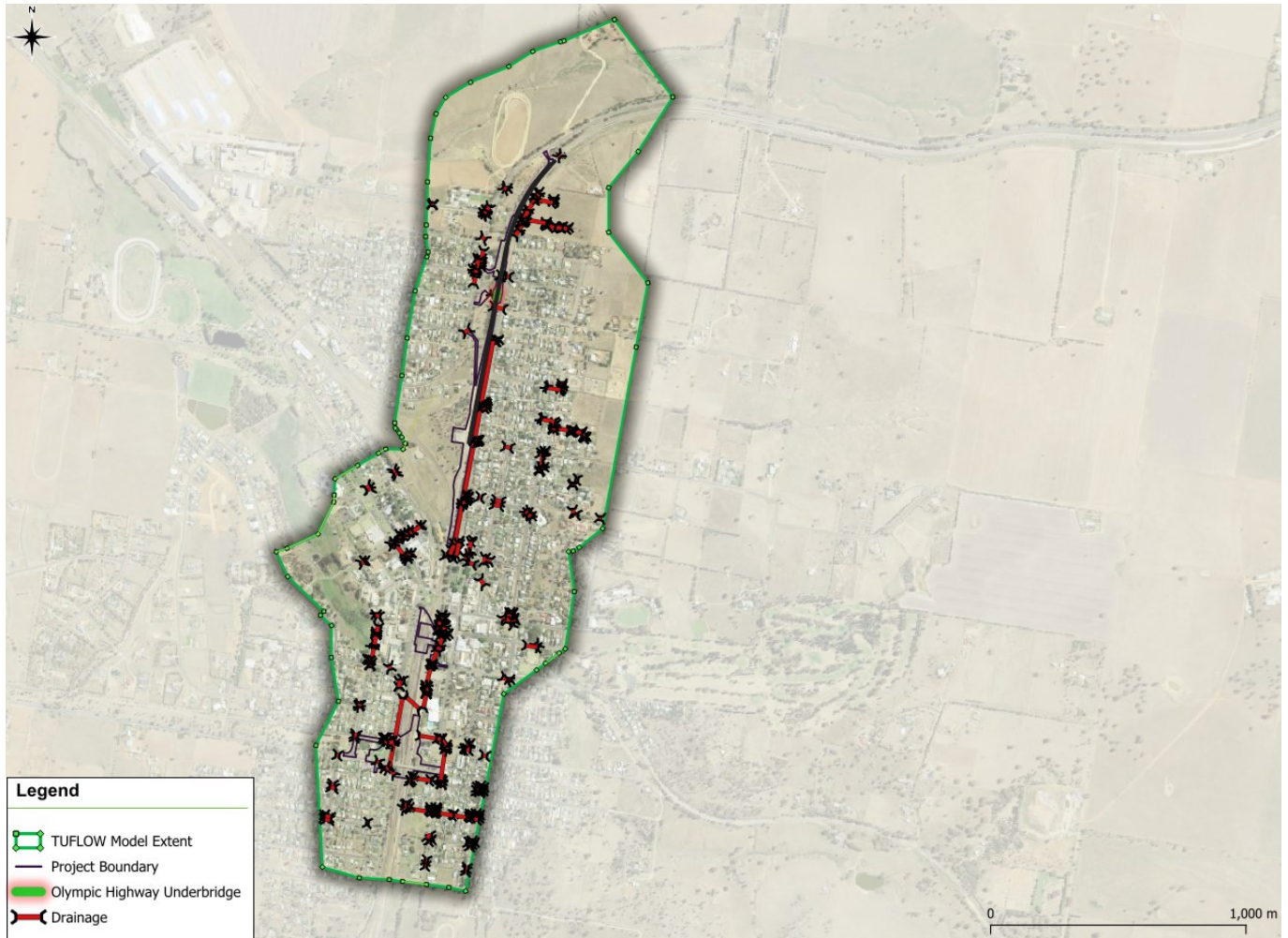


Figure 4-6: Drainage Infrastructure within TUFLOW Model

4.2.4. Design Model Update

The design model was updated from the existing condition by incorporating the Olympic Highway Underbridge works as part of the IFC stage, as shown in Table 1-2. A figure of the extent of these works is shown in Figure 4-7.

- Track design from Olympic Highway Underbridge Site
- Civil design from Olympic Highway Underbridge Site
- Track design from Junee Yard IFC

As previously indicated within this report, this flood assessment is based on the IFC design for Olympic Highway Underbridge which is the focus of this package, but has also included the relevant IFC designs from the Junee Yard package for the purposes of a cumulative assessment (refer to Section 5.4.5 for the results).

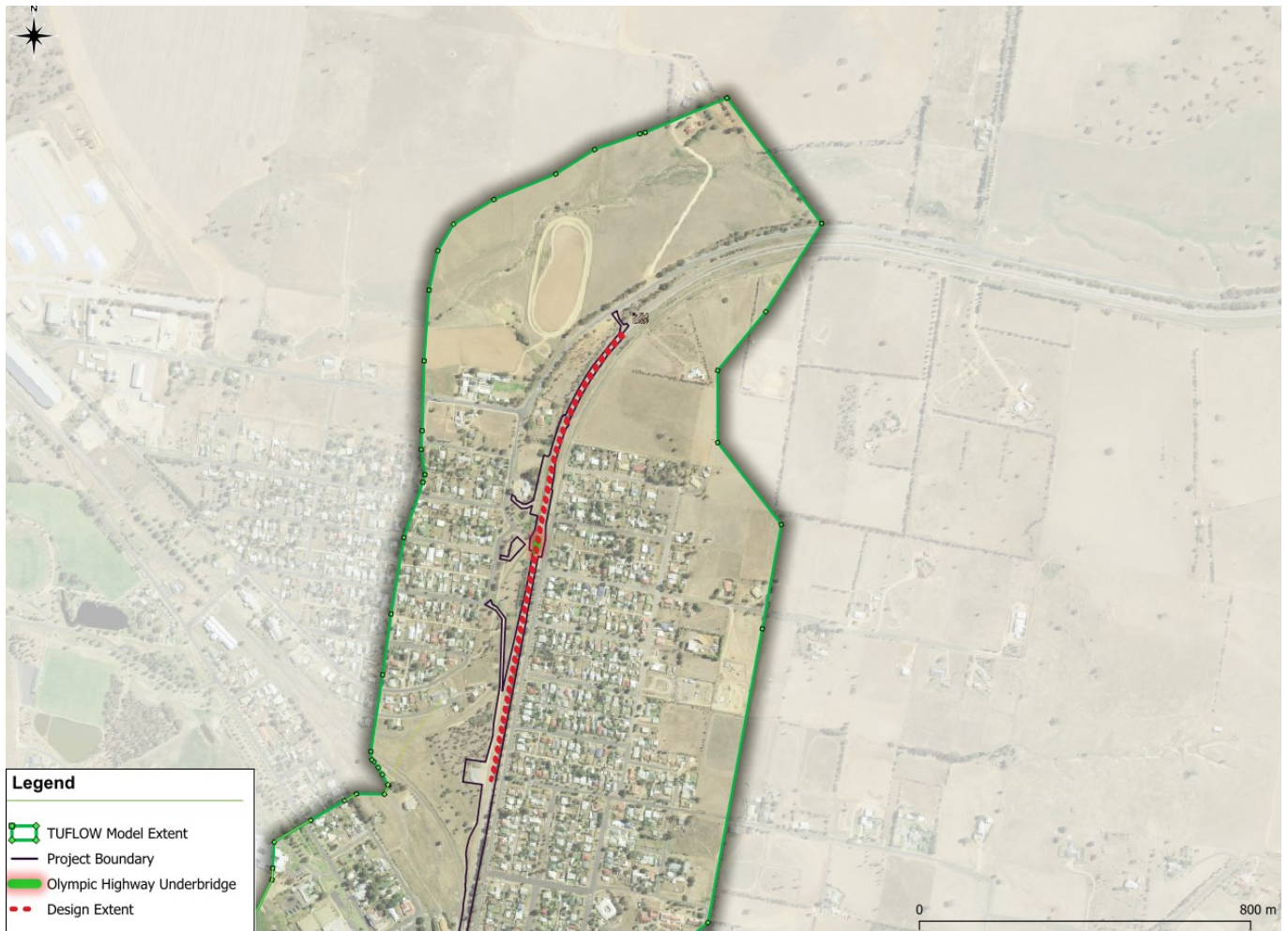


Figure 4-7: Extent of Olympic Highway Design Works

4.3. Hydraulic Model Comparison

The hydraulic model from The Lower Butlers Gully Flood Study (Lyal & 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 and used a HEC-RAS 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.

Results at a location were compared for the Lower Butlers Gully in the rail channel opposite Elizabeth 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. The results are compared in Table 4-8 below, the comparison points are seen in Figure 4-8.

There is a difference in the hydraulic model results between this assessment and the Lower Butlers Gully Flood Study - this is due to various possible reasons such as:

- The hydraulic modelling approach as the HEC-RAS model conveys flow more efficiently in the 1D system generated by a series of cross sections.
- In TUFLOW it uses a grid approach that takes into account hydraulic structures through 1D/2D connections.
- There is variability in the TUFLOW model in the flow paths through other differences in the terrain such as buildings and greater definition to the model roughness (Mannings N).
- The TUFLOW model uses different terrain with more recent survey of the area that is being compared.
- Different hydrological inflows are being used within each model.

Table 4-8 Hydraulic Model Comparison

AEP Event	Flood Level in the Channel opposite Elizabeth Street (mAHD)	
	Lower Butlers Gully Flood Study	IFC Assessment
1% AEP	305.87	305.89
5% AEP	305.58	305.80



Figure 4-8: Comparison Location (Figure 6.6 Lower Butlers Gully Flood Study)

4.4. Design Events

The TUFLOW hydraulic model was run for the 5%, 2%, and 1% AEP design events, 1% AEP + Climate Change and PMF. The TUFLOW model was run for the critical durations found from the RORB analysis described in Section 4.1.1, all temporal patterns for each design event were run in the TUFLOW model as per Table 4-9.

Table 4-9: TUFLOW Modelled Durations and Temporal Patterns

Design Events	Critical Durations	Adopted Temporal Pattern ID
5% AEP	30min/90min/120min	All 10 Temporal Patterns
2% AEP	30min/90min/120min	All 10 Temporal Patterns
1% AEP	30min/60min/90min	All 10 Temporal Patterns
0.05% AEP	30min/60min	All 10 Temporal Patterns
1% AEP + Climate Change	30min/60min/90min	All 10 Temporal Patterns
PMF	15min/90min (GSDM)	All 11 Temporal Patterns

5. FLOOD ASSESSMENT

5.1. Existing Conditions

Flood maps for the existing conditions including flood depths, velocities, and hazard for all modelled events are provided in Appendix A. In the existing scenario, there are three main flow paths that interact with the Olympic Highway site. Firstly, the water from the northern catchment flows west and overtops the rail from around Chainage 477 +700km and both flows further west towards the Olympic highway and between the tracks further to the south. The second flow path is upstream of Chainage 483 + 350km where water flow west towards the site and the underbridge location. Finally, further south, there is another local catchment overland flow path where the water flows west towards the rail around Chainage 484 + 800km.

Figure 5-1 shows the 1% AEP event in the existing scenario, in addition to the reporting locations used in the sections below.

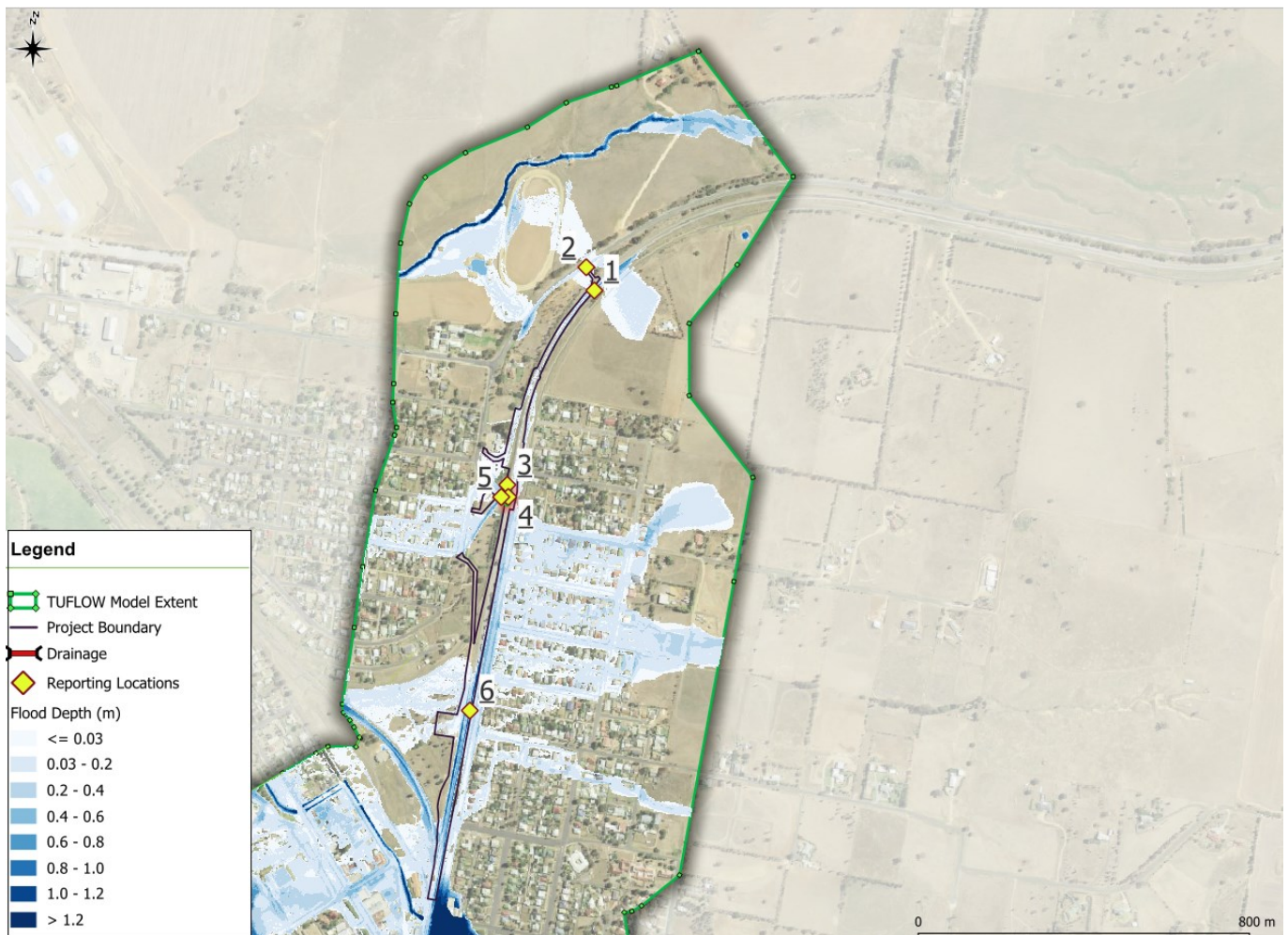


Figure 5-1: Existing Conditions Flood Extent – 1% AEP Event

The key points of interest as indicated in Figure 5-1, are described in Table 5-1 below.

Table 5-1: Points of Interest

Point of Interest	Notes
1	In channel upstream of the rail at CH 483+700km
2	In channel downstream of the rail at CH 483+700km
3	Downstream of rail near Olympic Highway Underbridge at CH 482+225km
4	Olympic Highway Underbridge underpass at CH 482 + 250km

Point of Interest	Notes
5	Natural channel downstream of Olympic Highway Underbridge at CH 482+250km
6	In channel upstream of the rail at CH 484+400km

The existing condition of the flood behaviour is discussed in Table 5-2 to Table 5-5.

Table 5-2: Rail Immunity – Existing Conditions

Design Event	Flood Levels
5% AEP	<ul style="list-style-type: none"> The floodwaters overtop the Main rail line between CH483+700km to CH483+800km, at CH 484+000km and from CH 484 +700km to CH485 + 260km
2% AEP	
1% AEP	
1% AEP + Climate Change	<ul style="list-style-type: none"> The floodwaters overtop the Main rail line between CH483+700km to CH483+850km, at CH 484+000km and from CH 484 +700km to CH485 + 260km
PMF	<ul style="list-style-type: none"> The floodwaters overtop the Main rail line between CH483+700km to CH483+850km, at CH 483+450km, and from CH 484 +600km to CH485 + 260km

Table 5-3: Points of Interest Data – Peak Flood Levels (mAHD) – Existing Conditions

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	319.46	319.53	319.56	319.56	319.62
Point 2	315.16	315.16	315.16	315.21	315.46
Point 3	Dry	Dry	Dry	Dry	Dry
Point 4	306.05	306.07	306.11	306.15	306.59
Point 5	305.52	305.55	305.60	305.62	306.04
Point 6	305.10	305.15	305.22	305.30	306.18

Table 5-4 shows the flood velocities at the Points of Interest below. The highest velocities occur near Point 4, where the flow path converges as it travels under the rail bridge at Olympic Highway while the velocities at the other locations are under 2m/s in all events.

Table 5-4: Points of Interest Data – Peak Flood Velocity (m/s) – Existing Conditions

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	0.6	0.7	0.7	0.8	1.2
Point 2	1.2	1.2	1.2	1.2	1.4
Point 3	Dry	Dry	Dry	Dry	Dry
Point 4	2.0	2.1	2.2	2.4	4.0
Point 5	0.9	0.9	0.9	0.9	1.8
Point 6	1.3	1.3	1.3	1.4	2.0

The flood hazard assessment is based on the general flood hazard classification set by the Australian Institute for Disaster Resilience in Australian Disaster Resilience Handbook Collection - Flood Hazard, 2017. This is the flood hazard classification specified in ARR2019. The Figure 5-2 demonstrates the flood hazard classification, the flood hazard experienced at the site is described below.

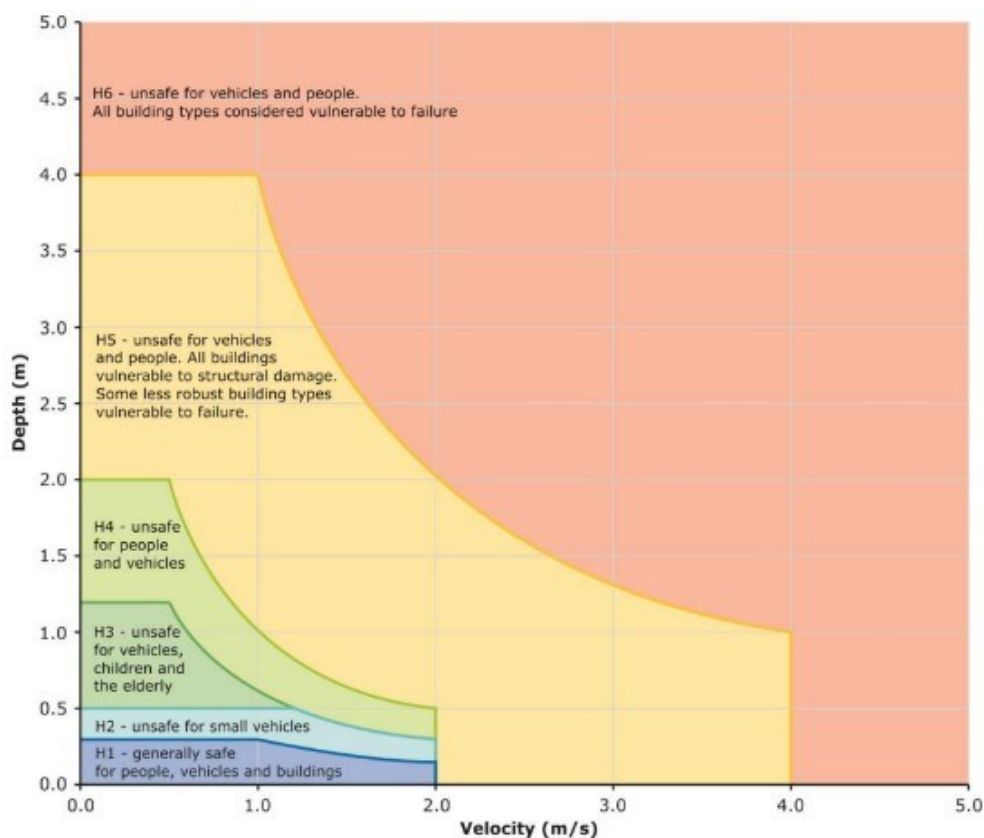


Figure 5-2: Hazard Category Classification

Table 5-5 shows the flood hazard at the points of interest within the model. As flood hazard is a product of velocity and depth, the highest areas of flood hazard are at Point 4 due to the high flow velocity and depth under the bridge. Points 1, 5 and Point 6 also have high flood hazard due to the depth of water at these locations.

As the flood hazard at point 4 on Olympic Highway is H5, and above for all flood events in both existing and design conditions, which is unsafe for vehicles and people, it is recommended that there be appropriate flood warnings and signage placed in the area.

Table 5-5: Points of Interest Data – Peak Flood Hazard Category – Existing Conditions

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	H3	H3	H3	H3	H4
Point 2	H1	H1	H1	H1	H2
Point 3	Dry	Dry	Dry	Dry	Dry
Point 4	H3	H5	H5	H5	H6
Point 5	H3	H3	H3	H3	H5
Point 6	H5	H5	H5	H5	H5

5.2. Design Conditions

The Design condition’s hydraulic modelling incorporated, proposed changes to the Olympic Highway Underbridge design and the Junee Yard track slews.

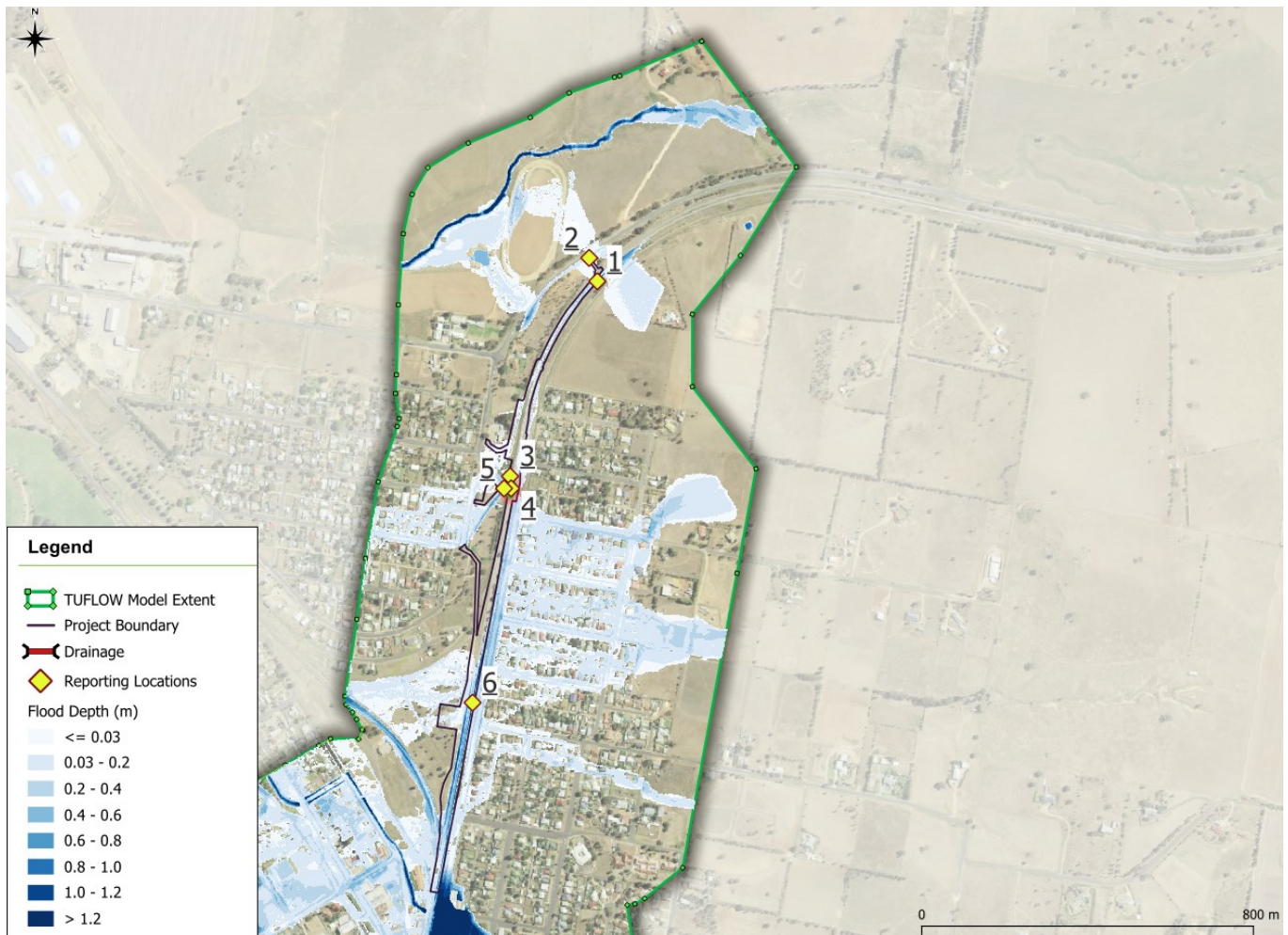


Figure 5-3: Design Conditions Flood Extent – 1% AEP Event

The design conditions for flooding behaviour are discussed in the Table 5-6, Table 5-7, Table 5-8 and Table 5-9 below. The rail immunity in the design conditions, is similar to those of the existing conditions, with no changes to the rail immunity with the sections of the rail being overtopped in the 5% AEP event in both existing and design conditions. This is indicated in Table 5-6.

Table 5-6: Rail Immunity – Design Conditions

Design Event	Flood Levels
5% AEP	<ul style="list-style-type: none"> The floodwaters overtop the Main rail line between CH483+700km to CH483+850km, at CH 483+950km and from CH 484 +700km to CH484 + 900km
2% AEP	
1% AEP	
1% AEP + Climate Change	<ul style="list-style-type: none"> The floodwaters overtop the Main rail line between CH483+700km to CH483+850km, at CH 483+950km and from CH 484 +675km to CH484 + 950km
PMF	<ul style="list-style-type: none"> The floodwaters overtop the Main rail line between CH483+700km to CH483+850km, at CH 483+950km and from CH 484 +575km to CH485 + 260km

Table 5-7 shows the flood depths for the points of interest locations in the design conditions. The flood behaviour in the existing conditions is largely similar to the design conditions with the same flow paths from the various catchments flowing west to the site area. However, due to the track design where the rail is raised at certain points, especially around CH483 + 700km, there is less flow travelling over the top of the rail west towards Olympic Highway and hence more flow towards

the south between the rail lines. This results in additional overtopping locations closer towards the underbridge between CH484+100km and CH484+250km in all events.

Table 5-7: Points of Interest Data – Peak Flood Levels (mAHD) – Design Conditions

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	319.47	319.55	319.57	319.58	319.64
Point 2	315.16	315.16	315.16	315.21	315.46
Point 3	Dry	Dry	Dry	309.84	309.84
Point 4	306.05	306.07	306.11	306.15	306.59
Point 5	305.52	305.55	305.59	305.62	306.04
Point 6	305.12	305.17	305.24	305.33	306.21

Table 5-7 shows the flood velocities for the points of interest locations in the design conditions. The flood velocities in the existing conditions are largely similar in the design conditions. The newly wet areas all have velocities of generally less than 1m/s. The highest velocities occur near Point, 4 where the flow path converges as it travels under the rail bridge at Olympic Highway while the velocities at the other locations are under 2m/s in all events.

Table 5-8: Points of Interest Data – Peak Flood Velocities (m/s) – Design Conditions

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	0.6	0.7	0.7	0.8	1.2
Point 2	1.2	1.2	1.2	1.2	1.4
Point 3	Dry	Dry	Dry	0.1	0.1
Point 4	2.0	2.1	2.2	2.4	4.0
Point 5	0.9	0.9	0.9	0.9	1.8
Point 6	1.3	1.3	1.3	1.4	2.0

Table 5-9 shows the flood hazard in the design conditions at the points of interest locations. Flood hazard is generally similar between the existing and design conditions. As flood hazard is a product of velocity and depth, the highest areas of flood hazard are at Point 4 due to the high flow velocity and depth under the bridge. Points 1, 5 and Point 6 also have high flood hazard due to the depth of water at these locations.

Table 5-9: Points of Interest Data – Peak Flood Hazard Category– Design Conditions

Locations	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	H3	H3	H3	H3	H4
Point 2	H1	H1	H1	H1	H2
Point 3	Dry	Dry	H1	H1	H1
Point 4	H3	H5	H5	H5	H6
Point 5	H3	H3	H3	H3	H5
Point 6	H5	H5	H5	H5	H5

5.3. Flood Immunity and Scour Protection

As discussed in Table 5-2 and Table 5-6 the Main Line track is flooded in the smallest modelled flood event (the 5% AEP event) in both existing and design conditions. The depth of overtopping is reduced to the north around Chainage 483+700km where less flow travels towards the north-west.

Table 5-10: Overtopping Details at CH483 + 690km and CH484+850km

Chainage	Top of the Rail Level (mAHD)		Top of the Formation Level (mAHD)		5% AEP Flood Level (mAHD)		2% AEP Flood Level (mAHD)		1% AEP Flood Level (mAHD)	
	Existing	Design	Existing	Design	Existing	Design	Existing	Design	Existing	Design
CH 483 + 690km	319.41	319.43	318.74	318.76	319.46	319.47	319.52	319.55	319.54	319.57
CH 484+850km	303.93	303.97	303.27	303.30	304.20	304.25	304.25	304.29	304.31	304.35

*Note that the existing top of the formation level has been assumed to be 667mm below the existing top of the rail level

Therefore, it can be seen that the flood immunity of the track line is maintained as in the existing case.

The changes in flood velocity are discussed further in Section 5.4.2, as seen in this section there are no increases in flood velocity which are greater than 0.5m/s outside the project boundary. There are a few minor areas within the project boundary between the two rail lines where the newly wet areas have velocities in excess of 0.5m/s. However, at these velocities, which are generally less than 1m/s, they are unlikely to cause any potential for scour issues.

5.4. Flood Impact Assessment

The flood impact assessment was conducted, and results are summarised below for events up to and including the 1% AEP event. These changes to the flood depths, velocities and flood hazard are within the permissible limits allowed within the Conditions of Approval (CoA).

The changes are discussed further in the sections below. The flood mapping for the flood impact assessment, is also attached in Appendix A.

5.4.1. Changes in Peak Flood Level

The impacts presented below in Table 5-11 are due to the implementation of the design works at the Olympic Highway Underbridge.

Table 5-11: Points of Interest Data – Changes in Flood Level (m)

Locations	5% AEP	2% AEP	1% AEP
Point 1	0.02	0.02	0.01
Point 2	<0.005	<0.005	<0.005
Point 3	No longer flooded	No longer flooded	No longer flooded
Point 4	<0.005	<0.005	<0.005
Point 5	<0.005	<0.005	<0.005
Point 6	0.02	0.02	0.02

There is one location at Chainage 484+200km that extends outside the project boundary where the newly wet area has flood depths being up to 100mm in depth. However, this area is located entirely within a natural channel and hence is deemed compliant. All other flood level increases are within the limits of the Conditions of Approval (CoA).

While there are no non-compliances with respect to the PSR and CoA, it should be noted that there is flow within the rail corridor due to the rail line being in cut. This should be taken into account when considering future stormwater drainage management measures.

5.4.2. Changes in Peak Flood Velocity

The impacts in Table 5-12 show the change in flood velocity across the points of interest, due to the implementation of the design works. The flood mapping for the changes in velocity is seen below in Appendix A. Across the reporting locations, the change in velocities is minor, being less than 0.5m/s. As seen in the flood mapping in Appendix A, there are no locations where there are increases in flood velocity of more than 0.5m/s. These increases are compliant with the CoA.

Table 5-12: Points of Interest Data – Changes in Flood Velocity (m/s)

Locations	5% AEP	2% AEP	1% AEP
Point 1	0.0	0.0	0.0
Point 2	0.0	0.0	0.0
Point 3	Dry	Dry	Dry
Point 4	0.0	0.0	0.0
Point 5	0.0	0.0	0.0
Point 6	0.0	0.0	0.0

5.4.3. Changes in Peak Flood Hazard

Table 5-13 shows the changes in flood hazard across the points of interest locations.

Table 5-13: Points of Interest Data – Changes in Flood Hazard

Locations	5% AEP	2% AEP	1% AEP
Point 1	No Change	No Change	No Change
Point 2	No Change	No Change	No Change
Point 3	Dry	Dry	Dry
Point 4	No Change	No Change	No Change
Point 5	No Change	No Change	No Change
Point 6	No Change	No Change	No Change

There are no material changes to flood hazard outside of the project boundary. Within the project boundary, there is however a few isolated areas of increased flood hazard at the Olympic Highway Underbridge location. As mentioned in Section 5.1, this is an area of already high flood hazard so appropriate signage should be in place. However, as this is all within the project boundary it is deemed compliant with the CoA.

5.4.4. Changes in Duration of Inundation

The analysis around the change in duration of inundation was undertaken by comparing the water level vs time for locations upstream and downstream of the site in the design and existing conditions. Reporting location A is downstream of the site on Regent Street while reporting location B is upstream of the site on Main Street. As seen in Figure 5-5 to Figure 5-9 the change in time in inundation is less than 1 hour and is therefore compliant with the CoA.

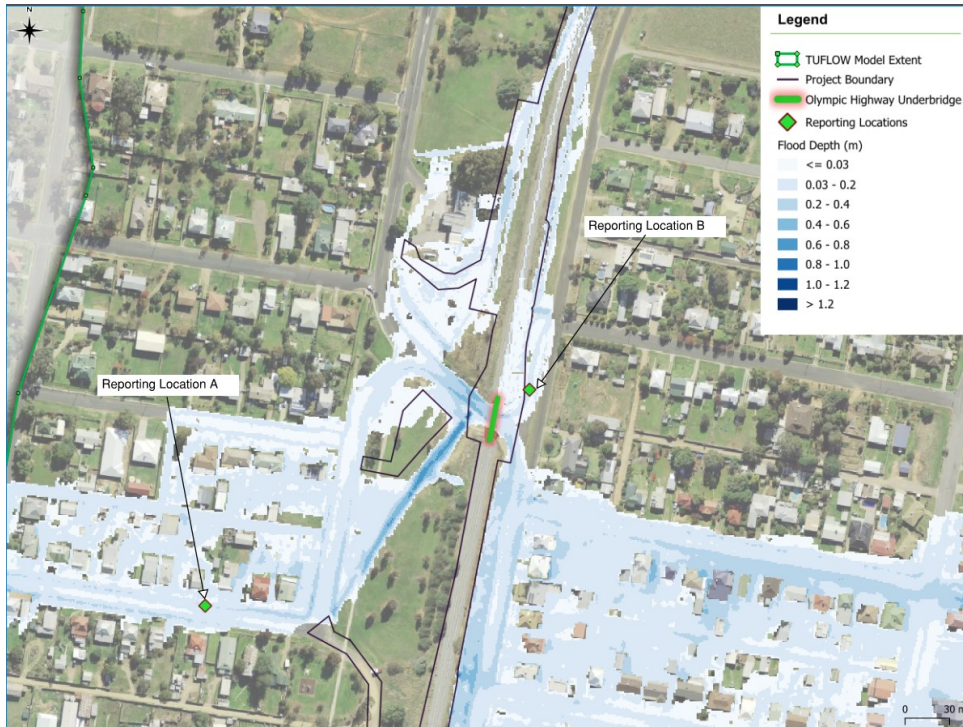


Figure 5-4: Duration of Inundation Reporting Location

1% AEP - Water Level vs Time

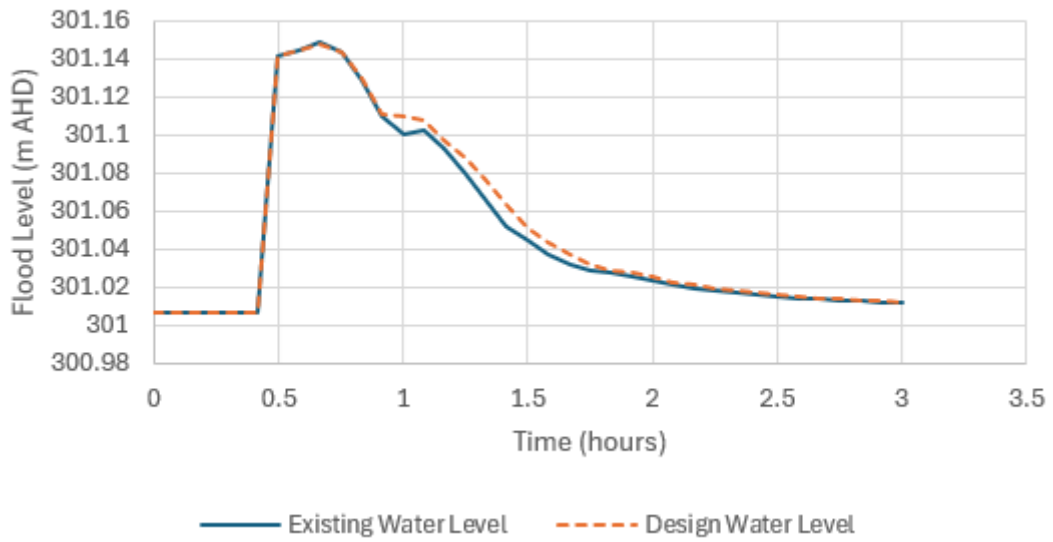


Figure 5-5: 1% AEP Duration of Inundation– Location A

1% AEP - Water Level vs Time

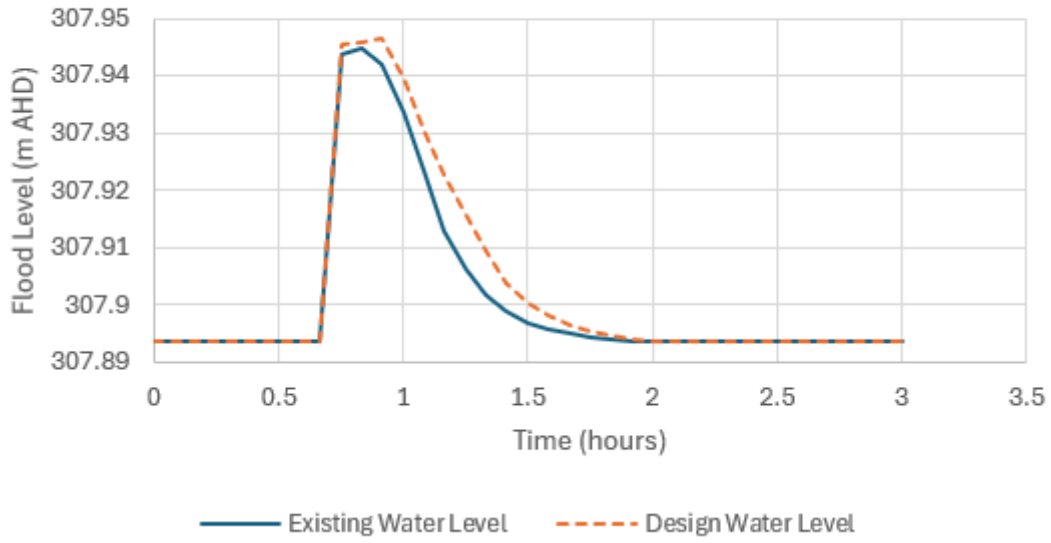


Figure 5-6: 1% AEP Duration of Inundation– Location B

2% AEP - Water Level vs Time

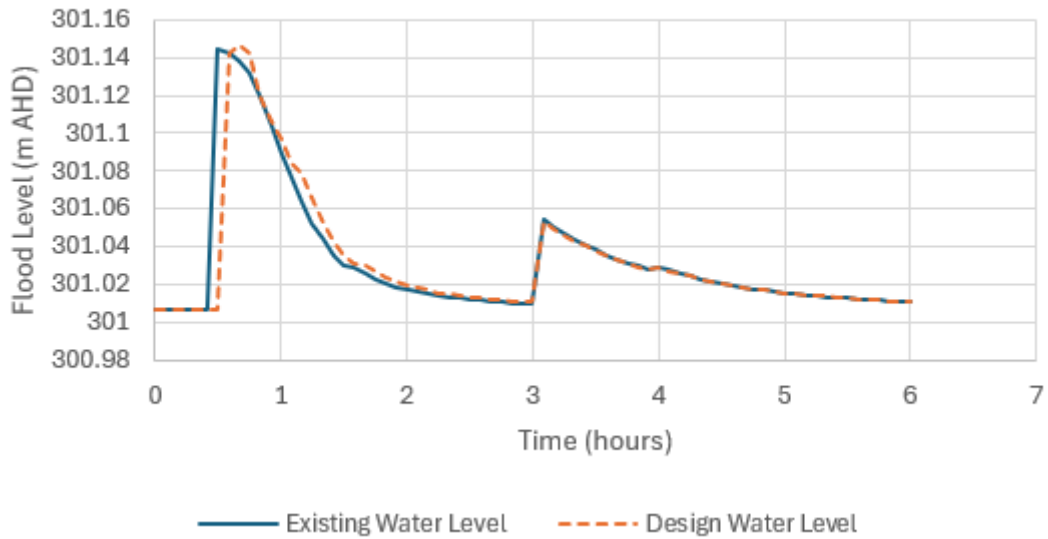


Figure 5-7: 2% AEP Duration of Inundation– Location A

2% AEP - Water Level vs Time

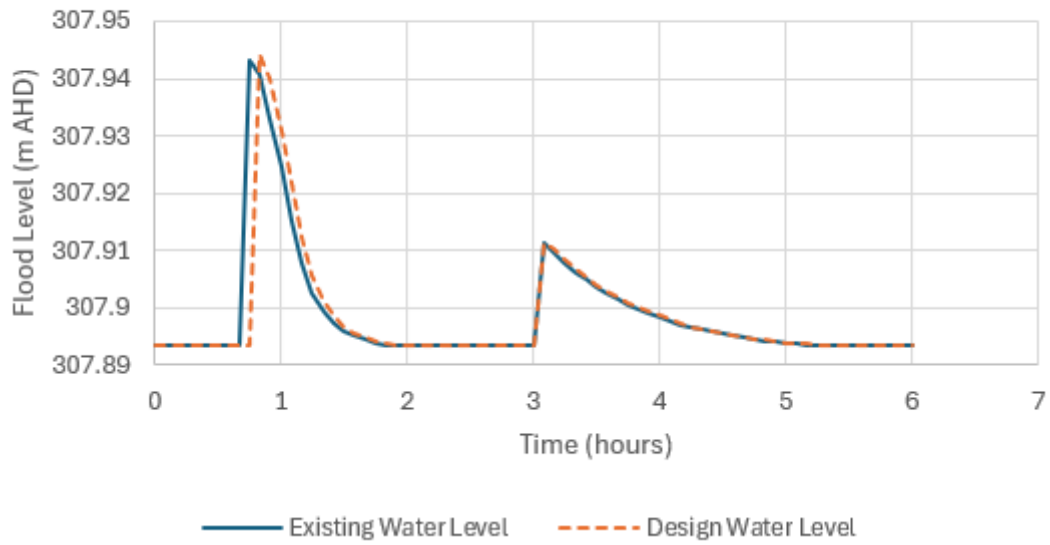


Figure 5-8: 2% AEP Duration of Inundation– Location B

5% AEP - Water Level vs Time

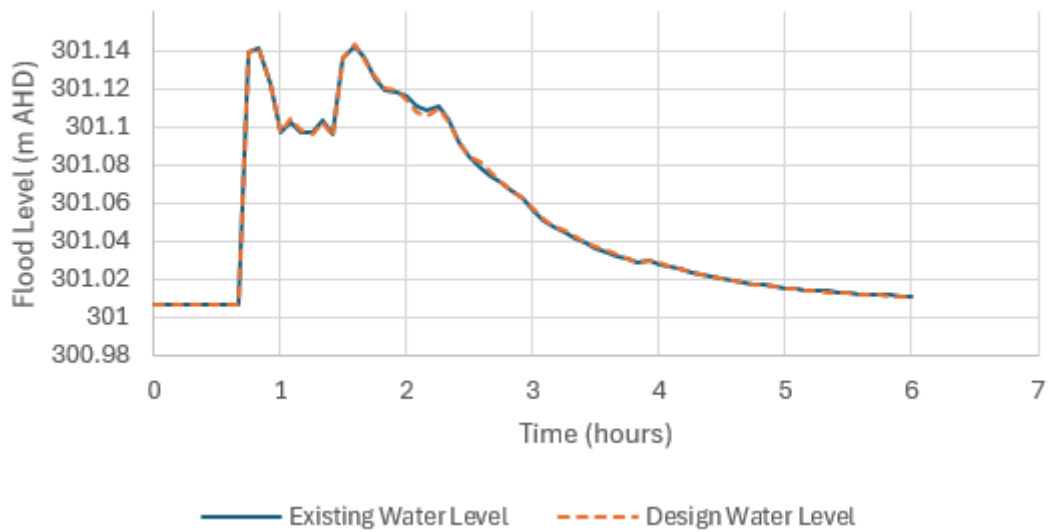


Figure 5-9: 5% AEP Duration of Inundation– Location A

5% AEP - Water Level vs Time

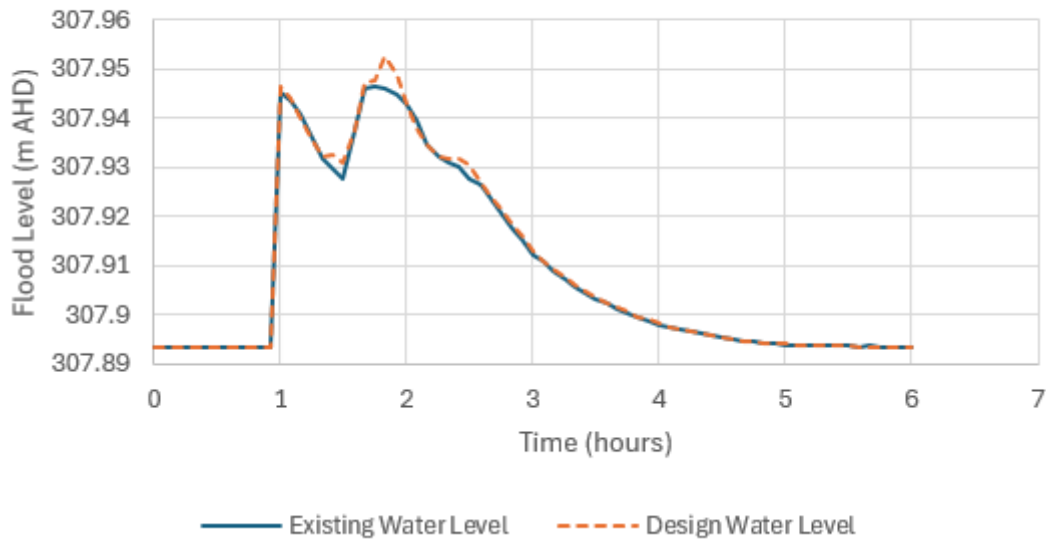


Figure 5-10: 5% AEP Duration of Inundation– Location B

5.4.5. Cumulative impact

As stated in Section 4 under “Modelling Methodology”, the master design condition incorporated the Olympic Highway Underbridge design (5-0052-210-PEN-J6-RP-0001) and Junee Yard design (5-0052-210-PEN-J4-RP-0001) to understand an overall cumulative impact on the site. The changes in flood level maps indicate that the only interaction between these designs occurs at approximately Chainage 484+800km where the Junee Yard northern section track design interacts with the Olympic Highway site area. However, the impacts from this are localised to the area as shown in Figures 32a,33a and 34a in Appendix A. It should be noted that the southern section of the Junee Yard design has no interaction with the Olympic Highway underbridge site.

5.5. Sensitivity Test

5.5.1. Climate Change Risk Assessment

There is no design criterion to assess flood impacts in a Climate Change scenario. Therefore, a sensitivity assessment was conducted to anticipate future climate change flood risk. As per the EIS report (Section 3.3.5 of Albury to Illabo Environmental Impact Statement Technical Paper 11), the Year 2090 RCP8.5 interim climate change factor sourced from the ARR Data Hub (<https://data.arr-software.org/>) was adopted. The use of the Year 2090 RCP8.5 interim climate change factor was associated with a 20.2% increase in rainfall.

A climate change risk assessment was carried out by running the 1% AEP with the Year 2090 RCP8.5 interim climate change factor (refer to Section 4 for details of the approach) and the results of flood depth, flood velocity and flood hazard can be found in Section 5.1 and Section 5.2. The corresponding flood maps can be found in Appendix A. The assessment is summarised as below:

- Within the study area, the railway track continues to be overtopped in both the existing and design conditions in the 1% AEP event + Climate Change event. However, the depth of overtopping is slightly increased due to the increased rainfall.

5.5.2. Blockage Assessment

A hydraulic blockage assessment was carried out for the Internal TUFLOW model as per the guidance set out in Australian Rainfall and Runoff 2019. The assessment involved assessing the site area for debris availability, mobility and transportability, and this in conjunction with culvert size was used to determine the relevant blockage factors shown below. For all culverts, pits and pipes outside the project boundary, a 20% blockage factor was applied. Refer to Technical Memo (5-0052-210-IHY-99-ME-0001) for the rationale and assessment methodology.

Table 5-14: Culvert Blockage Percentage

Culvert	Blockage Percentage (1% AEP)	Comments
Pipe3 (2 x 0.3 RCP) @ CH484+450km	25%	Inside the project boundary
Pipe323 (1 x 0.45 RCP) @ CH484+275km	25%	Inside the project boundary
Pipe324 (4 x 0.6 RCP) @ CH484+200km	25%	Inside the project boundary
Stormwater network	20% (on grade pit), 50% (sag pits)	Inside the project boundary
All others (culvert, pit and pipe)	20%	Outside of the project boundary



Figure 5-11: Culvert Blockage Setup

Table 5-15: Culvert Blockage Parameters

Debris Availability	Debris Mobility	Debris Transportability	AEP Adjusted Debris Potential	Blockage if Width is less than 1.8m	L10
Low	Low	Medium	Low	25%	1.8m

As shown in Figure 5-12, incorporation of blockage did not cause a significant change in flood levels. However, it should be noted that the blockage of the existing culvert at CH 483+700km causes an increase in flows and hence flood levels within the rail corridor to the south west compared to the unblocked condition.



Figure 5-12: 1% AEP Blockage – Flood Level Difference

6. MITIGATION MEASURES

No mitigation measures have been modelled in this IFC Flood Design Report, as there are no non-compliances observed, from the flood modelling.

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.

APPENDICES



APPENDIX A

Flood Maps



List of Flood Maps

Existing Conditions Maps
Figure 1 – Figure Set up
Figure 2/2a/2b/2c/2d : 5% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions
Figure 3/3a/3b/3c/3d : 2% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions
Figure 4/4a/4b/4c/4d : 1% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions
Figure 5/5a/5b/5c/5d : 1% AEP Climate Change Flood Depth (m) and Levels (m AHD) - Existing Conditions
Figure 6/6a/6b/6c/6d : PMF Flood Depth (m) and Levels (m AHD) - Existing Conditions
Figure 7/7a/7b/7c/7d : 5% AEP Flood Velocity (m/s) - Existing Conditions
Figure 8/8a/8b/8c/8d : 2% AEP Flood Velocity (m/s) - Existing Conditions
Figure 9/9a/9b/9c/9d : 1% AEP Flood Velocity (m/s) - Existing Conditions
Figure 10/10a/10b/10c/10d : 1% AEP Climate Change Flood Velocity (m/s) - Existing Conditions
Figure 11/11a/11b/11c/11d : PMF Flood Velocity (m/s) - Existing Conditions
Figure 12/12a/12b/12c/12d : 5% AEP Flood Hazard (ARR2019) - Existing Conditions
Figure 13/13a/13b/13c/13d : 2% AEP Flood Hazard (ARR2019) - Existing Conditions
Figure 14/14a/14b/14c/14d : 1% AEP Flood Hazard (ARR2019) - Existing Conditions
Figure 15/15a/15b/15c/15d : 1% AEP Climate Change Flood Hazard (ARR2019) - Existing Conditions
Figure 16/16a/16b/16c/16d : PMF Flood Hazard (ARR2019) - Existing Conditions
Developed Conditions Maps
Figure 17/17a/17b/17c/17d : 5% AEP Flood Depth (m) and Levels (m AHD) - Developed Condition
Figure 18/18a/18b/18c/18d : 2% AEP Flood Depth (m) and Levels (m AHD) - Developed Condition
Figure 19/19a/19b/19c/19d : 1% AEP Flood Depth (m) and Levels (m AHD) - Developed Condition
Figure 20/20a/20b/20c/20d : 1% AEP Climate Change Flood Depth (m) and Levels (m AHD) - Developed Condition
Figure 21/21a/21b/21c/21d : PMF Flood Depth (m) and Levels (m AHD) - Developed Condition
Figure 22/22a/22b/22c/22d : 5% AEP Flood Velocity (m/s) - Developed Condition
Figure 23/23a/23b/23c/23d : 2% AEP Flood Velocity (m/s) - Developed Condition
Figure 24/24a/24b/24c/24d : 1% AEP Flood Velocity (m/s) - Developed Condition
Figure 25/25a/25b/25c/25d : 1% AEP Climate Change Flood Velocity (m/s) - Developed Condition
Figure 26/26a/26b/26c/26d : PMF Flood Velocity (m/s) - Developed Condition
Figure 27/27a/27b/27c/27d : 5% AEP Flood Hazard (ARR2019) - Developed Conditions
Figure 28/28a/28b/28c/28d : 2% AEP Flood Hazard (ARR2019) - Developed Conditions
Figure 29/29a/29b/29c/29d : 1% AEP Flood Hazard (ARR2019) - Developed Conditions

Existing Conditions Maps

Figure 30/30a/30b/30c/30d : 1% AEP Climate Change Flood Hazard (ARR2019) - Developed Conditions

Figure 31/31a/31b/31c/31d : PMF Flood Hazard (ARR2019) - Developed Conditions

Flood Level Impact Maps

Figure 32/32a/32b/32c/32d : 5% AEP Change in Flood Levels (m) - Developed Less Existing

Figure 33/33a/33b/33c/33d : 2% AEP Change in Flood Levels (m) - Developed Less Existing

Figure 34/34a/34b/34c/34d : 1% AEP Change in Flood Levels (m) - Developed Less Existing

Flood Velocity Change Maps

Figure 35/35a/35b/35c/35d : 5% AEP Change in Flood Velocity (m/s) - Developed Less Existing

Figure 36/36a/36b/36c/36d : 2% AEP Change in Flood Velocity (m/s) - Developed Less Existing

Figure 37/37a/37b/37c/37d : 1% AEP Change in Flood Velocity (m/s) - Developed Less Existing

Flood Hazard Change Maps

Figure 38/38a/38b/38c/38d : 5% AEP Change in Flood Hazard (ARR2019) - Developed Less Existing

Figure 39/39a/39b/39c/39d : 2% AEP Change in Flood Hazard (ARR2019) - Developed Less Existing

Figure 40/40a/40b/40c/40d : 1% AEP Change in Flood Hazard (ARR2019) - Developed Less Existing

Blockage Assessment

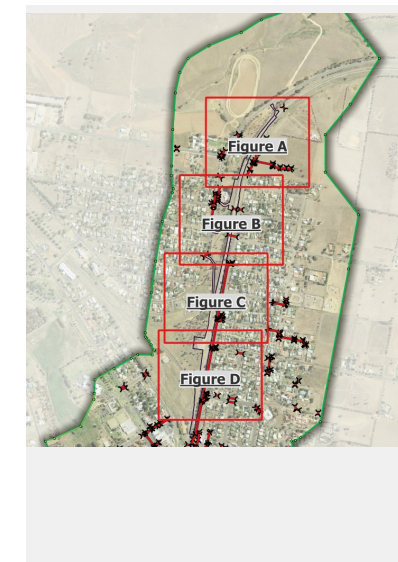
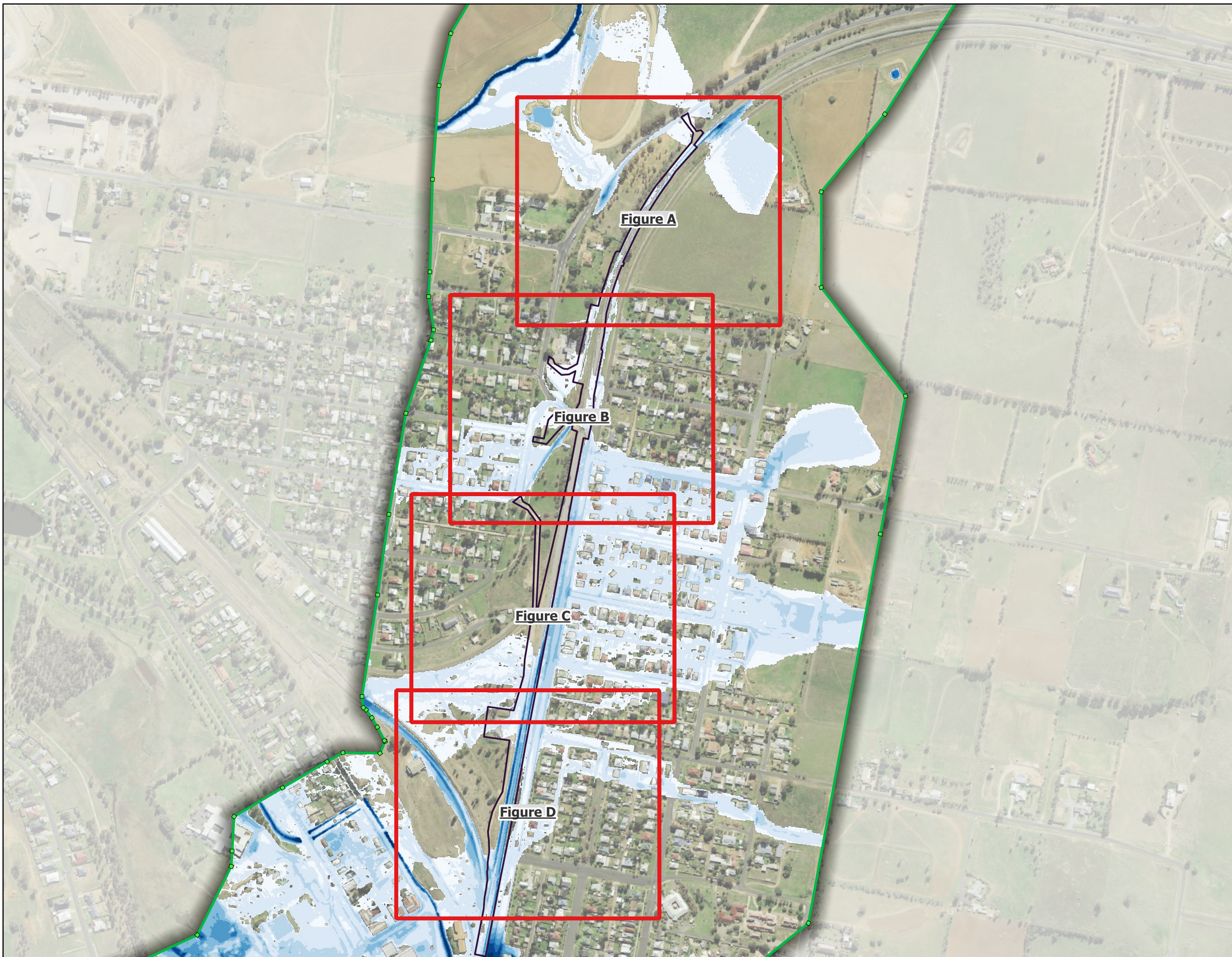
Figure 41/41a/41b/41c/41d : 1% AEP Flood Depth (m) and Levels (m AHD) - Blockage Sensitivity

Figure 42/42a/42b/42c/42d : 1% AEP Flood Velocity (m/s) - Blockage Sensitivity

Figure 43/43a/43b/43c/43d : 1% AEP Flood Hazard (ARR2019) - Blockage Sensitivity

R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM



0 200 400 m













A3 Scale: 1:6,951.772763

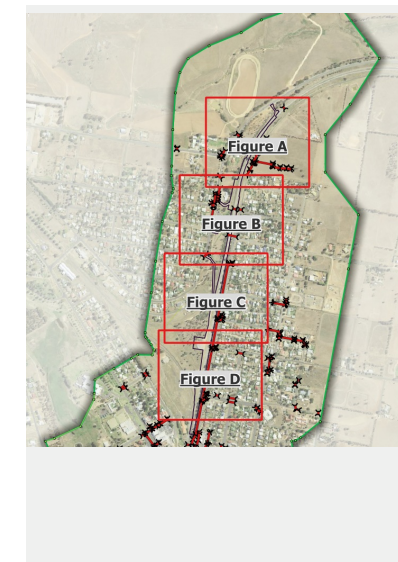
28/7/2025 GDA2020 MGA Zone55

Figure 1 - Olympic Highway Underbridge - IFC Stage

Figure Set Up

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM















0 60 120 m

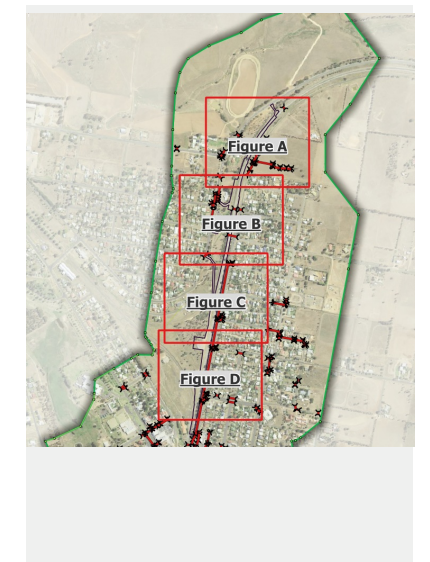
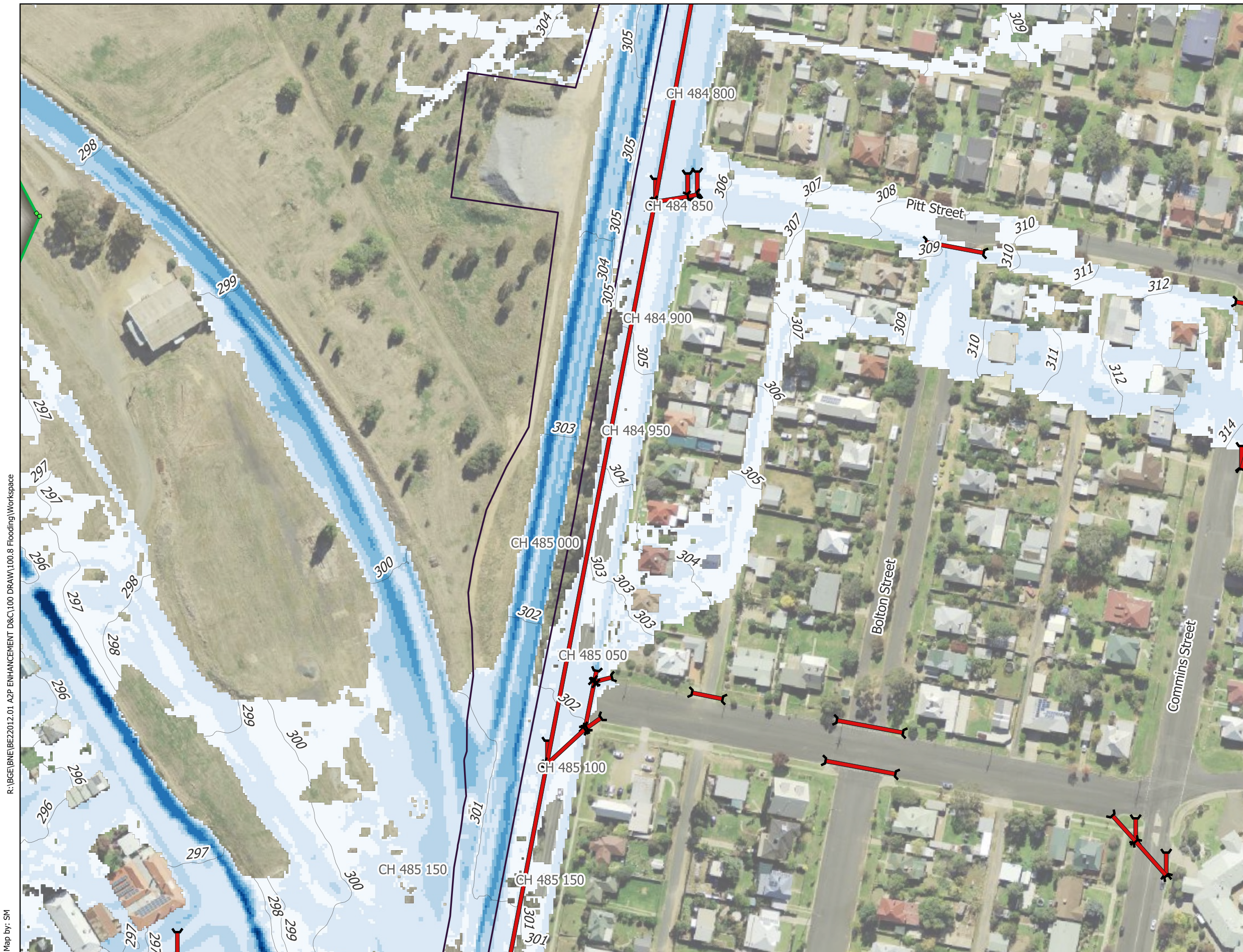
A3 Scale: 1:1,658.667834

28/7/2025 GDA2020 MGA Zone55

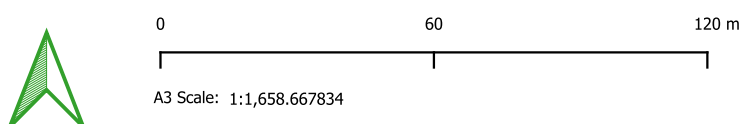
**Figure 2a - Olympic Highway Underbridge - IFC Stage
 5% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions**

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM














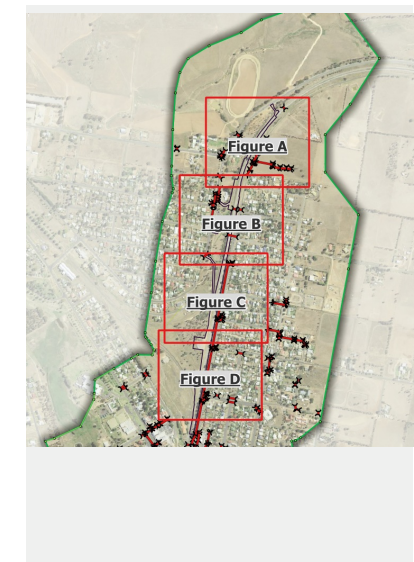
28/7/2025 GDA2020 MGA Zone55

**Figure 2a - Olympic Highway Underbridge - IFC Stage
 5% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions**

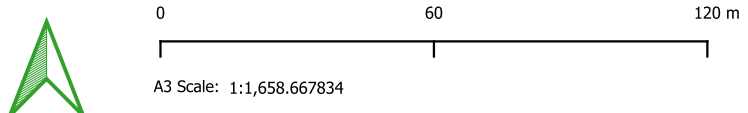
A3 Scale: 1:1,658.667834

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2















R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

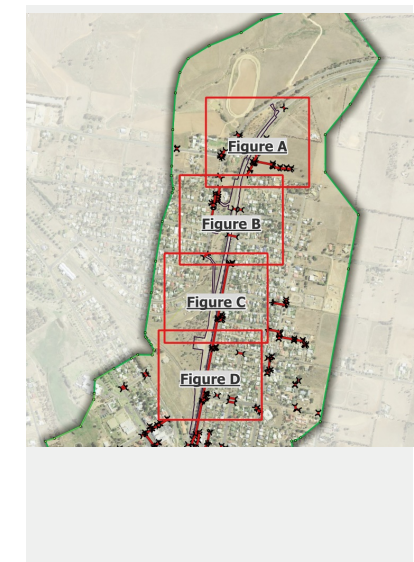


28/7/2025 GDA2020 MGA Zone55

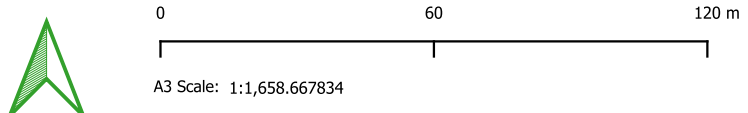
**Figure 2b - Olympic Highway Underbridge - IFC Stage
 5% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions**

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM















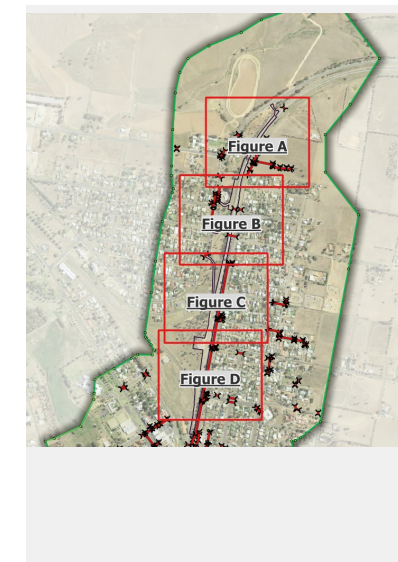
28/7/2025 GDA2020 MGA Zone55

**Figure 2c - Olympic Highway Underbridge - IFC Stage
 5% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions**

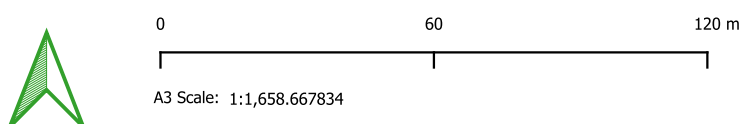
A3 Scale: 1:1,658.667834

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2















R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

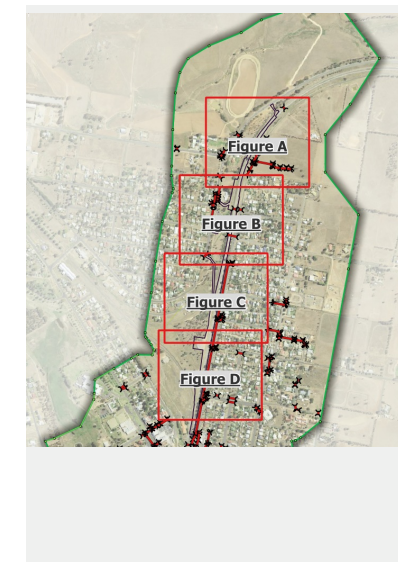
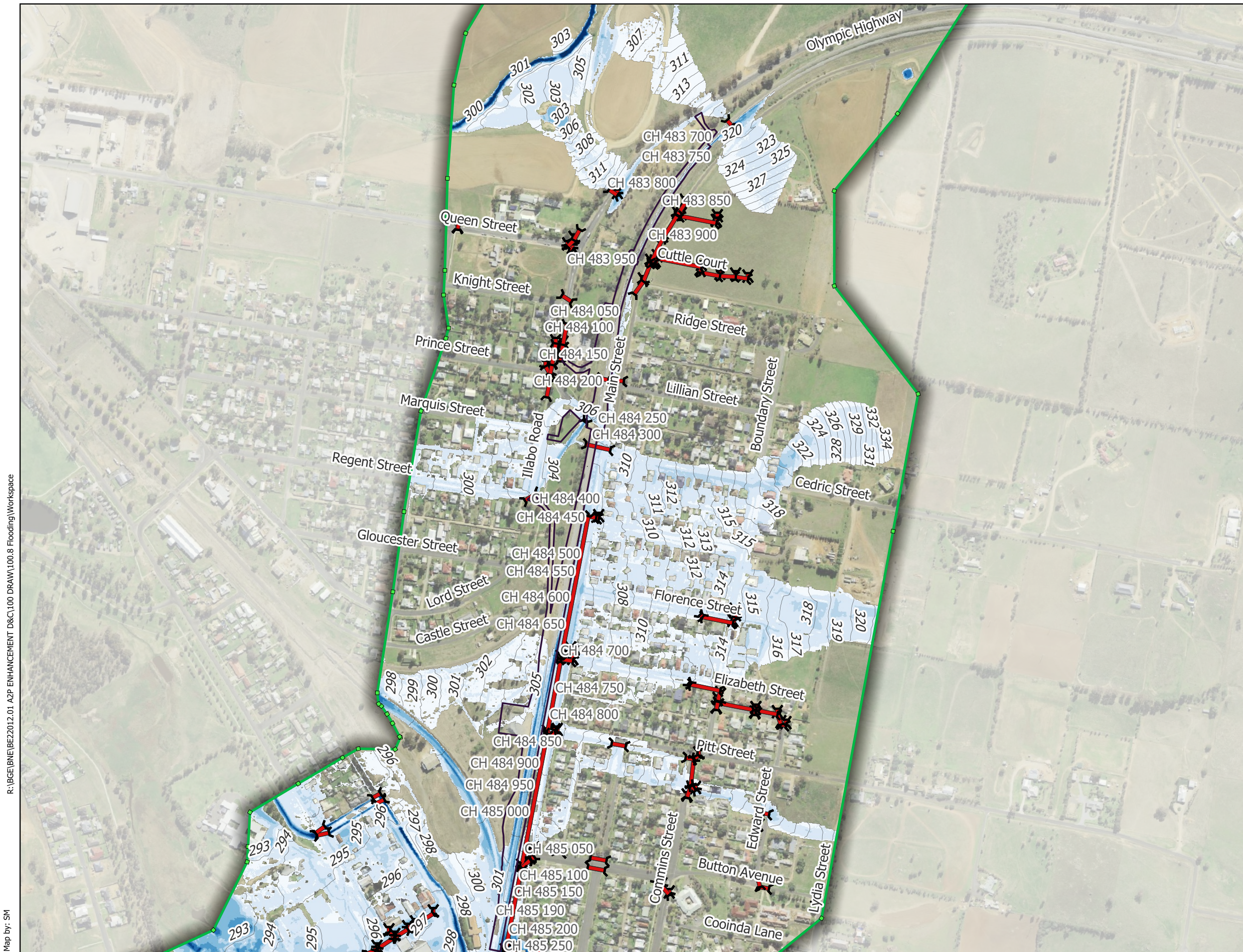


28/7/2025 GDA2020 MGA Zone55

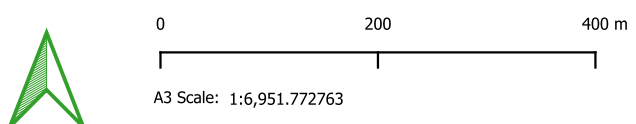
**Figure 2d - Olympic Highway Underbridge - IFC Stage
 5% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions**

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2















R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

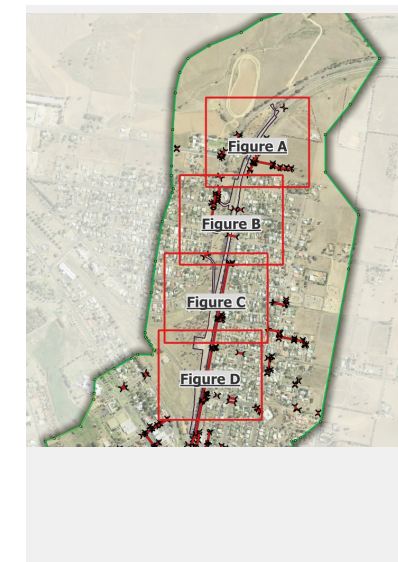


28/7/2025 GDA2020 MGA Zone55

**Figure 3 - Olympic Highway Underbridge - IFC Stage
 2% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions**

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM















0 60 120 m

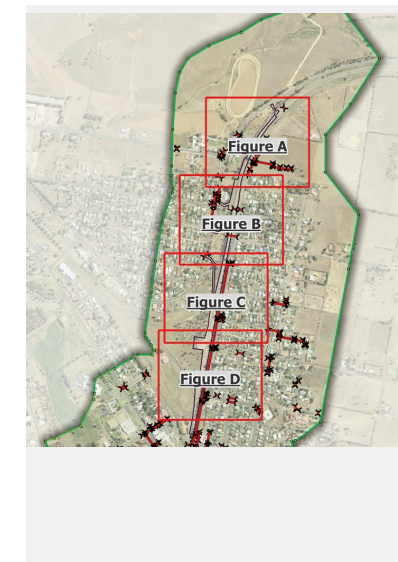
A3 Scale: 1:1,658,667,834

28/7/2025 GDA2020 MGA Zone55

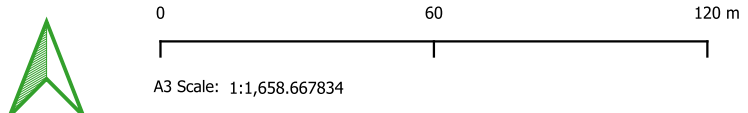
**Figure 3a - Olympic Highway Underbridge - IFC Stage
 2% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions**

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM















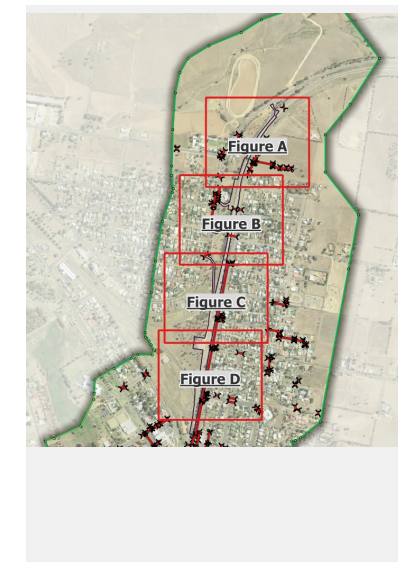
28/7/2025 GDA2020 MGA Zone55

Figure 3b - Olympic Highway Underbridge - IFC Stage
2% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions

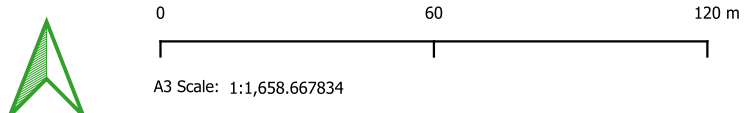
A3 Scale: 1:1,658.667834

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2















R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM



28/7/2025 GDA2020 MGA Zone55

**Figure 3c - Olympic Highway Underbridge - IFC Stage
 2% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions**

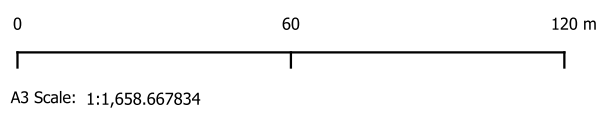
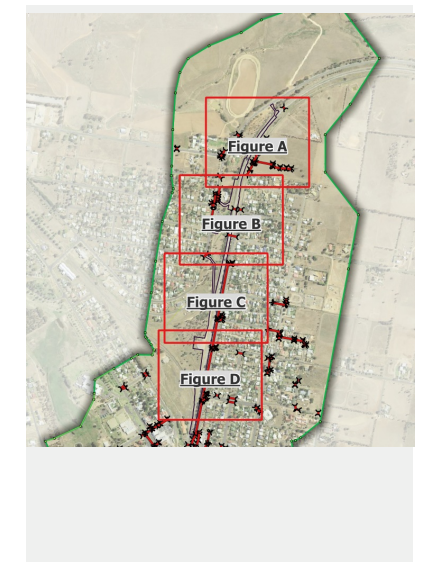
Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace













Map by: SM

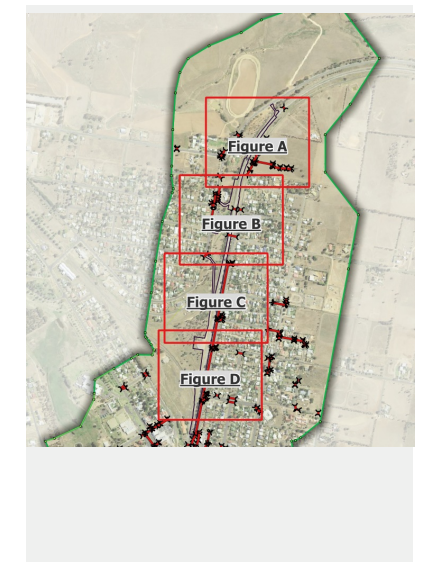


28/7/2025 GDA2020 MGA Zone55

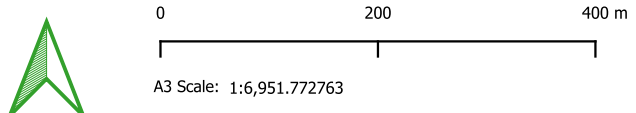
Figure 3d - Olympic Highway Underbridge - IFC Stage
2% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

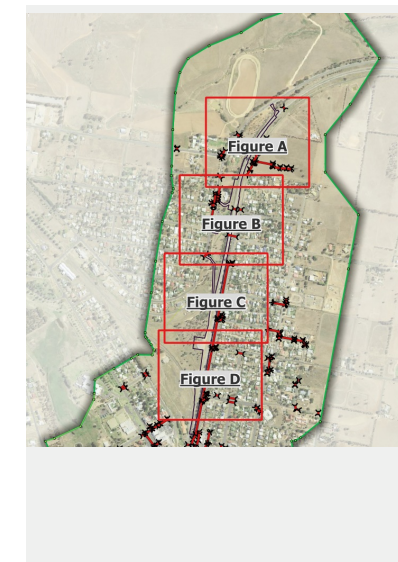


28/7/2025 GDA2020 MGA Zone55

**Figure 4 - Olympic Highway Underbridge - IFC Stage
 1% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions**

Legend

- TUFLOW Model Extent
 - Project Boundary
 - Drainage
 - 1m Water Level Contours (m AHD)
- Flood Depth (m)
- <= 0.03
 - 0.03 - 0.2
 - 0.2 - 0.4
 - 0.4 - 0.6
 - 0.6 - 0.8
 - 0.8 - 1.0
 - 1.0 - 1.2
 - > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM















0 60 120 m

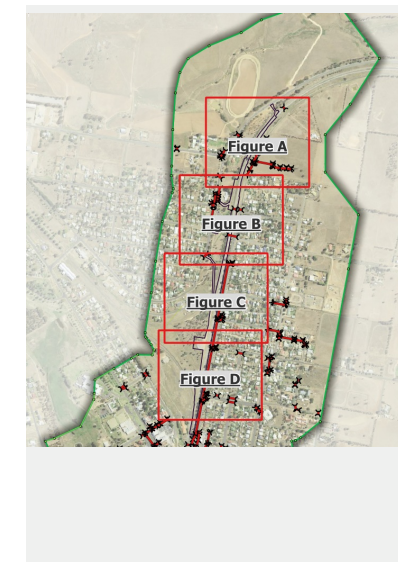
A3 Scale: 1:1,658,667834

28/7/2025 GDA2020 MGA Zone55

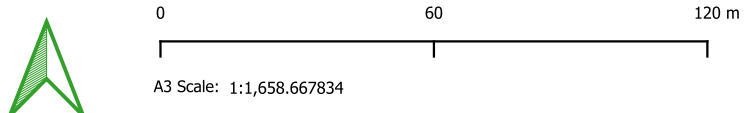
Figure 4a - Olympic Highway Underbridge - IFC Stage
1% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2















R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

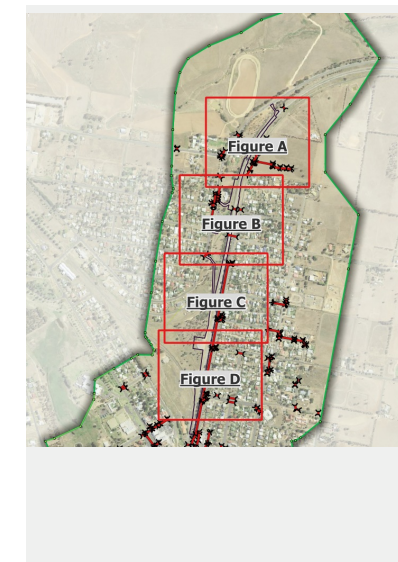


28/7/2025 GDA2020 MGA Zone55

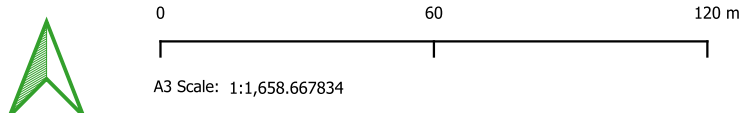
**Figure 4b - Olympic Highway Underbridge - IFC Stage
 1% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions**

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM















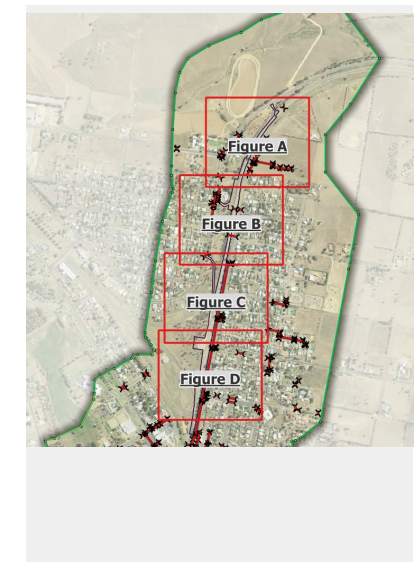
28/7/2025 GDA2020 MGA Zone55

**Figure 4c - Olympic Highway Underbridge - IFC Stage
 1% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions**

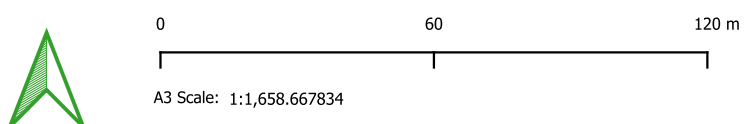
A3 Scale: 1:1,658.667834

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2















R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

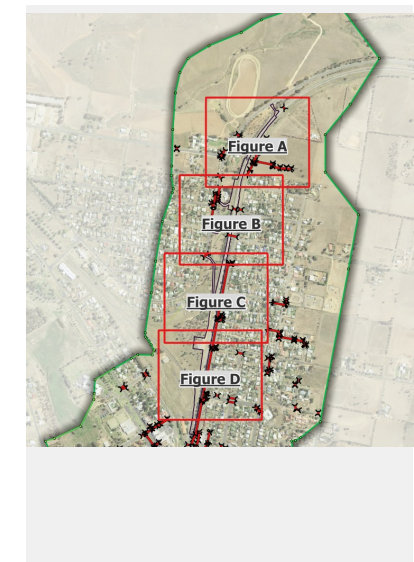


28/7/2025 GDA2020 MGA Zone55

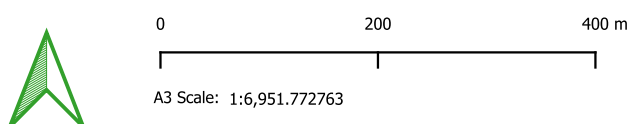
**Figure 4d - Olympic Highway Underbridge - IFC Stage
 1% AEP Flood Depth (m) and Levels (m AHD) - Existing Conditions**

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM















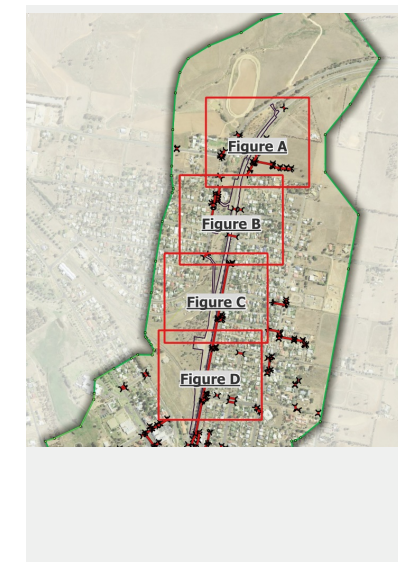
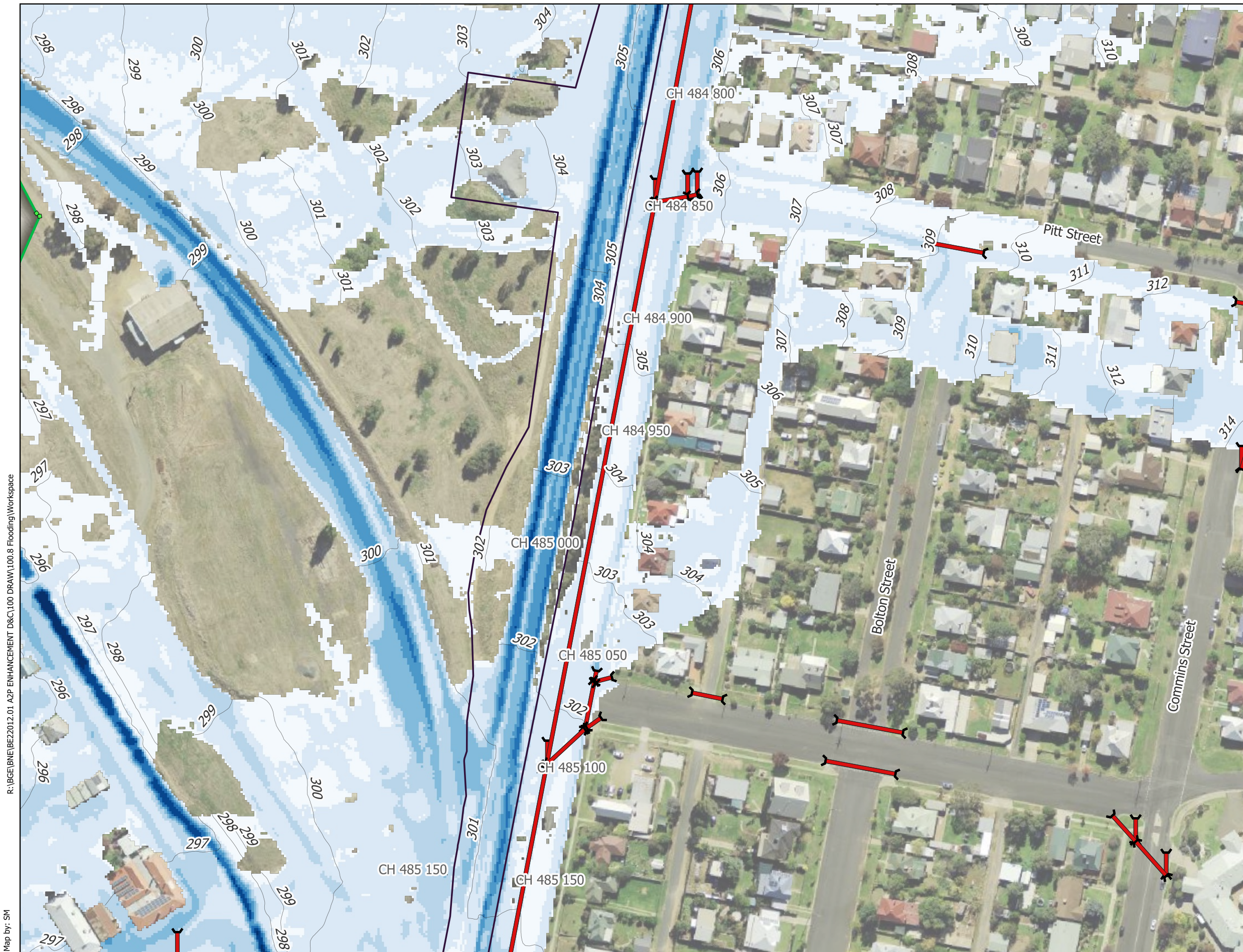
28/7/2025 GDA2020 MGA Zone55

Figure 5 - Olympic Highway Underbridge - IFC Stage

1% AEP Climate Change Flood Depth (m) and Levels (m AHD) - Existing Conditions

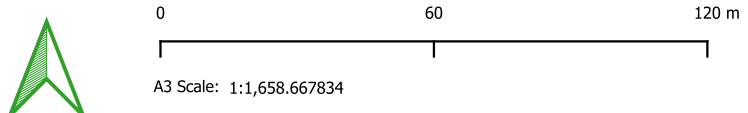
Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM



0 60 120 m












A3 Scale: 1:1,658.667834

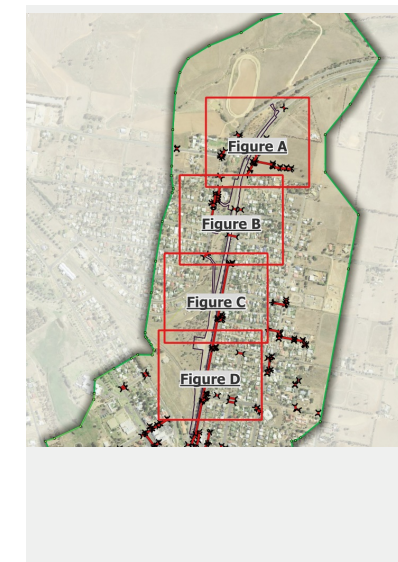
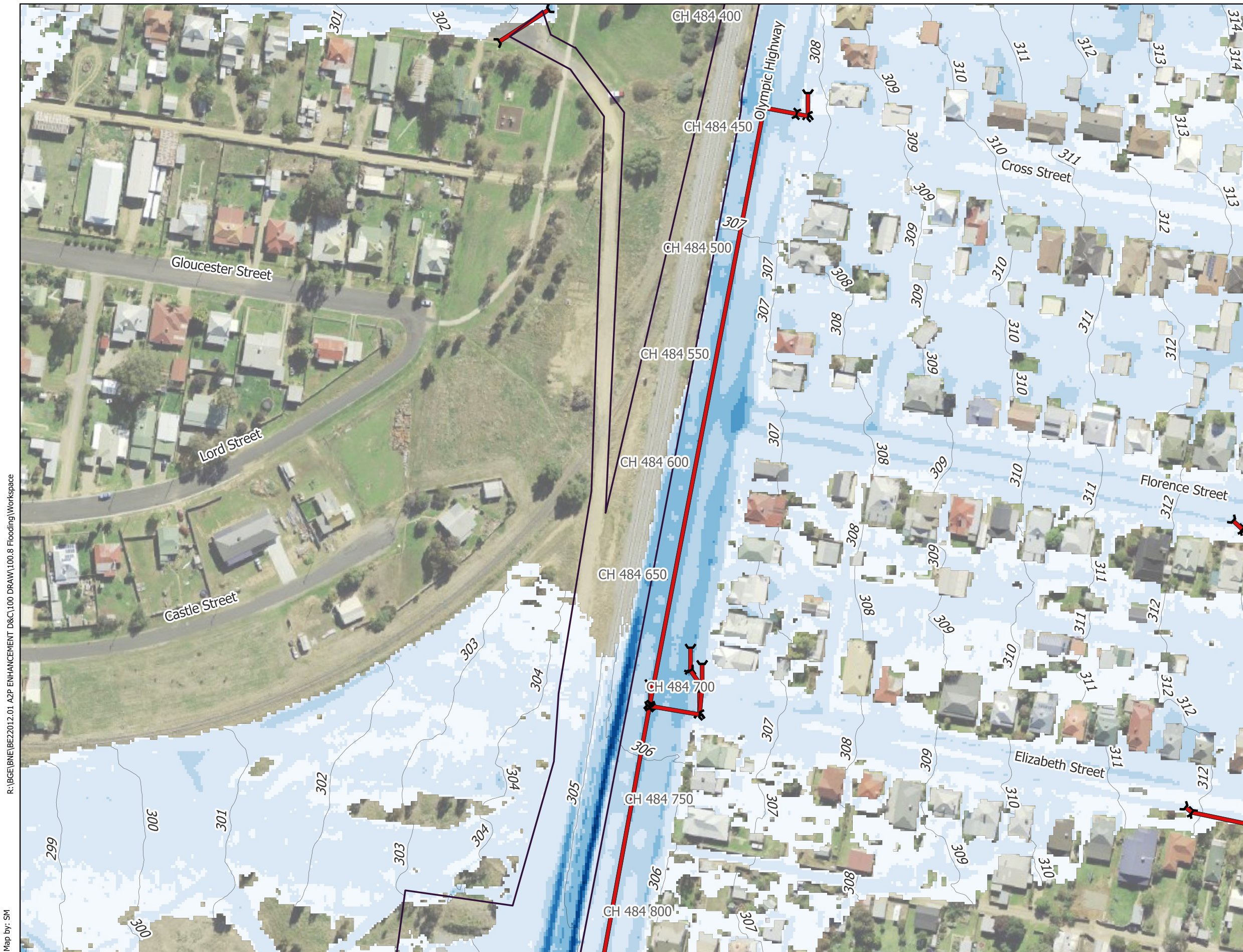
28/7/2025 GDA2020 MGA Zone55

Figure 5a - Olympic Highway Underbridge - IFC Stage

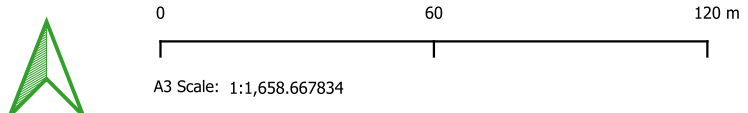
1% AEP Climate Change Flood Depth (m) and Levels (m AHD) - Existing Conditions

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM















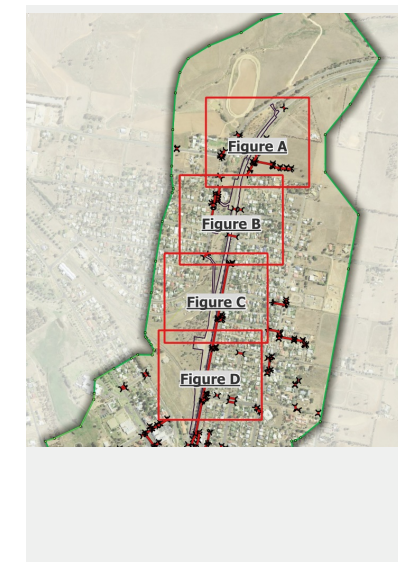
28/7/2025 GDA2020 MGA Zone55

Figure 5b - Olympic Highway Underbridge - IFC Stage

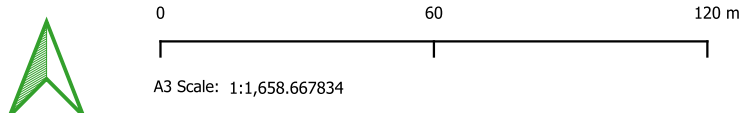
1% AEP Climate Change Flood Depth (m) and Levels (m AHD) - Existing Conditions

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM















28/7/2025 GDA2020 MGA Zone55

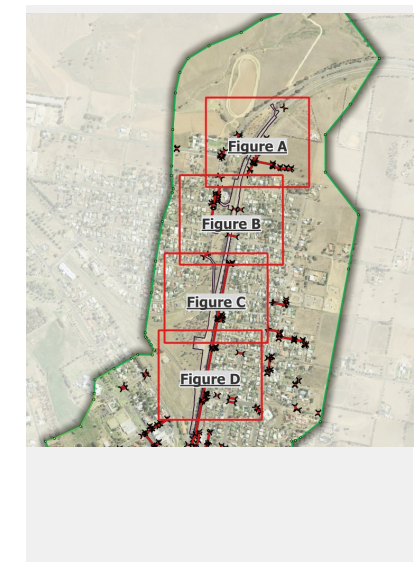
Figure 5c - Olympic Highway Underbridge - IFC Stage

1% AEP Climate Change Flood Depth (m) and Levels (m AHD) - Existing Conditions

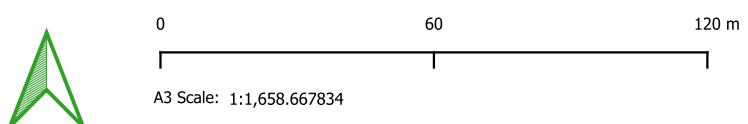
A3 Scale: 1:1,658.667834

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM















28/7/2025 GDA2020 MGA Zone55

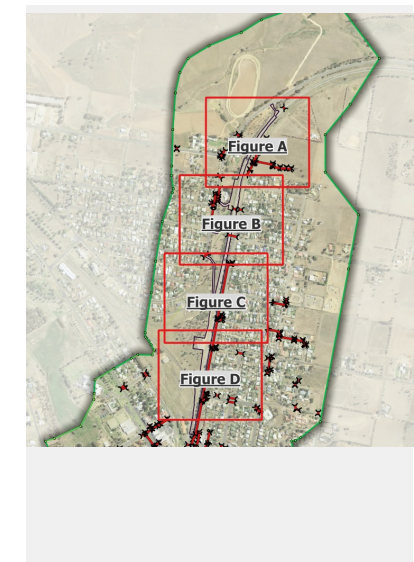
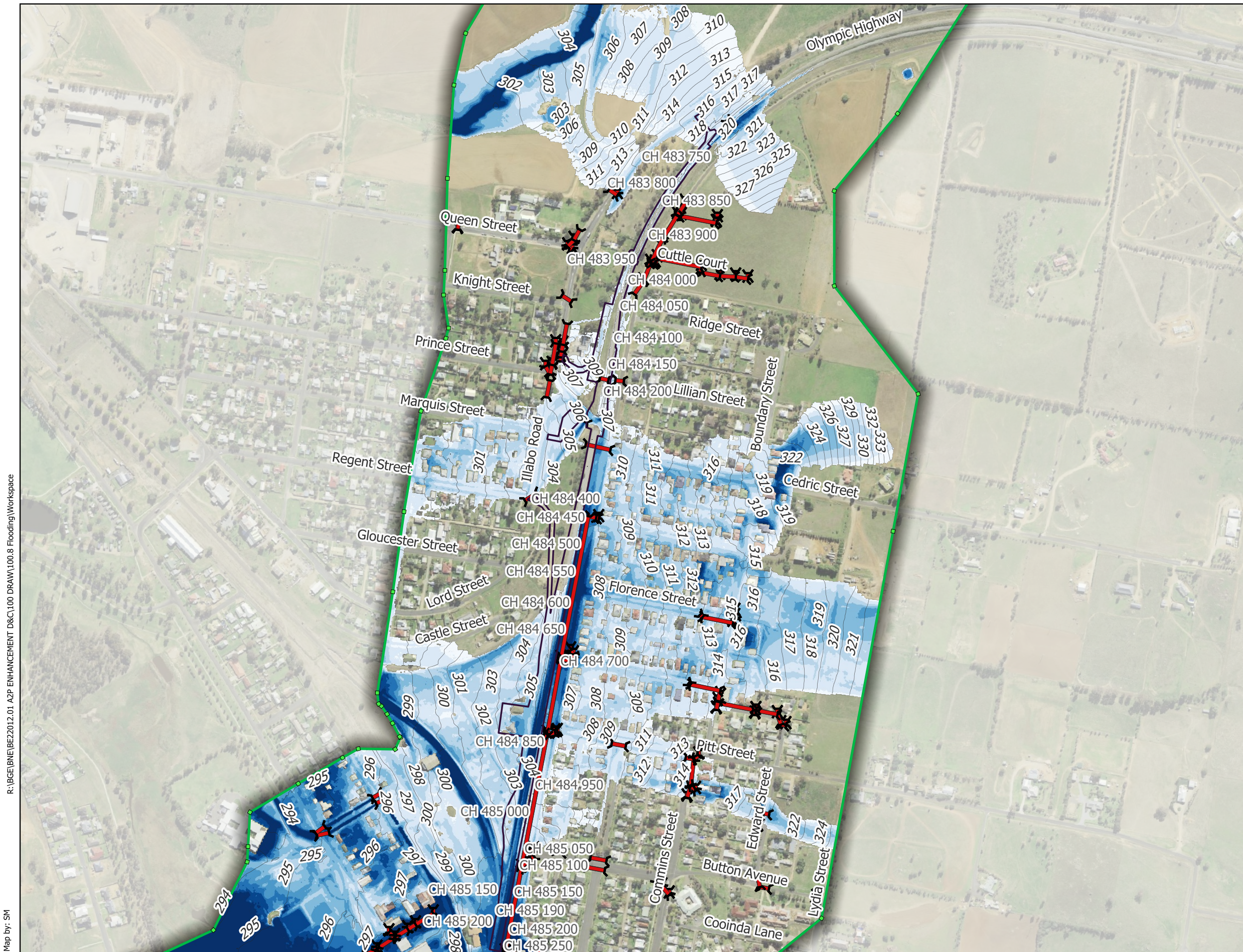
Figure 5d - Olympic Highway Underbridge - IFC Stage

1% AEP Climate Change Flood Depth (m) and Levels (m AHD) - Existing Conditions

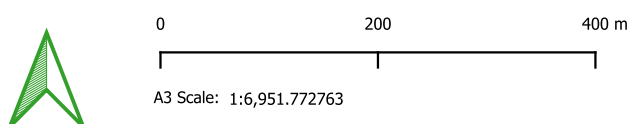
A3 Scale: 1:1,658.667834

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2














R:\BGE\BNE\BE22012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

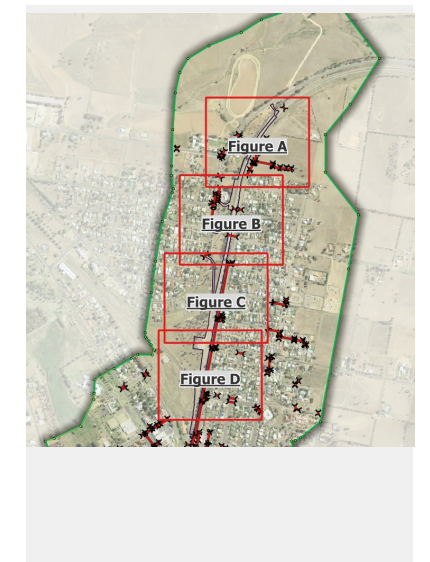
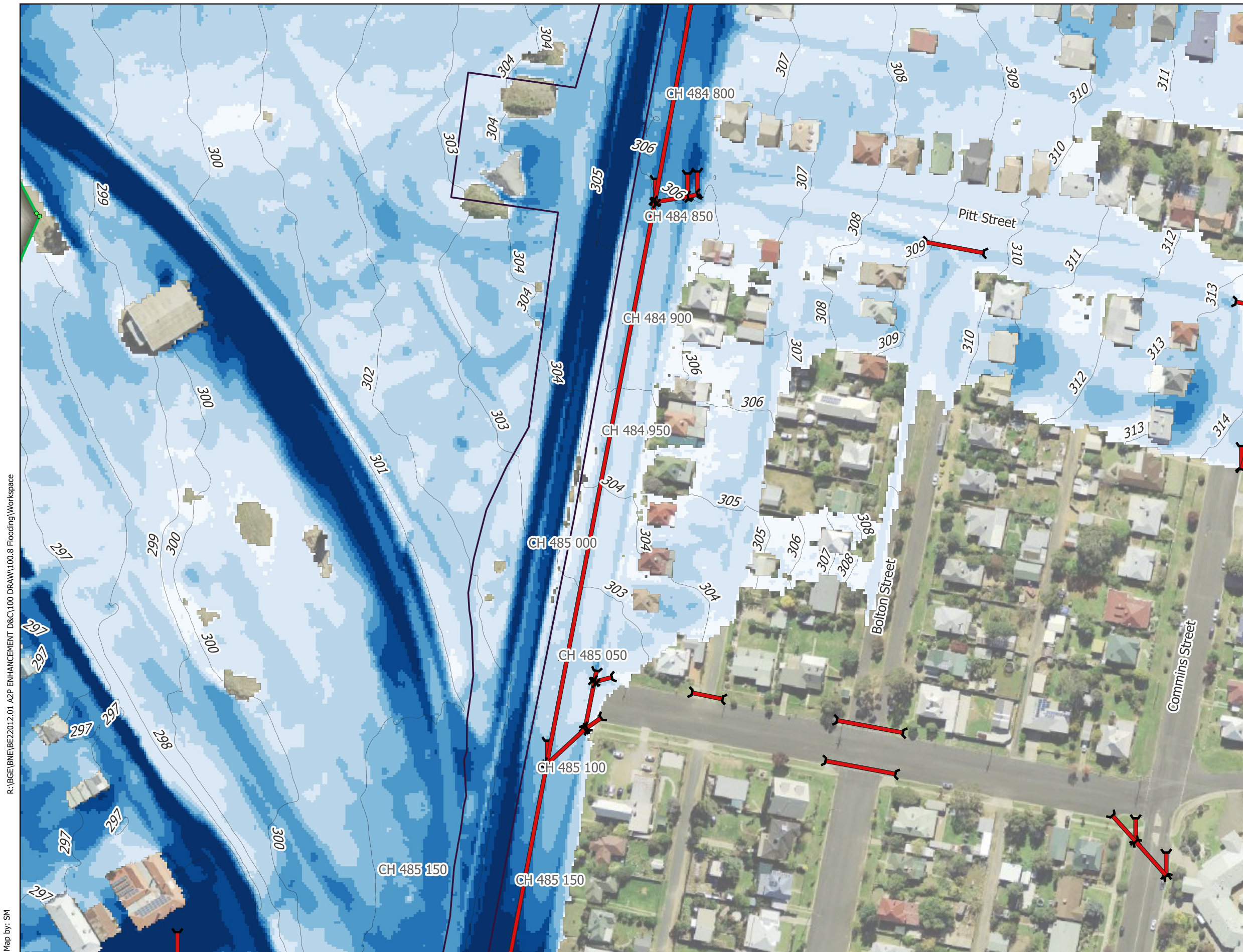


28/7/2025 GDA2020 MGA Zone55

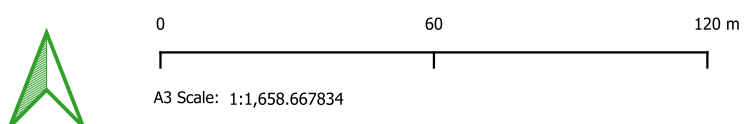
**Figure 6 - Olympic Highway Underbridge - IFC Stage
 PMF Flood Depth (m) and Levels (m AHD) - Existing Conditions**

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  > 1.2














R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

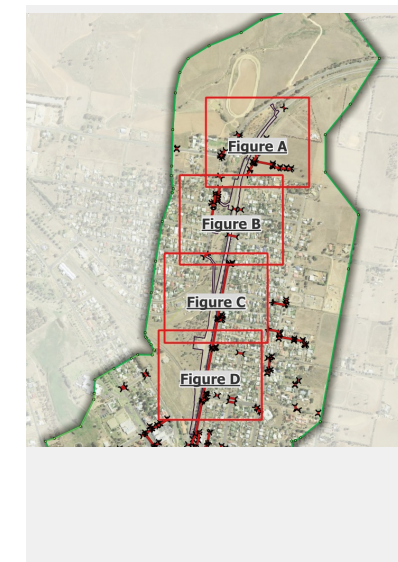
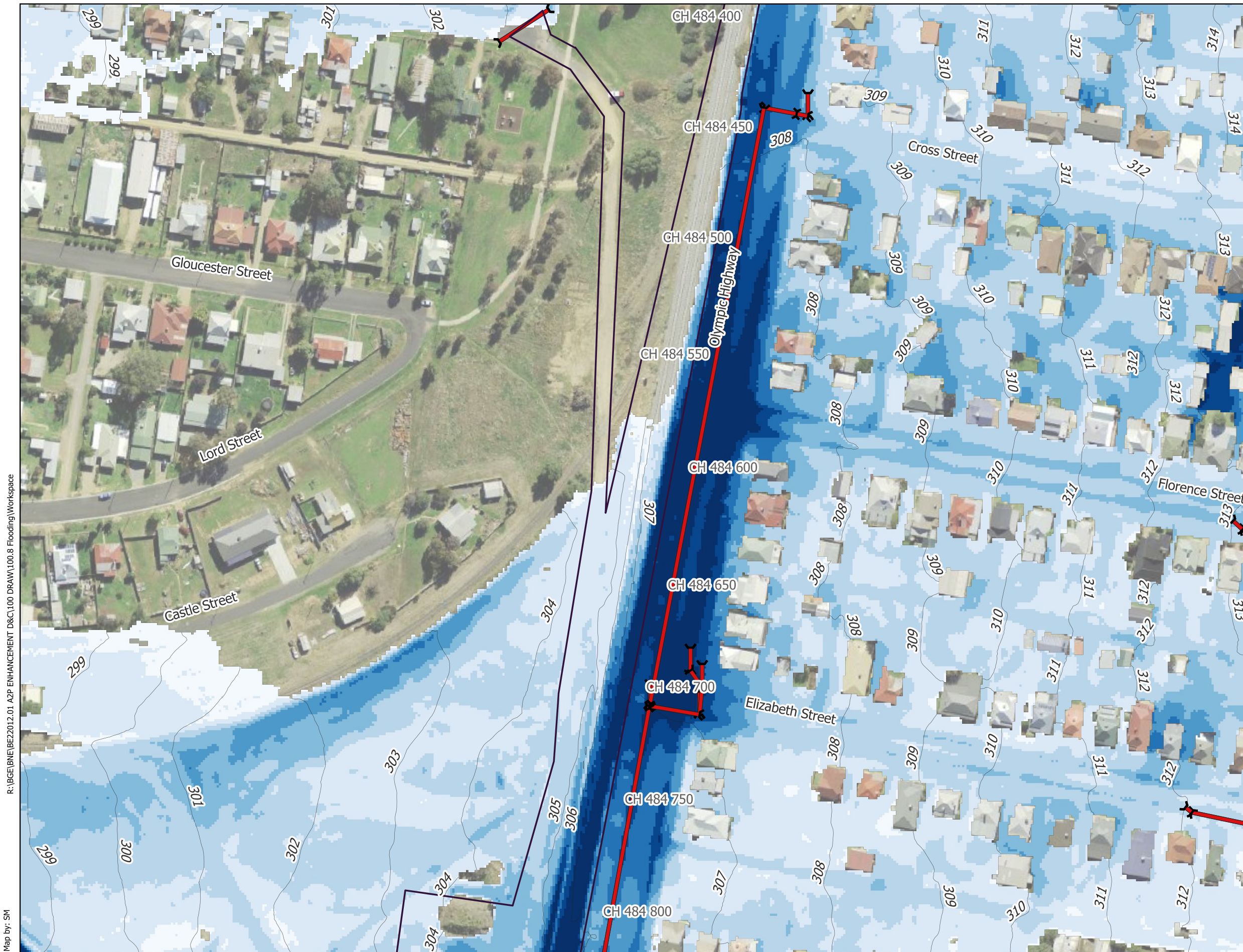


28/7/2025 GDA2020 MGA Zone55

**Figure 6a - Olympic Highway Underbridge - IFC Stage
 PMF Flood Depth (m) and Levels (m AHD) - Existing Conditions**

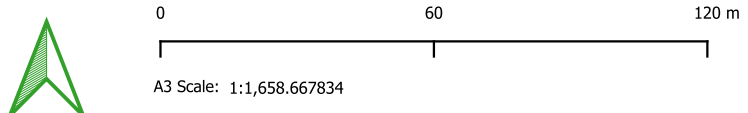
Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)**
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace













Map by: SM

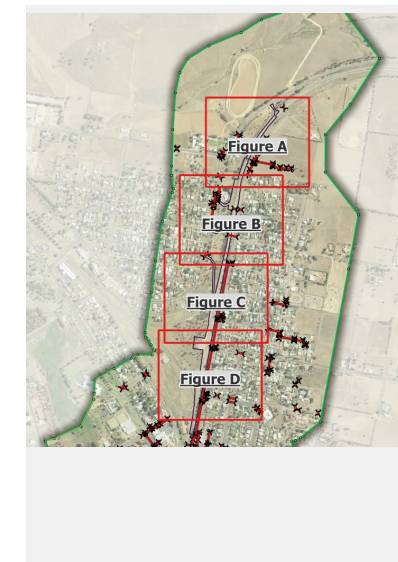
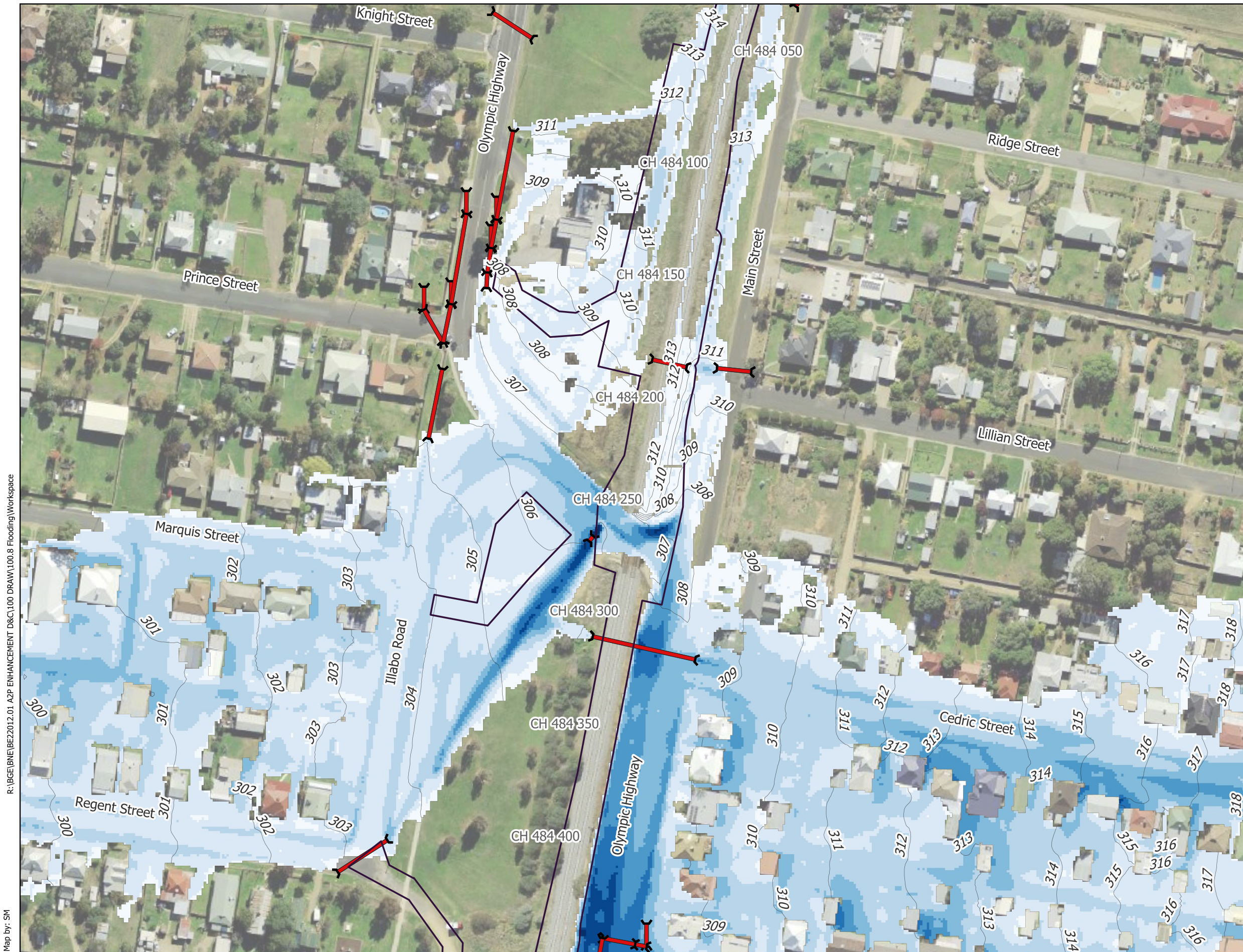


28/7/2025 GDA2020 MGA Zone55

**Figure 6b - Olympic Highway Underbridge - IFC Stage
 PMF Flood Depth (m) and Levels (m AHD) - Existing Conditions**

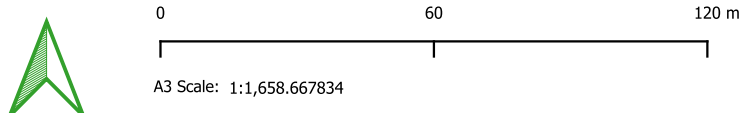
Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace













Map by: SM

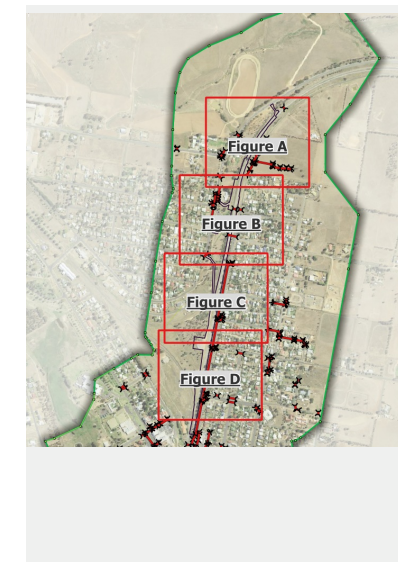


28/7/2025 GDA2020 MGA Zone55

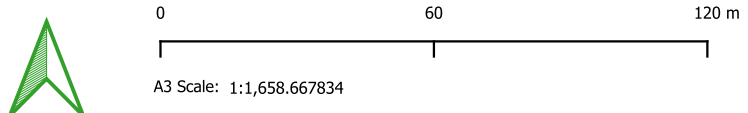
**Figure 6c - Olympic Highway Underbridge - IFC Stage
 PMF Flood Depth (m) and Levels (m AHD) - Existing Conditions**

Legend

-  TUFLOW Model Extent
 -  Project Boundary
 -  Drainage
 -  1m Water Level Contours (m AHD)
- Flood Depth (m)
-  <= 0.03
 -  0.03 - 0.2
 -  0.2 - 0.4
 -  0.4 - 0.6
 -  0.6 - 0.8
 -  0.8 - 1.0
 -  1.0 - 1.2
 -  > 1.2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM













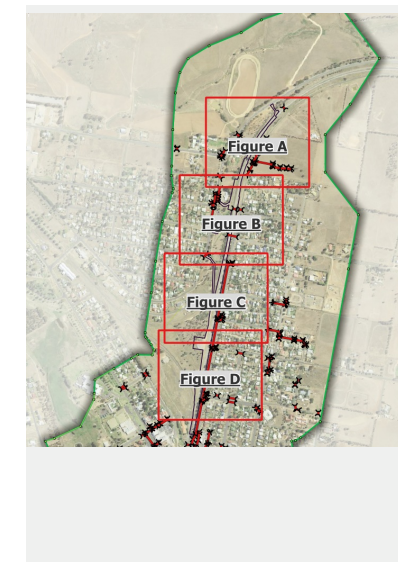
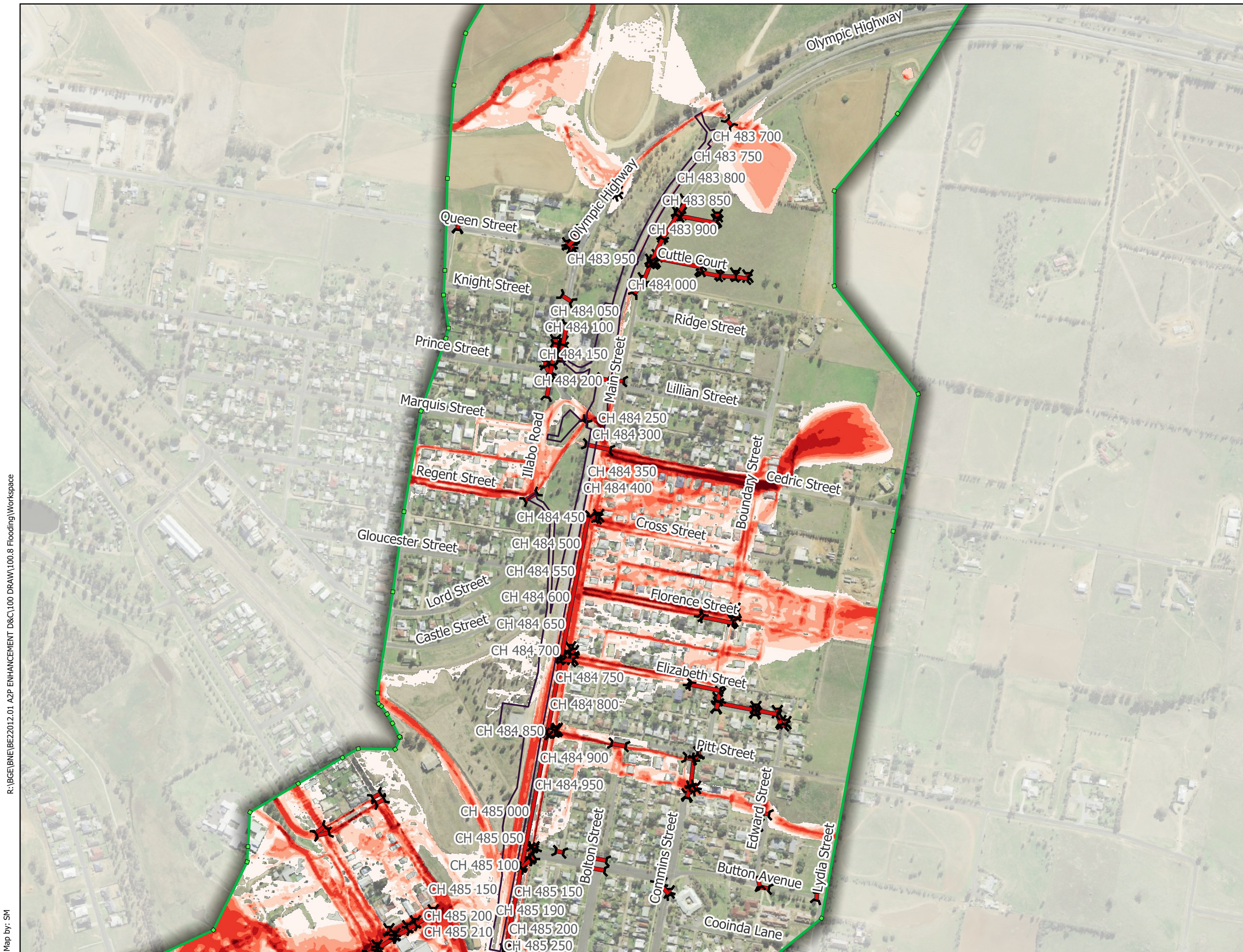
28/7/2025 GDA2020 MGA Zone55

**Figure 6d - Olympic Highway Underbridge - IFC Stage
 PMF Flood Depth (m) and Levels (m AHD) - Existing Conditions**

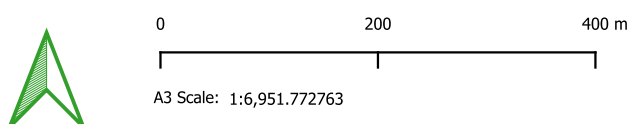
A3 Scale: 1:1,658.667834

Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  ≤ 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

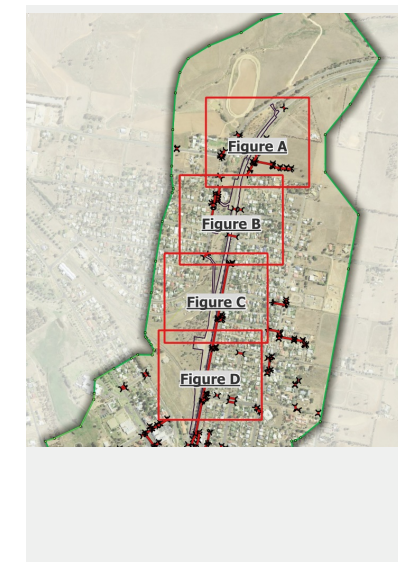


28/7/2025 GDA2020 MGA Zone55

Figure 7 - Olympic Highway Underbridge - IFC Stage
5% AEP Flood Velocity (m/s) - Existing Conditions

Legend

- TUFLOW Model Extent
- Project Boundary
- Drainage
- Velocity (m/s)
 - <= 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1
 - 1 - 1.5
 - 1.5 - 2
 - > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM











0 60 120 m

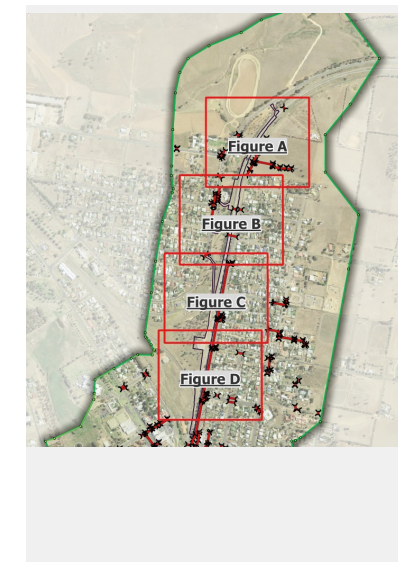
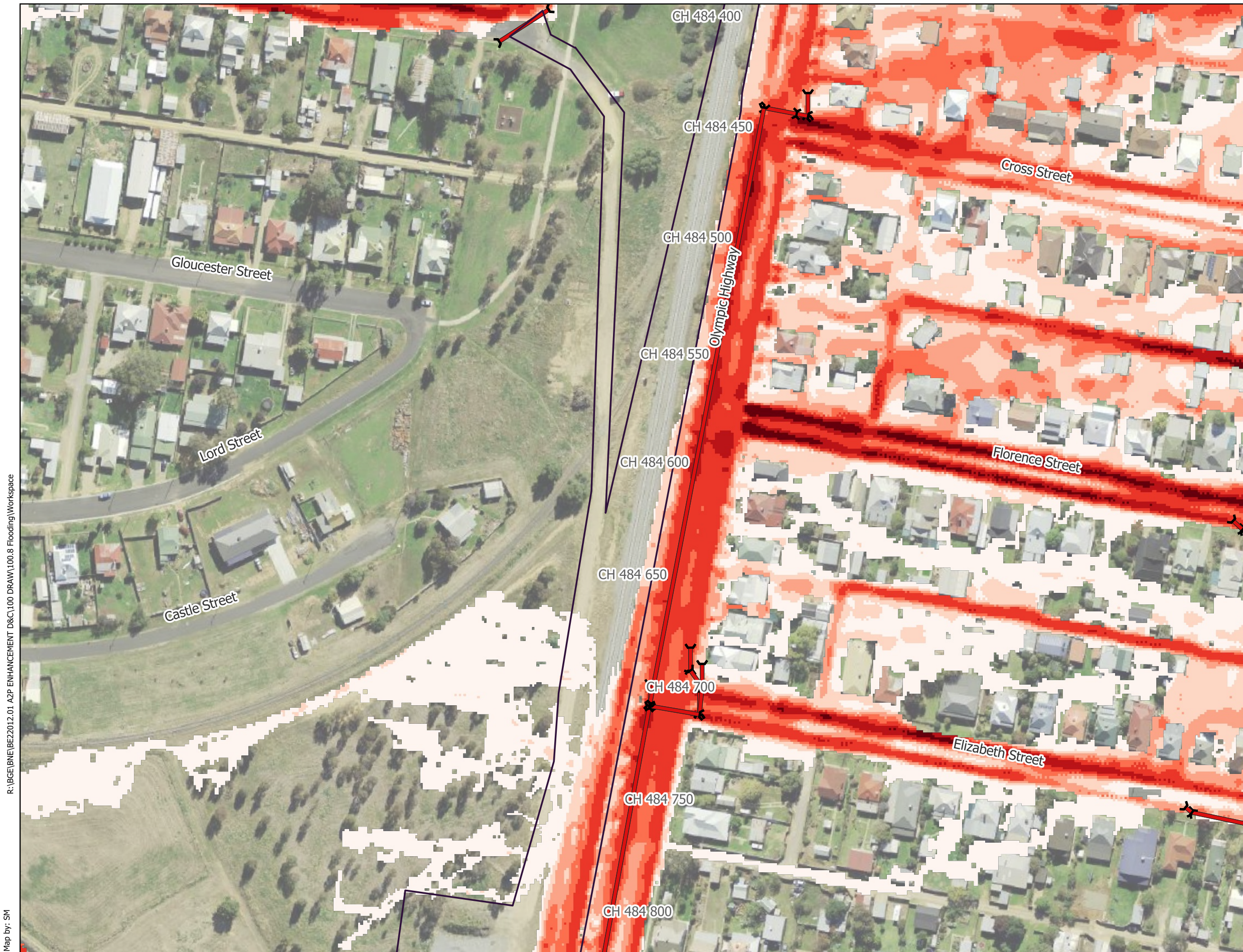
28/7/2025 GDA2020 MGA Zone55

A3 Scale: 1:1,658.667834

Figure 7a - Olympic Highway Underbridge - IFC Stage
5% AEP Flood Velocity (m/s) - Existing Conditions

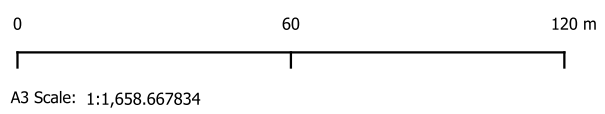
Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  ≤ 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace











Map by: SM

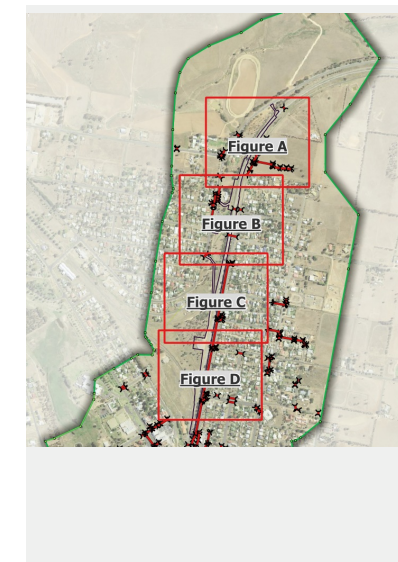


28/7/2025 GDA2020 MGA Zone55

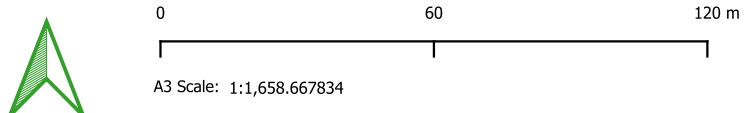
Figure 7b - Olympic Highway Underbridge - IFC Stage
5% AEP Flood Velocity (m/s) - Existing Conditions

Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  <= 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

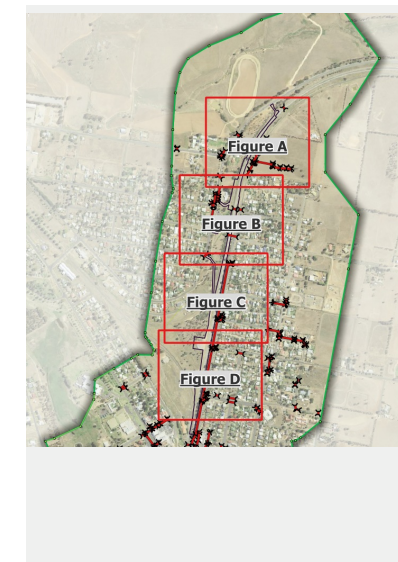


28/7/2025 GDA2020 MGA Zone55

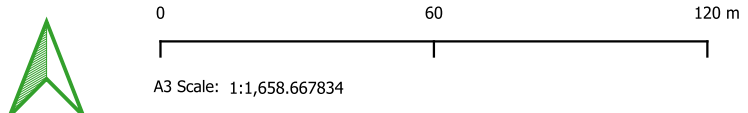
Figure 7c - Olympic Highway Underbridge - IFC Stage
5% AEP Flood Velocity (m/s) - Existing Conditions

Legend

- TUFLOW Model Extent
- Project Boundary
- Drainage
- Velocity (m/s)
 - <= 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1
 - 1 - 1.5
 - 1.5 - 2
 - > 2













R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
Map by: SM

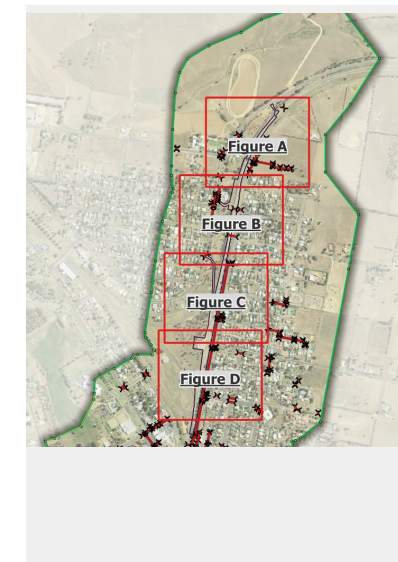
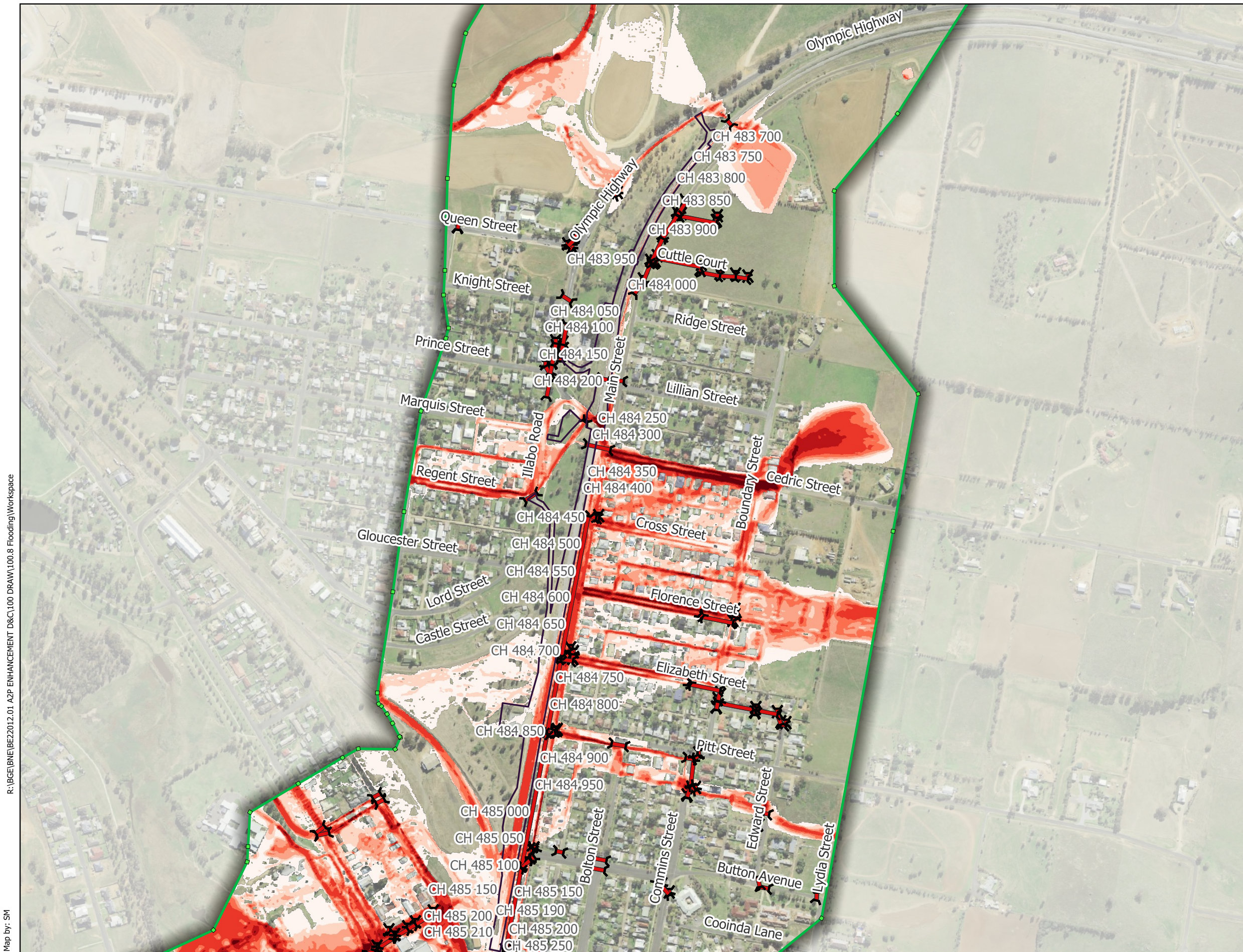


28/7/2025 GDA2020 MGA Zone55

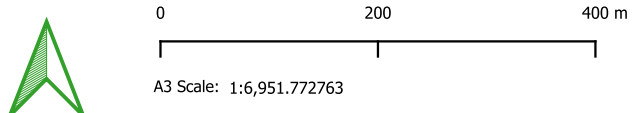
Figure 7d - Olympic Highway Underbridge - IFC Stage
5% AEP Flood Velocity (m/s) - Existing Conditions

Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  <= 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

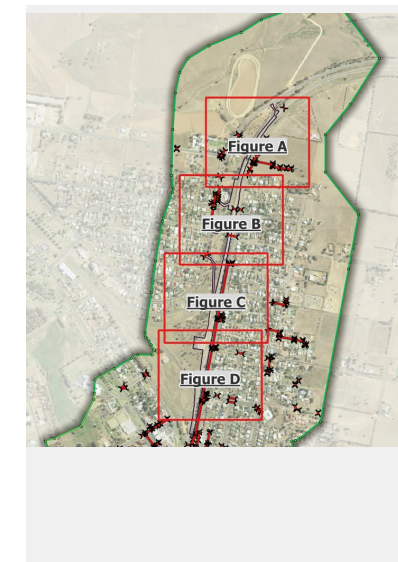


28/7/2025 GDA2020 MGA Zone55

Figure 8 - Olympic Highway Underbridge - IFC Stage
2% AEP Flood Velocity (m/s) - Existing Conditions

Legend

- TUFLOW Model Extent
- Project Boundary
- Drainage
- Velocity (m/s)
 - <= 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1
 - 1 - 1.5
 - 1.5 - 2
 - > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM













0 60 120 m

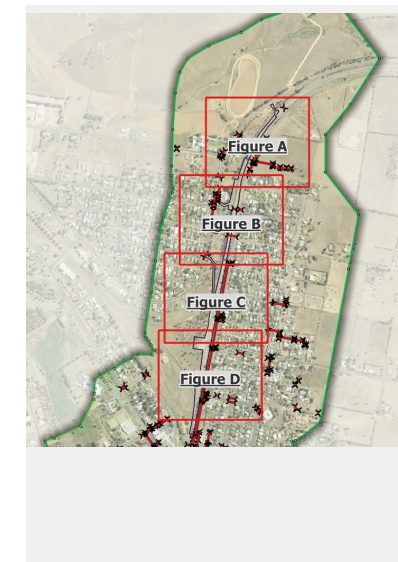
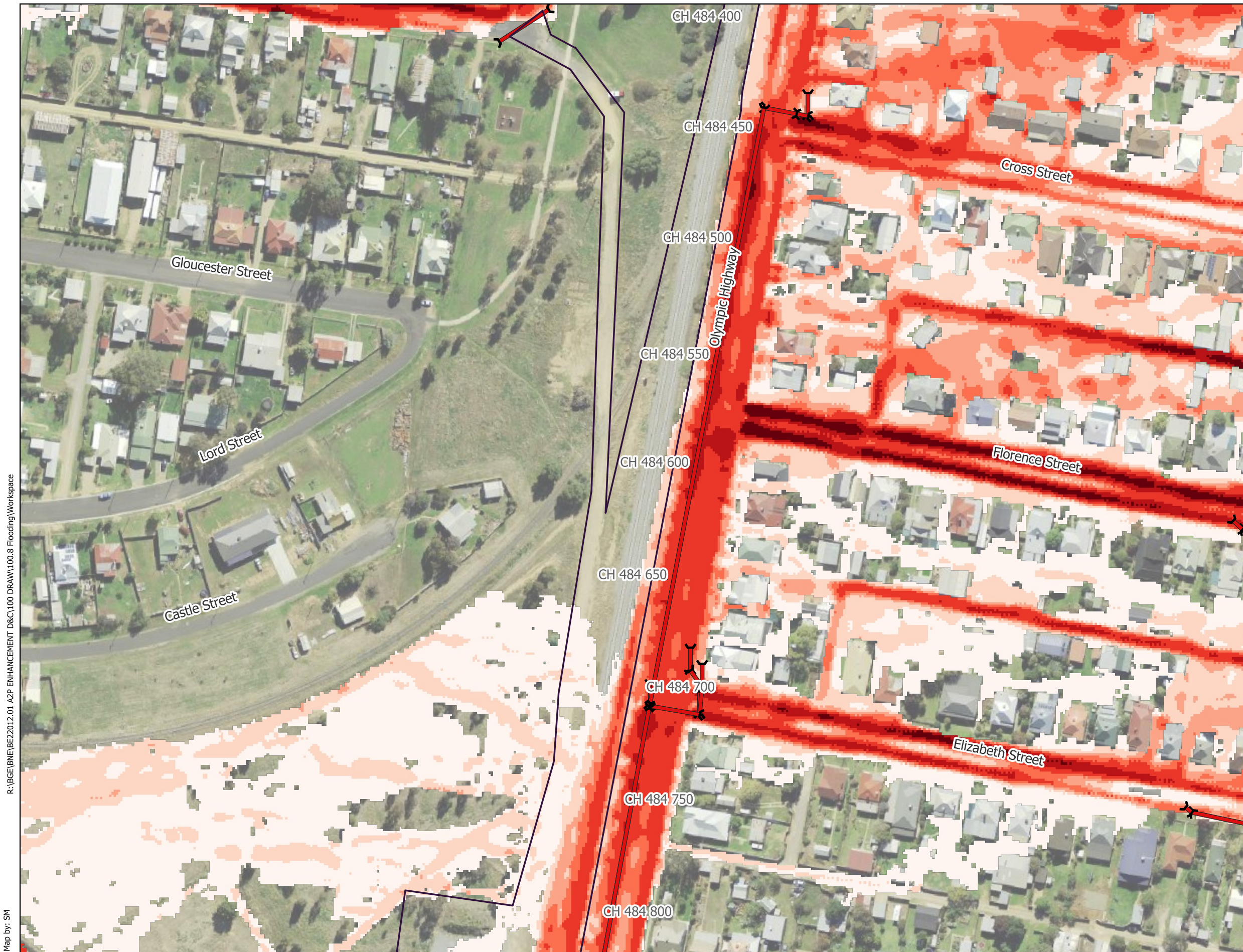
A3 Scale: 1:1,658,667834

28/7/2025 GDA2020 MGA Zone55

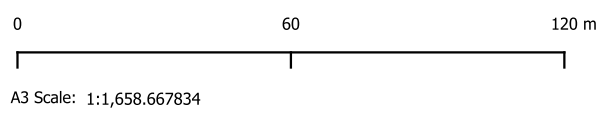
Figure 8a - Olympic Highway Underbridge - IFC Stage
2% AEP Flood Velocity (m/s) - Existing Conditions

Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  <= 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2













R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

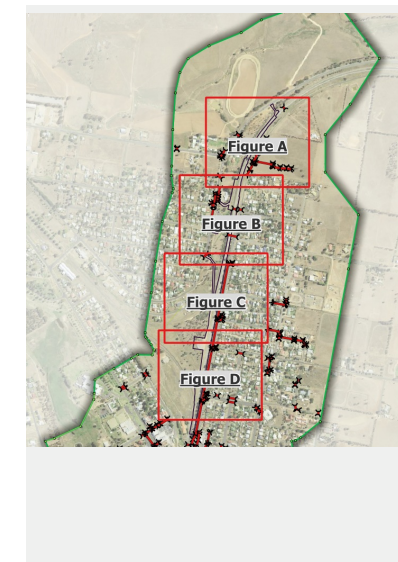


28/7/2025 GDA2020 MGA Zone55

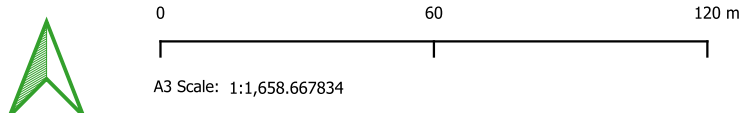
Figure 8b - Olympic Highway Underbridge - IFC Stage
2% AEP Flood Velocity (m/s) - Existing Conditions

Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  <= 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2













R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

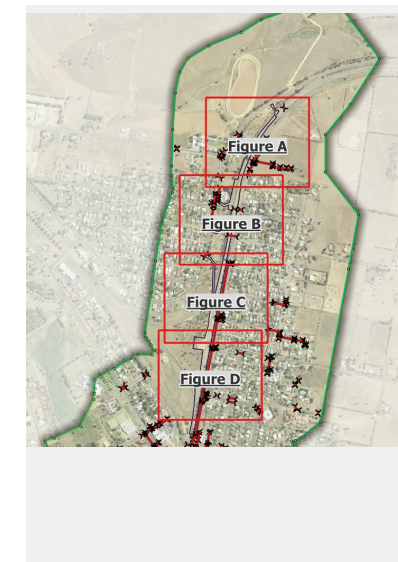


28/7/2025 GDA2020 MGA Zone55

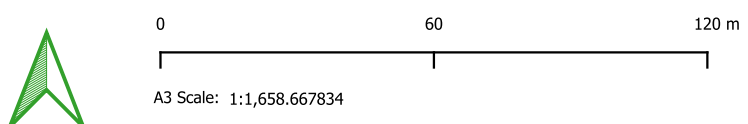
**Figure 8c - Olympic Highway Underbridge - IFC Stage
 2% AEP Flood Velocity (m/s) - Existing Conditions**

Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
 -  <= 0.25
 -  0.25 - 0.5
 -  0.5 - 0.75
 -  0.75 - 1
 -  1 - 1.5
 -  1.5 - 2
 -  > 2













R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

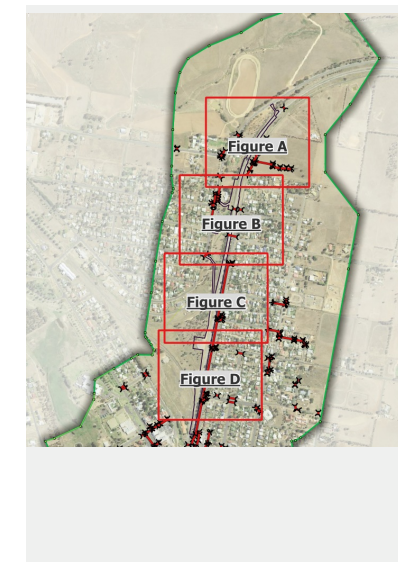
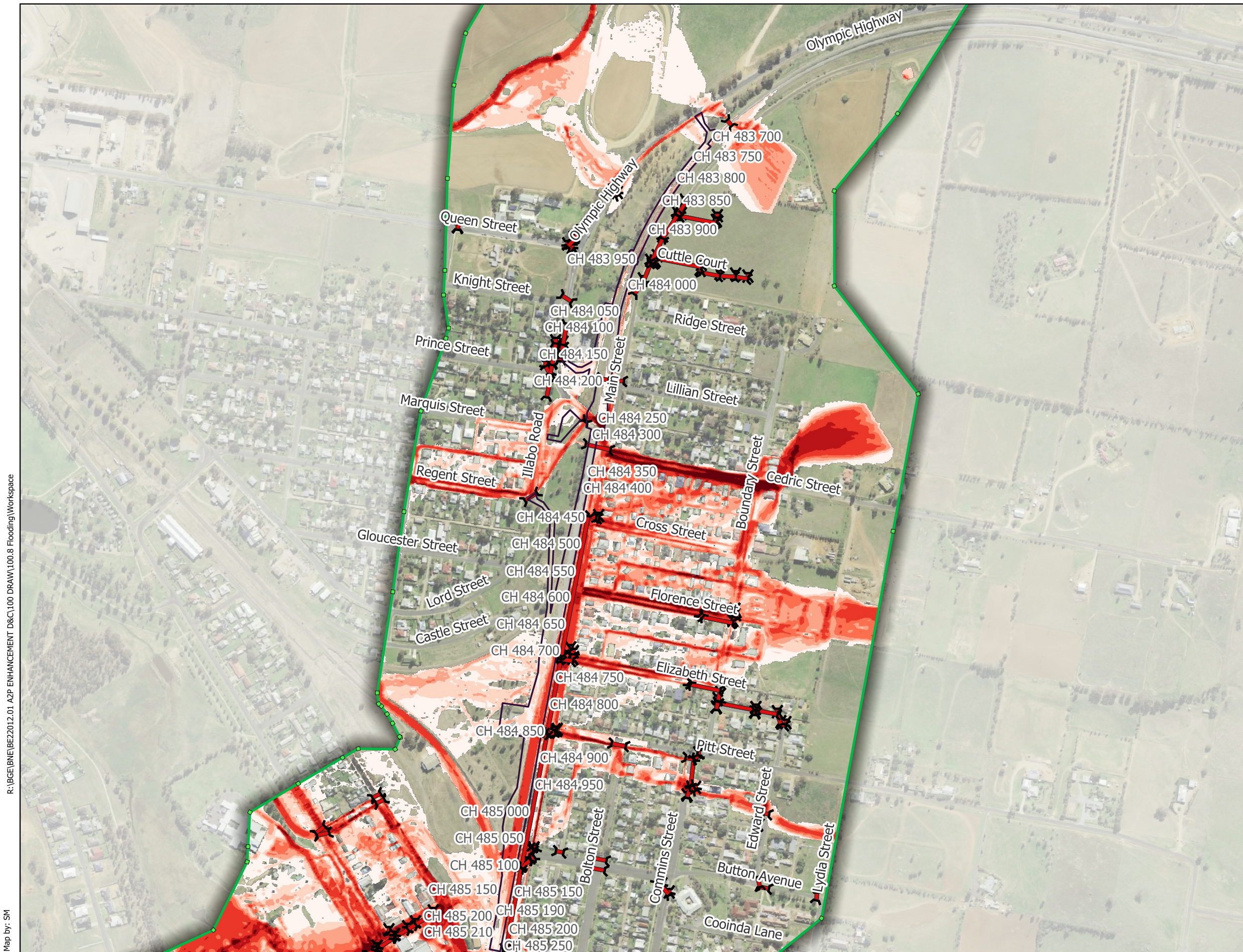


28/7/2025 GDA2020 MGA Zone55

Figure 8d - Olympic Highway Underbridge - IFC Stage
2% AEP Flood Velocity (m/s) - Existing Conditions

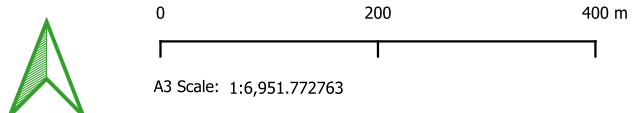
Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  <= 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace











Map by: SM

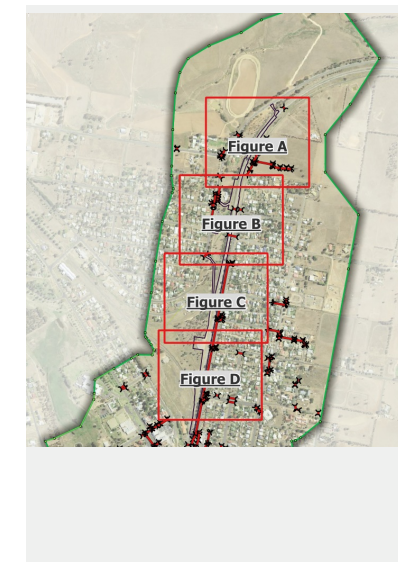


28/7/2025 GDA2020 MGA Zone55

Figure 9 - Olympic Highway Underbridge - IFC Stage
1% AEP Flood Velocity (m/s) - Existing Conditions

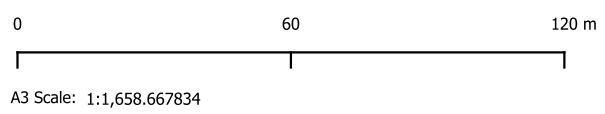
Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  ≤ 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM













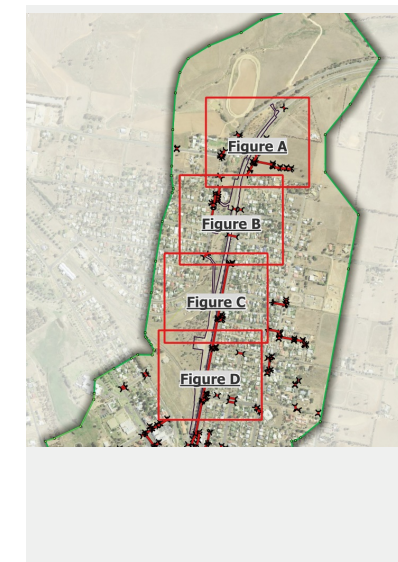
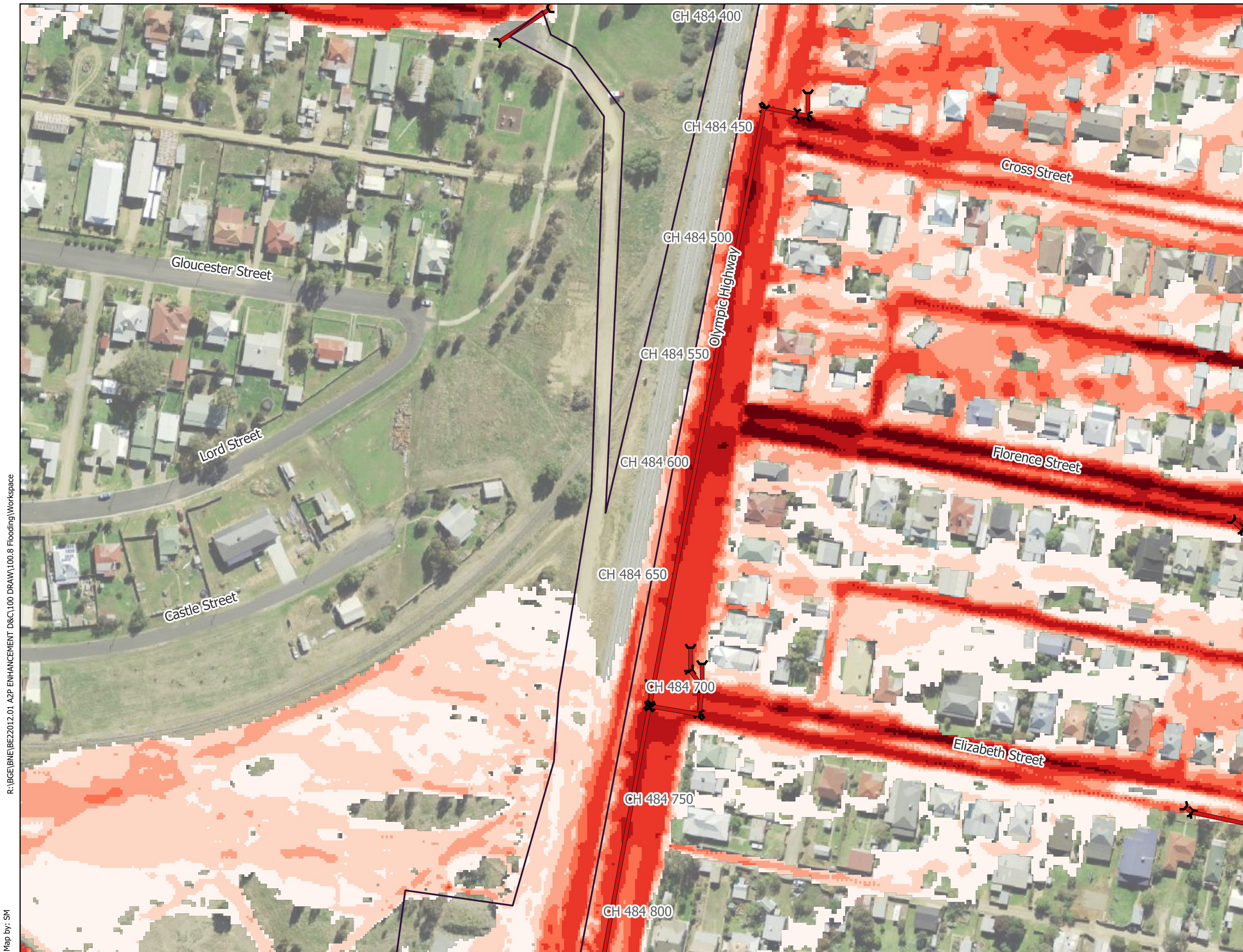
A3 Scale: 1:1,658.667834

28/7/2025 GDA2020 MGA Zone55

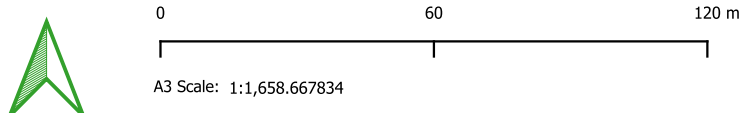
Figure 9a - Olympic Highway Underbridge - IFC Stage
1% AEP Flood Velocity (m/s) - Existing Conditions

Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  <= 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2













R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

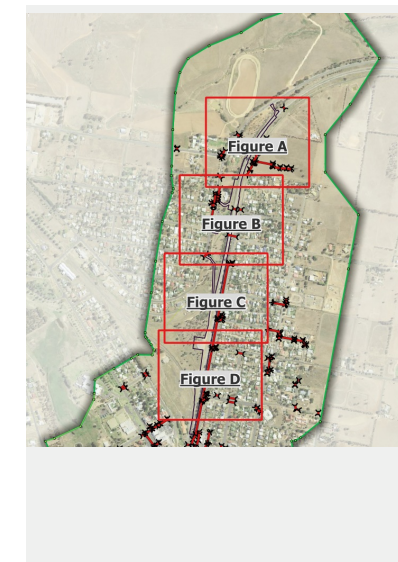


28/7/2025 GDA2020 MGA Zone55

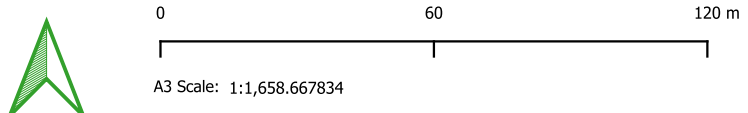
Figure 9b - Olympic Highway Underbridge - IFC Stage
1% AEP Flood Velocity (m/s) - Existing Conditions

Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  <= 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM



28/7/2025 GDA2020 MGA Zone55

Figure 9c - Olympic Highway Underbridge - IFC Stage
1% AEP Flood Velocity (m/s) - Existing Conditions

Legend

TUFLOW Model Extent

Project Boundary

Drainage

Velocity (m/s)

<= 0.25

0.25 - 0.5

0.5 - 0.75

0.75 - 1

1 - 1.5

1.5 - 2

> 2

R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM

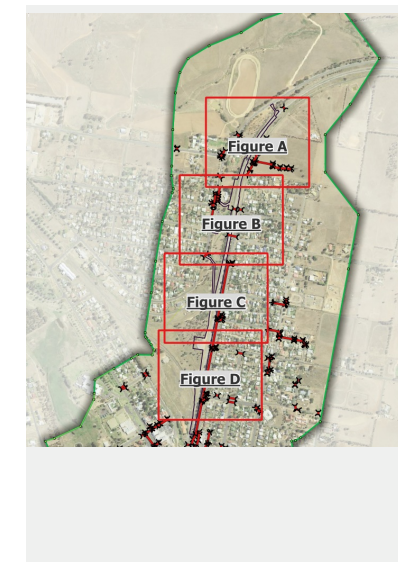


Figure 9d - Olympic Highway Underbridge - IFC Stage

1% AEP Flood Velocity (m/s) - Existing Conditions













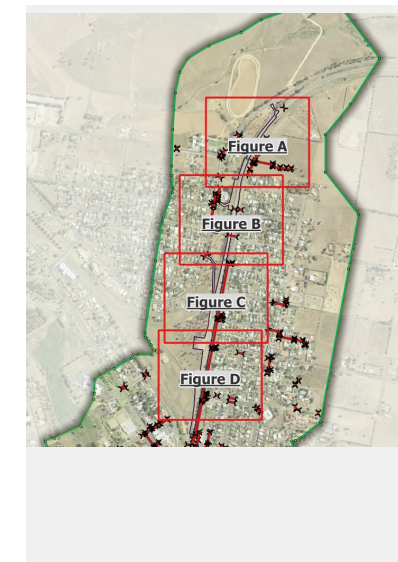
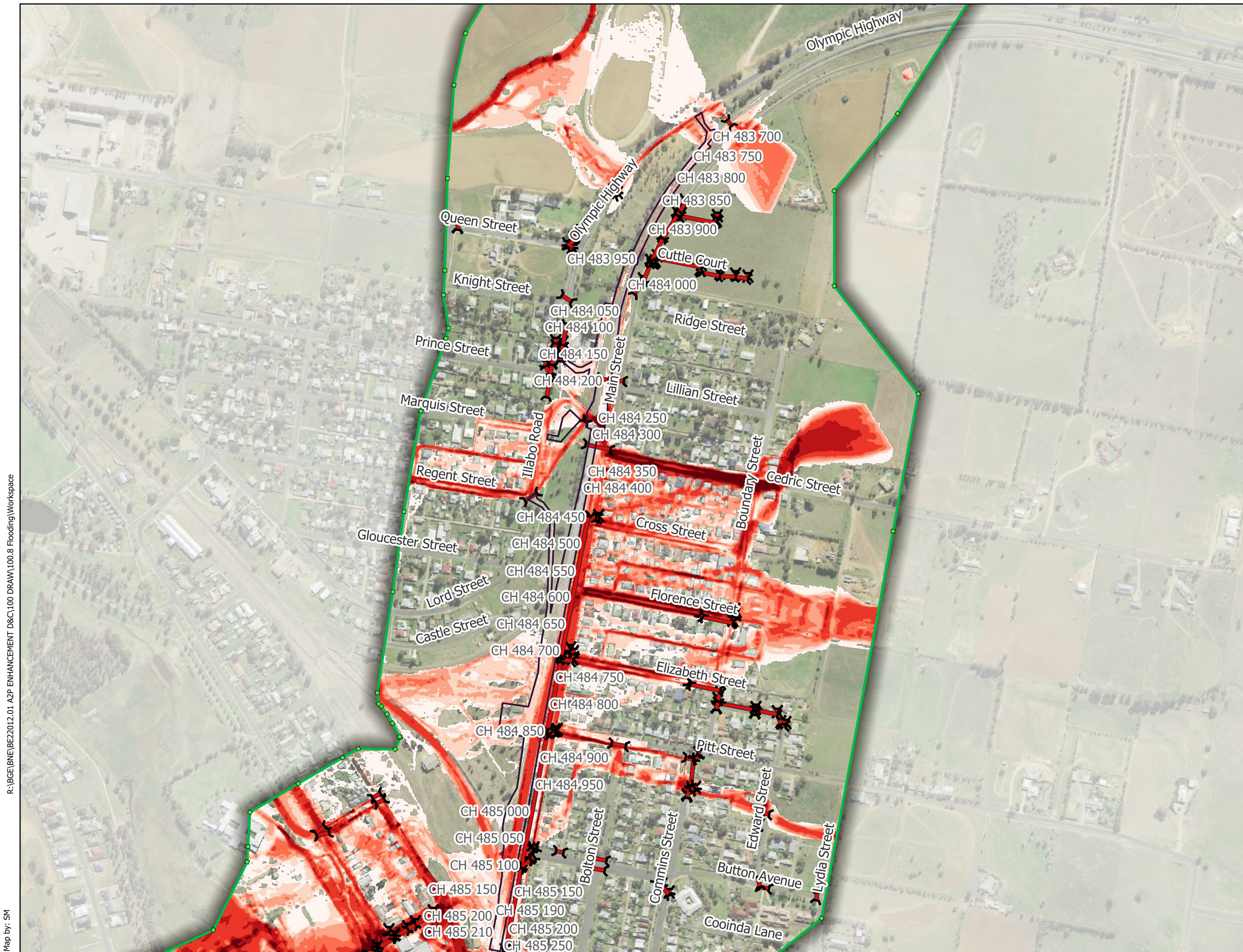
0 60 120 m

A3 Scale: 1:1,658.667834

28/7/2025 GDA2020 MGA Zone55

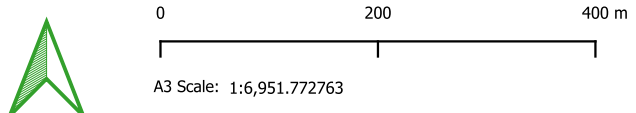
Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  ≤ 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM

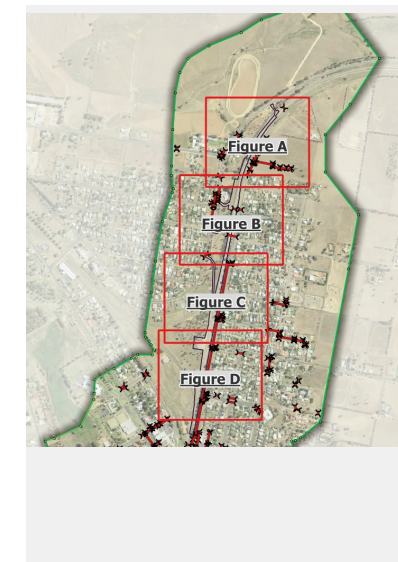
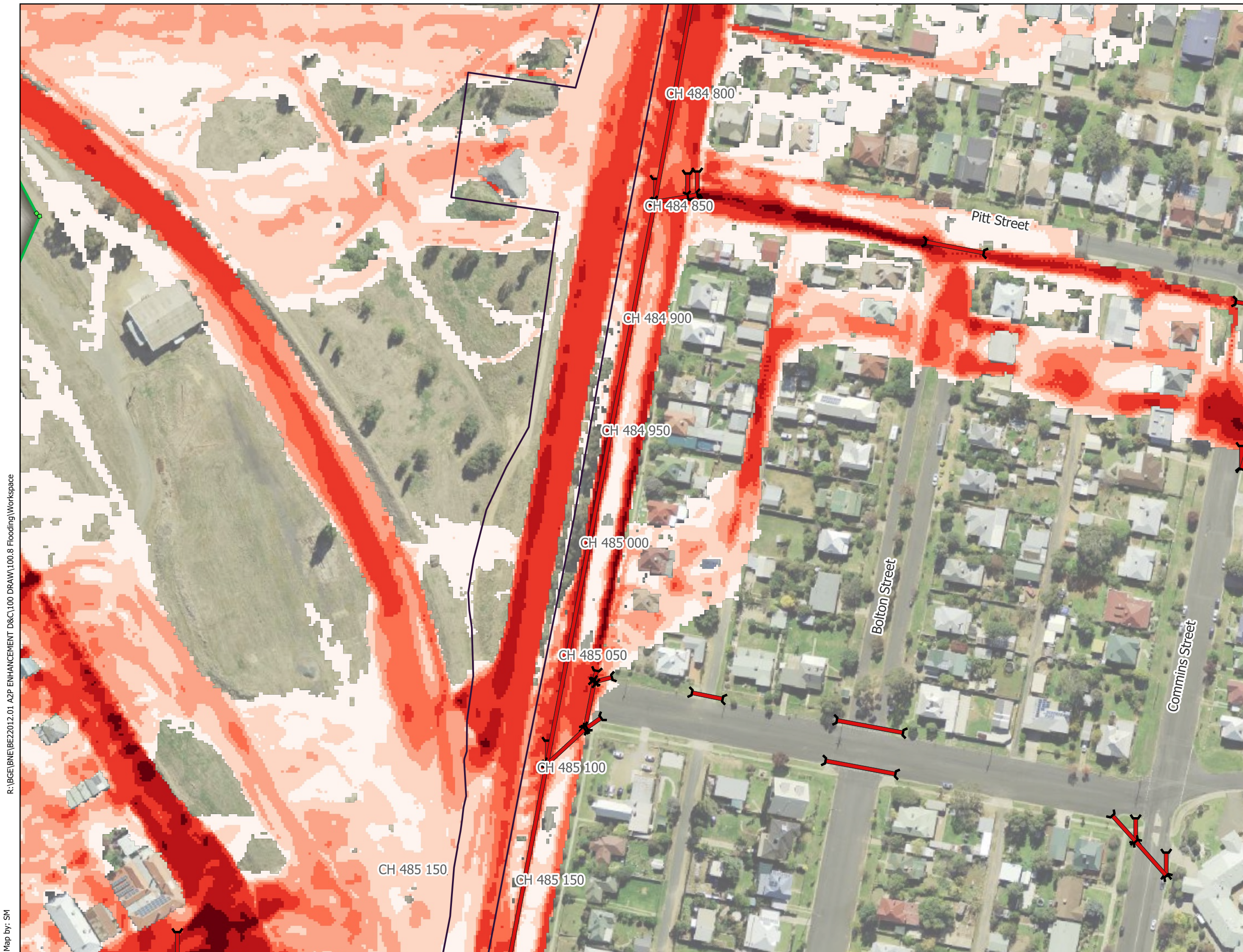


28/7/2025 GDA2020 MGA Zone55

Figure 10 - Olympic Highway Underbridge - IFC Stage
1% AEP Climate Change Flood Velocity (m/s) - Existing Conditions

Legend

- TUFLOW Model Extent
- Project Boundary
- Drainage
- Velocity (m/s)
 - <= 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1
 - 1 - 1.5
 - 1.5 - 2
 - > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM













0 60 120 m

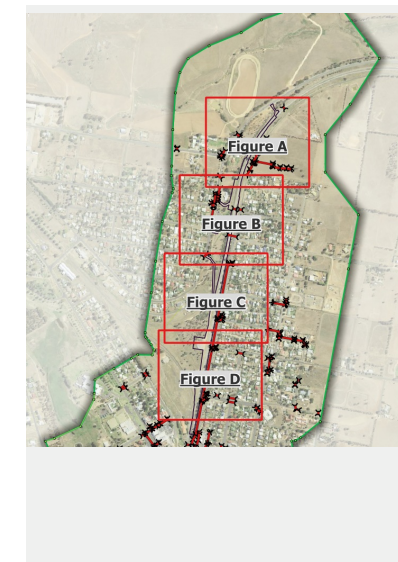
A3 Scale: 1:1,658.667834

28/7/2025 GDA2020 MGA Zone55

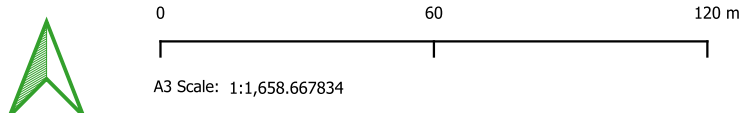
Figure 10a - Olympic Highway Underbridge - IFC Stage
1% AEP Climate Change Flood Velocity (m/s) - Existing Conditions

Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  ≤ 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2













R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM

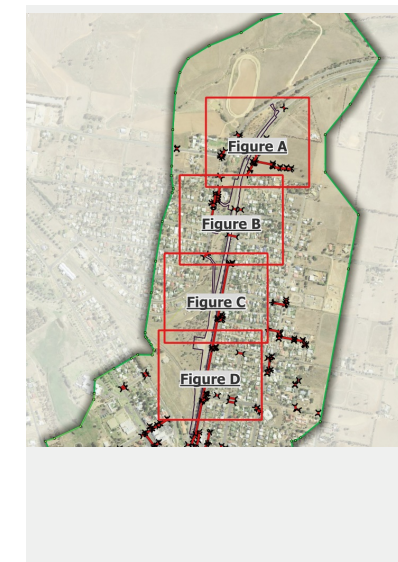
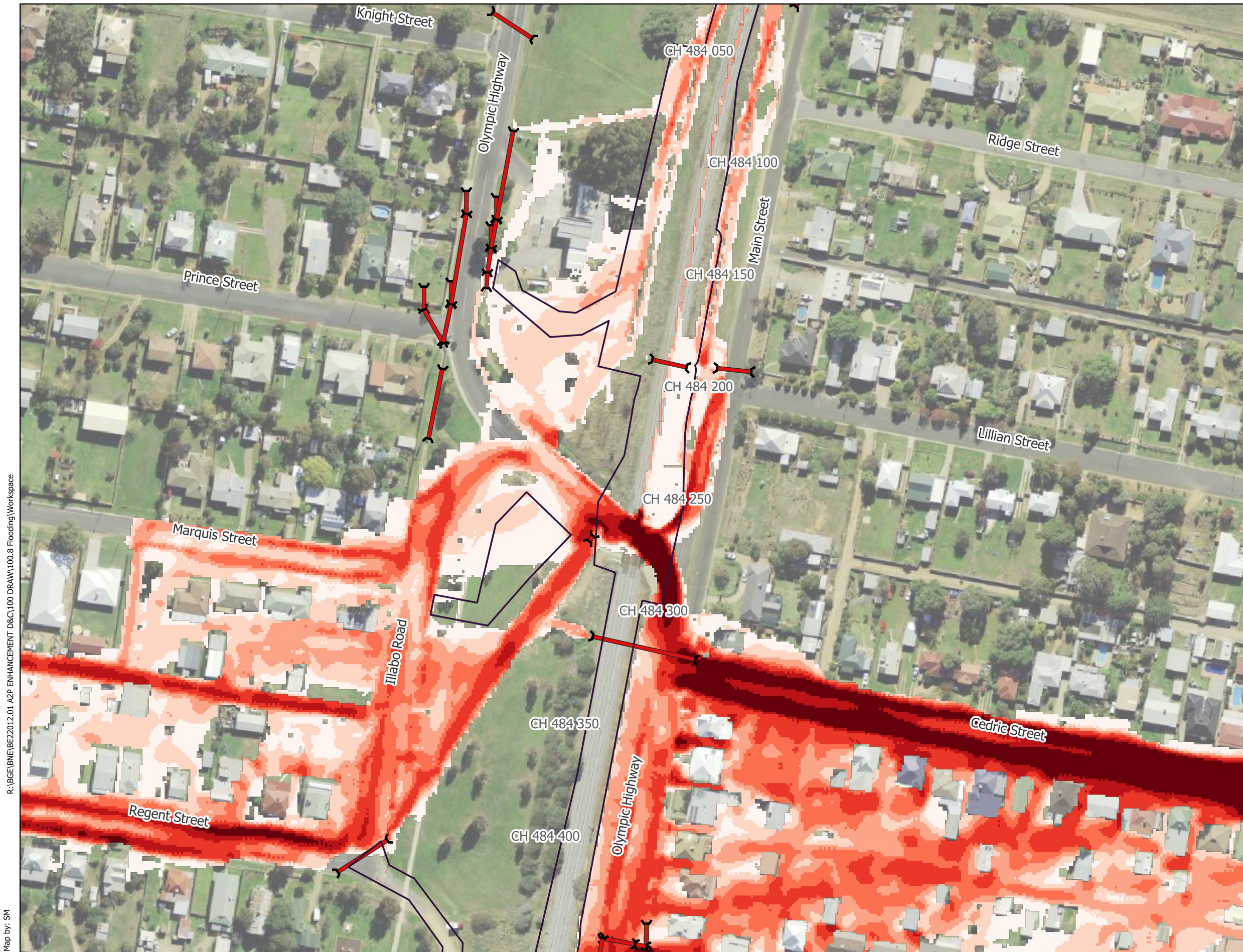


28/7/2025 GDA2020 MGA Zone55

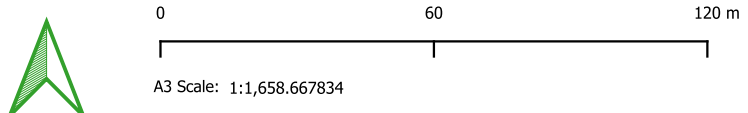
Figure 10b - Olympic Highway Underbridge - IFC Stage
1% AEP Climate Change Flood Velocity (m/s) - Existing Conditions

Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  <= 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM



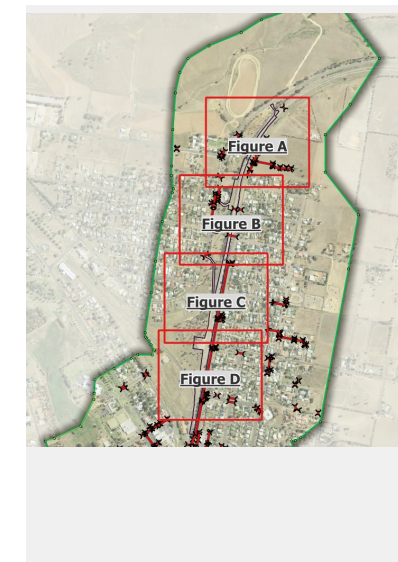
28/7/2025 GDA2020 MGA Zone55

Figure 10c - Olympic Highway Underbridge - IFC Stage
1% AEP Climate Change Flood Velocity (m/s) - Existing Conditions

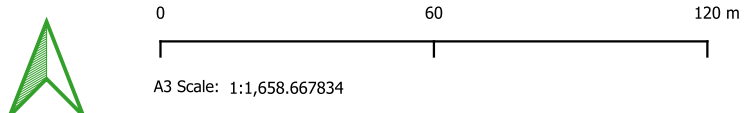
A3 Scale: 1:1,658.667834

Legend

- TUFLOW Model Extent
- Project Boundary
- Drainage
- Velocity (m/s)
 - <= 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1
 - 1 - 1.5
 - 1.5 - 2
 - > 2













R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
Map by: SM

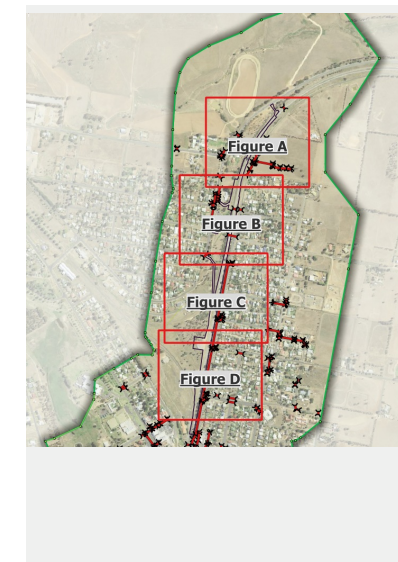
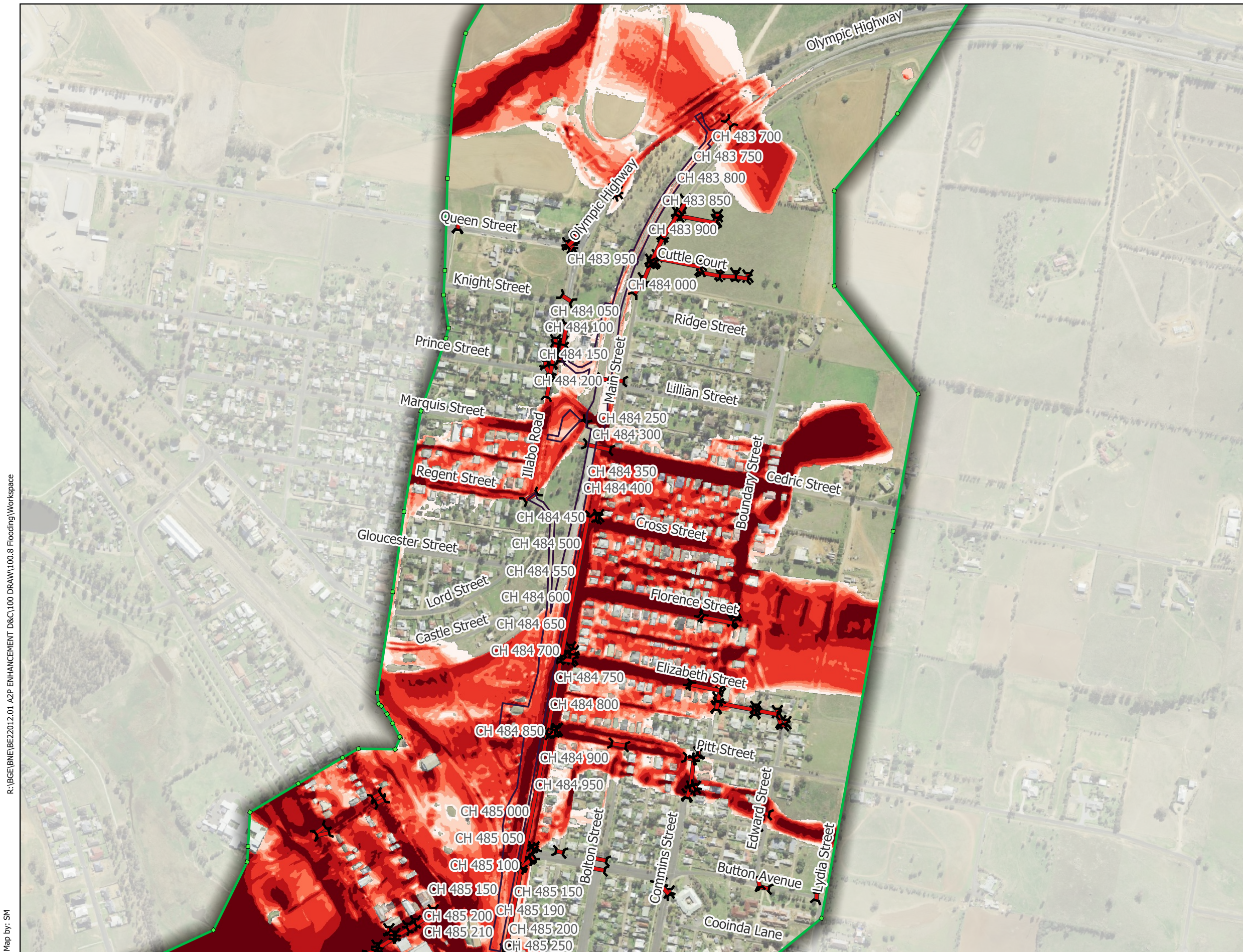


28/7/2025 GDA2020 MGA Zone55

Figure 10d - Olympic Highway Underbridge - IFC Stage
1% AEP Climate Change Flood Velocity (m/s) - Existing Conditions

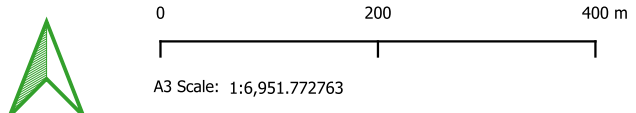
Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  <= 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM



0 200 400 m

A3 Scale: 1:6,951.772763

28/7/2025 GDA2020 MGA Zone55

**Figure 11 - Olympic Highway Underbridge - IFC Stage
 PMF Flood Velocity (m/s) - Existing Conditions**

Legend

TUFLOW Model Extent

Project Boundary

Drainage

Velocity (m/s)

<= 0.25

0.25 - 0.5

0.5 - 0.75

0.75 - 1

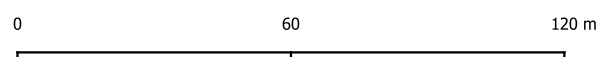
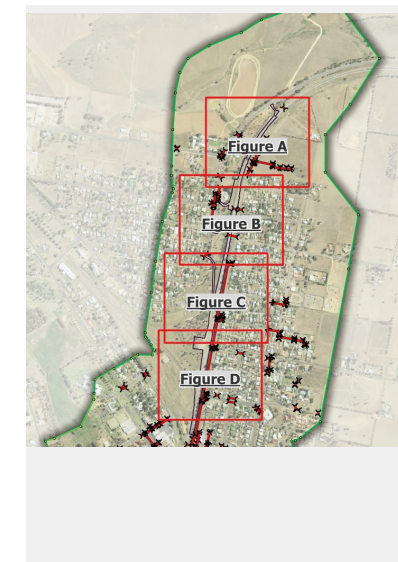
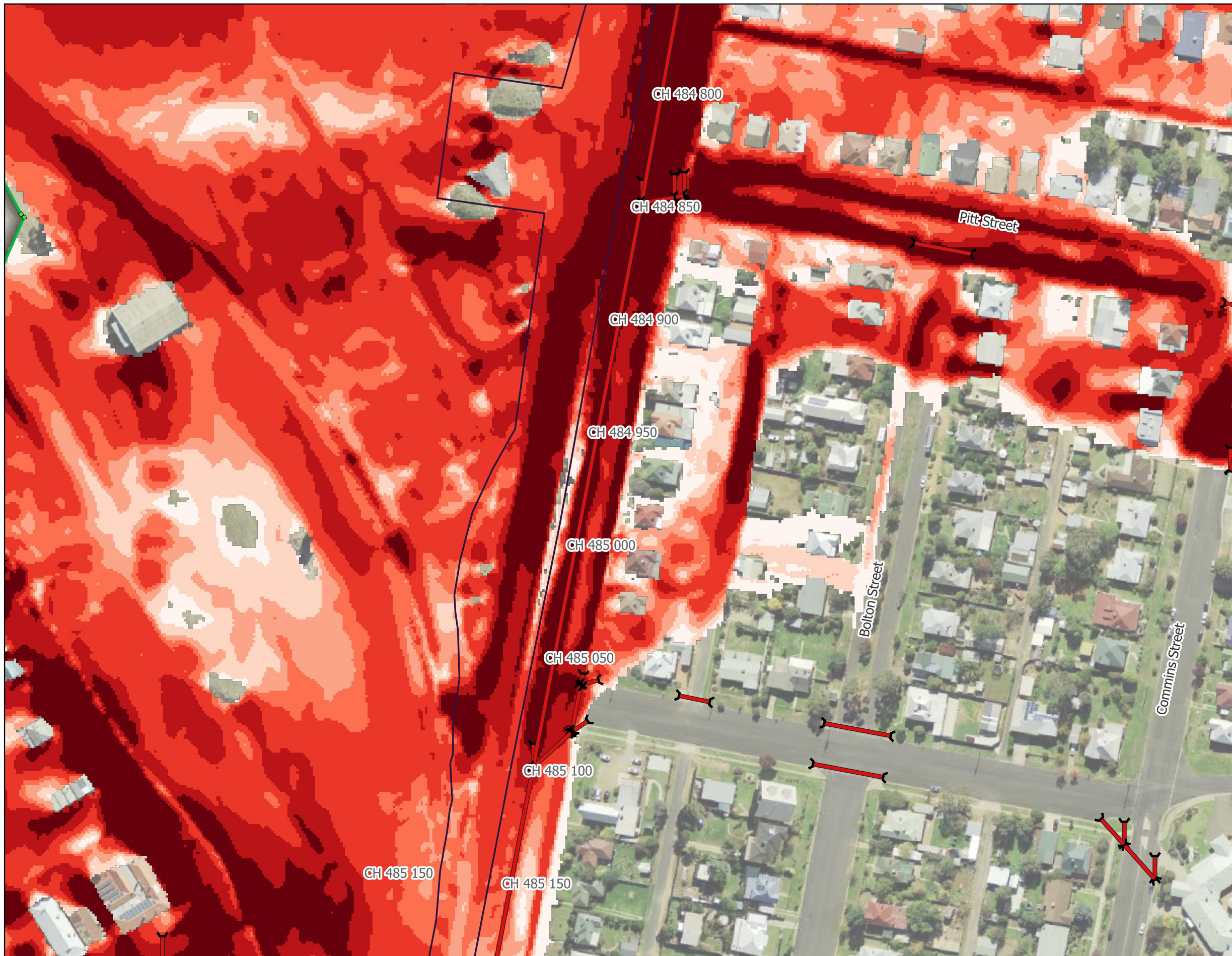
1 - 1.5

1.5 - 2

> 2

R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM













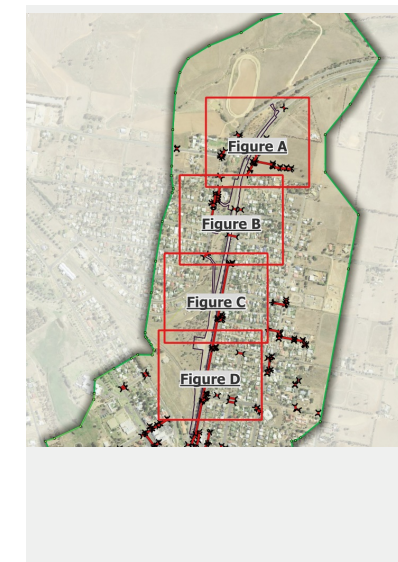
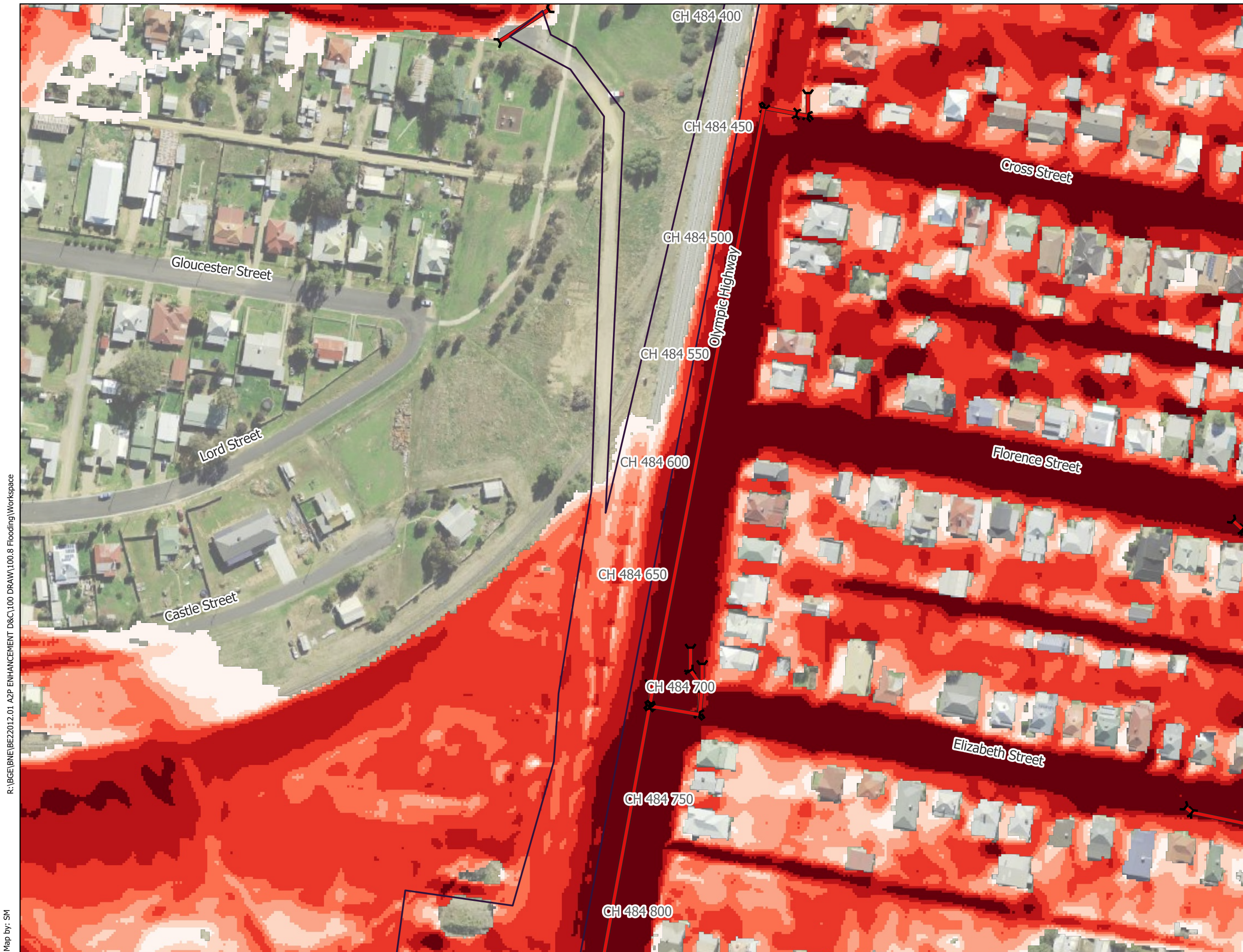
A3 Scale: 1:1,658.667834

28/7/2025 GDA2020 MGA Zone55

Figure 11a - Olympic Highway Underbridge - IFC Stage
PMF Flood Velocity (m/s) - Existing Conditions

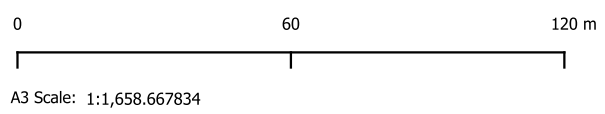
Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  ≤ 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace











Map by: SM

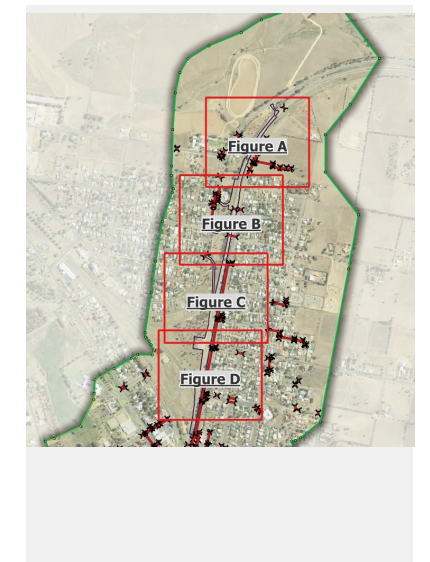
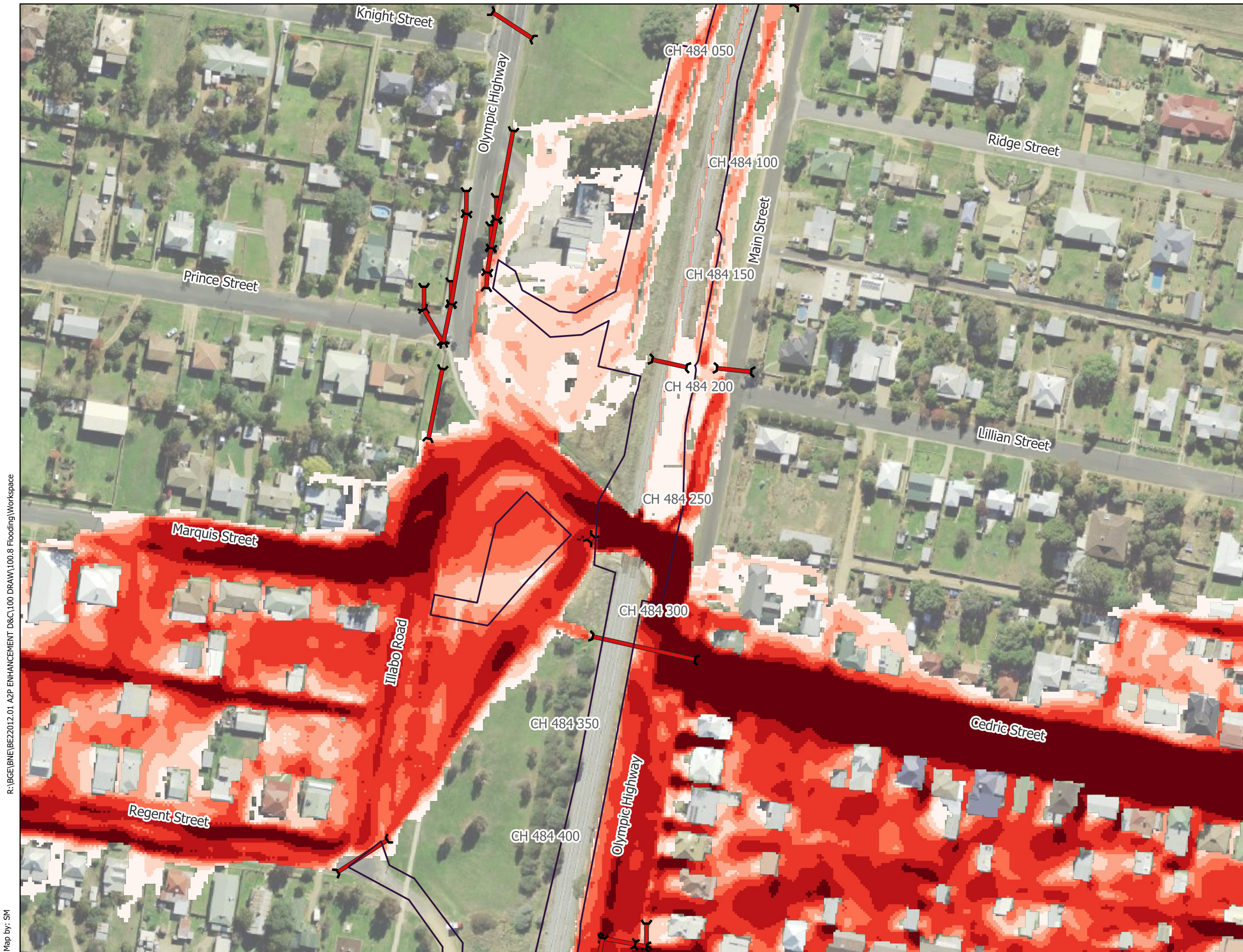


28/7/2025 GDA2020 MGA Zone55

**Figure 11b - Olympic Highway Underbridge - IFC Stage
 PMF Flood Velocity (m/s) - Existing Conditions**

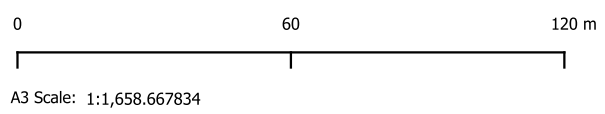
Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
-  <= 0.25
-  0.25 - 0.5
-  0.5 - 0.75
-  0.75 - 1
-  1 - 1.5
-  1.5 - 2
-  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace











Map by: SM

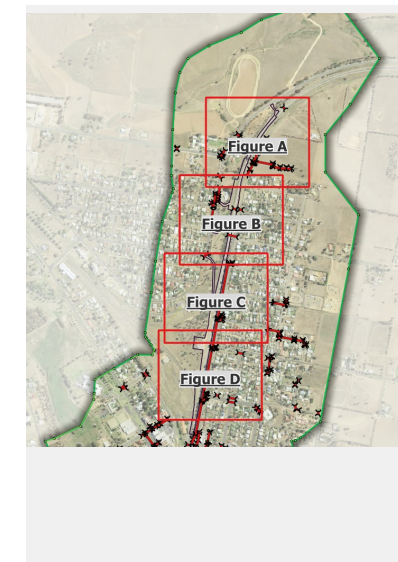
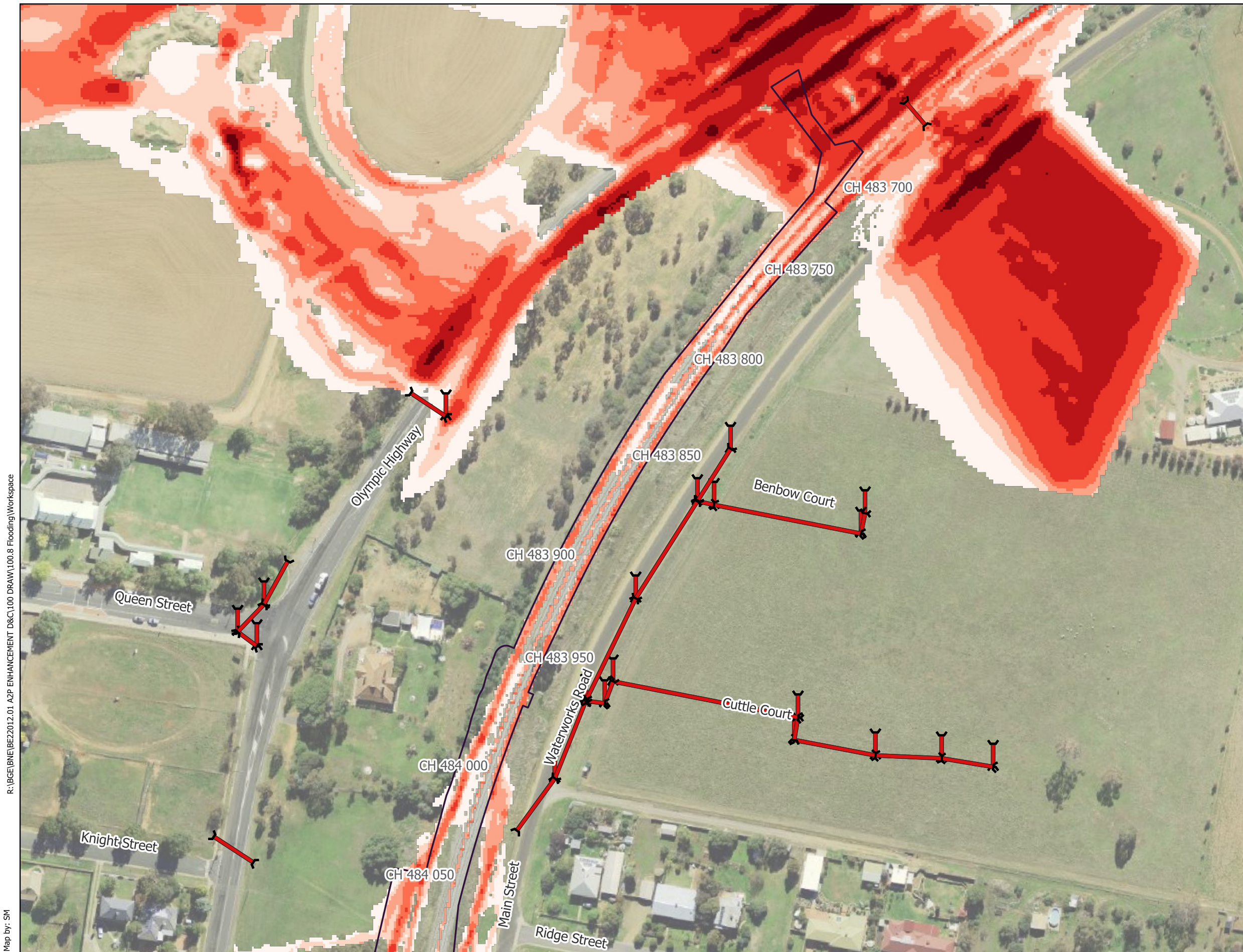


28/7/2025 GDA2020 MGA Zone55

**Figure 11c - Olympic Highway Underbridge - IFC Stage
 PMF Flood Velocity (m/s) - Existing Conditions**

Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Velocity (m/s)
 -  <= 0.25
 -  0.25 - 0.5
 -  0.5 - 0.75
 -  0.75 - 1
 -  1 - 1.5
 -  1.5 - 2
 -  > 2



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM












0 60 120 m

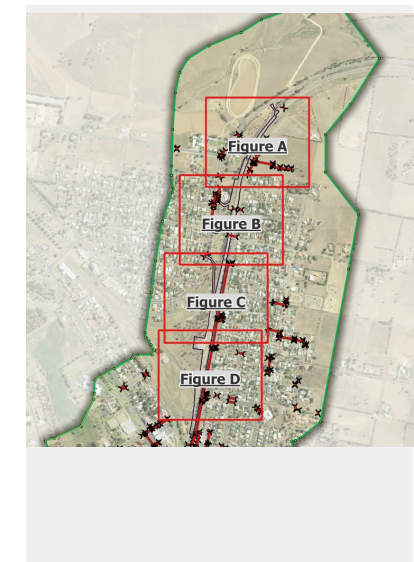
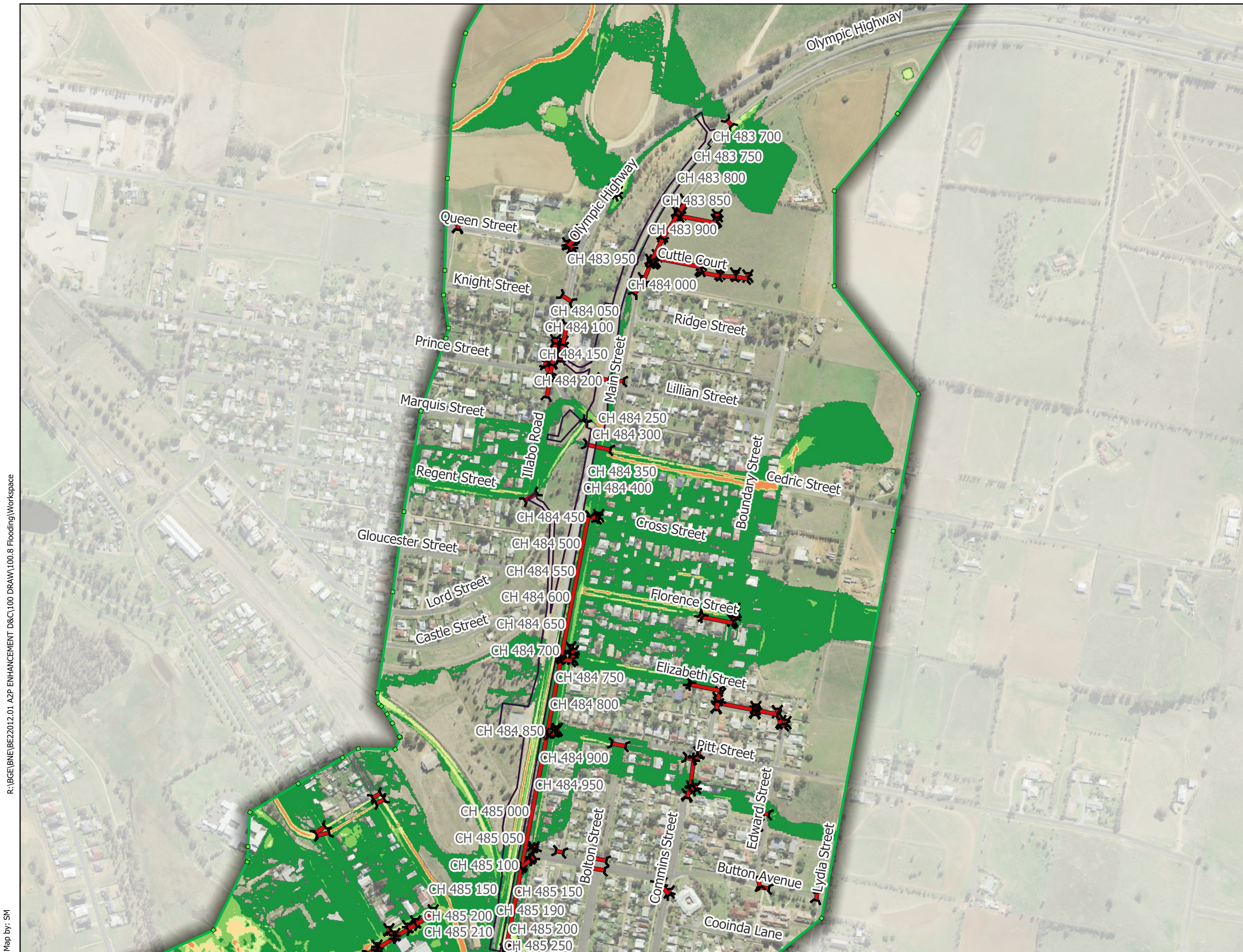
A3 Scale: 1:1,658,667834

28/7/2025 GDA2020 MGA Zone55

Figure 11d - Olympic Highway Underbridge - IFC Stage
PMF Flood Velocity (m/s) - Existing Conditions

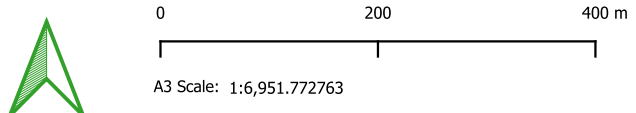
Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Flood Hazard Category**
-  H1
-  H2
-  H3
-  H4
-  H5
-  H6



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM



28/7/2025 GDA2020 MGA Zone55

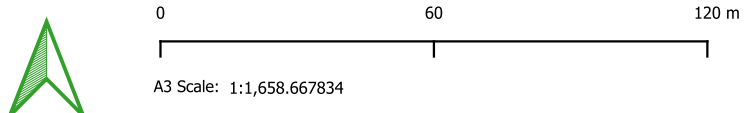
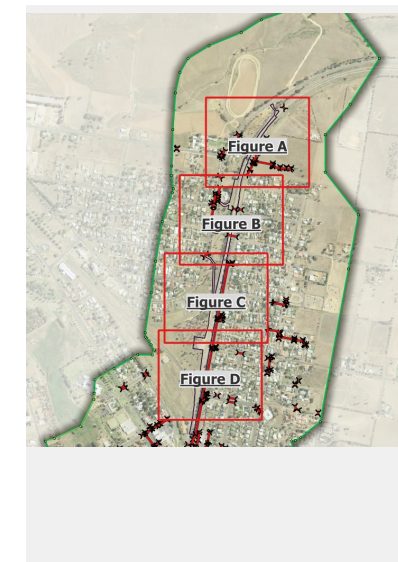
**Figure 12 - Olympic Highway Underbridge - IFC Stage
 5% AEP Flood Hazard (ARR2019) - Existing Conditions**

Legend

- TUFLOW Model Extent
- Project Boundary
- Drainage
- Flood Hazard Category
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6

R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM












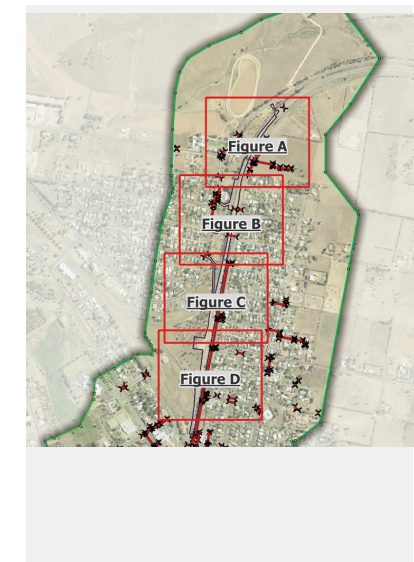
A3 Scale: 1:1,658.667834

28/7/2025 GDA2020 MGA Zone55

Figure 12a - Olympic Highway Underbridge - IFC Stage
5% AEP Flood Hazard (ARR2019) - Existing Conditions

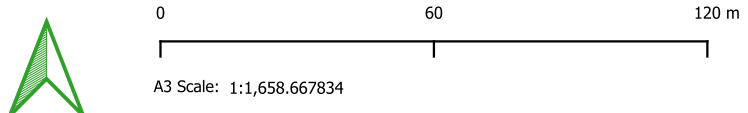
Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Flood Hazard Category**
-  H1
-  H2
-  H3
-  H4
-  H5
-  H6



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace

Map by: SM












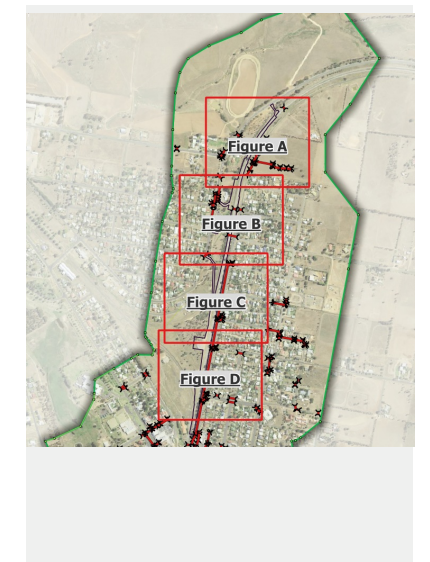
28/7/2025 GDA2020 MGA Zone55

**Figure 12b - Olympic Highway Underbridge - IFC Stage
 5% AEP Flood Hazard (ARR2019) - Existing Conditions**

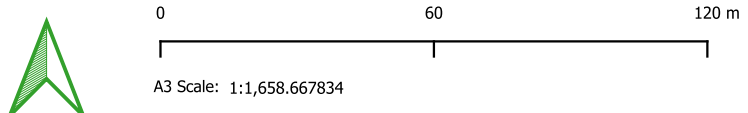
A3 Scale: 1:1,658,667834

Legend

-  TUFLOW Model Extent
-  Project Boundary
-  Drainage
- Flood Hazard Category**
-  H1
-  H2
-  H3
-  H4
-  H5
-  H6



R:\BGE\BNE\BE2012.01 A2P ENHANCEMENT D&C\100 DRAW\100.8 Flooding\Workspace
 Map by: SM



28/7/2025 GDA2020 MGA Zone55

**Figure 12c - Olympic Highway Underbridge - IFC Stage
 5% AEP Flood Hazard (ARR2019) - Existing Conditions**

A3 Scale: 1:1,658.667834