

SDLAM Program

RfS DE RfS_063

Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area

Revision B

3Rivers

Document record

RFS No.:	DE_RFS_063
RFS Name:	Yanco Creek Modernisation – Part 2 EIS
Document Title:	Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area
Document No.:	DE19-823-YCM2A-DE-HY-RPT-0001
Revision:	0
Date:	9/12/2024
Client Name:	The NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW)
Project Manager:	Matt Presswell – 3Rivers Project Delivery Coordinator
Author(s):	Peter Woodman & Eliza Karlson

Document history and status

Revision	Date	Status	Description	Author	Reviewed	Approved
A	23/02/2024	S4				
0	12/09/2024	Final	Appendix to EIS Flood Impact Assessment Report	P Woodman & E Karlson	P Pedruco	D. Chubb

© Copyright 2024 Jacobs Group (Australia) Pty Limited and GHD Pty Ltd forming the Joint Venture. The concepts and information contained in this document are the property of Jacobs and GHD. Use or copying of this document in whole or in part without the written permission of constitutes an infringement of copyright.

Contents

1. About this report 1
1.1 Purpose 1
1.2 Scope and limitations 1
1.3 Assumptions 1
2. Introduction 2
2.1 Background 2
2.2 Study objectives 2
2.3 Report Structure 4
3. Data 5
3.1 Data Review 5
3.1.1 Elevation Data 5
3.1.2 Channel and topographic survey 5
3.1.3 Structures 6
3.1.4 Bathymetric Survey 7
3.1.5 Gauge Data/Inflows 9
3.1.6 Existing Hydraulic Models 9
3.1.7 Landuse Layers 10
3.1.8 Aerial Imagery Caputre 11
3.2 Data collection programme 11
3.3 Inundation imagery 12
4. Existing Modelling Approach and Setup 14
4.1 General schematisation 14
4.1.1 Modelling approach 14
4.1.2 Software and reason for choice 14
4.2 Model Topography 18
4.2.1 Digital Elevation Model (DEM) 18
4.2.2 Model bathymetry 19
4.2.3 Terrain Modifications 19
4.2.4 Model Domain and Boundary 23
4.3 Boundary Conditions 23
4.4 Model Roughness 29
4.5 Hydraulic structures 31
4.5.1 Yanco Creek 31
4.5.2 Billabong Creek 38
4.5.3 Forest Creek 47
4.5.4 Piccaninny Creek 55
4.6 Model Losses 61
4.6.1 Summary of volumetric losses 61
4.6.2 Summary of structure losses 63
4.7 Flow Scenarios 65
4.8 Model Naming Convention 69

5. Existing Model Sensitivity and Calibration 71
5.1 Introduction 71
5.2 Sensitivity Analysis 71
5.2.1 Overview 71
5.2.2 Model grid size 74
5.2.3 Downstream boundary slope 77
5.2.4 Catchment Roughness 79
5.2.5 Volumetric Losses 82
5.2.6 Structure losses at bridges 85
5.2.7 Blockage 87
5.2.8 Parry's Weir Crest level 89
5.2.9 TUFLOW HPC Control Number Factor 92
5.2.10 Forest Creek Block Bank (FCBB) and Hartwood Weir Crest Level 94
5.2.11 Flood Impacts – Unsteady Hydrograph vs Steady State for 1% AEP 97
5.2.12 Conclusion 104
5.3 Calibration and Validation 105
5.3.1 Overview 105
5.3.2 Rating curves 108
5.3.3 August 2017 Event 112
5.3.4 August 2021 Event 117
5.3.5 September 2021 Event 122
5.3.6 October 2021 Event 129
5.3.7 August 2022 Event 132
5.3.8 Conclusion 142
6. Proposed Model Setup 143
6.1 Overview of changes 143
6.2 Hartwood Regulator Design 143
6.2.1 Proposed regulator structure 143
6.2.2 Existing regulator structure 148
6.2.3 Access Track 148
6.2.4 Forest Creek Offtake (FCO) Operations 148
6.3 Forest Creek Return Regulator Design 150
6.4 Wilsons Anabranch Offtake Design 151
6.5 Design changes not included in modelling 151
7. Results 152
7.1 Cumulative versus Hartwood Weir Works Only 152
7.2 Operational Flow Scenarios 152
7.2.1 Flow 152
7.2.2 Afflux 156
7.2.3 Flood Hazard 161
7.2.4 Velocity 164
7.3 Flood Flow Scenarios 169

7.3.1 Flows 169
7.3.2 Afflux 172
7.3.3 Flood Hazard 180
7.3.4 Velocity 180
7.4 Impact Conclusion 184
8. Limitations, assumptions and uncertainty 185
9. Conclusion 186
10. References 187
Appendix A. DEM Verification 188
Appendix B. Bridge loss calculation 195
Appendix C. Sensitivity afflux maps 197
Appendix D. Structure assumptions for Impact Assessment 199
Appendix E. Afflux Cumulative versus Hartwood Only 202
Appendix F. Impact Assessment – Operational Flow Scenarios 204
Appendix G. Impact Assessment – Flood Flow Scenarios 213

1. About this report

1.1 Purpose

The 3Rivers Joint Venture (3Rivers) has been engaged to provide certain Engineering Services for the NSW Sustainable Diversion Limit Adjustment Mechanism (SDLAM) program in accordance with the Agreement between 3Rivers and the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW).

The sole purpose of this report and the associated services performed by 3Rivers is to summarise the technical background, assumptions and setup of the hydraulic modelling undertaking for the assessment of proposed Yanco Modernisation works (namely Hartwood Weir, Forest Creek Return and Wilsons Anabranch Offtake structures) contained in the Hartwood Weir to Piccaninny Weir model (Hartwood model). The model was based on the Work Package 19 model created as part of the Reconnecting River Country (RRC) project (3Rivers, 2023a). This work was carried out in accordance with the scope of services set out in the Agreement and the following approved RFS forms:

- RFS63 – Yanco Creek Modernisation Project - Strategic Assessment and Concept Design Phase
- RFS76 – Yanco Creek Modernisation Detailed Design Enabling Works

This report has been prepared by 3Rivers for DCCEEW . 3Rivers otherwise disclaims responsibility to any person or organisation other than DCCEEW in connection with this report.

This document is in draft form. The contents, including any opinions, conclusions or recommendations contained in, or which may be implied from, this draft document must not be relied upon. 3Rivers reserves the right, at any time, without notice, to modify or retract any part or all of the draft document. To the maximum extent permitted by law, 3Rivers disclaims any responsibility or liability arising from or in connection with this draft document.

1.2 Scope and limitations

This report documents the background, assumptions and setup of the “existing” and “proposed” hydraulic models used to inform the design of proposed works and/or assess the impact of these works to inform the relevant Review of Environmental Factors (REF) or Environmental Effects Statement (EIS).

3Rivers has prepared this report to the usual standard of care and skill to be expected of the consulting profession. The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. No other warranty or guarantee, whether expressed or implied, is made to the extent permitted by law.

In preparing this report, 3Rivers has relied on information provided by DCCEEW (including but not limited to RFS documentation, existing modelling, and assumptions regarding status, condition or characteristics of structures) and others (including but not limited to filed survey information, operational and gauge data, bathymetry and LiDAR terrain information). 3Rivers has not independently verified or checked the information provided beyond the agreed scope of work. 3Rivers does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.3 Assumptions

The opinions, conclusions and any recommendations in this report are based on the assumptions made by 3Rivers described in this report. The assumptions have been made using the usual standard of care and skill to be expected of the consulting profession. 3Rivers disclaims liability arising from any of the assumptions being incorrect.

2. Introduction

2.1 Background

This technical Hydraulic Modelling Report has been developed by 3Rivers to summarise the hydraulic modelling activities undertaken to inform the design or assess impact of the proposed works for the Sustainable Diversion Limit Adjustment Mechanism (SDLAM) Yanco Creek Modernisation project.

Hydraulic modelling is being undertaken to provide understanding, information and/or assess impacts for a number of flow scenarios, which range from operational flows (or environmental baseflows) to flood flows (50% AEP up to PMF). The WP19 model created as part of the Reconnecting River Country (RRC) programme was used as the basis of this model (the Hartwood model), with some minor changes based on the flow scenarios required and/or new information (such as additional survey). The location and extent of the model used for both the RRC and current study are shown on Figure 2-1, which shows that the model covers the following key areas:

- Yanco Creek from upstream of Kidman Way to confluence with Billabong Creek.
- Billabong Creek from upstream of Lower Woolshed Weir to downstream of Piccaninny Weir.
- Forest Creek from where it breaks away from between Billabong Creek to just downstream of Warriston Weir and Conargo Road.
- Piccaninny Creek.

The model results are valid for the following area (referred to from here on in as the 'Study Area', which is also shown on Figure 2-1 relative to the hydraulic model boundaries):

- Yanco Creek downstream of Kidman Way.
- Billabong Creek between Lower Woolshed Weir and Wanganella model boundary approximately 2.2 km downstream of Piccaninny Weir.
- Forest Creek from breakaway from Billabong Creek to WP20 model boundary approximately 0.9 km downstream of Conargo Road.

2.2 Study objectives

The objectives of this study include and are not limited to the following for the Study Area:

- Inundation mapping of the study area for a number of flow scenarios and producing the datasets of hydraulic properties such as water level, depth, and velocity for the current ("existing") conditions.
- Providing information to assisting in the development of proposed designs for upgraded assets.
- Inundation mapping of the study area for a number of flow scenarios and producing the datasets of hydraulic properties such as water level, depth, and velocity for the "proposed" conditions with the proposed Yanco Modernisation Project works, both individually and cumulatively.
- Processing of results to understand impacts of the proposed works to inform the design of the works and the relevant REF or EIS process.

These objectives were achieved through the development of a fit-for-purpose 2D TUFLOW HPC hydraulic model for Yanco Creek, Billabong Creek, Piccaninny Creek and Forest Creek developed according to current best practice and guidance and the Hydraulic Modelling Standard Specification V1.2 (DPIE, 2021).

YANCO CREEK AT YANCO BRIDGE
410169

Eighteen Mile Dam

Wilson Anabranch
Offtake

BILLABONG CREEK AT CONARGO
(PUCKAWIDGEE)
410017

BILLABONG CREEK AT DOWNSTREAM
HARTWOOD WEIR
410168

YANCO CREEK AT WIRAKI
41000209

Boonoke Weir

Hartwood Weir

Forest Creek
Offtake

Piccaninny Weir

Warriston Weir

Parry Weir

Forest Creek Block
Bank

McCaughey Block Dam

Nine Mile Dam

FOREST CREEK AT OFFTAKE
41010309

Piccaninny Pipe
Offtake & Regulator

Piccaninny Offtake

Quiamong Weir

Lower Woolshed Weir

BILLABONG CREEK AT JERILDERIE
410016

FOREST CREEK AT WARRISTON WEIR
410148

Drivers Weir

Legend

- Hydraulic Model Boundary
- Modelled significant structures
- Gauge Locations

Key Watercourses

- Billabong Creek
- Forest Creek
- Piccaninny Creek
- Yanco Creek

N

GDA 2020 Zone 55
Scale: 1:200,000

0 4 8 km

DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023;
Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Study Area Overview
"G:\21\12537654\GIS\Maps\Working\
Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 2-1: Study Area Overview

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

2.3 Report Structure

This report has been structured to summarise the relevant hydraulic modelling work undertaken to develop the model and final setup used for impact assessment and includes relevant information based on work carried out as part of this Study as well that undertaken as part of the WP19 RRC study, for completeness. The report is structured with the following sections to highlight the development of the model for its current purpose:

- Data (see Section 3)
    - An overview of the review and identification of relevant information for the hydraulic model setup
- Existing Model Setup (see Section 4)
    - An outline of how the model was schematised and then ultimately setup to represent “existing” conditions.
- Model Sensitivity and Calibration (see Section 5)
    - A summary of the sensitivity and calibration activities undertaken on the “existing” model.
- Proposed Model Setup (see Section 5.3.8)
    - An overview of changes made to the model to represent “proposed” conditions, which include the final Yanco Creek Modernisation Project works. The section also summarises testing work to represent the proposed structures.
- Results (see Section 7)
    - A brief summary of results, highlighting the “existing” and “proposed” flood behaviour or characteristics and the associated change in flow, water surface level and/or velocity within the Study Area.
- Limitations, assumptions and uncertainty (see Section 8)
    - An outline of some of the key possible limitations, assumption and/or uncertainty around the modelling outcomes.

3. Data

3.1 Data Review

Sections 3.1.1 to 3.1.8 briefly summarise the existing datasets available in the study area that have been used to inform the development of the hydraulic model.

3.1.1 Elevation Data

The following LIDAR (Light Detection and Ranging) datasets were available within the study area:

- Yanco Creek DEM covers the upstream portion of the study area:
    - Provided by NSW Spatial Services
    - 5 m resolution
    - Collected January 2015
- Billabong Creek DEM covers the downstream half of the study area:
    - Provided by NSW Spatial Services
    - 5 m resolution
    - Collected December 2011
- Yanco_WFR_LIDAR_1m_2007, which covers the entire Study Area:
    - Provided by DCCEEW
    - 1m resolution
    - Collected in 2007 by Water for Rivers (WfR)
- DCCEEW_2021_LIDAR_and_Aerial, which covers the entire Study Area
    - Provided by DCCEEW
    - 2km x 2km tiles 1m DEM resolution
    - Collected from 13/09/2021 to 24/09/2021

3.1.2 Channel and topographic survey

There was some historical cross-section data of some of the key watercourses within the study area. These areas included:

- Cross-sections along Forest Creek between Billabong Creek and Warriston Weir collected as part of the “Forest Creek Weirs and Cross Sections” study in 2011. This included Forest Creek Offtake Regulator, Parrys Weir, Drivers Weir, Quiamong Weir and Warriston Weir. This data was used directly or indirectly to inform the study.
- Cross-sections along Billabong Creek and Yanco Creek (including Mundoora and Wilson Anabranches) collected as part of the “Yanco Creek Hydrology” Water for Rivers study in 2009". This data was used directly or indirectly to inform the study.

Cross sections were also collected as part of this study which included:

- Cross-sections along Piccaninny Creek at Piccaninny Return Flows. This data was used directly to inform topography at Piccaninny Return Flows (S1138 Piccaninny Creek Return 18.12.21 REV A-2 11022022 - Price Merrett Consulting, 25/02/2022).
- Weir cross sections at Hartwood and Piccaninny. This data was used directly to inform topography at Hartwood Weir (S1099 – Hartwood Weir and Pump Site Survey 11022022 - Price Merrett Consulting, 25/02/2022) and Piccaninny Weir (S1137 - Piccaninny Weir REV A 8-2-22 - Price Merrett Consulting, 23/02/2022).
- Additional channel cross-sections at some key locations on Yanco Creek, Billabong Creek & Forest Creek to validate some bathymetric modelling assumptions in these areas.

Feature survey was also obtained at the following locations in 2022/23, with all bar Hartwood Weir having an up to date local Digital Terrain Model (DTM) for inclusion in the modelling:

- Hartwood Weir.
- Forest Creek Block Bank
- Forest Creek Offtake
- Forest Creek Return Regulator (previously Piccaninny Offtake)

3.1.3 Structures

There are a substantial number of structures in the system with the key structures listed below (these are shown spatially within the Study Area on Figure 2-1):

- Lower Woolshed Weir
- Hartwood Weir
- Piccaninny Weir
- Bonooke Weir
- Forest Creek Offtake
- Forest Creek Block Bank
- Parrys Weir
- Drivers Weir
- Quiamong Weir
- Warriston Weir
- Piccaninny Creek return flow culverts

Other structures included in the model were:

- Culverts under Wanganella-Conargo Road on Piccaninny Creek
- Culverts under and bridge on Conargo Road at Piccaninny Creek and Forest Creek respectively
- Bridge and culvert on access track to Boonoke Homestead on Billabong Creek

- Two access bridges on Billabong Creek upstream of Hartwood Weir
- Bridge on Carrathool Road on Box Creek
- Two culverts under Carrathool Road near Conargo
- A number of culverts (6) and bridges (2) on or around Yanco Creek upstream of confluence with Billabong Creek

3.1.4 Bathymetric Survey

There were several sets of bathymetric data that covered some of the major watercourses in the study area, the location of which is shown in Figure 3-1. This data includes:

1. Water for Rivers: Yanco Creek System Bathymetric Survey (SKM, 2007) – "Yanco_All_shp" (SKM, 2007). This data source provided bathymetric details of the upstream pools of:
    - 9 Mile Dam
    - 18 Mile Dam
    - Boonoke Weir
    - Lower Woolshed Weir
    - Piccaninny Weir
2. Bathymetric Survey of Billabong Creek near Hartwood Weir – "hartwoods_point_3d.shp" (2008). This data source provided bathymetric survey of the pool upstream of Hartwood Weir.
3. Historic Cross-Sections along Yanco Creek ('WP19&20_Historic_XS_Locations_shp" - DCCEEW, 08/06/2020) and Forest Creek ("10376-Forest Creek Sections.xlsx" – State Water, 2011). These cross-sections along main waterways were used to inform bathymetry created in 12d to join areas of bathymetric data from items 1 & 2 above.
4. S1099 – Hartwood Weir and Pump Site Survey 11022022 (Price Merrett Consulting, 25/02/2022). The cross section and survey point were used to inform bathymetry created in 12d.
5. S1137 - Piccaninny Weir REV A 8-2-22 (Price Merrett Consulting, 23/02/2022). The cross section and survey point were used to inform bathymetry created in 12d.
6. S1138 Piccaninny Creek Return 18.12.21 REV A-2 11022022 (Price Merrett Consulting, 25/02/2022). The cross section and survey point were used to inform bathymetry created in 12d.

The creation of additional bathymetric profiles along key waterways was informed by a range of historical and recently obtained cross-sections as discussed above, the location of which are shown on Figure 3-1. Following the RRC modelling, additional bathymetry data was collected locally around the following key sites and was included in the model (this data is also shown spatially on Figure 3-1 as "2022/23 Survey DTM"):

- Forest Creek Block Bank.
- Forest Creek Offtake
- Forest Creek Return Regulator (or Piccaninny Offtake).

Boonoke Weir
Warriston Weir
Hartwood Weir
Forest Creek Offtake
Wilson Anabranch Offtake
Eighteen Mile Dam
Piccaninny Weir
Parry Weir
Forest Creek Block Bank
Nine Mile Dam
McCaughey Block Dam
Piccaninny Pipe Offtake & Regulator
Piccaninny Offtake
Quiamong Weir
Lower Woolshed Weir
Drivers Weir

Legend

- Hydraulic Model Boundary
- Modelled significant structures

Available Bathymetry Data Sources

- 2007 SKM Bathymetry
- 2008 Hartwoods Weir
- 2022/23 Survey DTM
- Historical Cross Sections
- 2021 Surveyed Cross Sections
- 2022 DPE Suvreyed Cross Sections

N

GDA 2020 Zone 55
Scale: 1:200,000

0 4 8 km

DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023; Bathymetry, Structures and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Bathymetry Data Sources "G:\21\12537654\GIS\Maps\Working\Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 3-1: Available Bathymetry Data Sources

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

3.1.5 Gauge Data/Inflows

Key gauges in the study area include (which are shown spatially relative to the Study Area on Figure 2-1):

- 410169 – Yanco Creek at Yanco Bridge
    - Zone 55; 388245E 6109811N
    - Data available 18/09/1995 to present
- 410016 – Billabong Creek at Jerilderie
    - Zone 55; 385117E 6086987N
    - Data available from 01/08/1912 to present
- 410168 – Billabong Creek at downstream of Hartwood Weir
    - Zone 55; 344397E 6091223N
    - Data available from 22/09/1995 to present
    - One of the two gauges used for calibration along with Billabong Creek at Conargo
- 410148 – Forest Creek at Warriston Weir
    - Zone 55; 329200E 6087785N
    - Data available from 01/09/1980 to present
- 410017 – Billabong Creek at Conargo
    - Zone 55; 337138E 6093780N
    - Data available from 01/08/1968 to present
    - One of the two gauges used for calibration along with Billabong Creek at downstream of Hartwood Weir
- 41010309 - Forest Creek at Offtake
    - Zone 55; 344933E 6089690N
    - Data available from 14/04/2006 to 28/08/2014

3.1.6 Existing Hydraulic Models

There are a few existing models that cover parts of the Study Area, which are detailed below.

Yanco Creek System Environmental Flows Study (May 2013)

This study aimed “to derive scientifically based recommendations to identify the benefits for the use of environmental water in the Yanco Creek system from the available sources in the regulated Murrumbidgee or NSW Murray River systems”. The “Final Report describes the environmental values and threats in the Yanco Creek system, environmental objectives for flow dependent environmental values, reach by reach environmental flow requirements to meet the objectives, and an assessment of the performance and risk associated with the current water management regime”. It describes the use of hydraulic modelling using HEC-RAS for some reaches in the Study Area and some terrain analysis for areas dominated by weir pools.

Some cross-sections of channels within the current Study Area were collected by Michael McBurnie and as part of this Study and have been used for checking and/or preparing the current bathymetry.

Conargo Floodplain Risk Management Study and Plan (2010)

There is an existing flood study of Conargo within the study area developed as part of the Conargo Floodplain Risk Management Study and Plan (2010). The HEC-RAS model was developed for the purposes of assessing flood risk for large and extreme events on a limited section of Billabong Creek and Piccaninny Creek around Conargo. This study does contain flood frequency analysis which has been indirectly used in the study. Some of the cross-section data from the HEC-RAS were located in the gap between bathymetry sources, but upon review against other sources appeared to be estimates only and subsequently were not used in checking and/or preparing the adopted bathymetry.

Yanco Creek System Water Recovery Scoping Study (2010)

This study aimed to produce a series of calibrated SOBEK models of various reaches of the Yanco Creek system, based on earlier scoping work. The work includes setting up a model, referred to as “Reach 5 - Yanco Bridge & Hartwood Gauge to Conargo”, which is within the Hartwood model Study Area. This model data was not readily available and has therefore not been used to obtain and/or check structure details and/or channel bathymetry.

Billabong Creek Floodplain Management Plan (2002)

This study aimed to achieve the following for the broader Billabong Creek system [with a focus upstream of Jerilderie]:

- “review works undertaken to date within the study area;
- identify areas of environmental significance that may be reliant of flood flows;
- develop an understanding of flood behaviour; and
- establish a computer model capable of assessing various floodplain management options.”

This study set up a MIKE-11 model for Billabong Creek upstream of Jerilderie, which is upstream of Hartwood model Study Area. This model data was provided but did not provide useful data to check or infer details of bathymetry in parts of the current study. The Flood Frequency Analysis (FFA) was however indirectly used to inform parts of this Study.

SDLAM Reconnecting River Country - Hydraulic Modelling: Work Package 17 - Innes Bridge to Hartwood Weir (2022)

This is the Work Package immediately upstream of Hartwood model on Billabong Creek and was used to confirm assumptions regarding timing of inputs for the calibration runs in this Study on Billabong Creek relative to Yanco Creek. The flows were not directly used due to the desire to adopt certain antecedent conditions and the timing of their provision.

3.1.7 Landuse Layers

Landuse layers have been provided to inform hydraulic roughness within the 2D floodplain extent. These are:

- ‘NSW Landuse 2017 V1.2’ has been provided which reflects land use characteristics within the Hartwood model study area such as food production, nature conservation and urban development.

3.1.8 Aerial Imagery Caputre

There are a number of aerial imagery products available including:

- Aerial imagery taken during the Jerilderie to Wanganella October 2021 LiDAR data capture.
- Aerial imagery taken during the August - September 2021 flow event in the Yanco and Billabong Creek system.
- Aerial imagery from NSW Spatial Information eXchange (SIX) Maps.
- Satellite data from Landsat and Sentinel as outlined in inundation below.

3.2 Data collection programme

Table 3-1 provides details of data collected as part of both the WP19 and Hartwood hydraulic modelling commission.

Table 3-1: Data collected as part of Study

Item	Comments
Elevation data	LiDAR data was captured from Jerilderie to Wanganella in October 2021 and has been used in this study.
Channel survey	On behalf of DCCEEW, Price Merrett Consulting collected cross section data that was used to inform bathymetry created in 12d for areas around Hartwood and Piccaninny Weir. Historic cross section data that covered several areas across the major watercourses were also made available by DCCEEW and were used to further inform bathymetry.
Topographic survey	On behalf of DCCEEW, 3Rivers has collected structure dimensions, photographs, and survey information many of the hydraulic structures requiring better representation within the hydraulic models.
Bathymetric survey	Apart from additional channel survey in the form of cross-sections described above, no additional bathymetric survey was obtained.
Hydraulic structures	Available information on Hydraulic Structures was reviewed as part of the model build. Any gaps in required data were identified and included as part of the survey request, although not all sites could be visited due to the size of the area and adverse weather conditions. Some structural information was also collected during a site visit that was conducted in March 2022. Remaining gaps were filled with engineering judgement.

3.3 Inundation imagery

To assist in the calibration/validation process the inundation imagery summarised in Table 3-2 was sourced for the project. The average daily flow rate at Yanco Creek (Gauge: 410169 Yanco Creek at Yanco Bridge) and Billabong Creek (410168 Billabong Creek downstream of Hartwood Weir) has been used to represent the corresponding flow rate at the time of the given inundation image. The timing of the imagery below against the flow rate at the nominated gauges is also presented graphically in Figure 3-2 and Figure 3-3.

Table 3-2: Summary of Satellite Imagery Suitable for Model Calibration

Imagery date	Source	Reference gauge	Approx. flow (ML/day)	Trend	Suitability
11/8/2017	Sentinel	410169	400	Rising	Ok - no cloud cover.
		410168	216	Rising	
24/08/2017	Sentinel	410169	223	Falling	Ok - no cloud cover.
		410168	392	Peak	
13/08/2021	Sentinel	410169	856	Rising	Ok - no cloud cover.
		410168	1,855	Peak	
25/08/2021	Sentinel	410169	1511	Peak	Ok - no cloud cover.
		410168	1,125	Falling	
2/09/2021	Sentinel	410169	533	Falling	Not suitable.
		410168	987	Falling	
16/09/2021 – 18/09/2021	Aerial Imagery	410169	313 - 534	Rising	Ok - no cloud cover.
		410168	1,241 - 1,494	Rising	
22/10/2021	Sentinel	410169	1,004	Peak	Ok - no cloud cover..
		410168	1,067	Falling	
27/10/2021	Sentinel	410169	665	Falling	Not suitable.
		410168	746	Falling	
23/08/2022	Sentinel	410169	1,286	Rising	Ok – minimal cloud cover, but occurs too early in event.
		410168	1,156	Rising	
28/08/2022	Sentinel	410169	1,693	Rising	Ok – minimal cloud cover, but occurs too early in event.
		410168	1,286	Rising	
2/09/2022	Sentinel	410169	1,947	Rising	Ok – minimal cloud cover, but occurs a bit before initial peak.
		410168	1,577	Rising	
17/09/2022	Sentinel	410169	1,397	Falling after first peak	Not suitable.
		410168	1,652	Falling	
22/09/2022	Sentinel	410169	1,362	Start of rise of second peak	Ok – minimal cloud cover and occurs a little after initial peak.
		410168	1,801	Rising on third peak	
2/10/2022	Sentinel	410169	1,818	Approx. second peak	Ok – no cloud cover, but occurs too late in event and includes start of next peak.
		410168	2,325	Rising on third peak	

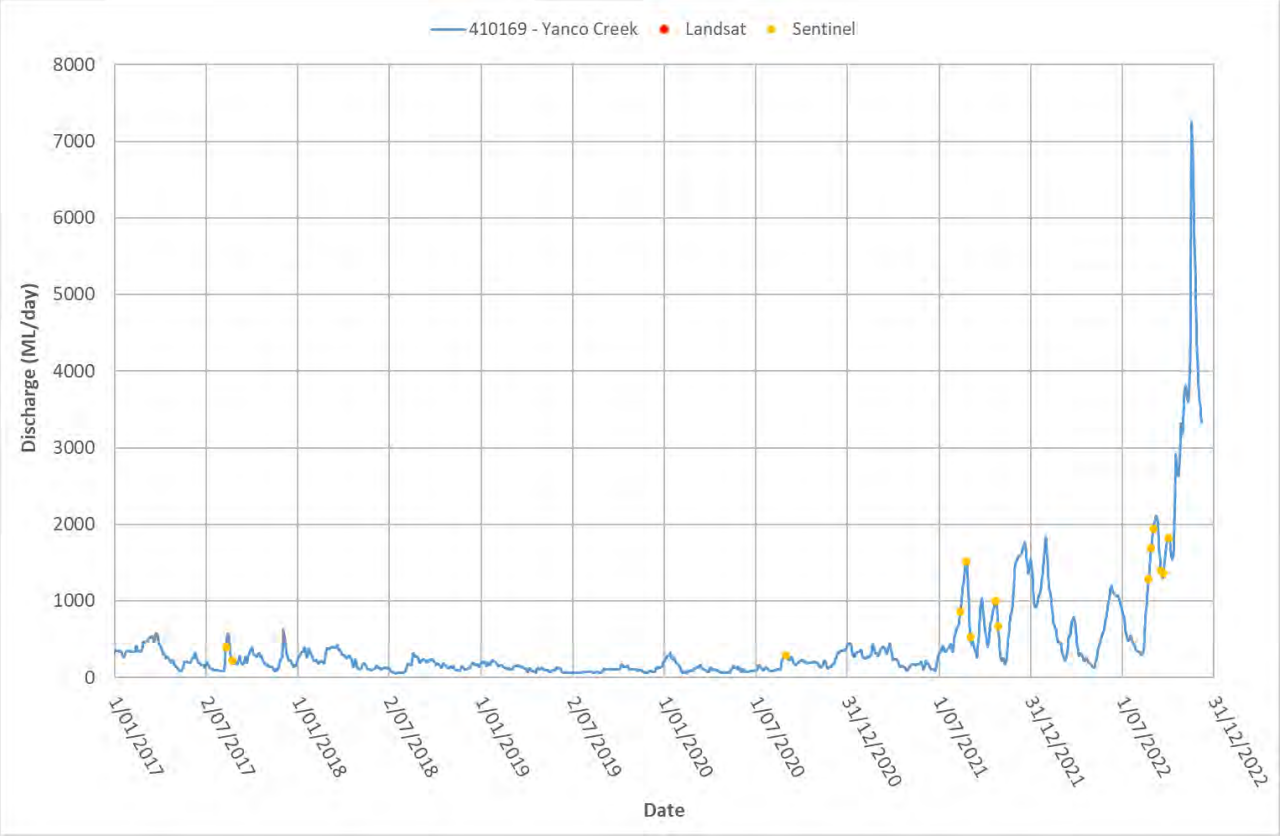


Figure 3-2 Timing of inundation imagery against flow at "Yanco Creek at Yanco Bridge gauge (410169)"

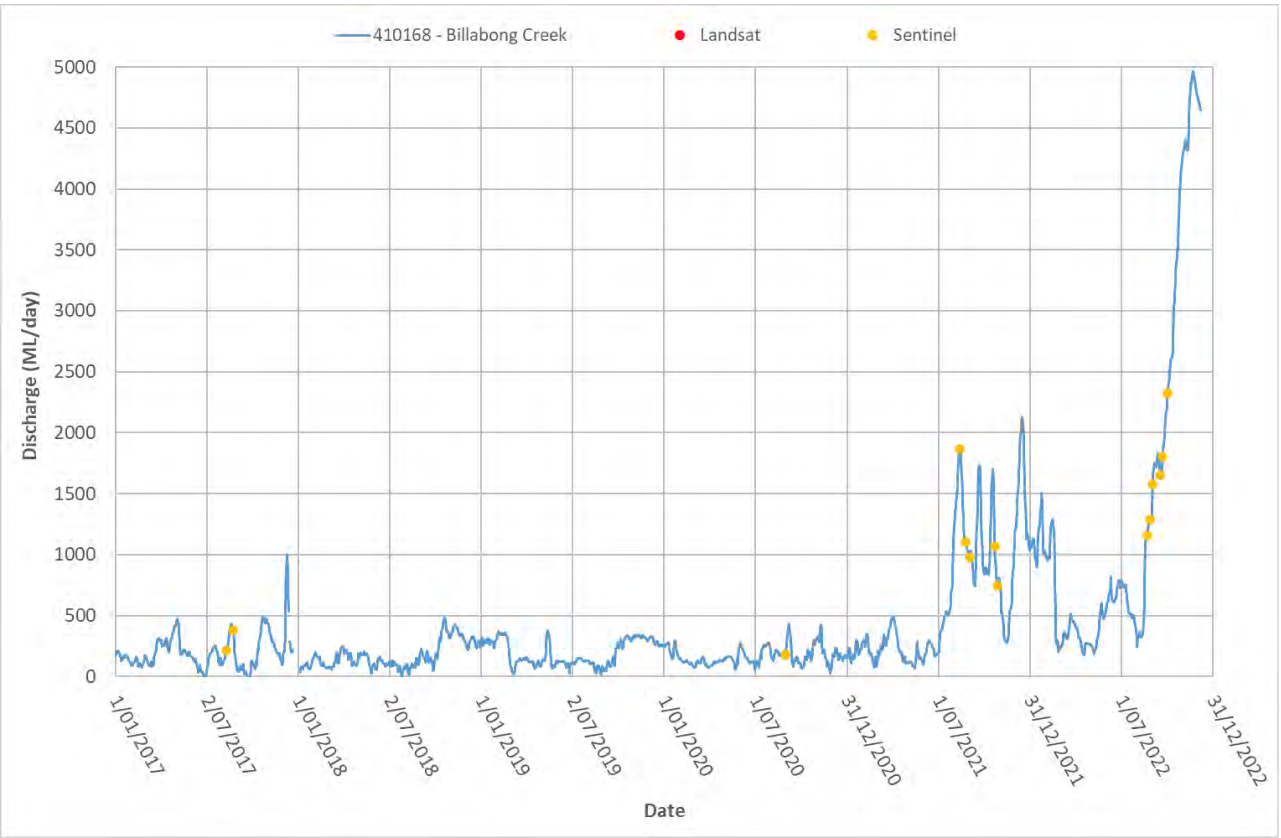


Figure 3-3 Timing of inundation imagery against flow at "Billabong Creek @ downstream of Hartwood Weir gauge (410168)"

4. Existing Modelling Approach and Setup

4.1 General schematisation

4.1.1 Modelling approach

The general model setup adopted for the modelling is presented in Figure 4-1.

Both the floodplain and channels were predominately modelled in 2-Dimensions (2D) at a grid resolution of 16 m with the sub-grid sampling (SGS) feature enabled at a spacing of 1 m (see discussion on model topography in 'Model Development' section of report). The use of quadtree functionality to alter the grid size was tested where the major waterways of interest are narrower (i.e. Piccaninny Creek) but was deemed unnecessary as outlined in the 'Model Development' section of report.

1-Dimensional (1D) structures representing sub-grid scale features and operational structures will be added as appropriate to represent key features within watercourses and/or on the floodplain.

The key watercourses in the Study Area have the following characteristics:

- Yanco Creek is typically 20 - 40 m wide with a typical cross-section similar to that shown in Figure 4-2 although the width varies from around 12 m to more than 60 m in places.
- Billabong Creek is typically 40 - 50 m wide, although the width varies from around 10 m to more than 50 m in places. This watercourse has a typical cross-section similar to that show in Figure 4-3.
- Forest Creek is smaller than Billabong Creek with a typical width of between 10 - 25 m (although ranges up to 30 m in some areas) and a typical cross section similar to that shown in Figure 4-4. Piccaninny Creek is the smallest of these waterways, with a typical width of 10 - 20 m between Forest Creek and Billabong Creek (this does however broaden to 20 – 30 m upstream of Forest Creek). A typical cross-section for the area between Forest Creek and Billabong Creek looks something like that shown in Figure 4-5.

4.1.2 Software and reason for choice

A 2D -TUFLOW HPC hydraulic model using the Graphical Processing Unit (GPU) and double precision (version 2023-01-AA-iDP) was used to allow the model to better represent small flows. All watercourses were represented in 2D based on the available LiDAR, bathymetric survey, and the infilled bathymetric data.

This approach was considered appropriate due to the following factors or characteristics of the Study Area:

- Given the braided nature of the watercourses and floodplain in the area it is was considered that 2D solution would better represent that movement of water across the landscape as opposed to a 1D solution. A 2D solution requires fewer assumptions regarding the connectivity and movement of water and allows this to be dynamically calculated through the simulation based on the topography and hydraulics. This is of particular benefit when direction of flow changes throughout a simulation as occurs in the study area.
- The Sub Grid Scale (SGS) sampling feature in TUFOW incorporates topographic detail from within each grid cell and effectively creates a stage-storage relationship for each cell and cross-section at each grid face. This allows water to move through the model more realistically as sub-grid scale flowpaths are represented in the model. This means that coarser grids can run and produce accurate waters levels but increases the importance of defining ridge lines appropriately.
- The width of the channels was generally in the range of 3-5 grid cells recommended to accurately model channels in 2D and capture macro-losses. Further, given the low velocities it is not expected that hydraulic losses will be significant.

Boonoke Weir
Warriston Weir
Hartwood Weir
Forest Creek Offtake
Wilson Anabranch Offtake
Eighteen Mile Dam
Piccaninny Weir
Parry Weir
Forest Creek Block Bank
Nine Mile Dam
McCaughey Block Dam
Piccaninny Pipe Offtake & Regulator
Piccaninny Offtake
Quiamong Weir
Lower Woolshed Weir
Drivers Weir

Legend

- Hydraulic Model Boundary
- Modelled significant structures

Available Bathymetry Data Sources

- 2007 SKM Bathymetry
- 2008 Hartwoods Weir
- 2022/23 Survey DTM
- Historical Cross Sections
- 2021 Surveyed Cross Sections
- 2022 DPE Suvreyed Cross Sections

N

GDA 2020 Zone 55
Scale: 1:200,000

0 4 8 km

DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023; Bathymetry, Structures and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Bathymetry Data Sources "G:\21\12537654\GIS\Maps\Working\Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 3-1: Available Bathymetry Data Sources

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

- With the exception of the major watercourses (Yanco Creek, Billabong Creek, Forest Creek and Piccaninny Creek) most watercourses are ephemeral and have been captured in the LiDAR.
- A significant portion of the Billabong Creek was covered by bathymetric survey which allowed for the development of an accurate bathymetric surface for this watercourse.
- Other bathymetry can be infilled using Billabong Creek bathymetry together with surveyed cross section, historical creek cross-sections and local survey of structures.

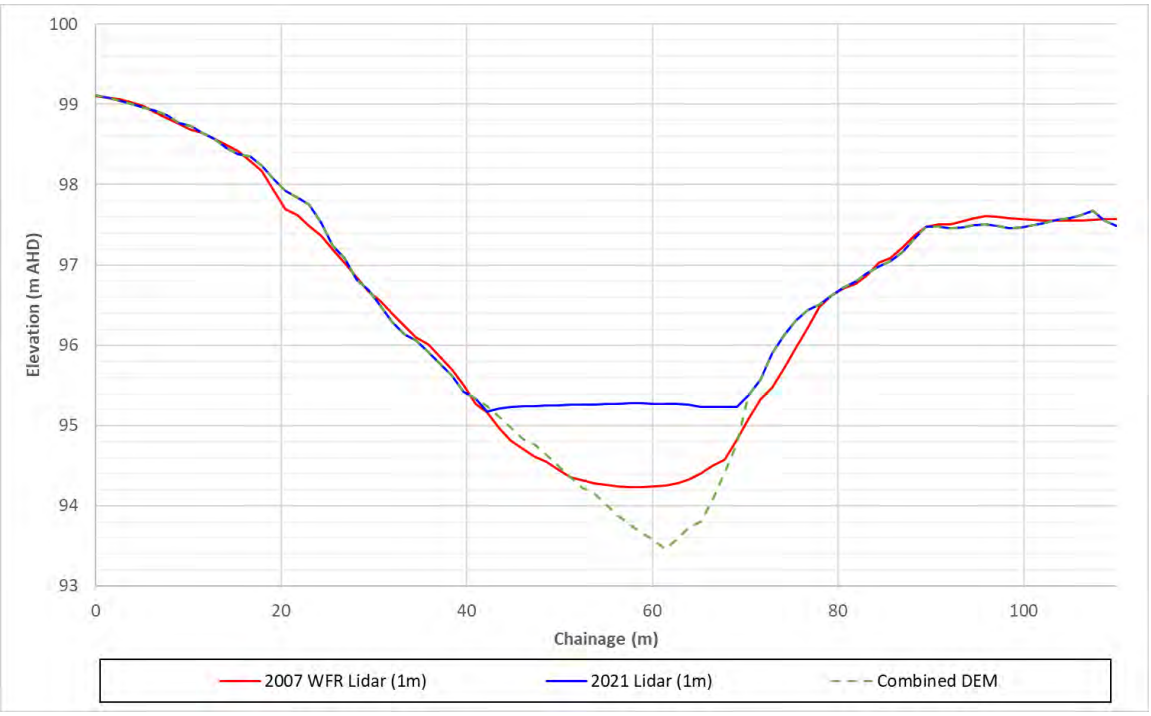


Figure 4-2: Example typical cross-section along Yanco Creek

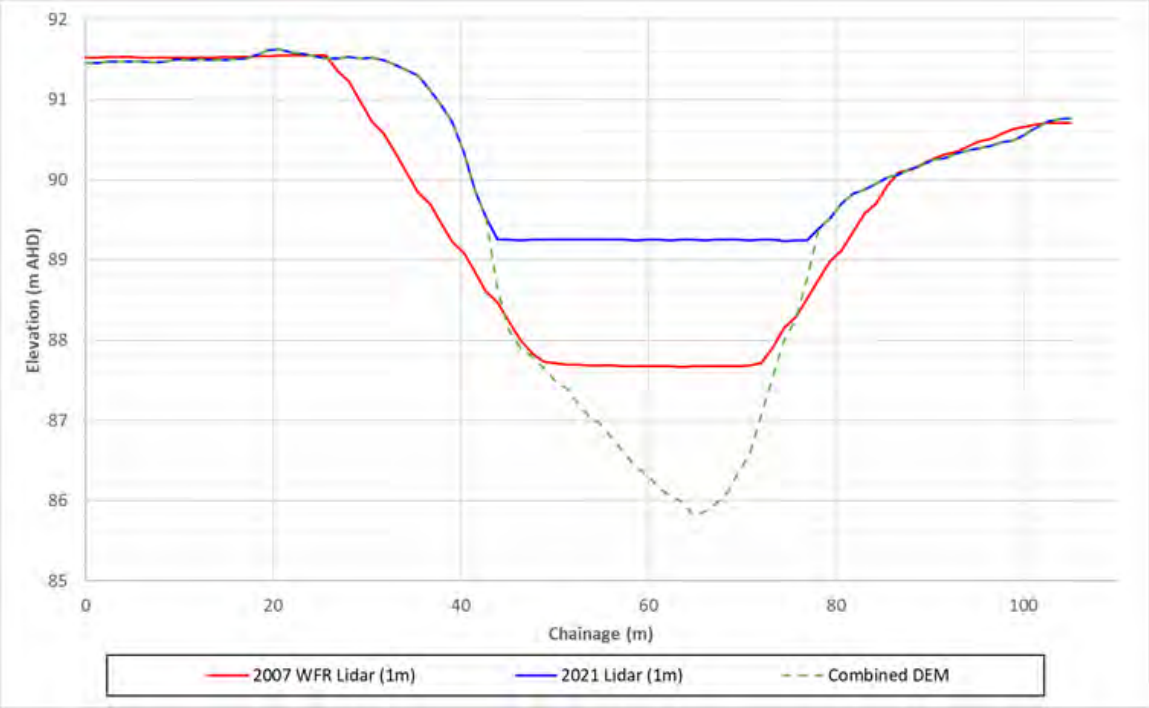


Figure 4-3: Example typical cross-section along Billabong Creek

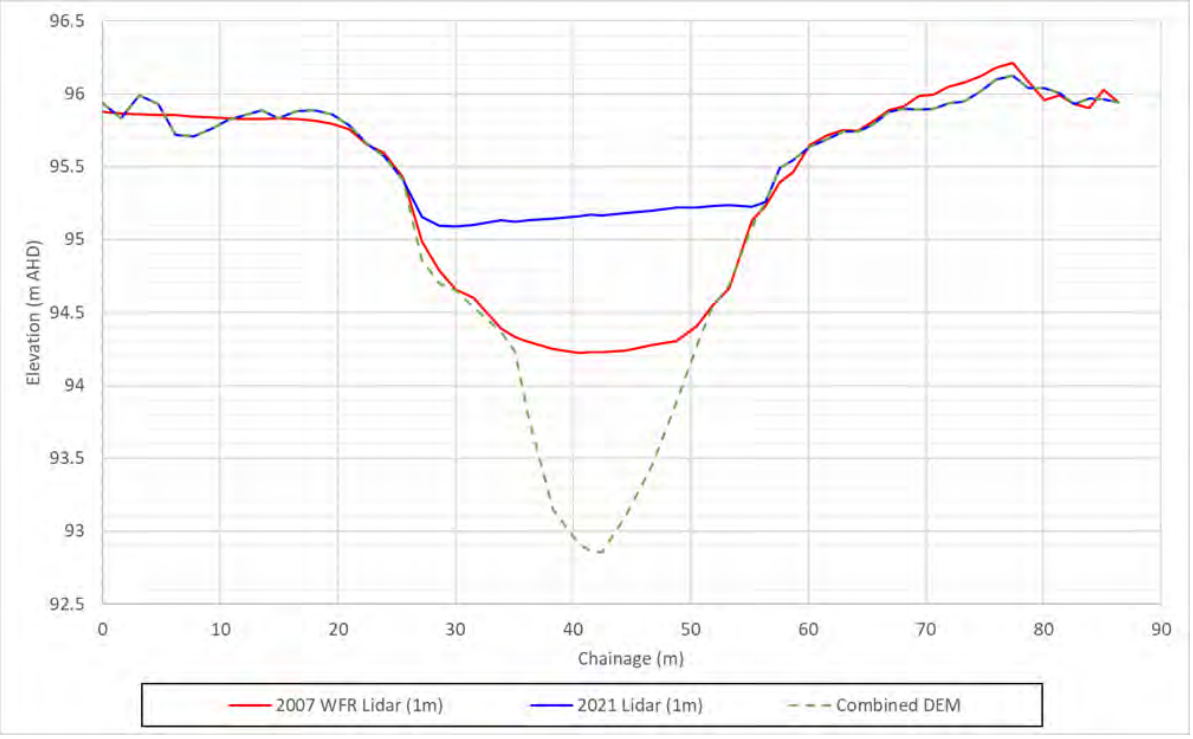


Figure 4-4: Example typical cross-section along Forest Creek

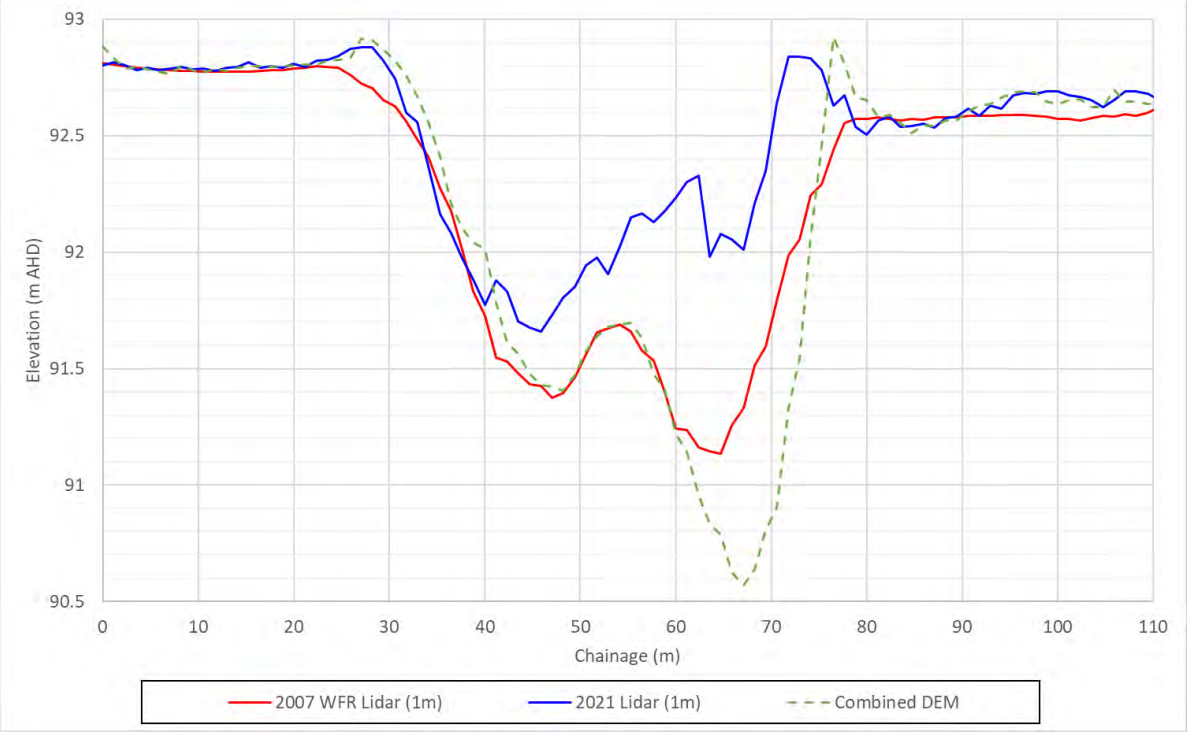


Figure 4-5: Example typical cross-section along Piccaninny Creek

4.2 Model Topography

4.2.1 Digital Elevation Model (DEM)

Due to the 2D nature of the model, considerable effort has been put into creating a Digital Elevation Model (DEM) for this study, especially along the channel beds of the main creeks.

The final DEM is presented as Figure 4-6 and was assembled from the following data sources (the spatial distribution of which is presented in Figure 4-7 with the exception of the 2021 LiDAR which covers all other areas):

- DPIE_2021_LIDAR_and_Aerial
    - Provided by DCCEEW
    - 1m resolution
    - Collected in October 2021
    - Utilised to represent the vast majority of the model, including riverbanks, floodplains, and surrounding topography
    - Was the primary source of data for the floodplain
- Yanco_WFR_LIDAR_1m_2007
    - Provided by DCCEEW
    - 1m resolution
    - Collected in 2007 by Water for Rivers (WFR)
    - Utilised to define several areas of creek, riverbed and flowpaths as water surface levels were low during the time of LIDAR collection, as well as a transition from 2021 to bathymetric data (see further discussion below).
- Bathymetry data from the combination of sources described in Section 4.2.2 below.

The 1m LiDAR flown in September 2021 covered the entire Study Area, but at the time it was flown in September 2021, the water level in the creeks were high and as a result in a number of areas the water level rather than bed level was captured. This was considered unsuitable for representing the channel topography.

A new DEM called “Combined DEM” was created in ArcGIS Pro which amalgamated a number of datasets following the data preference sequence below when creating the channel topography:

- Adopt the 2021 LiDAR for all out of bank areas.
- Adopt all bathymetric data where available.
- Adopt the 2007 DEM where –
    - The 2021 LiDAR was not suitable due to high water levels within the main waterways (Yanco Creek, Billabong Creek, Forest Creek & Piccaninny Creek).
    - Channels appear to be dry in this LiDAR dataset.
- Adopt a digitally created channel bed where there was neither bathymetric data, nor suitable 2007 LiDAR. The channel was created for the main creeks (Yanco Creek, Billabong Creek, Forest Creek and Piccaninny Creek) using surveyed and/or historical cross sections where available to inform definition of the thalweg in the 12d software.

Additionally, a number of modifications have been incorporated into the model using z-shape features these are discussed further in Section 4.2.3 below.

The 2021 dataset was also used during the model calibration process of the September 2021 flood event. During this process, some additional areas along some minor waterways were modified to incorporate terrain data based on the 2007 LiDAR to better reflect areas that were shown to be inundated during this event.

A summary of validation of the DEM against known data sources is provided in Appendix A. This comparison shows that the DEM reliably represents known elevation points and is suitable as the basis for hydraulic modelling.

4.2.2 Model bathymetry

Bathymetric survey was collected and applied in the model along sections of Yanco Creek and Billabong Creek together with 12d generated bathymetry informed by surveyed cross-sections used on remaining sections of these creeks and along the full length of Forest Creek and Piccaninny Creek. The location of these areas within the Study Area are also shown on Figure 4-7.

4.2.3 Terrain Modifications

To improve the representation of the Study Area a number of terrain modifications have been incorporated into the models. The modifications include the following and the location of these model changes are highlighted in Figure 4-8:

- Ridge lines defining the crest or flow control elevation of linear floodplain features, such as road embankments and levees (represented as thin z-shape features that raise the cell side only). Given the increased magnitude of the modelled flows the coverage of these elements have been increased substantially compared to the RRC WP19 model.
- Shaping to block off the 2D domain where weirs are represented as 1D elements (represented as thin z-shape features that raise the cell side only to an arbitrary height of 200 m AHD).
- A coarse representation of minor floodplain structures with limited data (modelled as one cell gaps in the obstruction with inverts based on upstream and downstream terrain and a cell width reduction factor limiting the width of the cell to 3 m).
- Minor smoothing at interface between some sources of bathymetry (modelled as a shaping region to connect invert from one data source to that from another).
- Minor lowering of terrain at structures based on surveyed invert levels of structures differing to terrain (these were represented as regions and/or lines with points lowering local cells to allow “SX” regions to operate).
- Minor lowering of thalweg (around 1 m) in and around Wilsons Anabranch to improve connectivity of flooding shown in models based on anecdotal evidence from historic events.
- Minor adjustment of terrain based on recent survey post-RRC modelling that picked up some additional detail around the following sites:
    - Forest Return Regulator - modelled as DEM and a shaping region with tin lines to merge the various terrain sources.
    - Forest Creek Offtake - modelled as DEM.
    - Forest Creek Block Bank - modelled as DEM with some edits to generated bathymetry along Forest Creek to tie in with this survey. Due to changes in the minimum elevation in a range of available surveys, it appears that the block bank has likely been eroded over time due to overtopping events and based on discussions with DCCEEW (pers comm D. Clarke email dated 15/06/2023) it was decided that it should be assumed the block bank should be reinstated to a higher elevation than most recent survey (see adopted details in Section 4.5.3.1).

YANCO CREEK AT YANCO BRIDGE
410169

Eighteen Mile Dam

Wilson Anabranch
Offtake

BILLABONG CREEK AT CONARGO
(PUCKAWIDGEE)
410017

BILLABONG CREEK AT DOWNSTREAM
HARTWOOD WEIR
410168

YANCO CREEK AT WIRAKI
41000209

Boonoke Weir

Hartwood Weir

Forest Creek
Offtake

Piccaninny Weir

Warriston Weir

Nine Mile Dam

Parry Weir

Forest Creek Block
Bank

McCaughey Block Dam

FOREST CREEK AT OFFTAKE
41010309

Piccaninny Pipe
Offtake & Regulator

BILLABONG CREEK AT JERILDERIE
410016

Lower Woolshed Weir

Piccaninny Offtake

Quiamong Weir

FOREST CREEK AT WARRISTON WEIR
410148

Drivers Weir

Legend

- Hydraulic Model Boundary
- Modelled significant structures
- Gauge Locations

Elevation (m AHD)

- <= 90
- 90 - 92
- 92 - 94
- 94 - 96
- 96 - 98
- 98 - 100
- 100 - 102
- 102 - 104
- 104 - 106
- 106 - 108
- 108 - 110
- 110 - 112
- 112 - 114
- > 114

N

GDA 2020 Zone 55
Scale: 1:200,000

0 4 8 km

DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023;
Structures and Gauges, NSW DCCEEW, 2021.

WORKSPACE:
Adopted Model DEM
"G:\21\12537654\GIS\Maps\Working\
Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 4-6: Adopted Model Digital Elevation Model (DEM)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Boonoke Weir
Warriston Weir
Hartwood Weir
Forest Creek Offtake
Wilson Anabranch Offtake
Eighteen Mile Dam
Piccaninny Weir
Parry Weir
Forest Creek Block Bank
Nine Mile Dam
McCaughey Block Dam
Piccaninny Pipe Offtake & Regulator
Piccaninny Offtake
Quiamong Weir
Lower Woolshed Weir
Drivers Weir

Legend

- Hydraulic Model Boundary
- Modelled significant structures

DEM Data Sources

- 12d created bathymetry
- 2007 SKM Bathymetry
- 2008 Hartwoods Weir
- 2007 Lidar within 2021 Lidar area
- 2022/23 Survey DTM
- Wilsons Anabranch Terrain Shaping

Note:
Areas outside available data sources above were based on 2021 LiDAR

N

GDA 2020 Zone 55
Scale: 1:200,000

0 4 8 km

DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Adopted DEM Data Sources
"G:\21\12537654\GIS\Maps\Working\Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 4-7: Adopted data sources for modelled DEM

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Boonoke Weir
Warriston Weir
Hartwood Weir
Forest Creek Offtake
Wilson Anabranch Offtake
Eighteen Mile Dam
Piccaninny Weir
Parry Weir
Forest Creek Block Bank
Nine Mile Dam
McCaughey Block Dam
Piccaninny Pipe Offtake & Regulator
Piccaninny Offtake
Quiamong Weir
Lower Woolshed Weir
Drivers Weir

Legend

- Hydraulic Model Boundary
- Modelled significant structures
- Modelled ridgelines (All Scenarios)
- Modelled ridgelines (Flood Scenarios Only)
- Modelled ridgelines (PMF Only)
- Interface terrain modifications
- Structure terrain modifications
- Minor floodplain structure terrain modifictaions
- Other terrain modifications

N

GDA 2020 Zone 55
Scale: 1:200,000

0 4 8 km

DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023; Structures and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Adopted Terrain Modifications
"G:\21\12537654\GIS\Maps\Working\Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 4-8: Adopted terrain modifications

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

4.2.4 Model Domain and Boundary

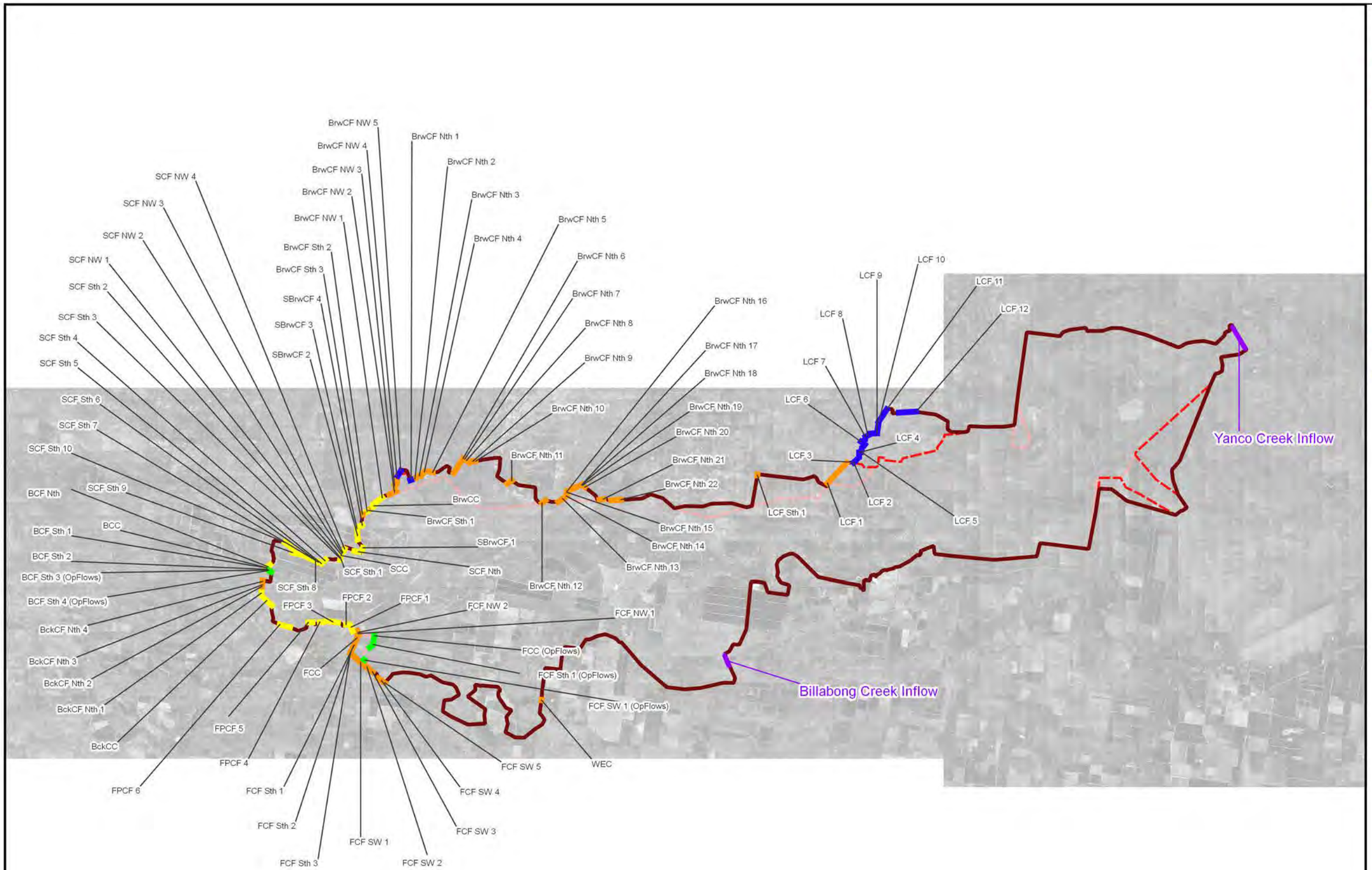
Given the sinuosity and braided nature of much of the main waterways within the Study Area, the modelling grid was orientated to minimise the domain size and hence RAM required to run the model. Further, SGS reduces the effect of grid orientation on results.

The Hartwood model domain has dimensions of 25 km by 75 km, which is an increase from the 21 km by 74 km for the RRC model. The RRC model grid cell size of 16 m was maintained with the sub-grid sampling (SGS) feature enabled at a spacing of 1 m as a compromise between detail and model run time. The use of quadtree functionality to alter the grid size in some areas was investigated, particularly where the major waterways of interest are narrower (i.e. Piccaninny Creek), but was ultimately considered unnecessary due to model run time overhead. The ability to do this was largely the result of using the SGS feature as it allows larger cells to quasi-represent the storage and conveyance effects that have traditionally required smaller cell sizes (there is some discussion on the influence of grid size on model results in the “Sensitivity” section of this report).

As the modelling was developed from the RRC models, the model boundary was progressively increased (and downstream boundaries shifted) to allow modelling of larger flow events. The adopted model boundaries for the flow scenarios in this Study are presented on Figure 4-9.

4.3 Boundary Conditions

The model has two sets of boundary conditions, one representing inflows to the model at the upstream end and one representing tailwater conditions to remove water from the model at the downstream end. The location of the adopted upstream and downstream boundary conditions are shown on Figure 4-9 and the nature of these boundaries is summarised in Table 5 and Table 6 respectively. The inflow boundaries are applicable for all modelled scenarios, but the downstream boundaries have been shifted and/or are not all activated in all scenarios (i.e. some are only engaged in higher flow events, such as flood flows). No internal flow boundaries were included in the model as inflows into the system through Yanco Offtake and unregulated inflows along Billabong Creek make up the vast majority of flow in the system. Further, analysis of gauged flow and the calibrated Source model results has demonstrated that the Yanco Creek system in the vicinity of the Hartwood model is a losing system; that is, water is lost to infiltration rather than gained from local inflow. For the unregulated Billabong Creek, downstream of Jerilderie, analysis of high flows during the 2022 event demonstrated that watercourse was gaining. Further investigation found that during higher flow events Wangamong Creek begins to flow and bypasses the Jerilderie gauge with inflow returning to Billabong Creek downstream of the gauge.



Legend

- Hydraulic Model Boundary (Flood Flows - PMF Only)
- Hydraulic Model Boundary (Flood Flows - excl. PMF)
- Hydraulic Model Boundary (Operational Flows Only)
- Upstream Inflows (2d_SA)

Downstream Boundaries (2d_bc "HQ")

- All Flow Scenarios
- Operational Flow Scenarios Only
- Flood Flow Scenarios
- PMF Flood Flow Scenario Only

N

GDA 2020 Zone 55

Scale: 1:275,000

0 4 8 km

DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Modelled Boundary Conditions
"G:\21\12537654\GIS\Maps\Working\Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 4-9: Modelled Boundary Conditions

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Table 4-1: Summary of upstream inflow boundary conditions

Inflow Boundaries	Description
BillabongCk (Billabong Creek Inflow)	This is a fluvial inflow representing inflows from Billabong Creek at the upstream extent of the model approximately 5.5 km upstream of the private Lower Woolshed Weir (Zone 55: 352780E, 6086862N). The study area has a large contributing area from Billabong Creek upstream of the model, which includes flow from Colombo Creek (a breakout from Yanco Creek). Flows for the model were derived from interpretation of the following gauges: • "Billabong Creek @ Jerilderie" (410016). • "Billabong Creek @ DS Hartwood" (410168). • "Forest Creek Offtake" (41010309). This was represented as flow versus time relationship ("QT" boundary) applied to the model via a relatively large "SA" (source area) polygon covering Billabong Creek and surrounding floodplain. This approach was adopted to facilitate a more realistic flow distribution when flows exceed the capacity of the main channel (i.e. flows are initially applied within main channel and then spread-out as the floodplain becomes wet).
YancoCk (Yanco Creek Inflow)	This is a fluvial inflow representing inflows from Yanco Creek at the upstream extent of the model approximately 0.5 km upstream of Yanco Bridge on Kidman Way (Zone 55: 388370E, 6110113N). The majority of the Yanco Creek flow is from a Murrumbidgee River through the Yanco Offtake upstream of the model, with flows to the model derived from interpretation of the "Yanco Creek @ Yanco Bridge" (410169) gauge. This was represented as flow versus time relationship ("QT" boundary) applied to the model via a relatively large "SA" polygon covering Yanco Creek and the surrounding floodplain upstream of Kidman Way. This approach was adopted to facilitate a more realistic flow distribution when flows exceed the capacity of the main channel (i.e. flows are initially applied within main channel and then spread-out as the floodplain becomes inundated).

Table 4-2: Summary of downstream tailwater boundary conditions

Outflow Boundaries (location)	Description
Billabong Creek Channel (BCC) – All Flow Scenarios (Zone 55: 320450E, 6093417N)	This is a downstream boundary representing outflows from Billabong Creek via the main channel at the downstream extent of the model approximately 7.9 km downstream of the existing Piccaninny Weir. This was represented as head versus discharge ("HQ") boundary snapped to the model boundary with a slope (or "b" attribute) of 0.0002 derived from slope of water profile between the following gauges: • "Billabong Creek @ Conargo" (410017); and • "Billabong Creek @ Wanganella" (41010810).
Billabong Creek Floodplain (BCF) – All Flow Scenarios Nth (Zone 55: 320573E, 6093525N) Sth 1 (Zone 55: 320429E, 6093329N) Sth 2 (Zone 55: 320497E, 6093246N) Operational Flow Scenarios Only Sth 3 (Zone 55: 320539E, 6093206N) Sth 4 (Zone 55: 320633E, 6093146N)	These are a series of downstream boundaries representing outflows from floodplain to the north and south of Billabong Creek. These were represented as head versus discharge ("HQ") boundaries snapped to the model boundary with a slope (or "b" attribute) of 0.0002 to match that applied on Billabong Creek.

Outflow Boundaries (location)	**Description**
Forest Creek Channel (FCC) – Operational Flow Scenarios (Zone 55: 327957E, 6088409N) Flood Flow Scenarios (Zone 55: 326793E, 6088522N)	This is a downstream boundary representing outflows from Forest Creek via the main channel at the downstream extent of the model approximately 1.7 km and 3 km downstream of Warriston Weir in the operational and flood flow scenarios respectively. This was represented as head versus discharge ("HQ") boundary snapped to the model boundary with a slope (or "b" attribute) of 0.0002 derived from slope of water profile between the following gauges: • "Forest Creek @ Warriston Weir" (410148); and • "Billabong Creek @ Wanganella" (41010810).
Forest Creek Floodplain (FCF) – All Flow Scenarios NW 1 (Zone 55: 326840E, 6088756N) NW 2 (Zone 55: 326814E, 6088919N) Operational Flow Scenarios Only Sth 1 (Zone 55: 327785E, 6087907N) SW 1 (Zone 55: 327274E, 6086935N) Flood Flow Scenarios (incl. PMF) Sth 1 (Zone 55: 326612E, 6088099N) Sth 2 (Zone 55: 326432E, 6087709N) Sth 3 (Zone 55: 326313E, 6087450N) SW 1 (Zone 55: 326666E, 6087062N) SW 2 (Zone 55: 327213E, 6086611N) SW 3 (Zone 55: 327672E, 6086229N) SW 4 (Zone 55: 328361E, 6085566N) SW 5 (Zone 55: 328606E, 6085402N)	These are a series of downstream boundaries representing outflows from floodplain to the north and south of Forest Creek. These were represented as head versus discharge ("HQ") boundaries snapped to the model boundary with a slope (or "b" attribute) of 0.0002 to match that applied on Forest Creek.
Forest / Piccaninny Creek Floodplain (breakaway flow path) (FPCF) – All Flow Scenarios 1 (Zone 55: 326395E, 6089106N) 2 (Zone 55: 326098E, 6089406N) 3 (Zone 55: 325238E, 6089584N) 4 (Zone 55: 324477E, 6089615N) 5 (Zone 55: 323484E, 6089570N) 6 (Zone 55: 321545E, 6089365N)	These are a series of downstream boundaries representing outflows from floodplain where flows breakaway from Forest Creek to the north and Piccaninny Creek to the south. These were represented as head versus discharge ("HQ") boundaries snapped to the model boundary with a slope (or "b" attribute) of 0.0002 to match that applied on Forest Creek.
Back Creek Channel (BckCC) – All Flow Scenarios (Zone 55: 320424E, 6091097N)	This is a downstream boundary representing outflows from Back Creek via the main channel at the downstream extent of the model approximately 4.4 km as the bird flies south-west of the confluence of Billabong Creek and Piccaninny Creek. This was represented as head versus discharge ("HQ") boundary snapped to the model boundary with a slope (or "b" attribute) of 0.0002 to match that applied on Billabong Creek. This was considered appropriate as Back Creek breaks away from Billabong Creek approximately 5 km along the river downstream of confluence with Piccaninny Creek and re-joins via Forest Creek just upstream of the Wanganella township in high flow events.

Outflow Boundaries (location)	Description
Back Creek Floodplain (BckCCF) – All Flow Scenarios Nth 1 (Zone 55: 320075E, 6091979N) Nth 2 (Zone 55: 320091E, 6092140N) Nth 3 (Zone 55: 320108E, 6092308N) Nth 4 (Zone 55: 320124E, 6092468N)	These represent a series of downstream boundaries representing outflows from the floodplain to the north and south of Back Creek at the downstream extent of the model. These were represented as head versus discharge ("HQ") boundaries snapped to the model boundary with a slope (or "b" attribute) of 0.0002 to match that applied on Back Creek.
Browns Creek Channel (BrwCC)– All Flow Scenarios (Zone 55: 327814E, 6097605N)	This is a downstream boundary representing outflows from Browns Creek via the main channel at the downstream extent of the model approximately 9 km as the bird flies north-west of the Conargo township. This was represented as head versus discharge ("HQ" boundary) snapped to the model boundary with a slope (or "b" attribute) of 0.0002 to match that applied on Billabong Creek. This was considered appropriate as Browns Creek breaks away from Billabong Creek just upstream of Conargo and re-joins via Sheepwash Creek just upstream of the Wanganella township in high flow events.
Browns Creek Floodplain (BrwCF) – All Flow Scenarios NW 1 (Zone 55: 328222E, 6098066N) Sth 1 (Zone 55: 327527E, 6097373N) Sth 2 (Zone 55: 327364E, 6097270N) Flood Flow Scenarios (incl. PMF) NW 2 (Zone 55: 329199E, 6098585N) NW 3 (Zone 55: 329468E, 6098960N) NW 4 (Zone 55: 329575E, 6099533N) Nth 2 (Zone 55: 330649E, 6099578N) Nth 3 (Zone 55: 330649E, 6099767N) Nth 4 (Zone 55: 331413E, 6100015N) Nth 5 (Zone 55: 331956E, 6100109N) NW 6 (Zone 55: 333910E, 6100574N) NW 7 (Zone 55: 334396E, 6100964N) NW 8 (Zone 55: 334474E, 6100901N) Nth 9 (Zone 55: 334814E, 6100812N) Nth 10 (Zone 55: 335010E, 6100861N) Nth 11 (Zone 55: 337437E, 6099365N) NW 12 (Zone 55: 339868E, 6098001N) NW 13 (Zone 55: 341058E, 6098117N) NW 14 (Zone 55: 341370E, 6098337N) Nth 15 (Zone 55: 341517E, 6098708N) Nth 16 (Zone 55: 341517E, 6098742N) Nth 17 (Zone 55: 341950E, 6098940N) Nth 18 (Zone 55: 342578E, 6099210N) Nth 19 (Zone 55: 342602E, 6099189N) NW 21 (Zone 55: 343867E, 6098170N) NW 22 (Zone 55: 344906E, 6098131N) Sth 3 (Zone 55: 327161E, 6097151N)	These represent a series of downstream boundaries representing outflows from the floodplain to the north and south of Browns Creek at the downstream extent of the model. These were represented as head versus discharge ("HQ") boundaries snapped to the model boundary with a slope (or "b" attribute) of 0.0002 to match that applied on Back Creek.

Outflow Boundaries (location)	Description
Flood Flow Scenarios - PMF Only NW 5 (Zone 55: 329734E, 6099999N) Nth 1 (Zone 55: 330529E, 6099534N) Nth 20 (Zone 55: 342683E, 6099124N)	
Sheepwash Creek Channel (SCC) - All Flow Scenarios (Zone 55: 325628E, 6094177N)	This is a downstream boundary representing outflows from Sheepwash Creek via the main channel at the downstream extent of the model approximately 3.5 km as the bird flies north-west of Boonoke Weir. This was represented as head versus discharge ("HQ" boundary) snapped to the model boundary with a slope (or "b" attribute) of 0.0002 to match that applied on Billabong Creek. This was considered appropriate as Sheepwash Creek breaks away from Billabong Creek just upstream of Conargo and re-joins just upstream of the Wanganella township in high flow events.
Sheepwash Creek Floodplain (SCF) – All Flow Scenarios NW 1 (Zone 55: 325652E, 6094297N) NW 2 (Zone 55: 325705E, 6094370N) NW 3 (Zone 55: 325741E, 6094435N) NW 4 (Zone 55: 325821E, 6094578N) Nth (Zone 55: 326661E, 6094531N) Sth 1 (Zone 55: 325618E, 6094127N) Sth 2 (Zone 55: 325603E, 6094054N) Sth 3 (Zone 55: 325590E, 6093992N) Sth 4 (Zone 55: 324498E, 6093898N) Sth 5 (Zone 55: 324372E, 6093783N) Sth 6 (Zone 55: 324039E, 6093783N) Sth 7 (Zone 55: 323990E, 6093817N) Sth 8 (Zone 55: 323504E, 6094015N) Sth 9 (Zone 55: 322665E, 6094347N) Sth 10 (Zone 55: 321808E, 6095077N)	These represent a series of downstream boundaries representing outflows from the floodplain to the north and south of Sheepwash Creek at the downstream extent of the model. These were represented as head versus discharge ("HQ") boundaries snapped to the model boundary with a slope (or "b" attribute) of 0.0002 to match that applied on Sheepwash Creek.
Browns / Sheepwash Creek Floodplain (breakaway flow path) (BrwSCF) – All Flow Scenarios 1 (Zone 55: 327153E, 6094663N) 2 (Zone 55: 326815E, 6095477N) 3 (Zone 55: 326779E, 6095908N) 4 (Zone 55: 327012E, 6096317N)	These are a series of downstream boundaries representing outflows from floodplain where flows breakaway between Browns Creek and Sheepwash Creek. These were represented as head versus discharge ("HQ") boundaries snapped to the model boundary with a slope (or "b" attribute) of 0.0002 to match that applied on both Browns Creek and Sheepwash Creek.
Wollamai Escape Channel (WEC) (Zone 55: 339735E, 6084122N)	This is a boundary representing a connection to Wollamai Escape Channel, which connects to Forest Creek just downstream of Drivers Weir. The boundary was located just upstream of Drivers Road and was represented as a head versus discharge ("HQ" boundary) snapped to the model boundary with a slope (or "b" attribute) of 0.0002 to match that applied on the other boundaries. This was considered appropriate to avoid water spilling into a much larger area when it is only activated in events rarer than 0.2% AEP (i.e. only activated in the modelled PMF scenario) and was applied consistently to the "existing" and "proposed" scenarios.

Outflow Boundaries (location)	Description
Lignum Creek Floodplain (LCF) – All Flow Scenarios 1 (Zone 55: 360464E, 6100002N) 2 (Zone 55: 361678E, 6100780N) 3 (Zone 55: 361766E, 6100860N) 4 (Zone 55: 362046E, 6101339N) 5 (Zone 55: 362206E, 6101604N) 6 (Zone 55: 362277E, 6102158N) 7 (Zone 55: 362487E, 6102497N) 8 (Zone 55: 362586E, 6102625N) 9 (Zone 55: 362892E, 6102800N) 10 (Zone 55: 363342E, 6103033N) 11 (Zone 55: 363705E, 6104074N) 12 (Zone 55: 365400E, 6104298N) Sth 1 (Zone 55: 354894E, 6099894N)	These are a series of downstream boundaries representing outflows from floodplain adjacent to Lignum Creek, which breaks away from Wilsons Anabranch just north of Eighteen Mile Dam on Yanco Creek. These were represented as head versus discharge ("HQ") boundaries snapped to the model boundary with a slope (or "b" attribute) of 0.0002 to match those on Browns Creek as these flowpaths would join floodplain flows from Browns Creek downstream of the model.

4.4 Model Roughness

Model roughness for both the 1D and 2D models was defined using Manning's (n) coefficients based on a combination of readily available spatial data (including land use, wetlands, and water dependent vegetation spatial datasets) and aerial imagery or photos collected via site visit, surveyors and/or as part of broader LiDAR capture. The adopted values are presented in Table 4-3 for the 2D domain and 1D structures were given a Manning's 'n' coefficient of 0.010, 0.012 and 0.013 for plastic, steel and concrete assets respectively. These values have been tested and refined throughout the model build and proving activities, some of which is discussed in the "Sensitivity" section of this report. The adopted distribution of the roughness is also presented spatially in Figure 4-10.

Table 4-3: 2D Roughness Categories

Feature Code or Material Number	Description	Manning's *n* coefficient
1	Some brush. Crops in rows/furrowed land	0.04
3	Residential	0.05
4	Open space - mostly grass	0.03
5	Open space - some trees	0.035
7	Creek or Open space - some bush	0.05
6 / 8	Open space - mostly bush to dense bush	0.07
10	Low density residential	0.04
14	Farmland / cropping	0.04
100	River - choked with cumbungi or very dense trees	0.10
101	River - limited/some vegetation in waterway	0.05
102	River - moderate vegetation in waterway	0.07
9999	River - generally clear waterway	0.035

YANCO CREEK AT YANCO BRIDGE
410169

Eighteen Mile Dam

Wilson Anabranch
Offtake

BILLABONG CREEK AT CONARGO
(PUCKAWIDGEE)
410017

BILLABONG CREEK AT DOWNSTREAM
HARTWOOD WEIR
410168

YANCO CREEK AT WIRAKI
41000209

Boonoke Weir

Warriston Weir

Hartwood Weir

Forest Creek
Offtake

Piccaninny Weir

Nine Mile Dam

Parry Weir

Forest Creek Block
Bank

McCaughey Block Dam

FOREST CREEK AT OFFTAKE
41010309

Piccaninny Pipe
Offtake & Regulator

Lower Woolshed Weir

BILLABONG CREEK AT JERILDERIE
410016

Piccaninny Offtake

Quiamong Weir

FOREST CREEK AT WARRISTON WEIR
410148

Drivers Weir

Legend

- Hydraulic Model Boundary
- Modelled significant structures
- Gauge Locations

Material Number
(Manning's 'n')

- 1 (0.04)
- 3 (0.05)
- 4 (0.03)
- 5 (0.035)
- 6 (0.07)
- 7 (0.05)
- 8 (0.07)
- 10 (0.04)
- 14 (0.04)
- 100 (0.10)
- 101 (0.05)
- 102 (0.07)
- 9999 (0.035)

N

GDA 2020 Zone 55
Scale: 1:200,000

0 4 8 km

DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023;
Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Catchment Roughness
"G:\21\12537654\GIS\Maps\Working\
Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 4-10: Adopted catchment roughness (material classification and roughness value)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

4.5 Hydraulic structures

The section outlines the hydraulic structures included within the model domain, which have been separated into the following categories within each waterway:

- Key Structures – which includes a summary of the purpose and modelling approach used to represent these more significant structures modelled in either the 1D or 2D domain along that watercourse.
- Other Structures – a section that tabulates the remaining structures modelled in either the 1D or 2D domain along that watercourse with actual or assumed details.

The spatial distribution of all of these modelled structures are shown in Figure 4-11, which also includes some “nominal floodplain structures” that were added to the model to allow for continuity of flow paths in certain areas based on initial and/or calibration/validation modelling (these are represented as 3 m gaps in obstruction using a combination of terrain modifications and cell width reduction factors, or 2d_zsh and 2d_cwf layers).

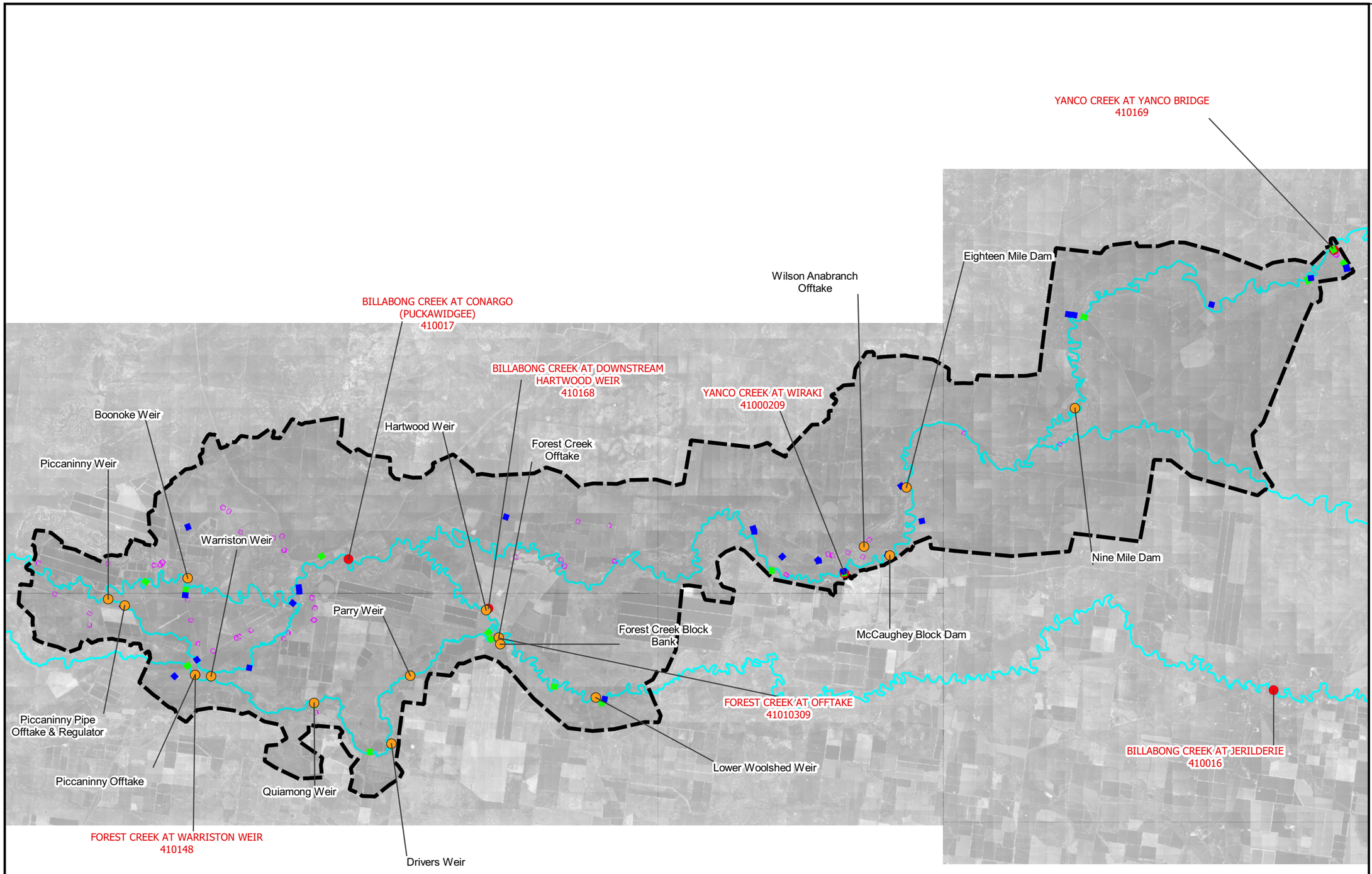
4.5.1 Yanco Creek

4.5.1.1 Key Structures

Within the Study Area, there are the following four (4) key structures along Yanco Creek:

1. 9 Mile Dam.
2. 18 Mile Block Bank.
3. McCaugheys Block Bank.
4. Wilsons Anabranch Offtake.

A description and the adopted details of these structures for the modelling are explored in the proceeding section.



Legend

- Hydraulic Model Boundary
- Gauge Locations
- Key watercourses
- Modelled significant structures
- Other Modelled Stuctures (1D Domain)
- Modelled Bridges (2d_lfcsh)
- Nominal Floodplain Structures (2d_zsh)

N

GDA 2020 Zone 55
Scale: 1:200,000

0 4 8 km

DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023;
Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Modelled Structures
"G:\21\12537654\GIS\Maps\Working\
Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 4-11: Modelled Structures

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

9 Mile Dam

Nine Mile Dam is an operating weir that is located along Yanco Creek a little upstream of confluence with Turn Back Jimmy Creek. Information about operational conditions and structural measurements have not been provided. The adopted modelling assumptions for 9 Mile Dam are summarised Table 4-4.

Table 4-4 Modelling assumptions for 9 Mile Dam

Structure Name	**9 Mile Dam**
Location	GDA 2020 / MGA Zone 55 (374815E, 6101606N)
Included in model	Yes
3 Rivers Structure Identification Code	Z19_012
Type of structure	Block bank
How has the structure been modelled	Modelled as a 2d_zsh line, option set to MAX Structure height defined by combined DEM created for the model
Photo of upstream face 	Photo of downstream face 

18 Mile Block Bank

Eighteen Mile Dam is operating as a privately owned earthen block bank structure. The structure is located along Yanco Creek, downstream of Turn Back Jimmy Creek and near the northern end of Wilsons Anabranch. Information about operational conditions and structural measurement have not been provided. The “Yanco Creek System Water Recovery Scoping Study” indicates that this is a fixed crest structure with a crest level of 101.5 m AHD and a crest width of 50 m. The adopted modelling assumptions for 18 Mile Block Bank are summarised in Table 4-5.

Table 4-5 Modelling assumptions for 18 Mile Dam

Structure Name	**18 Mile Block Bank**
Location	GDA 2020 / MGA Zone 55 (366075E, 6097496N)
Included in model	Yes
3 Rivers Structure Identification Code	Z19_017
Type of structure	Block bank
How has the structure been modelled	Modelled as a 2d_zsh line, option set to MAX Structure height defined by combined DEM created for the model
Photo of upstream face 	Photo of downstream face 

McCaugheys Block Bank

McCaughey Block Dam is a brick block bank structure located along Yanco Creek, downstream of Turn Back Jimmy Creek and just upstream of Wilsons Anabranch Offtake regulator structure. Information about operational conditions and structural measurement have not been provided. The “Yanco Creek System Water Recovery Scoping Study” indicates that this is a fixed crest structure with a crest level of 100.65 m AHD and a crest width of 100 m. The adopted modelling assumptions for McCaugheys Block Bank are summarised in Table 4-6.

Table 4-6 Modelling assumptions for McCaugheys Block Bank

Structure Name	**McCaugheys Block Bank**
Location	GDA 2020 / MGA Zone 55 (365237, 6093961)
Included in model	Yes
3 Rivers Structure Identification Code	Z19_022
Type of structure	Block bank
How has the structure been modelled	Modelled as a 2d_zsh line, option set to MAX Structure height defined by combined DEM created for the model
Photo of upstream face 	Photo of downstream face 

Wilsons Anabranch Offtake

Wilson Anabranch Offtake is located along Yanco Creek. The offtake operates as a 750 mm pipe with a control door. Drawings have been provided but operational conditions have not. The adopted modelling assumptions for Wilsons Anabranch Offtake are summarised in Table 4-7.

Table 4-7 Modelling assumptions for Wilsons Anabranch Offtake

Structure Name	**Y245.9_RC – Wilsons Anabranch Offtake**
Location	GDA 2020 / MGA Zone 55 (363888E, 6094427N)
Included in model	Yes
3 Rivers Structure Identification Code	Z19_024
Type of structure	Pipe culvert with control door through block bank
How has the structure been modelled	Modelled in the 1D domain as a circular pipe culverts (C) Modelled dimensions: 0.75 m in diameter, 6.0 m in length Invert levels: 99.3 m AHD U/S, 99.25 m AHD D/S Structure details collected as part of the “Yanco Creek Hydrology” Water for Rivers study in 2009. Structure was modelled as closed for operational flows and open for flood flows.
Photo upstream of face 	Photo of downstream face 

4.5.1.2 Other Structures

Table 4-8 list the assumptions and approximate location of other structures modelled explicitly in 1D or 2D domain in the hydraulic model, along either Yanco Creek or linked tributaries, such as Wilsons Anabranch.

Table 4-8 Modelling assumptions for other structures on Yanco Creek

Structure Name	3 Rivers Structure Code	Location (GDA 2020 / MGA Zone 55)	Type of structure	Modelling approach	Dimensions
Y179.35_LC1	Z18_077	388897, 6108906	Culvert	1D domain (C)	Diameter: 0.9 m Length: 30 m
Y179.35_LC1	N/A	388919, 6108838	Culvert	1D domain (C)	Diameter: 0.9 m Length: 30 m
Y182.05_C	Z19_002	387046, 6108352	Culvert	1D domain (C)	Diameter: 0.75 m Length: 10 m
Access bridge DS of Kidman Way	Z19_003	386888, 6108240	Bridge	2D domain (2d_lfcsh, Method C)	N/A
Y190.65_RC	Z19_005	381903, 6106981	Culvert	1D domain (C)	Diameter: 0.4 m Length: 10 m
Wilsons Rd crossing	Z19_007	375292, 6106339	Bridge	2D domain (2d_lfcsh, Method C)	N/A
Y204.65_RRC1	Z19_008	374788, 6106435	Three rectangular culverts	1D domain (R)	Width: 3.0 m Height: 2.1 m Length: 10 m
Y204.65_RRC2	Z19_056	374614, 6106456	Two pipe culverts	1D domain (C)	Diameter: 1.2 m Length: 10 m
Y204.6_RRC	Z19_009	374456, 6106479	Three rectangular culverts	1D domain (R)	Width: 3.0 m Height: 1.8 m Length: 10 m
Y237.75_RC	Z19_019	365796, 6097572	Culvert	1D domain (C)	Diameter: 0.75 m Length: 7.0 m
Y244.3_C	N/A	365103, 6094013	Culvert	1D domain (C)	Diameter: 0.6 m Length: 5.0 m
Access bridge over Yanco Creek	Z19_025	362849, 6093055	Bridge	2D domain (2d_lfcsh, Method C)	
Y248.8_RC2	Z19_026	362811, 6093160	Culvert	1D domain (C)	Diameter: 1.375 m Length: 9.0 m
Y248.8_RC1	Z19_026	362811, 6093160	Culvert	1D domain (C)	Diameter: 0.9 m Length: 6.0 m
Old bridge crossing Yanco Creek	N/A	359093, 6093168	Bridge	2D domain (2d_lfcsh, Method C)	
Y257.0_RC	Z19_057	358185, 6095204	Culvert	1D domain (C)	Diameter: 0.49 m Length: 6.0 m

4.5.2 Billabong Creek

4.5.2.1 Key Structures

Within the Study Area, there are the following five (5) key structures along Billabong Creek:

1. Lower Woolshed Weir.
2. Forest Creek Offtake (FCO).
3. Hartwood Weir.
4. Bonooke Weir.
5. Picaninny Weir.

A description and the adopted details of these structures for the modelling are explored in the proceeding section.

Lower Woolshed Weir

This is a privately owned operational structure. It is located along Billabong Creek, upstream of where Forest Creek diverges. Information about operational conditions and structural measurement have not been provided. The adopted modelling assumptions for Lower Woolshed Weir are summarised in Table 4-9 and Figure 4-12.

Table 4-9 Modelling assumptions for Lower Woolshed Weir

Structure Name	**B129.0_W – Lower Woolshed Weir**
Location	GDA 2020 / MGA Zone 55 (349972E, 6086612N)
Included in model	Yes
3 Rivers Structure Identification Code	Z17_045
Type of structure	Weir
How has the structure been modelled	Modelled in 1D domain as a WW type structure with cross-section Weir sill level: 97.8 m AHD Sill level derived from available LiDAR Upstream invert level 94.7 m AHD
Photo of upstream face 	Photo of downstream face 

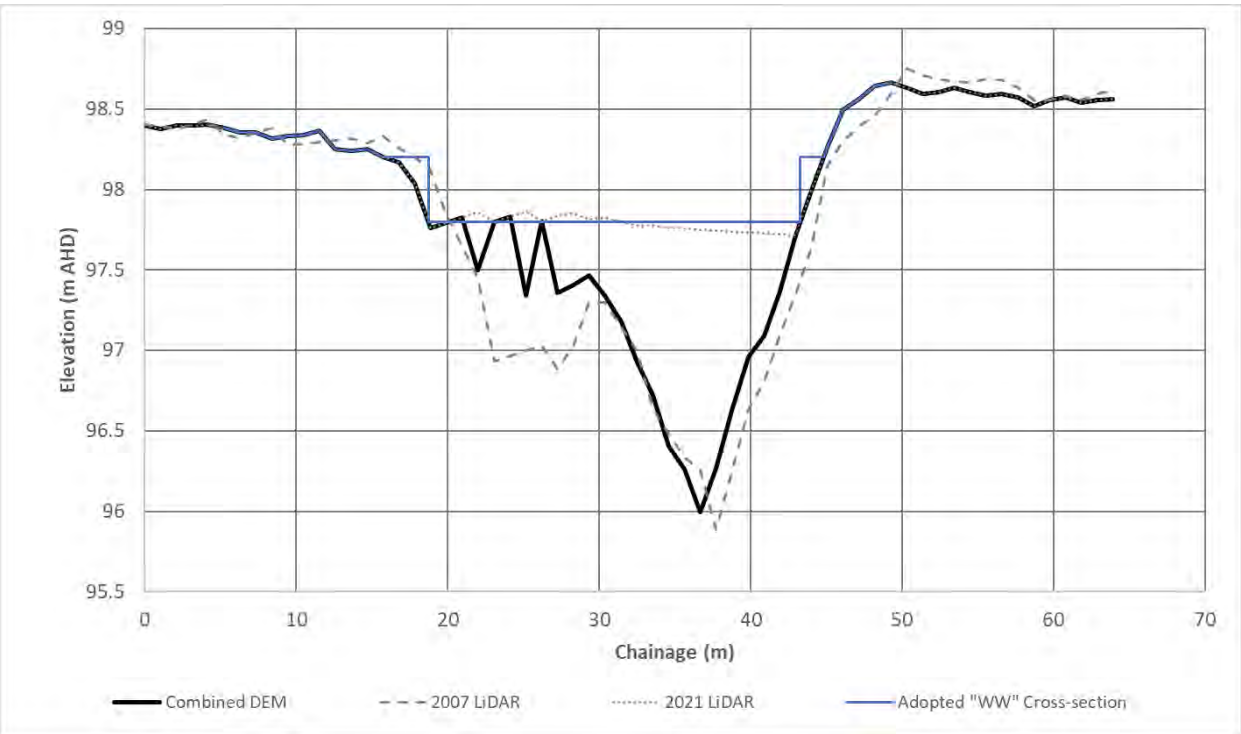


Figure 4-12 Adopted Lower Woolshed Weir Cross-section

Forest Creek Offtake

Forest Creek Offtake (FCO), shown in Figure 4-13 below, is located on the western bank of the weir pool at Hartwood Weir and this structure manages flows into Forest Creek until Forest Creek Block Bank is overtopped. This was modelled as a 1D structure to allow representation of the level-flow relationship between Hartwood weir pool and Forest Creek Offtake. The structures operations will be based on flows in Billabong Creek and/or the need for water in Forest Creek for irrigation and/or environmental purposes depending on the modelled scenario. The adopted modelling assumptions for Lower Woolshed Weir are summarised in Table 4-10.



Figure 4-13: Forest Creek Offtake (Photo Courtesy of David Clarke)

Table 4-10 Modelling assumptions for Forest Creek Offtake

Structure Name	**B142.00_LG & B142.00_LW – Forest Creek Offtake**
Location	GDA 2020 / MGA Zone 55 (344931E, 6089712N)
Included in model	Yes
3 Rivers Structure Identification Code	Z20_003
Type of structure	Offtake structure with two sluice gates
How has the structure been modelled	Modelled as either a 1D structure or an extraction and inflow using "2d_sa" feature to transfer water from Billabong Creek to the FCO channel. When modelled as a 1D structure, FCO structure consisted of the following: • An operational sluice gate element ("SGO") with the following properties - o Two vertical sluice gates that are 2.435 m wide and 1.4 m high. o With a gate sill level of 93.59 m AHD o Operational logic based on WaterNSW rules. • A fixed broad-crested weir ("WB") element with the following properties - o A flat 4.45 m wide section either side of gates o With a weir crest level of 96.89 m AHD Offtake information and details have been derived from survey data, gate operational data and/or "As Conn" drawings provided by 3Rivers, DCCEEW and/or collected by State Water. When modelled as an extraction/inflow via "2d_sa" polygons, the sluice gate component of the structure was represented as a constant flow that has been extracted from Billabong Creek upstream of the FCO structure and then applied as an inflow in the channel downstream of the FCO structure. Flow rates were based on nominated operation rules and/or gauge data. Upstream invert level in channel at structure was 94.2 m AHD
Photo of upstream face 	Photo of downstream face 

Hartwood Weir

Hartwood Weir shown in Figure 4-14 below, is located approximately 42 km west of Jerilderie and maintains the water levels within Billabong Creek via a concrete sill and drop boards creating a weir pool that extends upstream to Lower Woolshed Weir. The backwater from this weir pool discharges to Forest Creek via the Forest Creek Offtake and/or Forest Creek Block Bank in larger events. This structure is being investigated for upgrade as part of the Yanco modernisation project. This upgrade will include operational gates and for this reason the structure was modelled as a 1D structure to allow use of the logical control feature in TUFLOW (ESTRY). The level of the weir pool is dependent on the presence or absence of dropboards, which will be assumed based on interpretation of historical flow data and information provided by WNSW. The dropboards will not be explicitly modelled but represented as a weighted-average revision of the minimum elevation of the weir. The adopted modelling assumptions for Hartwood Weir are summarised in Table 4-11 and Figure 4-15.



Figure 4-14: Hartwood Wier (Photo Courtesy of David Clarke)

Table 4-11 Modelling assumptions for Hartwood Weir

Structure Name	**B145.25_W – Hartwood Weir**
Location	GDA 2020 / MGA Zone 55 (344280E, 6091138N)
Included in model	Yes
3 Rivers Structure Identification Code	Z20_090
Type of structure	Weir
How has the structure been modelled	Modelled in 1D domain as a WW type structure with cross-section. Weir sill has been built at several levels: 94.93 - 94.96 m AHD. Weir crest level: 96.06 m AHD. Weir cross section and sill level derived from level provided in the Price Merrett Hartwood Weir survey. Upstream invert level 92.86 m AHD.
Photo of upstream face 	Photo of downstream face 

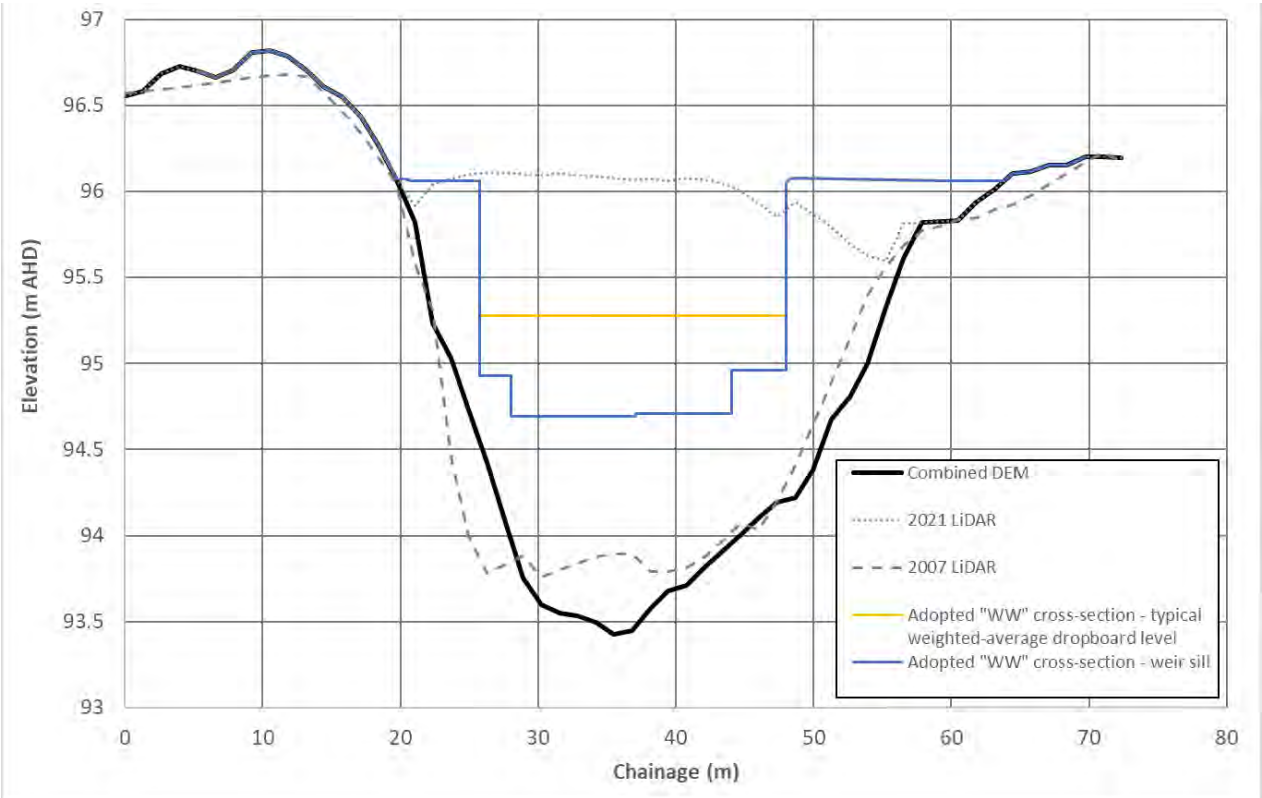


Figure 4-15 Adopted Hartwood Weir Cross-section

Boonoke Weir

Boonoke Weir is owned by Australia Food Agriculture and is located approximately 12 km downstream of Conargo Bridge and 8 km upstream of Piccaninny Weir on Billabong Creek. This structure is a fixed crest overshot concrete weir with a sill level of 91.14 m AHD. Other structural and operational information has not been provided. The adopted modelling assumptions for Boonoke Weir are summarised in Table 4-12 and Figure 4-16.

Table 4-12 Modelling assumptions for Boonoke Weir

Structure Name	**B179.55_W – Boonoke Weir**
Location	GDA 2020 / MGA Zone 55 (328805, 6092797)
Included in model	Yes
3 Rivers Structure Identification Code	Z19_051
Type of structure	Weir
How has the structure been modelled	Modelled in the 1D domain as a WW type structure. Weir sill level: 91.14 m AHD. Weir crest level: 92.3 m AHD. Weir cross section and sill level derived from DCCEEW NSW Detailed Weir Review (2007) and Water for Rivers: Yanco Creek System Bathymetric Survey (SKM, 2007). Upstream invert level 89.4 m AHD.

Photo of upstream face



Photo of downstream face



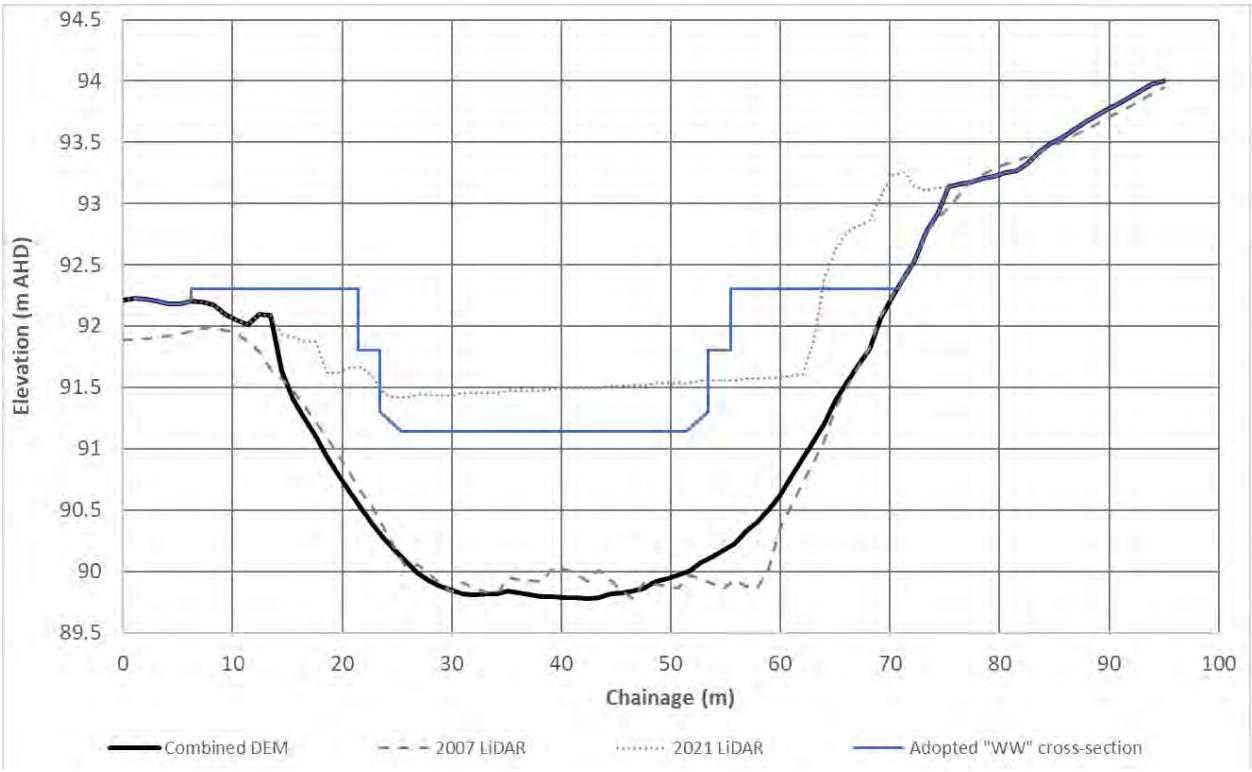


Figure 4-16 Adopted Boonoke Weir Cross-section

Piccaninny Weir

Piccaninny Weir is downstream of the confluence of Piccaninny Creek with Billabong Creek and is a fixed crest weir at approximately 89.58 m AHD as shown in Figure 4-17 below. This structure controls water levels within Billabong Creek and was initially being investigated for upgrade as part of the Yanco modernisation project, but was slater removed from the scope. The adopted modelling assumptions for Hartwood Weir are summarised in Table 4-11 and Figure 4-15.



Figure 4-17: Piccaninny Weir (Photo Courtesy of David Clarke)

Table 4-13 Modelling assumptions for Piccaninny Weir

Structure Name	**B188.85_W – Piccaninny Weir**
Location	GDA 2020 / MGA Zone 55 (324677E, 6091711N)
Included in model	Yes
3 Rivers Structure Identification Code	Z20_028
Type of structure	Weir
How has the structure been modelled	Modelled in 1D domain as a WW type structure with a cross-section. Weir sill level: 89.58 m AHD. Weir cross section and sill level derived from DCCEEW 2021 LiDAR, and 3 Rivers cross section and survey data collected by Price Merrett. Upstream invert level 87.6 m AHD.
Photo of upstream face 	Photo of downstream face 

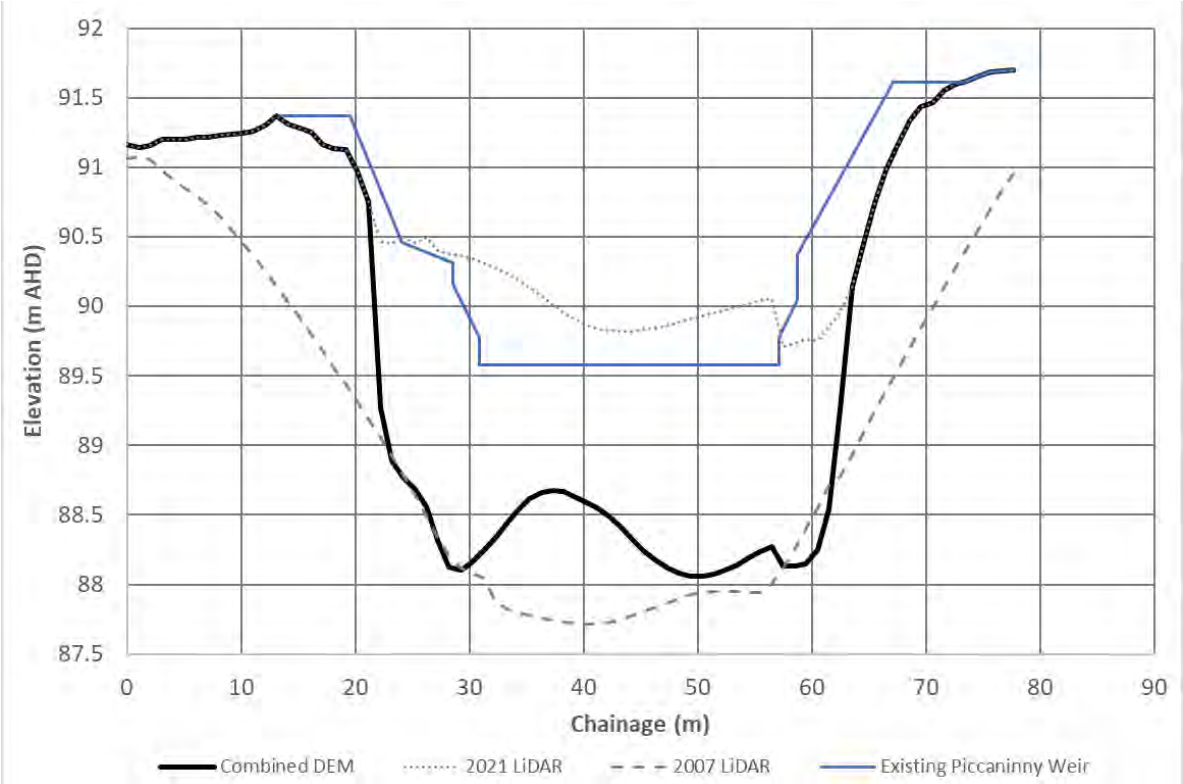


Figure 4-18 Adopted Piccaninny Weir Cross-section

4.5.2.2 Other Structures

Table 4-14 list the assumptions and approximate location of other structures modelled explicitly in 1D or 2D domain in the hydraulic model along Billabong Creek.

Table 4-14 Modelling assumptions for other structures on Billabong Creek

Structure Name	3 Rivers Structure Code	Location (GDA 2020 / MGA Zone 55)	Type of structure	Modelling approach	Dimensions
Crossing over Billabong Creek, US of Lower Woolshed Weir	N/A	350275E, 6086317N	Bridge	2D domain (2d_lfcsh, Method C)	N/A
B128.2_C	N/A	350427E, 6086523N	Culvert	1D domain (C)	Diameter: 0.9 m Length: 6.0 m
Access bridge 12 over Billabong Creek	Z20_001	347819E, 6087166N	Bridge	2D domain (2d_lfcsh, Method C)	N/A
Access bridge 10 over Billabong Creek	Z20_004	344403E, 6089978N	Bridge	2D domain (2d_lfcsh, Method C)	N/A
Carrathool Rd crossing	Z19_043	335743E, 6093928N	Bridge	2D domain (2d_lfcsh, Method C)	N/A
B166.4_LC	Z19_045	334577E, 6092323N	Culvert	1D domain (C)	Diameter: 0.45 m Length: 10.0 m
B166.9_LC	Z19_046	334594E, 6092095N	Culvert	1D domain (C)	Diameter: 0.375 m Length: 10.0 m
B167.65_C	Z19_048	334255E, 6091495N	Culvert	1D domain (C)	Diameter: 0.9 m Length: 14.0 m
Boonoke Rd bridge	Z19_052	328708E, 6092179N	Bridge	2D domain (2d_lfcsh, Method C)	N/A
B178.6_LC	Z19_053	328678E, 6091914N	Culvert	1D domain (C)	Diameter: 0.8 m Length: 9.0 m
Access bridge 2, US of Piccaninny Weir	N/A	326617E, 6092609N	Bridge	2D domain (2d_lfcsh, Method C)	N/A

4.5.3 Forest Creek

4.5.3.1 Key Structures

Within the Study Area, there are the following five (5) key structures along Forest Creek:

1. Forest Creek Block Bank (FCBB).
2. Parrys Weir.
3. Drivers Weir.
4. Quiamong Weir.
5. Warriston Weir.

A description and the adopted details of these structures for the modelling are explored in the proceeding section.

Forest Creek Block Bank

Forest Creek Block Bank (FCBB), shown in Figure 4-19 below, is located on Forest Creek approximately 0.5 km downstream of where it breaks away from Billabong Creek (which is around 4.3 km upstream of Hartwood Weir). This structure acts as an additional flow relief for the weir pool upstream of Hartwood Weir in larger events. With survey pre- and post- recent events showing changes to the observed crest level (see Figure 4-20), it was deemed that block bank has been eroded over time and should be reinstated to a higher level than the most recent survey. Based on discussions with DCCEEW, the level of reinstatement was set to 95.91 m AHD – which is between level noted in 2010/11 survey and that from the 2021 survey. The adopted modelling assumptions for FCBB are summarised in Table 4-15 and Figure 4-20.



Figure 4-19: Forest Creek Block Bank

Table 4-15 Modelling assumptions for Forest Creek Block Bank

Structure Name	**F0.5_W – Forest Creek Block Bank**
Location	GDA 2020 / MGA Zone 55 (344990E, 6089400N)
Included in model	Yes
3 Rivers Structure Identification Code	-
Type of structure	Block Bank
How has the structure been modelled	Modelled in 1D domain as WW structure with a cross-section. Block Bank level modelled with irregular cross-section. Upstream of block bank the channel is choked with cumbungi. Upstream invert level of channel was set to around 93.65 m AHD.
Photo of upstream face 	Photo of downstream face 

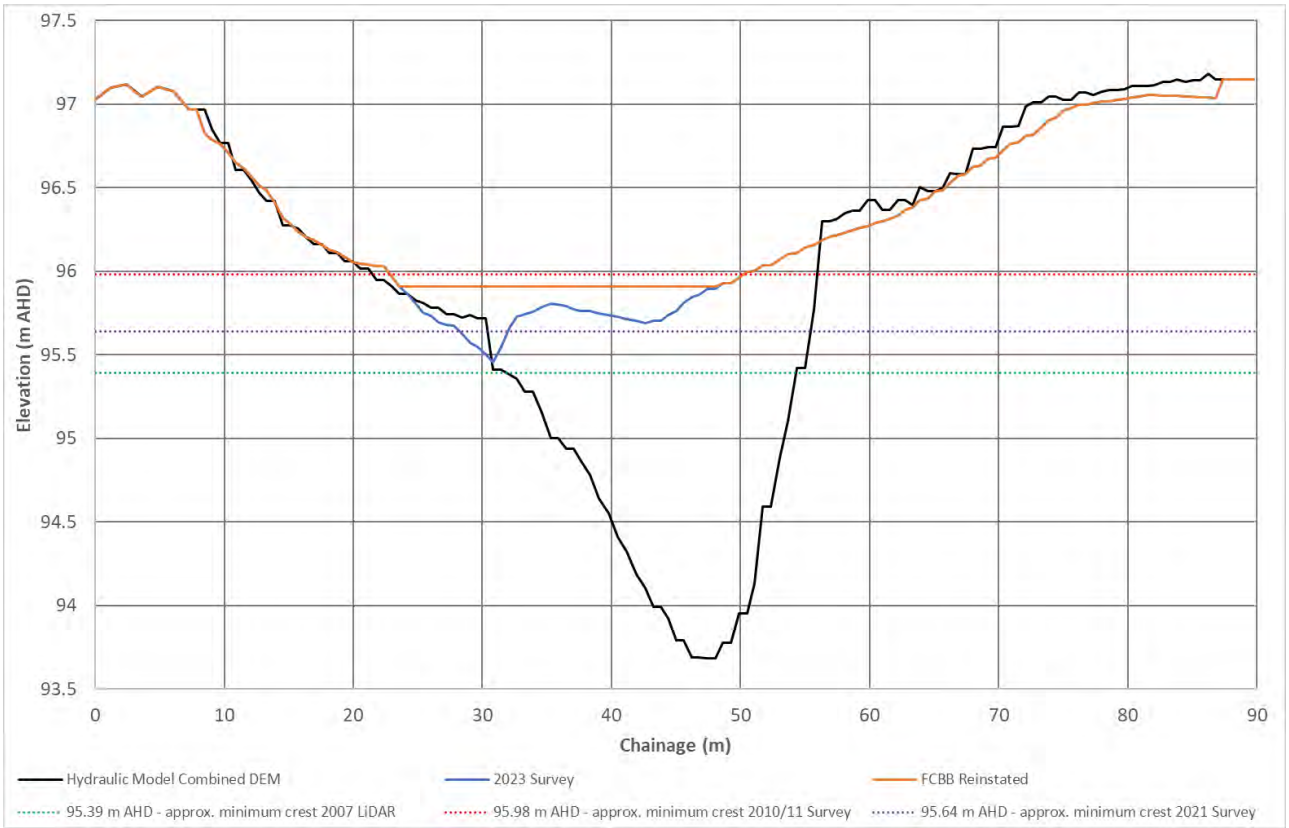


Figure 4-20 Adopted Forest Creek Block Bank Cross-section

Parrys Weir

Parry Weir, shown in Figure 4-21, is a privately owned structure that is located along Forest Creek approximately 6.8 km downstream of Conargo Road. General arrangement drawings have been provided outlining that the weir has been constructed at 3 levels, spanning 15.2 m across the bottom of the channel. Drop boards of varying elevations are known to be used at Parry Weir and will be represented as a weighted-average revision of the minimum elevation of the weir. Operational information has not been provided. The adopted modelling assumptions for Parrys Weir are summarised in Table 4-16 and Figure 4-22.



Figure 4-21: Parrys Weir

Table 4-16 Modelling assumptions for Parrys Weir

Structure Name	**F8.05_W – Parrys Weir**
Location	GDA 2020 / MGA Zone 55 (340344E, 6087736N)
Included in model	Yes
3 Rivers Structure Identification Code	Z20_008
Type of structure	Weir
How has the structure been modelled	Modelled in 1D domain as WW structure with a cross-section. Weir sill level modelled as average dropboard level: 94.96 m AHD. Weir cross section and sill level derived from DCCEEW NSW Detailed Weir Review (2007) and 3 Rivers Forest Creek Weirs survey data, collected by State Water in 2011. Upstream invert level 93.2 m AHD.

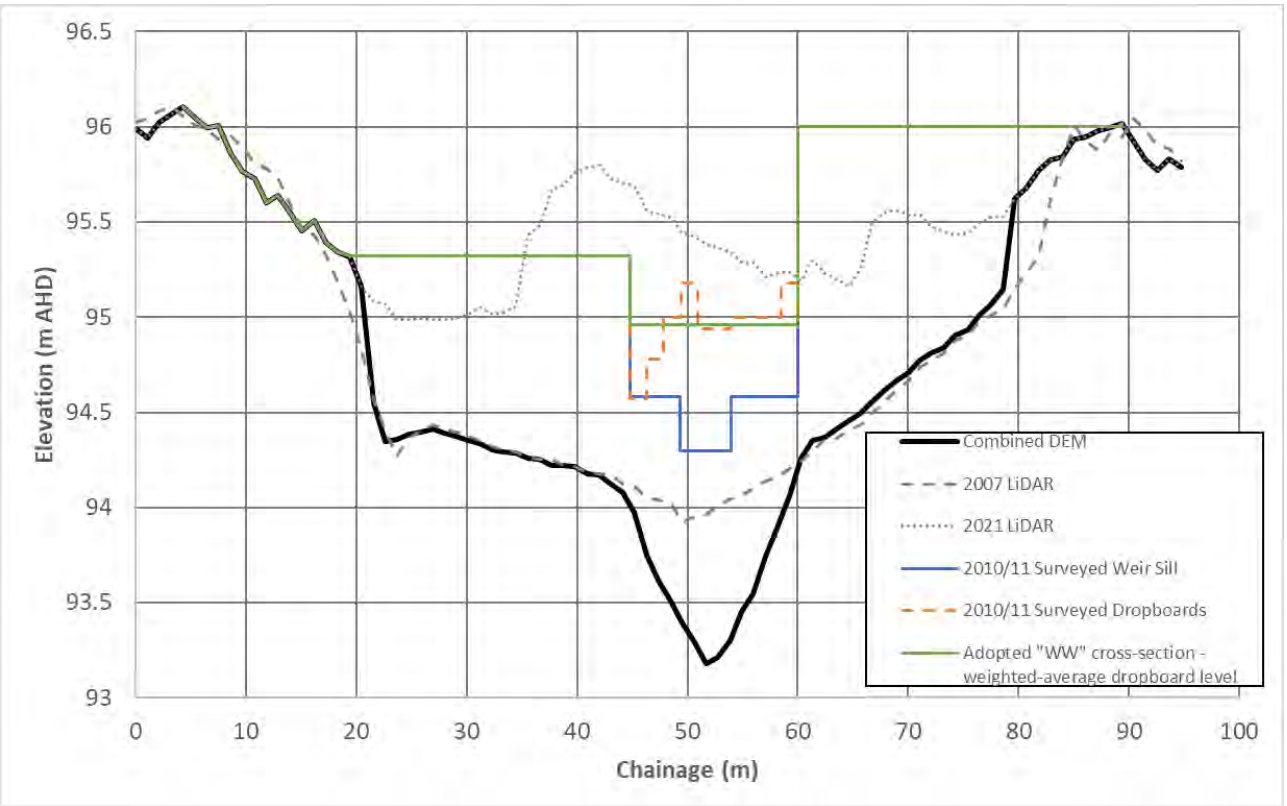


Figure 4-22 Adopted Parrys Weir Cross-section

Drivers Weir

Drivers Weir, shown in Figure 4-23, is a privately owned structure that is located along Forest Creek approximately 6.2 km downstream of Parrys Weir. General arrangement drawings have been provided outlining that the weir measures 15.7 m wide across the bottom of the channel. The sill level of Drivers Weir is noted as 93.14 m AHD and drop boards are known to be used. The dropboards will not be explicitly modelled and will be represented as a weighted-average revision of the minimum elevation of the weir. Operational information has not been provided. The adopted modelling assumptions for Drivers Weir are summarised in Table 4-17 and Figure 4-24.



Figure 4-23: Drivers Weir

Table 4-17 Modelling assumptions for Drivers Weir

Structure Name	**F22.15_W – Drivers Weir**
Location	GDA 2020 / MGA Zone 55 (339366E, 6084213N)
Included in model	Yes
3 Rivers Structure Identification Code	Z20_009
Type of structure	Weir
How has the structure been modelled	Modelled in 1D domain as WW structure with a cross-section. Weir crest level modelled as average dropboard level: 93.89 m AHD. Weir cross section and sill level derived from 3 Rivers Forest Creek Weirs survey data, collected by State Water in 2011. Upstream invert level 92.75 m AHD.

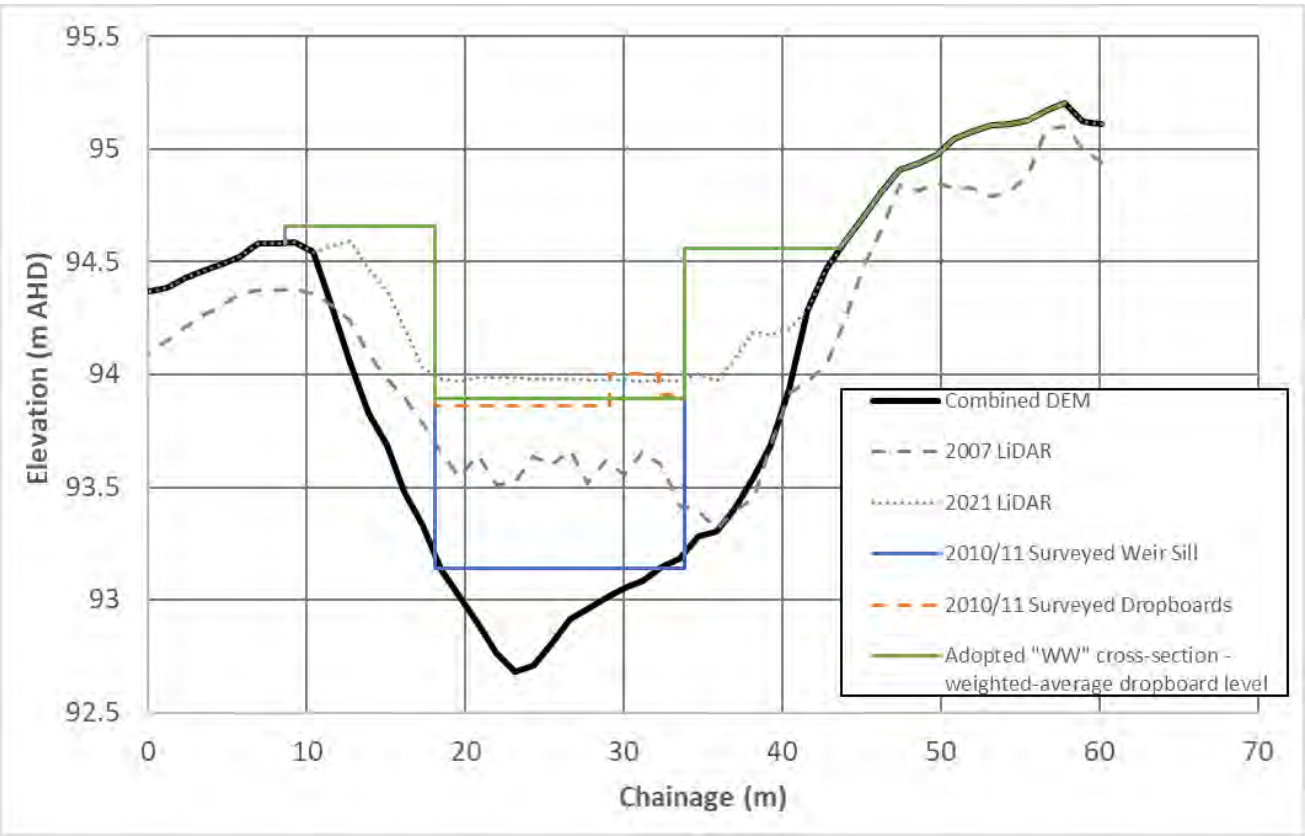


Figure 4-24 Adopted Drivers Weir Cross-section

Quiamong Weir

Quiamong Weir is a privately owned structure and includes an access bridge across Forest Creek. General arrangement drawings have been provided outlining that the weir measures 9.7 m wide across the bottom of the channel. The mean sill level of the weir is 92.3 m AHD. Dropboards of varying elevations are known to be used at Quiamong Weir. No other operational information has been provided. The adopted modelling assumptions for Quiamong Weir are summarised in Table 4-18 and Figure 4-25.

Table 4-18 Modelling assumptions for Quiamong Weir

Structure Name	**F12.15_W – Quiamong Weir**
Location	GDA 2020 / MGA Zone 55 (335357E, 6086187N)
Included in model	Yes
3 Rivers Structure Identification Code	Z20_014
Type of structure	Weir
How has the structure been modelled	Modelled in 1D domain as WW structure with a cross-section. Weir sill level modelled as average dropboard level: 93.42 m AHD. Weir cross section and sill level derived from 3 Rivers Forest Creek Weirs survey data, collected by State Water in 2011 Upstream invert level 91.55 m AHD. Bridge over top has not been modelled – this would likely require use of an irregular pipe conduit in TUFLOW, which would behave quite differently to a weir. Given that for operational flows this bridge will not be engaged and that in flood flows it will quickly drown out, the need to add this was deemed unnecessary.

Photo of upstream face



Photo of downstream face



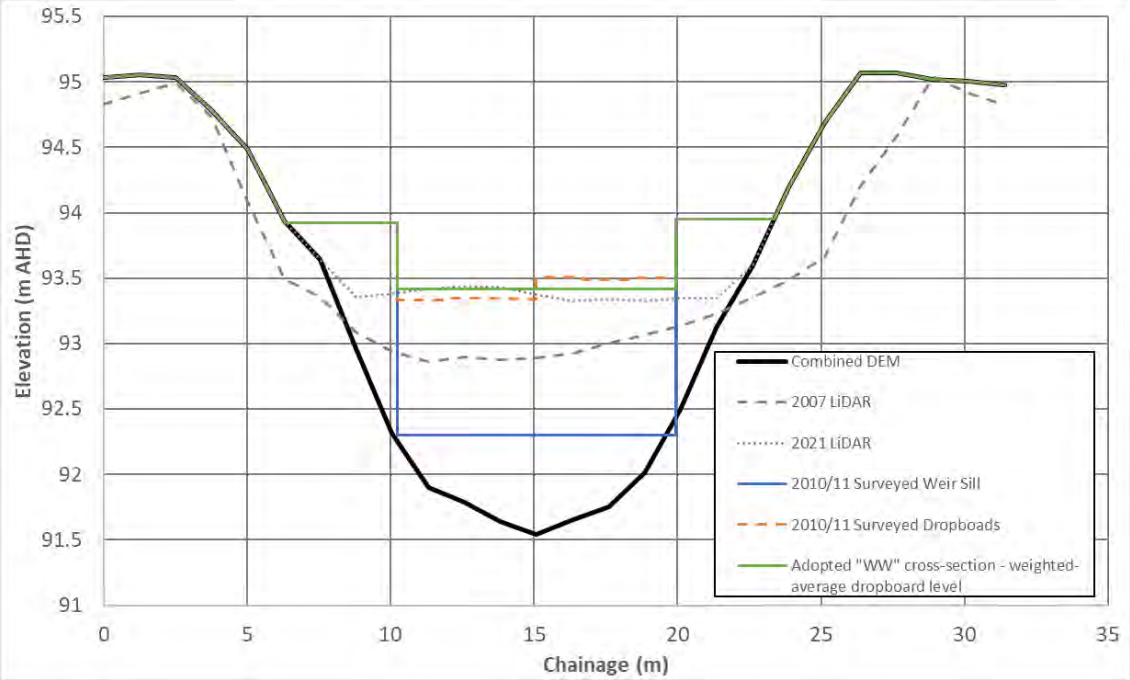


Figure 4-25 Adopted Quiamong Weir Cross-section

Warriston Weir

Warriston Weir, shown in Figure 4-26 below, is a fixed crest weir near the confluence of Forest Creek and Picaninny Creek that discharges to Forest Creek creating a weir pool. Warriston weir has a sill level of 92.16 m AHD and the backwater from this weir pool discharges to Piccaninny Creek via a block bank and pipe outlet, which may be upgraded to include operational features as part of the Yanco modernisation project. This was represented as a 1D structure. There is also a side channel to the south of the main Forest Creek channel that will be activated in certain events. The adopted modelling assumptions for Warriston Weir are summarised in Table 4-19 and Figure 4-27.



Figure 4-26: Warriston Weir (Photo Courtesy of David Clarke)

Table 4-19 Modelling assumptions for Warriston Weir

Structure Name	**F30.65_W – Warriston Weir**
Location	GDA 2020 / MGA Zone 55 (329185E, 6087775N)
Included in model	Yes
3 Rivers Structure Identification Code	Z20_022
Type of structure	Weir
How has the structure been modelled	Modelled in 1D domain as WW structure with a cross-section. Weir sill level: 92.16 m AHD. Weir cross section and sill level derived from 3 Rivers Forest Creek Weirs survey data, collected by State Water in 2011. Upstream invert level 89.8 m AHD. Bridge over top has not currently been modelled – this would likely require use of an irregular pipe conduit in TUFLOW, which would behave quite differently to a weir.
Photo of upstream face 	Photo of downstream face 

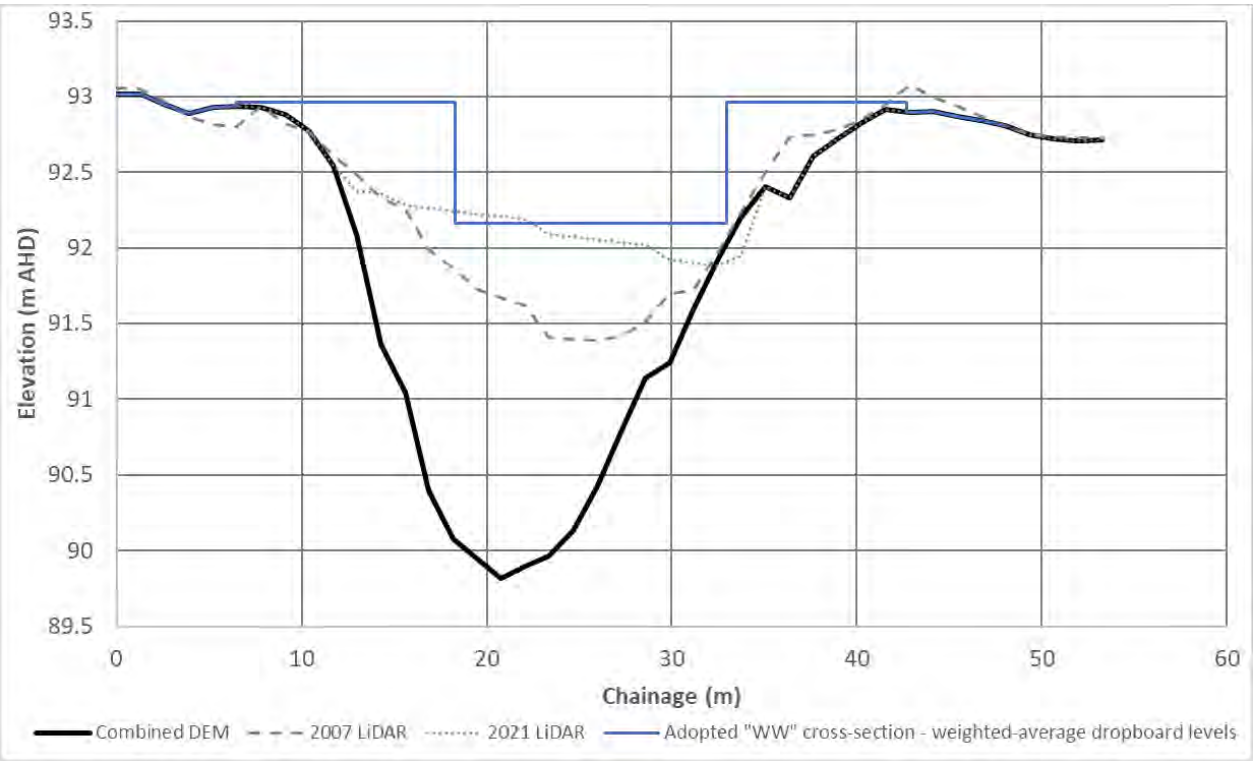


Figure 4-27 Adopted Warriston Weir Cross-section

4.5.3.2 Other Structures

Table 4-20 list the assumptions and approximate location of other structures modelled explicitly in 1D or 2D domain in the hydraulic model along Forest Creek.

Table 4-20 Modelling assumptions for other structures on Forest Creek

Structure Name	3 Rivers Structure Code	Location (GDA 2020 / MGA Zone 55)	Type of structure	Modelling approach	Dimensions
Conargo Rd crossing, DS of Forest Creek Offtake	Z20_005	344525E, 6089618N	Bridge	2D domain (2d_lfcsh, Method C)	N/A
Access bridge 9, DS of Drivers Weir	Z20_010	338241E, 6083775N	Bridge	2D domain (2d_lfcsh, Method C)	N/A
Road bridge 1, Conargo Rd crossing	Z20_024	328790E, 6088253N	Bridge	2D domain (2d_lfcsh, Method C)	N/A
F30.45_LRC	N/A	328118E, 6087705N	Culvert	1D domain (R)	Width: 2.4 m Height: 1.2 m Length: 15.0 m

4.5.4 Piccaninny Creek

4.5.4.1 Key Structures

Within the Study Area, there are the following four (4) key structures along Piccaninny Creek:

1. Piccaninny Offtake (structure returning flows from Forest Creek to Piccaninny Creek)
2. Conargo Road Culvert.
3. Piccaninny Access Culvert.
4. Piccaninny Crossing (culverts under Wanganella-Conargo Road).

A description and the adopted details of these structures for the modelling are explored in the proceeding section.

Piccaninny Offtake

Piccaninny offtake is located on a diversion channel from Forest Creek to Piccaninny Creek approximately 1.1 km upstream of Warriston Weir. This structure consists of a block bank with two culverts passing through it to divert flow from Forest Creek back to Billabong Creek via Piccaninny Creek from the weir pool upstream of Warriston Weir. The adopted modelling assumptions for Piccaninny Offtake are summarised in Table 4-21.

Table 4-21 Modelling assumptions for Piccaninny Offtake

Structure Name	**P0.1_LC & P0.1_RC –Piccaninny Offtake**
Description	Piccaninny Offtake includes an access track that crosses Piccaninny Creek. The offtake is a block bank with 2 pipe outlets with the following details noted on recent survey of Piccaninny Return (S1464 Forest Creek Creek Return Regulator.dwg Revison B from 28/03/2023): • A top of bank of around 93 m AHD – but variable with a low point just below this level around western culvert. • A 680 mm diameter RCP with an adverse grade from 91.62 – 91.77 m AHD towards the western end of the block bank within the main channel area. • A 450 mm diameter RCP with an unknown upstream invert and downstream invert of 91.99 m AHD towards the eastern end of the block bank within the main channel area. Based on survey and site visits it was agreed with NSW DCCEEW that this culvert was non-functioning and it was therefore excluded from the modelling.
Location	GDA 2020 / MGA Zone 55 (33000, 6087709)
Included in model	Yes
3 Rivers Structure Identification Code	Z20_091
Type of structure	Two circular concrete pipe culverts
How has the structure been modelled	Western culvert modelled in the 1D domain as circular pipe element (“C”) called “P0.1_LC” with: Modelled dimensions: 0.68 m diameter with a 9.6 m length Modelled invert levels: 91.62 m AHD U/S, 91.77 m AHD D/S.
Photo of P0.1_LC upstream face 	Photo of bank at P0.1_LC 
Photo of P0.1_RC upstream face 	Photo of P0.1_RC bank 

Conargo Road Culvert

Conargo Road crossing is located on Piccaninny Creek just over 1 km downstream of where diversion channel from Piccaninny Offtake joins Piccaninny Creek. The structure provides cross-drainage for Piccaninny Creek under Conargo Road. The adopted modelling assumptions for Piccaninny Offtake are summarised in Table 4-22.

Table 4-22 Modelling assumptions for culvert under Conargo Road

Structure Name	**P1.65_RC – Culvert under Conargo Rd**
Description	Cross-drainage to allow Piccaninny Creek to drain passed Conargo Road.
Location	GDA 2020 / MGA Zone 55 (329277E, 6088564N)
Included in model	Yes
3 Rivers Structure Identification Code	-
Type of structure	Two rectangular culverts under road crossing
How has the structure been modelled	Modelled in the 1D domain as two barrel pipe culvert (“C”) element at present. Modelled dimensions: 2.0 m diameter RCP. Invert levels: 91.35 m AHD U/S, 91.25 m AHD D/S. Structure details collected during 3Rivers site visit in March 2022.
Photo of upstream face 	Photo of downstream face 

Piccaninny Access Culvert

Piccaninny Access culvert provides cross-drainage for Piccaninny Creek beneath an access track that crosses the creek approximately 3.7 km upstream of Conargo Road. The adopted modelling assumptions for Piccaninny Offtake are summarised in Table 4-23.

Table 4-23 Modelling assumptions for Piccaninny Access Culvert

Structure Name	**P2.65_C – Piccaninny Access Culvert**
Description	Drainage under access track on Piccaninny Creek upstream of Conargo Road.
Location	GDA 2020 / MGA Zone 55 (331994, 6088146)
Included in model	Yes
3 Rivers Structure Identification Code	Z20_020
Type of structure	Circular concrete pipe culvert
How has the structure been modelled	Modelled in the 1D domain as a circular pipe culverts (C). Modelled dimensions: diameter of 0.4 m, 5.0 m in length. Invert levels: 91.37 m AHD U/S, 91.37 m AHD D/S. Structure information has been derived from Piccaninny Creek survey data provided by DCCEEW, collected by Price Merrett.
Photo of upstream face 	Photo of downstream face 

Piccaninny Crossing

Piccaninny Crossing is a set of two culvert banks that control flow along Piccaninny Creek passing under Wanganella-Conargo Road. They are located just under 1 km upstream of confluence between Piccaninny Creek and Billabong Creek, immediately upstream of Piccaninny Weir. The western structure is located immediately downstream of an additional poor condition block bank that has a steel structure passing beneath it with a nominal diameter of around 1 m, which as a result of the modelling grid has been represented as a single structure connected by a dummy 1D link. The adopted modelling assumptions for the western culvert set (including upstream asset) and eastern culvert set of Piccaninny Offtake are summarised in Table 4-24 and Table 4-25 respectively.

Table 4-24 Modelling assumptions for western culvert bank of Piccaninny Crossing

Structure Name	**B7.87_C & B7.85_C – Piccaninny Creek crossing under Wanganella-Conargo Rd**
Description	The western bank of culverts at Piccaninny Crossing consists of a steel pipe under a block bank that is directly connected to a concrete pipe culvert under Wanganella-Conargo Road.
Location	GDA 2020 / MGA Zone 55 (325533E, 6091380N)
Included in model	Yes
3 Rivers Structure Identification Code	Z20_027 & Z20_026
Type of structure	1 single steel pipe culvert, followed by two circular concrete pipe culverts.
How has the structure been modelled	Modelled in the 1D domain as: B7.85_C – one circular steel pipe culvert (“C”) element with Modelled dimensions: 1 m diameter, length of 11 m. Modelled invert levels: 90.47 m AHD U/S, 90.35 m AHD D/S. B7.87_C – one circular concrete pipe culvert (“C”) element with Modelled dimensions: 1.125 m diameter, 13.0 m in length. Modelled invert levels: 90.25 m AHD U/S, 90.22 m AHD D/S. Structure information has been derived from Piccaninny Creek survey data provided by DCCEEW, collected by Price Merrett.
Photo of B7.85_C downstream face 	Photo of channel between B7.85_C and B7.87_C 
Photo of B7.87_C upstream face 	Photo of B7.85_C downstream face 

Table 4-25 Modelling assumptions for eastern culvert bank of Piccaninny Crossing

Structure Name	**B7.85_RC– Eastern Culvert Crossing**
Description	Additional culvert for higher flows on Piccaninny Creek to pass under Wanganella-Conargo Road
Location	GDA 2020 / MGA Zone 55 (325594E, 6091404N)
Included in model	Yes
3 Rivers Structure Identification Code	Z20_025
Type of structure	Circular concrete pipe culvert
How has the structure been modelled	Modelled in the 1D domain as a circular pipe culvert (“C”) element. Modelled dimensions: diameter of 0.63 m, 11 m in length. Modelled invert levels: 90.92 m AHD U/S, 91.07 m AHD D/S. Structure information has been derived from Piccaninny Creek survey data provided by DCCEEW, collected by Price Merrett.
Photo of upstream face 	Photo of downstream face 

4.5.4.2 Other Structures

Table 4-26 list the assumptions and approximate location of other structures modelled explicitly in 1D or 2D domain in the hydraulic model along Forest Creek.

Table 4-26 Modelling assumptions for other structures on Piccaninny Creek

Structure Name	**3 Rivers Structure Code**	**Location (GDA 2020 / MGA Zone 55)**	**Type of structure**	**Modelling approach**	**Dimensions**
P7.9_LC	-	325437E, 6091320N	Culvert	1D domain (C)	Diameter: 0.6 m Length: 14.0 m

4.6 Model Losses

The model has two sets of losses applied, one representing volumetric losses and one representing structure losses. These losses are applicable for all model scenarios/events and the means of application is summarised in subsections 4.6.1 and Figure 4-28 respectively. The evaporation losses have been applied globally across the model, with the infiltration losses applied via the three zones below (and shown spatially in Figure 4-28):

- "Billabong Creek @ Jerilderie to Billabong Creek @ DS Hartwood", which includes Forest Creek upstream of Warriston Weir.
- "Yanco Creek @ Yanco Bridge to Billabong Creek @ Conargo", which includes portion of Billabong Creek downstream of Hartwood Weir.
- "Billabong Creek @ Conargo to Billabong Creek @ Wanganella", which includes Forest Creek downstream of Warriston Weir and Piccaninny Creek downstream of Conargo Road.

Analysis of the calibrated Source model results demonstrated that infiltration losses varied between reach (typically defined by river gauging stations) with higher losses in the Yanco Creek and Billabong Creek downstream of Conargo, and lower losses on Billabong Creek between Jerilderie and Hartwood.

4.6.1 Summary of volumetric losses

4.6.1.1 Evaporation

This has been represented as a negative rainfall depth based on available data for time period of the modelled flow event. The calibration/validation events had these losses applied as a timeseries which are presented in Figure 4-29 and Figure 4-30 for the 'Exist_Aug2021' and 'EXIST_Aug2017' events respectively.

For scenario models, the 'Exist_Aug2022' calibration event and the baseline volumetric loss sensitivity run a loss rate of 0.1 mm/hr was applied (this was based on an average loss of 2.46 mm/day over the April to October period).

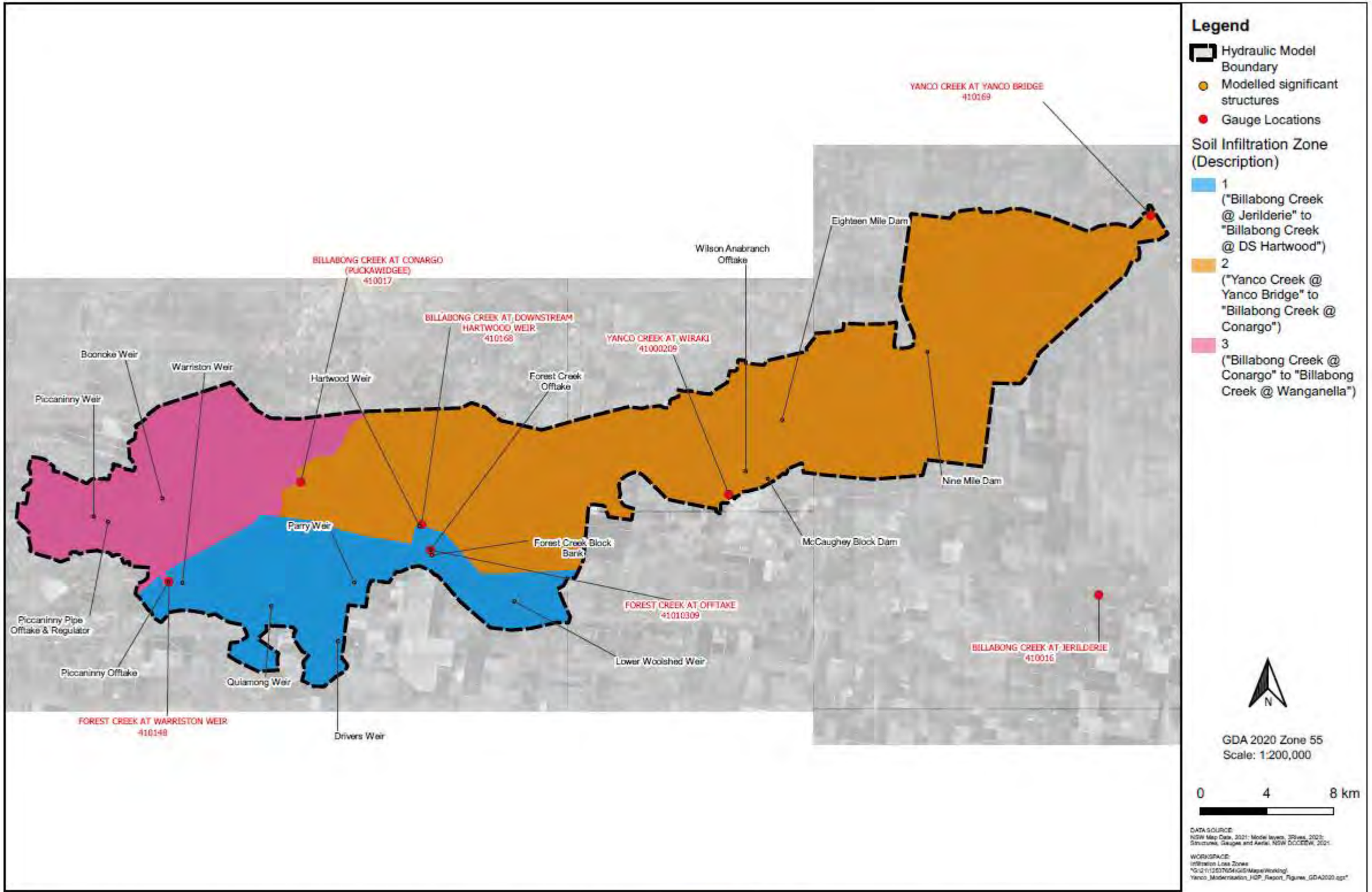
For the impact assessment simulations, no evaporation losses have been modelled as these losses were deemed insignificant given the nature and/or mechanism generating the flow scenarios been assessed.

4.6.1.2 Infiltration

This has been represented via a soils layer and/or negative rainfall. A soils layer was used for lower flows as it was found that for low flows the losses were relatively constant whereas for higher flows losses were found to vary with flow. For lower calibration flows an average loss was calculated from the Source model results which was converted to a loss in mm per day by taking into account the water surface area for a steady state flow of the average of the scenarios listed in 'Model Development' section of report. For the 2021 validation events the loss between relevant gauges (as the Source model results were not available post 2020) was calculated and converted to a mm per day rate as described above and applied as a negative rainfall boundary that varied each day. This approach was also initially applied to the 2022 calibration event; but was found to not be appropriate due to differences in the gauge flows as discussed in the "Calibration and Validation" section (Section 5.3) of this report.

The loss rate applied to the zones of the model via the soils layer (presented spatially in Figure 4-28) for each of the nominated events is summarised in Figure 4-28 and those applied via a negative rainfall timeseries are presented in Figure 4-29 for the 'EXIST_Aug2021' high flow event.

For the impact assessment simulations, no infiltration losses have been modelled as these losses were deemed insignificant given the nature and/or mechanism generating the flow scenarios been assessed.



Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 4-28: Modelled infiltration loss zones (via TUFLOW's soils layer)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Table 4-27: Overview of Infiltration Losses

Event	Infiltration Loss (mm/hr)		
	Billabong Creek @ Jerilderie to Billabong Creek @ DS Hartwood	Yanco Creek @ Yanco Bridge to Billabong Creek @ Conargo	Billabong Creek @ Conargo to Billabong Creek @ Wanganella
'EXIST_Aug2022' calibration event and the baseline volumetric loss sensitivity run	0.25	0.75	1
'EXIST_Aug2017'	0.111	0.107	0.195
'EXIST_Aug2021'	0.053	Applied as negative rainfall timeseries (see Figure 4-29).	Applied as negative rainfall timeseries (see Figure 4-29).

4.6.2 Summary of structure losses

4.6.2.1 Culverts

Standard entrance (0.5) and exit losses (1) have been applied, with default height and width contraction coefficients.

4.6.2.2 Bridges

Bridges have been represented as 2D layered flow constrictions using the newly introduced "Method C" to determine losses based on assigned FLC values, which calculated as follows:

- Level 1 – based on Bradley, 1980 considering blockage and pier types
- Level 2 – difference between Layer 1 FLC and total cumulative FLC target of 0.3, which was adopted from the maximum deck depth to height below deck or D/H ratio for low set and minimum D/H ratio for high set bridges as noted in the TUFLOW Release Notes for the 2020-10-AD Build.
- Level 3 – assumed no FLC at this stage.

Calculation of the losses for each bridge are summarised in Appendix B and were considered appropriate given the nature of the structures and flow scenarios being considered.

4.6.2.3 Weirs

No additional losses other than default weir coefficients have been applied. The following weir types have been used in the modelling, unless otherwise stated:

- Lay-flat gates – modelled as sharp-crested weirs or "WR" type channels with default parameters as per TUFLOW Version 2023-03-AA.
- Block banks and fixed crest weirs – modelled as broad-crested weirs using either "WB" or "WW" type channels when have a flat level with a known width or cross-section applied respectively. These have also adopted default parameters as per TUFLOW Version 2023-03-AA.

4.6.2.4 Sluice Gates

No additional losses other than default gate coefficients for "SG" channels have been applied.

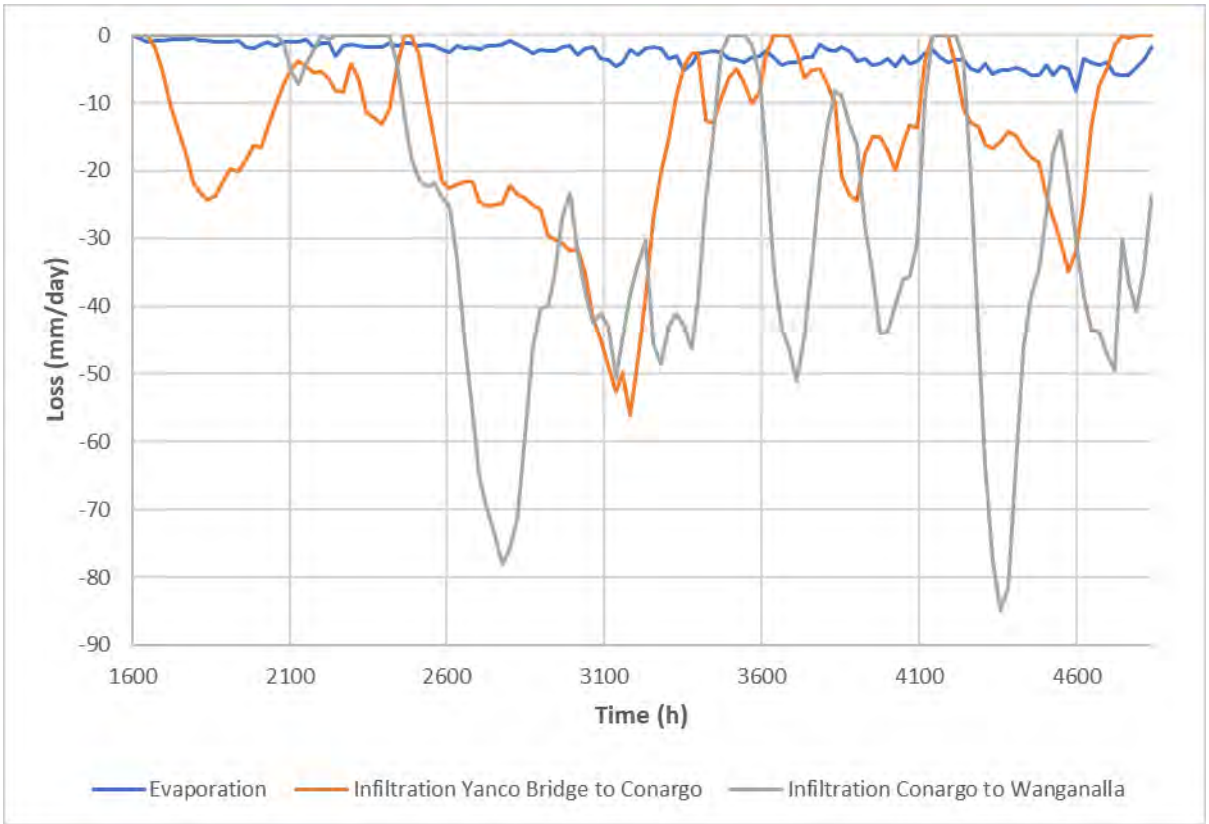


Figure 4-29: Evaporation and infiltration loss timeseries applied for 'EXIST_Aug2021' event

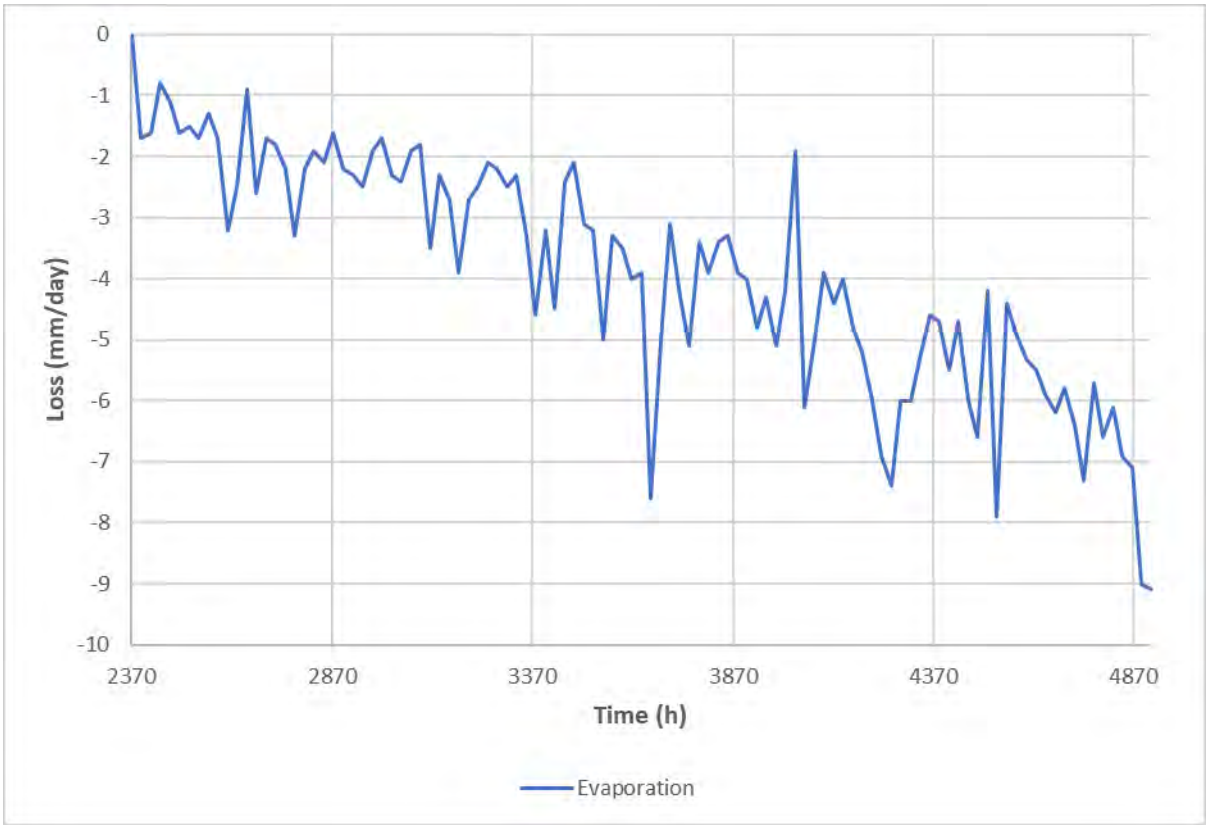


Figure 4-30: Evaporation loss timeseries applied for 'EXIST_Aug2017' event

4.7 Flow Scenarios

Based on the information required by the design team and as part of the Environmental Impact Statement (EIS) process for Hartwood Weir, there were numerous flow scenarios to be assessed for works individually and in combination across the WP19 model. The required flow scenarios are detailed in Table 4-28, which breaks the flow into the following two categories and scenarios:

1. Operational Flows ("OpFlows") – which are steady-state runs with flows based on the following –

    - Maximum Operating Flow ("MaxOF") – flows were based on maximum operating flow for Hartwood Regulator based on Water NSW advice (email dated 17/12/2021)) and the minimum environmental baseflow provisions for "Forest Creek @ Offtake (41010309)" and "Yanco Creek @ Morundah (410015)" based on the draft operations plan (DCCEEW, 2023).
    - Minimum Operating Flow ("MinOF") – flows based on the minimum environmental baseflow provisions for "Billabong Creek @ downstream Hartwood Regulator (410168)", "Forest Creek @ Offtake (41010309)" and "Yanco Creek @ Moonyanco" (a proposed new hydrometric station about 10km west of the junction between Billabong Creek & Yanco Creek) based on the draft operations plan (DCCEEW, 2023).

2. Flood Flows ("Flood") – which are unsteady flow simulations of design flood flows (i.e. event hydrographs) with peak flows based on the Flood Frequency Analysis (FFA) on the "Yanco Creek @ Morundah (410015)" and "Billabong Creek @ Jerilderie (410016)" gauges (3Rivers, 2023b) with some adjustment for bypass and/or loss between these locations and the model inflow location. Given the nature of the Study Area, a given flood event is likely to be dominated by flows in either Billabong Creek or Yanco Creek and as a result flow scenarios have been developed for each of these possible scenarios for each AEP based on the outcomes of the FFA study (3Rivers, 2023b) - the definition of these are presented in Table 4-29. The approximate shape of the hydrograph was developed based on actual recorded flow from a series of gauges during the August 2022 flow event and is presented against the actual quality controlled data in Figure 4-31, with the hydrograph peak then being factored up or down to match the peak flow nominated by the FFA as shown in Table 4-28

The flow scenarios run as part of the RRC Programme that are relevant to the current Study are also listed in Table 4-28. The location of the two inflows are described in detail in Section 4.3, but can be described as follows:

- Yanco Creek Inflow – is located approximately 0.5 km upstream of Yanco Bridge on Kidman Way.
- Billabong Creek Inflow – is located approximately 5.5 km upstream of Lower Woolshed Weir.

It was not considered feasible to undertake rainfall runoff modelling techniques to calculate the PMF of the Murrumbidgee Catchment to Yanco Offtake given its size and complexity. Rather the PFM flow was based on 5 times the 1% AEP flow rates which was considered appropriate for this assessment.

Table 4-28 Flow Scenarios

Flow Category	Flow Scenario	Dominant Creek (DC)	Peak Inflow (ML/day)[1]	
			Yanco Creek Inflow	Billabong Creek Inflow
Operational Flows ("OpFlows")	Maximum Operating Flow ("MaxOF")	n/a	100	510
	Minimum Operating Flow ("MinOF")	n/a	25	35
Flood Flows ("Flood")	50% or 1 in 2 AEP ("50AEP")	n/a	1,120	2,000
	20% or 1 in 5 AEP ("20AEP_<DC Suffix>")	Billabong Ck ("BD")	1,120	4,000
		Yanco Ck ("YD")	2,720	4,000
	10% (1 in 10) AEP ("10AEP_<DC Suffix>")	Billabong Ck ("BD")	2,720	5,600
		Yanco Ck ("YD")	4,400	4,000
	5% (1 in 20) AEP ("5AEP_<DC Suffix>")	Billabong Ck ("BD")	2,720	7,100
		Yanco Ck ("YD")	6,640	5,600
	2% (1 in 50) AEP ("2AEP_<DC Suffix>")	Billabong Ck ("BD")	4,400	9,100
		Yanco Ck ("YD")	10,480	7,100
	1% (1 in 100) AEP ("1AEP_<DC Suffix>")	Billabong Ck ("BD")	6,640	10,900
		Yanco Ck ("YD")	14,320	9,100
	0.5% (1 in 200) AEP ("0p5AEP_<DC Suffix>")	Billabong Ck ("BD")	10,480	13,100
		Yanco Ck ("YD")	19,040	10,900
	0.3% (1 in 300) AEP ("0p3AEP_<DC Suffix>")	Billabong Ck ("BD")	14,320	14,700
		Yanco Ck ("YD")	22,320	13,100
	0.2% (1 in 500) AEP ("0p2AEP_<DC Suffix>")	Billabong Ck ("BD")	19,040	16,500
		Yanco Ck ("YD")	26,960	14,700
	PMF	n/a	71,600	54,500
	Calibration event from 06/2022 – 12/2022 ("Aug2022")	n/a	11,050	3,129
	Calibration Event from 08/2017 – 09/2017 ("Aug2017")	n/a	575.4	499.4
	Calibration Event from 07/2021– 10/2021 ("Aug2021")	n/a	August - 1,360 September – 1,000 October – 1,013	August - 2,153 September - 2,173 October – 1,937
	Calibration Event from 06/2022 – 10/2022 ("Aug2022")	n/a	August - 2,130 End (mid-October) - 1,822	August - 1,836 End (mid-October) - 3,201
	Average peak flow of RRC flow scenarios used for sensitivity testing ("2078BC1405YC")	n/a	1,405	2,078

Table 4-29 Combination of flows based on joint probability analysis presented in FFA Memo (3Rivers, 2023b)

Flow Scenario	AEP (%) at reference gauge		Reference Gauge Flow (ML/day)		Flow adjustment from reference gauge to inflow	
	Yanco Creek at Morundah (41010309)	Billabong Creek at Jerilderie (410016)	Yanco Creek at Morundah (41010309)	Billabong Creek at Jerilderie (410016)	Yanco Creek Inflow	Billabong Creek Inflow
50AEP	50	50	1,400	2,000	80% of reference gauge AEP flow	Reference gauge AEP flow plus 0 ML/day
20AEP_BD	50	20	1,400	4,000		
20AEP_YD	20	20	3,400	4,000		
10AEP_BD	20	10	3,400	5,500		Reference gauge AEP flow plus 100 ML/day
10AEP_YD	10	20	5,500	3,900		
5AEP_BD	20	5	3,400	6,900		Reference gauge AEP flow plus 200 ML/day
5AEP_YD	5	10	8,300	5,400		
2AEP_BD	10	2	5,500	8,600		Reference gauge AEP flow plus 500 ML/day
2AEP_YD	2	5	13,100	6,600		
1AEP_BD	5	1	8,300	9,900		Reference gauge AEP flow plus 1,000 ML/day
1AEP_YD	1	2	17,900	8,100		
0p5AEP_BD	2	0.5	13,100	11,100		Reference gauge AEP flow plus 2,000 ML/day
0p5AEP_YD	0.5	1	23,800	8,900		
0p3AEP_BD	1	0.3	17,900	11,700		Reference gauge AEP flow plus 3,000 ML/day
0p3AEP_YD	0.3	0.5	27,900	10,100		
0p2AEP_BD	0.5	0.2	23,800	12,500		Reference gauge AEP flow plus 4,000 ML/day
0p2AEP_YD	0.2	0.3	33,700	10,700		
PMF	1	1	89,500	49,500	80% of 5 times reference gauge AEP flow	5 times reference gauge AEP flow plus 5,000 ML/day

Note:
[1] indicates that these ifnlows refer to the inflow boundary conditions described in Section 4.3

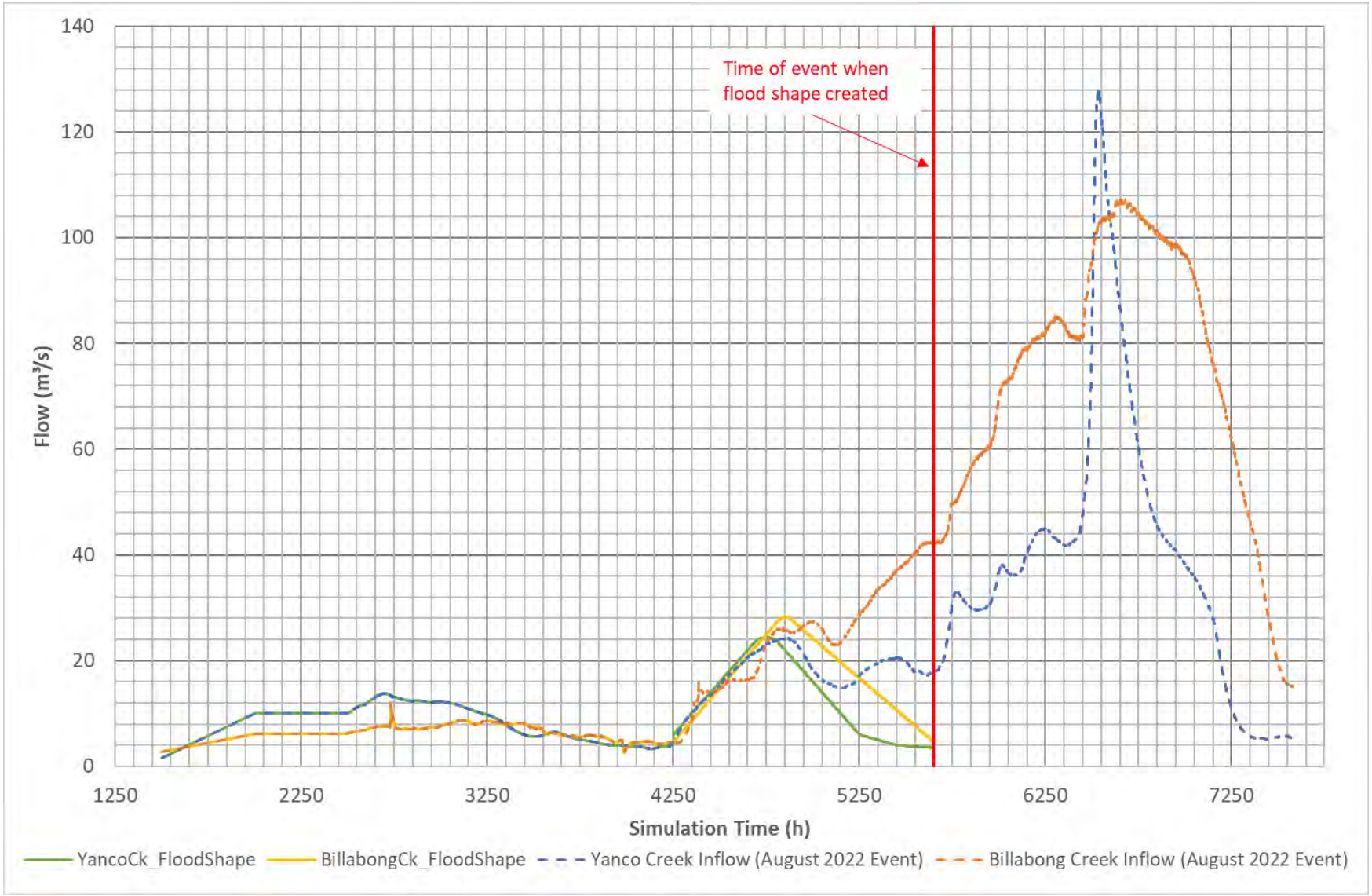


Figure 4-31 Flood Hydrograph Shape

4.8 Model Naming Convention

Models for this study have been named in accordance with the Hydraulic Modelling Standard Specification (DCCEEW, 2021) as summarised below and detailed in Table 4-30. Some of the results are based on RRC modelling, for details on model scenarios from this package refer to RRC Model User Report (3Rivers, 2023a).

<Region>_< Package>_<Model-Version>_~s1~_~e1~.tcf

Table 4-30: Summary of naming convention

Variable	Description
Region	YNC (Yanco Creek)
Package	WP19 (Hartwood model)
Model-Version	As per the naming convention, we have adopted the following version names for this Study: • B204005_Flood - model used to run all “existing” and ”proposed” flood flow scenarios from 50% AEP to PMF for this Study. • B204007_OpFlowsFlood - model used to run all “existing” and ”proposed” operational flow scenarios for this Study. This is the latest incarnation of the model run for final results, but is very similar to the ‘B204006_OpFlows’ version that was used to inform parts of the design. • B204007_Flood - model used to run the full 2022 calibration event. This is the latest incarnation of the model with minor tweaks to previous versions with results being very similar to the ‘B204005_Flood’ version used for assessment of EIS impacts.
Scenario ~s1~	The current study all just have the following scenario: • 16mSGS – a model where we have adopted a 16 m cell size with an SGS sampling frequency of 1 m and no blockage of Wilsons Anabranch outlet structures (assumes current issues will be fixed).
Events ~e1~	The current study ‘B204007_OpFlows’ model version was run for the following events: • “EXIST_MinOF” – a steady state model for existing conditions with minimum operating flow on Billabong Creek and the minimum environmental baseflow for “Yanco Creek @ Moonyanco” on Yanco Creek (see Section 4.7). • “PROP_MinOF_MinOL” – a steady state model with minimum operating flow on Billabong Creek, the minimum environmental baseflow for “Yanco Creek @ Moonyanco” on Yanco Creek (see Section 4.7) and a target weir pool level of 95.28 m AHD. • “PROP_MinOF_MaxOL” – a steady state model with minimum operating flow on Billabong Creek, the minimum environmental baseflow for “Yanco Creek @ Moonyanco” on Yanco Creek (see Section 4.7) and a target weir pool level of 95.44 m AHD. • “PROP_MinOF_FSL” – a steady state model with minimum operating flow on Billabong Creek, the minimum environmental baseflow for “Yanco Creek @ Moonyanco” on Yanco Creek (see Section 4.7) and a target weir pool level of 95.74 m AHD. • “EXIST_MaxOF” – a steady state model for existing conditions with maximum operating flow on Billabong Creek and the minimum environmental baseflow for “Yanco Creek @ Morundah” on Yanco Creek (see Section 4.7). • “PROP_MaxOF_MinOL” – a steady state model with maximum operating flow on Billabong Creek and the minimum environmental baseflow for “Yanco Creek @ Morundah” on Yanco Creek (see discussion in Section 4.7) and a target weir pool level of 95.28 m AHD. • “PROP_MaxOF_MaxOL” – a steady state model with maximum operating flow on Billabong Creek and the minimum environmental baseflow for “Yanco Creek @ Morundah” on Yanco Creek (see discussion in Section 4.7) and a target weir pool level of 95.44 m AHD. • “PROP_MaxOF_FSL” – a steady state model with maximum operating flow on Billabong Creek and the minimum environmental baseflow for “Yanco Creek @ Morundah” on Yanco Creek (see discussion in Section 4.7) and a target weir pool level of 95.74 m AHD.

Variable	Description
Events ~e1~ (cont.)	The current study 'B204005_Flood' model version was run for the following events, where "<Condition>" refers to either "Existing" (EXIST) or "Proposed" (PROP) catchment conditions based on Flood Frequency Analysis (FFA) of key gauges (see discussion in Section 4.7): • "<Condition>_50AEP" – a 50% AEP equivalent unsteady flow event for Study Area. • "<Condition>_20AEP_BD" / "<Condition>_20AEP_YD" – a 20% AEP equivalent unsteady flow event for Study Area where Billabong Creek is dominant (BD) or Yanco Creek is dominant (YD). • "<Condition>_10AEP_BD" / "<Condition>_10AEP_YD" – a 10% AEP equivalent unsteady flow event for Study Area where Billabong Creek is dominant (BD) or Yanco Creek is dominant (YD). • "<Condition>_5AEP_BD" / "<Condition>_5AEP_YD" – a 5% AEP equivalent unsteady flow event for Study Area where Billabong Creek is dominant (BD) or Yanco Creek is dominant (YD). • "<Condition>_2AEP_BD" / "<Condition>_2AEP_YD" – a 2% AEP equivalent unsteady flow event for Study Area where Billabong Creek is dominant (BD) or Yanco Creek is dominant (YD). • "<Condition>_1AEP_BD" / "<Condition>_1AEP_YD" – a 1% AEP equivalent unsteady flow event for Study Area where Billabong Creek is dominant (BD) or Yanco Creek is dominant (YD). • "<Condition>_0p5AEP_BD" / "<Condition>_0p5AEP_YD" – a 0.5% AEP equivalent unsteady flow event for Study Area where Billabong Creek is dominant (BD) or Yanco Creek is dominant (YD). • "<Condition>_0p3AEP_BD" / "<Condition>_0p3AEP_YD" – a 0.3% AEP equivalent unsteady flow event for Study Area where Billabong Creek is dominant (BD) or Yanco Creek is dominant (YD). • "<Condition>_0p2AEP_BD" / "<Condition>_0p2AEP_YD" – a 0.2% AEP equivalent unsteady flow event for Study Area where Billabong Creek is dominant (BD) or Yanco Creek is dominant (YD). • "<Condition>_PMF" – a Probable Maximum Flood (PMF) equivalent unsteady flow event for Study Area.

5. Existing Model Sensitivity and Calibration

5.1 Introduction

This section of the report summarises model sensitivity testing, calibration and validation that was undertaken as part of this Study.

5.2 Sensitivity Analysis

5.2.1 Overview

Sensitivity analysis of model parameters is a required step in the development of a hydraulic model to understand the model's dependence upon model assumptions. The results of the sensitivity testing can be used to gain an understanding of the likely "level of confidence" that can be associated with the model results. This section documents the sensitivity analysis undertaken as part of the RRC study - the results of which are still relevant given the current model is largely an extension and/or minor update of this model.

All sensitivity testing has been undertaken for a steady state flow scenario with the following flow based on the nominated RRC flow scenarios:

- Billabong Creek – 2,078 ML/day or 24.1 m³/s
  (the average of the 10 RRC flow scenario peaks, which range from 1,300 – 2,560 ML/day).
- Yanco Creek – 1,405 ML/day or 16.3 m³/s
  (the average of the 10 RRC flow scenario peaks, which range from 900 – 1,700 ML/day).

As part of the RRC study, the following eight (8) sensitivity scenarios were completed to understand the performance and potential variability in model results:

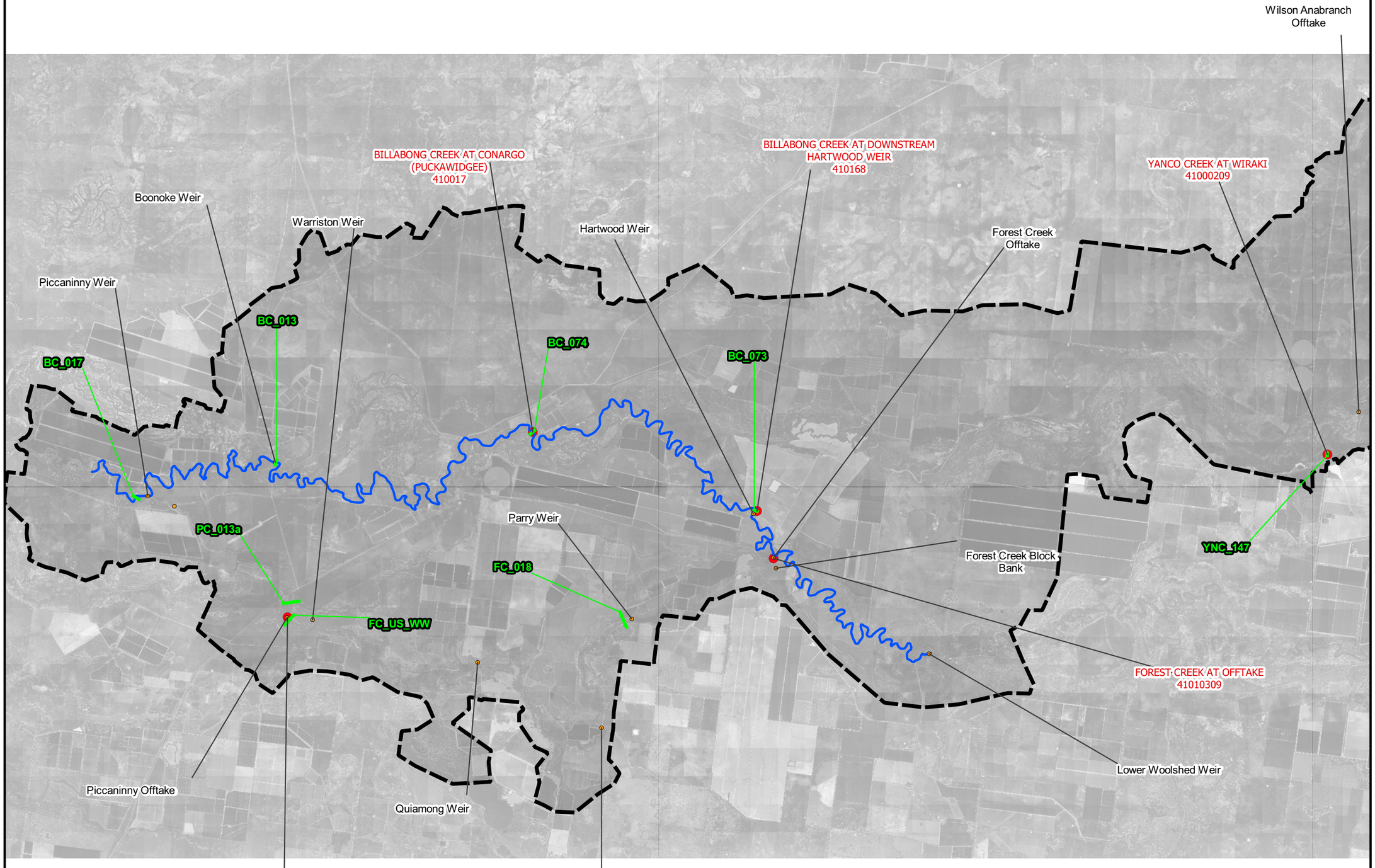
1. Impact of the model grid cell size (8 m vs 16 m).
2. Impact of the adopted slope on downstream boundary conditions (half and double adopted slope).
3. Impact of change in hydraulic roughness in the channel and in the floodplain (Manning's 'n' ± 20%).
4. Impact of volumetric losses (Evaporation and infiltration set to reasonable upper and lower values).
5. Impact of structural losses at bridges (Level 1 Form Loss Coefficient ± 20%).
6. Impact of blocking culvert structures by 50%.
7. Impact of the assumed crest level of Parry's Weir.
8. Impact of the TUFLOW control numbers on results and model stability (default vs factor of 0.5).

Some additional sensitivity runs regarding the assumed Hartwood Weir and Forest Creek Block Bank (FCBB) crest level were also undertaken to understand the implications of this assumption on "calibration" results as part of the RRC Study.

As part of the current Study, the following additional sensitivity runs were undertaken:

- A few simulations were run to understand the potential implications of the assumed unsteady flood hydrograph shape, with the results from the 1% AEP event where Billabong Creek is dominant and/or Yanco Creek dominant being compared to the same event where the peak flow from the hydrograph on Billabong Creek and Yanco Creek was adopted as a steady state flow.

Results for these sensitivity runs were compared in terms of flow at key locations, as well as the change in WSL via a long-section plot along Billabong Creek and afflux plots across the Study Area. The flow comparison location and adopted thalweg for WSL comparison along Billabong Creek are presented in Figure 5-1 and Figure 5-2.



Legend

- Hydraulic Model Boundary
- Modelled significant structures
- Gauge Locations
- Print out locations (2d_po) for comparison
- Billabong Creek thalweg for comparison

N

GDA 2020 Zone 55
Scale: 1:125,000

0 2 4 km

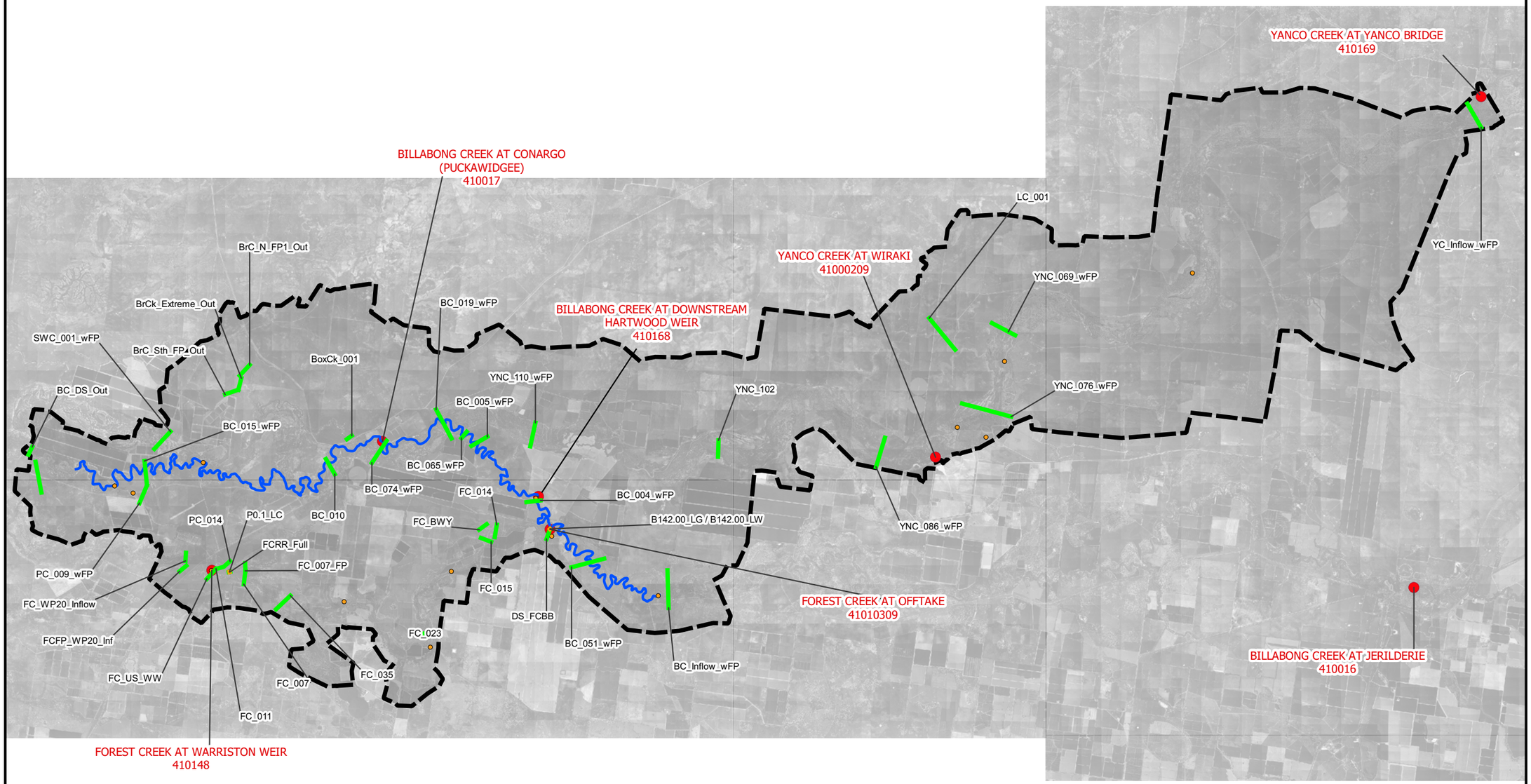
DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
RRC Comparison Locations
"G:\21\12537654\GIS\Maps\Working\Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 5-1: RRC Study Sensitivity Comparison Locations

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Hydraulic Model Boundary
- Modelled significant structures
- Gauge Locations
- Billabong Creek thalweg for compariosn
- Print out locations (2d_po) for flow comparison
- Modelled Structure (1d_nwk) for flow comparison

N

GDA 2020 Zone 55
Scale: 1:200,000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023;
Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Modernisation Comparison Locations
"G:\21\12537654\GIS\Maps\Working\
Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 5-2: Current Study Comparison Locations

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

5.2.2 Model grid size

The impact of model grid size was tested by simply changing the nominated grid size in the Tuflow Geometry Control (or *.tgc) file from the base 16 m to a reduced 8 m. This change did require minor modifications to 1D/2D boundary conditions at some key structures and resulted in the impact presented in Table 5-7 and Figure 5-3 for flow and WSL respectively (an afflux map is also presented in Appendix C). These results show that grid size has the following impact on results:

- Generally minimal change in flow (around ± 25 ML/day), except for the slightly greater change of around ± 180 ML/day due to the altered flow split between Piccaninny Creek and Forest Creek upstream of Warriston Weir.
- WSL was generally only slightly higher (plus 30 – 40 mm) with the smaller grid size, except for:
    - Upstream of Piccaninny Weir that experience a minor drop (up to 40 mm).
    - Downstream of Piccaninny Weir that experiences a significant increase (in the order of 540 mm); and
    - A local relatively significant difference at the modelled weirs, likely due to a minor change in where the model sees the position of the weir.
- Afflux plot shows similar results to the long-section, with general minor increases and decrease in WSL (up to around ±40 mm), except where flow splits have changed due to an altered representation of a control structure (or elevation). Key areas of change with a smaller grid size were:
    - Reduced levels in Piccaninny Creek due to more flows being directed down Forest Creek;
    - Significant increased levels (greater than 100 mm) on Forest Creek within and downstream of pool formed by Piccaninny Creek return flow block bank (i.e. the block bank where some flows return to Billabong Creek via Piccaninny Creek) and Warriston Weir;
    - No breakaway flow via Sheepwash Creek;
    - Higher levels in behind McCaugheys Blockbank (generally around 180 mm);
    - Lower levels behind 18 Mile Blockbank (generally around 25 – 30 mm); and
    - Significant higher levels on both Billabong Creek and Forest Creek upstream of downstream boundary.

Although these results suggest the outcome is sensitive to grid size, some of the impacts noted above would have been resolved through minor changes to the model (such as impacts in and around the existing weirs). Further the run time implications mean reducing the grid size completely or locally around control structures using Quadtree is impractical. However, as discussed in the proceeding “Calibration” section the higher grid size model was shown to perform well compared to the gauges within the Study Area.

Table 5-1: Flow change at key locations due to grid size

Location [PO_ID]	Flow (ML/day)		
	8 m Grid	16 m Grid (baseline)	Difference (8 m – 16 m)
Flow Yanco Creek @ Waraki (41000209) [YNC_147]	1,253	1,279	-25.6
Flow Billabong Creek @ DS Hartwood (410168) [BC_073]	1,434	1,426	8.3
Flow Billabong Creek @ Conargo (410017) [BC_074]	2,837	2,830	6.3
Flow Billabong Creek @ Boonoke Weir [BC_013]	2,727	2,730	-2.9
Flow DS Piccaninny Weir [BC_017]	2,843	3,022	-179.9
Flow DS Parry's Weir [FC_018]	644.0	652.3	-8.3
Flow US Warriston Weir [FC_US_WW]	528.7	356.6	172.1
Flow Piccaninny Creek DS offtake [PC_013a]	115.3	295.8	-180.5

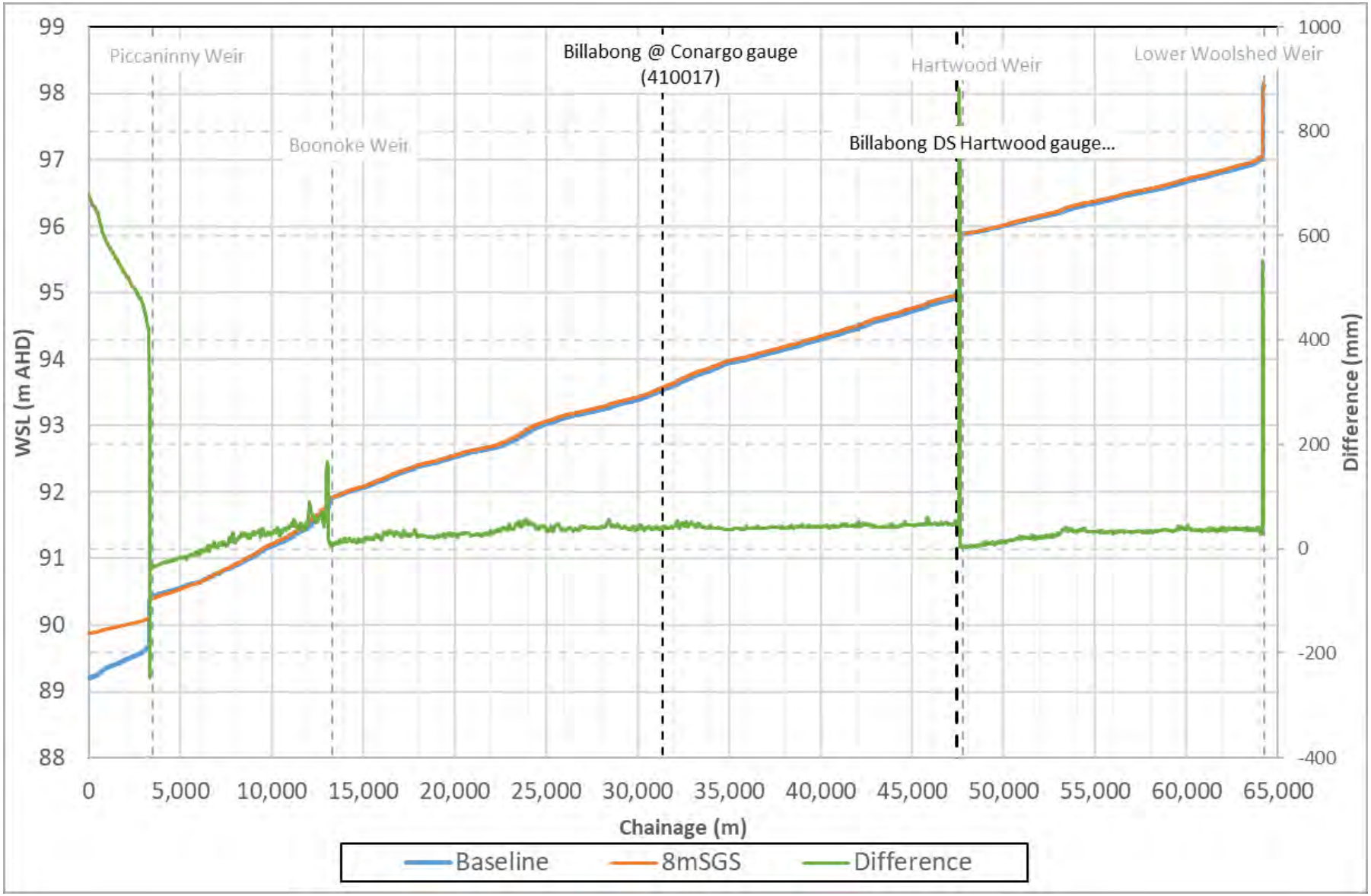


Figure 5-3: Grid size WSL comparison along Billabong Creek

5.2.3 Downstream boundary slope

The impact of the adopted downstream boundary slope was tested by simply changing the stated slope on all the "HQ" lines in the 2d_bc layer referred to in the Tuflow Boundary Control (or *.tbc) file from the base of 0.0002 (or 0.02%) to:

- 0.0004 (or 0.04%) – double the baseline model assumption.
- 0.0001 (or 0.01%) – half the baseline model assumption.

This change did not require any other modifications to model inputs and resulted in the impact presented in Table 5-2 and Figure 5-4 for flow and WSL respectively (an afflux map is also presented in Appendix C). These results show that downstream boundary slope has the following impact on results:

- Minimal change in flow with a peak change of:
  - Less than ±2 ML/day at all locations when slope doubled.
  - Less than ±32 ML/day at all locations when slope halved.
- Only nominal changes in WSL along the thalweg of Billabong Creek with:
  - An average difference of -0.4 mm (with a range of -16.4 mm to +1.6 mm) when slope doubled.
  - An average difference of +5.6 mm (with a range of -5.7 mm to +27.3 mm) when slope halved.
- Afflux plot shows similar results to the long-section, with -
  - Doubling the slope shows minimal change to WSL throughout the model (± 10 mm) – except for small sections of Billabong Creek, Forest Creek and breakaway flows on Browns Creek that are reduced.
  - Halving the slope shows larger changes with increased water levels on Billabong Creek downstream of Piccaninny Weir, Forest Creek downstream of Warriston Weir and the breakaway flow paths together with connected small sections of Billabong Creek at Browns Creek and Sheepwash Creek.

The results are more sensitive to reduced slopes, but this scenario is considered less realistic as the adopted slopes are already very flat and based on slopes between gauges.

Table 5-2: Flow change at key locations due to downstream "HQ" boundary slope

Location	**Flow (ML/day)**				
	0.01% (half baseline)	0.02% (baseline)	0.04% (double baseline)	Half 0.01% – 0.02% Difference	Double 0.04% – 0.02% Difference
Flow Yanco Creek @ Waraki (41000209) [YNC_147]	1,279	1,279	1279	0.0	0.0
Flow Billabong Creek @ DS Hartwood (410168) [BC_073]	1,426	1,426	1,426	0.0	0.0
Flow Billabong Creek @ Conargo (410017) [BC_074]	2,830	2,830	2,830	0.0	0.0
Flow Billabong Creek @ Boonoke Weir [BC_013]	2,762	2,730	2,732	32.3	1.7
Flow DS Piccaninny Weir [BC_017]	3,053	3,022	3024.0	30.8	1.6
Flow DS Parry's Weir [FC_018]	652.3	652.3	652.3	0.0	0.0
Flow US Warriston Weir [FC_US_WW]	356.6	356.6	356.6	0.0	0.0
Flow Piccaninny Creek DS offtake [PC_013a]	295.8	295.8	295.8	0.0	0.0

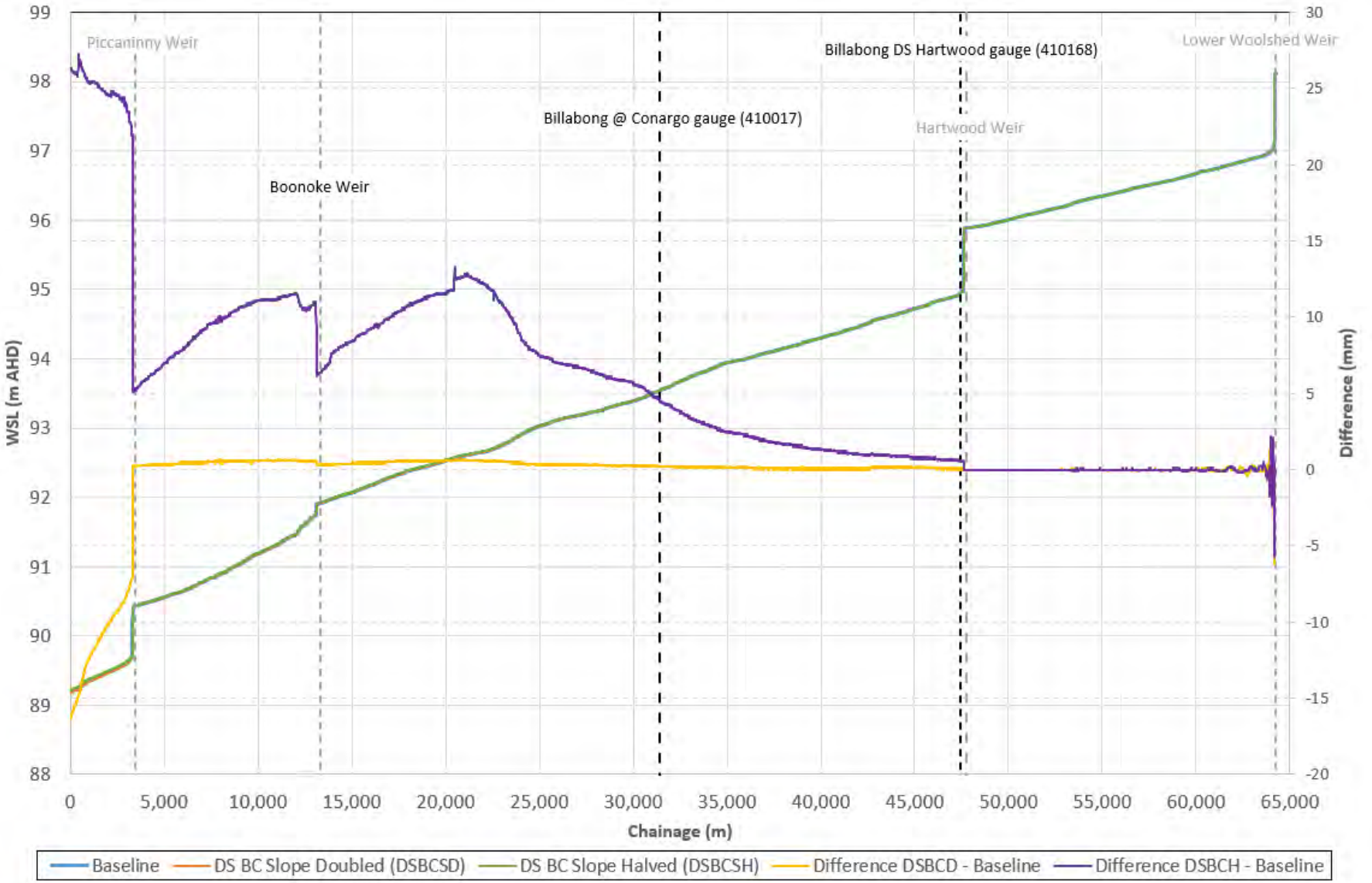


Figure 5-4: "HQ" boundary slope WSL comparison along Billabong Creek

5.2.4 Catchment Roughness

The impact of the adopted catchment roughness was tested by factoring the Manning's 'n' values specified in the Tuflow Material File (or *.tmf) using the following multipliers in the Tuflow Control File (or *.tcg):

- 1.2 – this increases the Manning's 'n' value in *.tmf by 20% (i.e., 0.35 x 1.2 = 0.42).
- 0.8 – this decreases the Manning's 'n' value in *.tmf by 20% (i.e., 0.35 x 0.8 = 0.28).

This change did not require any other modifications to model inputs and resulted in the impact presented in Table 5-3 and Figure 5-5 for flow and WSL respectively (an afflux map is also presented in Appendix C). These results show that catchment roughness has the following impact on results:

- Minor change in flow with a peak change of –
    - Less than ±56 ML/day at all locations when catchment roughness reduced by 20%.
    - Less than ±45 ML/day at all locations when catchment roughness increased by 20%.
- Noticeable changes in WSL along the thalweg of Billabong Creek with –
    - An average difference of -173 mm (with a range of -297 mm to +0.2 mm) when catchment roughness reduced by 20%.
    - An average difference of +163 mm (with a range of -2 mm to +264 mm) when catchment roughness increased by 20%.
- Afflux plot shows similar results to the long-section, with noticeable changes to the WSL along all creeks within the Study Area when the catchment roughness is adjusted by ±20 %.

Table 5-3: Flow change at key locations due to catchment roughness

Location	Flow (ML/day)				
	Baseline - 20%	Baseline	Baseline + 20%	-20% - Baseline Difference	+20% - Baseline Difference
Flow Yanco Creek @ Waraki (41000209) [YNC_147]	1,306	1,279	1,266	27.2	-13.4
Flow Billabong Creek @ DS Hartwood (410168) [BC_073]	1,370	1,426	1,470	-55.9	44.3
Flow Billabong Creek @ Conargo (410017) [BC_074]	2,774	2,830	2,875	-55.9	44.6
Flow Billabong Creek @ Boonoke Weir [BC_013]	2,707	2,730	2,760	-23.3	28.9
Flow DS Piccaninny Weir [BC_017]	3,028	3,022	3,005	5.4	-17.9
Flow DS Parry's Weir [FC_018]	708.3	652.3	608.0	55.9	-44.3
Flow US Warriston Weir [FC_US_WW]	387.1	356.6	332.8	30.6	-23.8
Flow Piccaninny Creek DS offtake [PC_013a]	321.1	295.8	275.2	25.4	-20.6

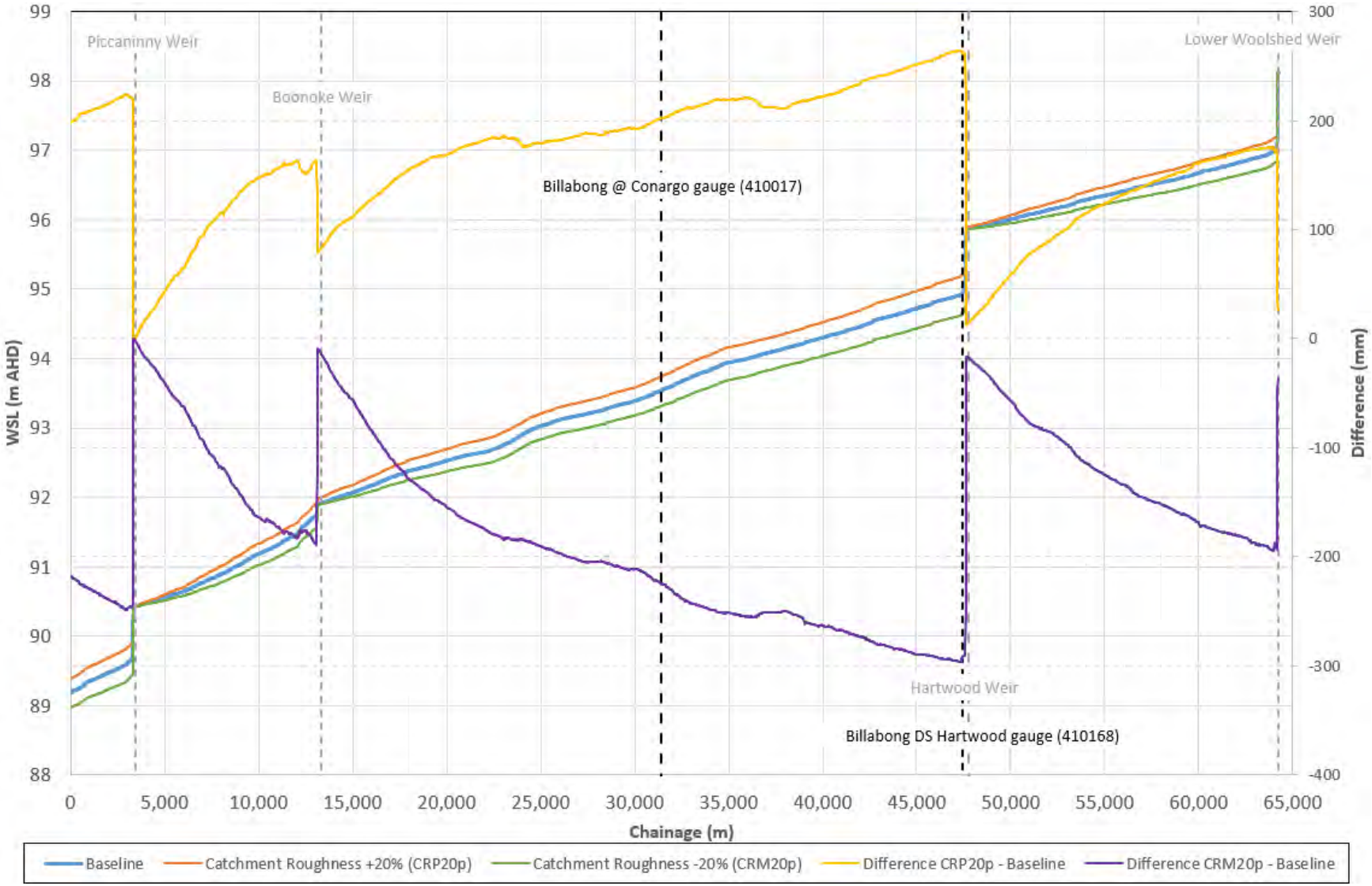


Figure 5-5: Catchment roughness WSL comparison along Billabong Creek

5.2.5 Volumetric Losses

The impact of the adopted volumetric losses were tested by factoring both the adopted negative rainfall hyetograph (representing evaporation) applied via a 2d_rf polygon and the continuing loss (representing infiltration) set in soils file for the three zones discussed in the 'Model Development' section of the report. The models have adopted the loss rates described in Table 5-4 for the runs, with the baseline values being derived based on the following:

- Evaporation – the approximate average daily evaporation between May and October for the study area.
- Infiltration– an assessment of flow losses between the gauges from the Source model results, assuming a nominal flooded area based on the median flow on main waterway.

This change did not require any other modifications to model inputs and resulted in the impact presented in Table 5-5 and Figure 5-6 for flow and WSL respectively (an afflux map is also presented in Appendix C). These results show that volumetric losses have the following impact on results:

- Minor change in flow with a peak change of –
    - Less than +210 ML/day at all locations when volumetric losses were reduced.
    - Less than -238 ML/day at all locations when volumetric losses were increased.
- Minor changes in WSL along the thalweg of Billabong Creek with –
    - An average difference of +48 mm (with a range of +0.8 mm to +103 mm) when volumetric losses were reduced.
    - An average difference of -56 mm (with a range of -1.1 mm to -123 mm) when volumetric losses were increased.
- Afflux plot shows similar results to the long-section, with some noticeable changes to WSL along Yanco Creek, Billabong Creek downstream of Hartwood Weir and Piccaninny Creek, but minimal difference along most of Forest Creek and Billabong Creek upstream of Hartwood Weir.

Table 5-4: Adopted volumetric losses

Volumetric Loss	Lower Sensitivity	Baseline	Upper Sensitivity
Evaporation (mm/hr)	0	0.1	0.2
Infiltration for "Billabong Creek @Jerilderie to Billabong Creek @ DS Hartwood" zone (mm/hr)	0	0.25	0.5
Infiltration for "Yanco Creek @Yanco Bridge to Billabong Creek @ Conargo" zone (mm/hr)	0.375	0.75	1.5
Infiltration for "Billabong Creek @ Conargo to Billabong Creek @ Wanganella" zone (mm/hr)	0.5	1	2

Table 5-5: Flow change at key locations due to volumetric losses

Location	Flow (ML/day)				
	Lower Sensitivity	Baseline	Upper Sensitivity	Lower Sensitivity – Baseline Difference	Upper Sensitivity – Baseline Difference
Flow Yanco Creek @ Waraki (41000209) [YNC_147]	1,227	1,141	1,036	85.9	-104.2
Flow Billabong Creek @ DS Hartwood (410168) [BC_073]	1,426	1,412	1,407	13.4	-5.7
Flow Billabong Creek @ Conargo (410017) [BC_074]	2,708	2,552	2,368	156.7	-183.7
Flow Billabong Creek @ Boonoke Weir [BC_013]	2,592	2,421	2,214	171.2	-206.5
Flow DS Piccaninny Weir [BC_017]	2,874	2,665	2,427	209.2	-237.6
Flow DS Parry's Weir [FC_018]	652.3	646.8	644.4	5.6	-2.4
Flow US Warriston Weir [FC_US_WW]	356.6	338.5	331.0	18.1	-7.5
Flow Piccaninny Creek DS offtake [PC_013a]	295.8	273.1	263.9	22.6	-9.3

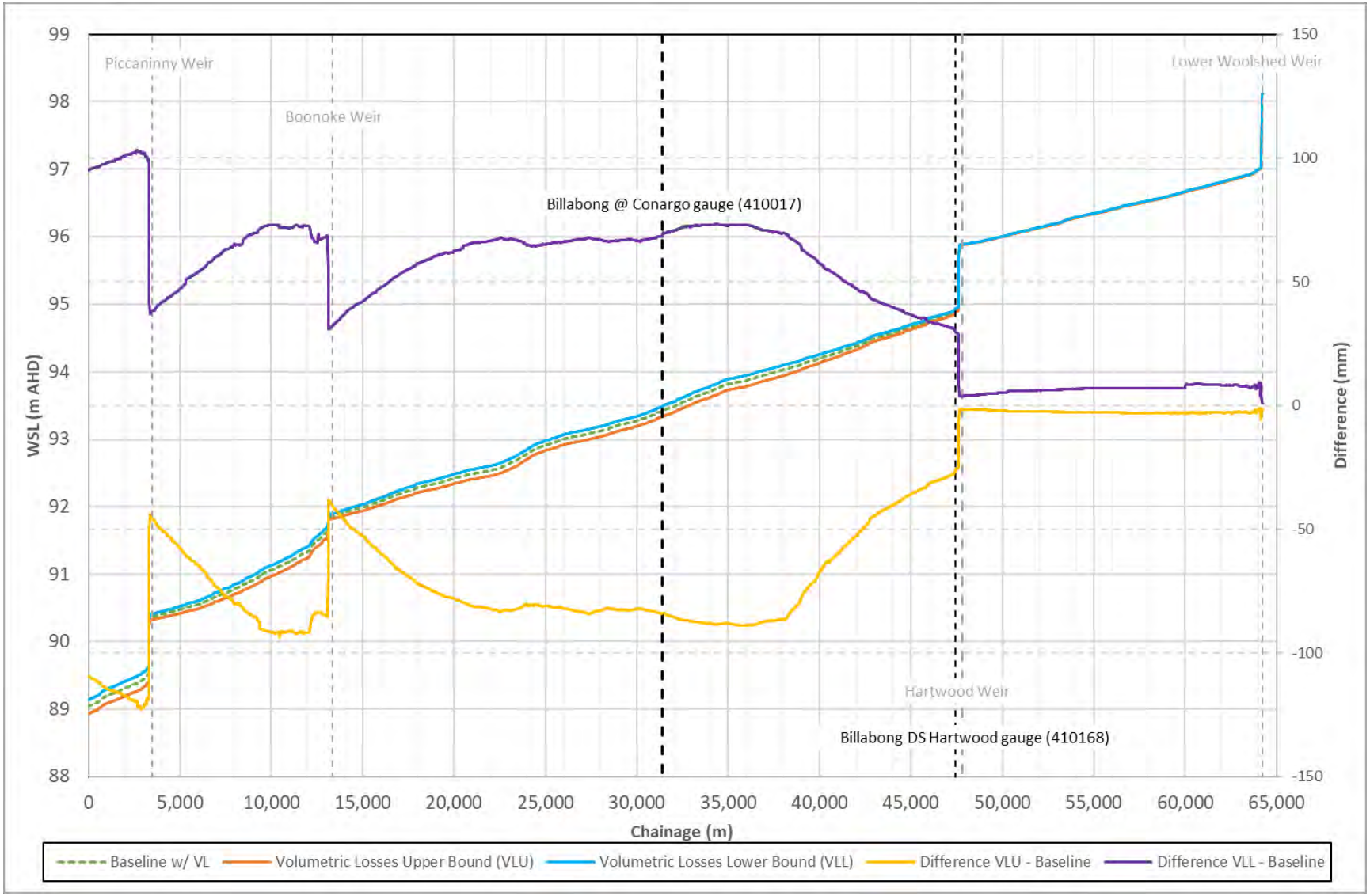


Figure 5-6: Volumetric losses WSL comparison along Billabong Creek

5.2.6 Structure losses at bridges

The impact of the adopted structure losses were tested by factoring the Layer 1 FLC values on all bridges modelled as layered flow constrictions (2d_lfcsh) up and down by 20%. The location of the bridges affected by this change are shown in Figure 4-11 in the 'Model Structures' section. This change resulted in the impact presented in Table 5-6 and Figure 5-7 for flow and WSL respectively (an afflux map is also presented in Appendix C). These results show that structure losses have the following impact on results:

- Minimal change in flow with a peak change of –
    - Less than +12.4 ML/day at all locations when the Layer 1 FLC at bridges were increased by 20%.
    - Less than +6.1 ML/day at all locations when the Layer 1 FLC at bridges were decreased by 20%.
- Negligible changes in WSL along the thalweg of Billabong Creek with –
    - An average difference of less than -0.1 mm (with a range of -3.9 mm to +1.2 mm) when the Layer 1 FLC at bridges were increased by 20%.
    - An average difference of -0.2 mm (with a range of -7.2 mm to +2.4 mm) when the Layer 1 FLC at bridges were decreased by 20%.
- Afflux plot shows similar results to the long-section, with the vast majority of the Study Area showing minimal difference (±10 mm), including the main waterways (Yanco Creek, Forest Creek & Piccaninny Creek), in both increased and decreased scenarios.

Table 5-6: Flow change at key locations due to structure losses

Location	Flow (ML/day)				
	Layer 1 FLC – 20%	Layer 1 FLC (Baseline)	Layer 1 FLC + 20%	Layer 1 FLC – 20% to Baseline Difference	Layer 1 FLC + 20% to Baseline Difference
Flow Yanco Creek @ Waraki (41000209) [YNC_147]	1,285	1,279	1,291	6.1	12.4
Flow Billabong Creek @ DS Hartwood (410168) [BC_073]	1,426	1,426	1,426	0.0	0.0
Flow Billabong Creek @ Conargo (410017) [BC_074]	2,830	2,830	2,830	0.0	0.0
Flow Billabong Creek @ Boonoke Weir [BC_013]	2,730	2,730	2,730	0.0	0.0
Flow DS Piccaninny Weir [BC_017]	3,022	3,022	3,022	0.0	0.0
Flow DS Parry's Weir [FC_018]	652.3	652.3	652.3	0.0	0.0
Flow US Warriston Weir [FC_US_WW]	356.6	356.6	356.6	0.0	0.0
Flow Piccaninny Creek DS offtake [PC_013a]	295.8	295.8	295.7	0.0	0.0

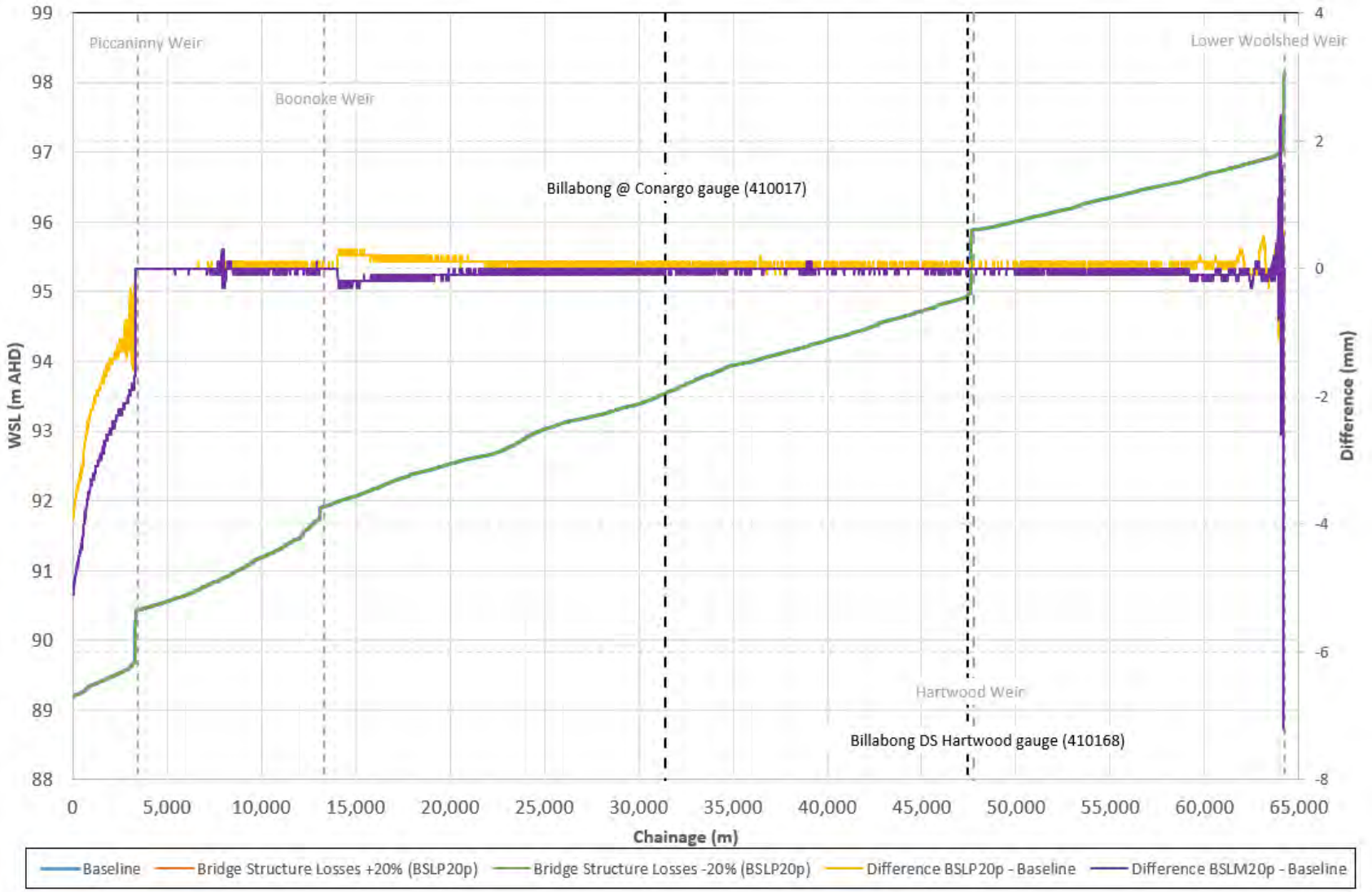


Figure 5-7: Structure losses (Bridge Layer 1 FLC) WSL comparison along Billabong Creek

5.2.7 Blockage

The impact of blockage was tested by applying 50% blockage (via 'pBlockage' attribute) to all pipe and box culverts in the Study Area. The location of the structures affected by this change are shown in Figure 4-11 in the 'Model Structures' section. This change resulted in the impact presented in Table 5-7 and Figure 5-8 for flow and WSL respectively (an afflux map is also presented in Appendix C). These results show that blockage has the following impact on results:

- Minimal change in flow with a peak change of less than ±19 ML/day at all locations.
- Negligible changes in WSL along the thalweg of Billabong Creek with an average difference of less than -0.4 mm (with a range of -8.8 mm to +1.7 mm).
- Afflux plot shows similar results to the long-section, with the vast majority of the Study Area showing minimal difference (±10 mm), except for –
    - Part of Wilsons Anabranch and a connected section of Yanco Creek around Billabong Creek @ Waraki gauge (41000209).
    - A section of Forest Creek around Picaninny Creek offtake and downstream of Warriston Weir.

Table 5-7: Flow change at key locations due to blockage

Location	Flow (ML/day)		
	50% blockage	No blockage (baseline)	Difference (50% blockage – No blockage)
Flow Yanco Creek @ Waraki (41000209) [YNC_147]	1,298	1,279	18.9
Flow Billabong Creek @ DS Hartwood (410168) [BC_073]	1,426	1,426	0.0
Flow Billabong Creek @ Conargo (410017) [BC_074]	2,830	2,830	0.0
Flow Billabong Creek @ Boonoke Weir [BC_013]	2,730	2,730	0.0
Flow DS Piccaninny Weir [BC_017]	3,008	3,022	-14.2
Flow DS Parry's Weir [FC_018]	652.3	652.3	0.0
Flow US Warriston Weir [FC_US_WW]	370.7	356.6	14.1
Flow Piccaninny Creek DS offtake [PC_013a]	281.6	295.8	-14.1

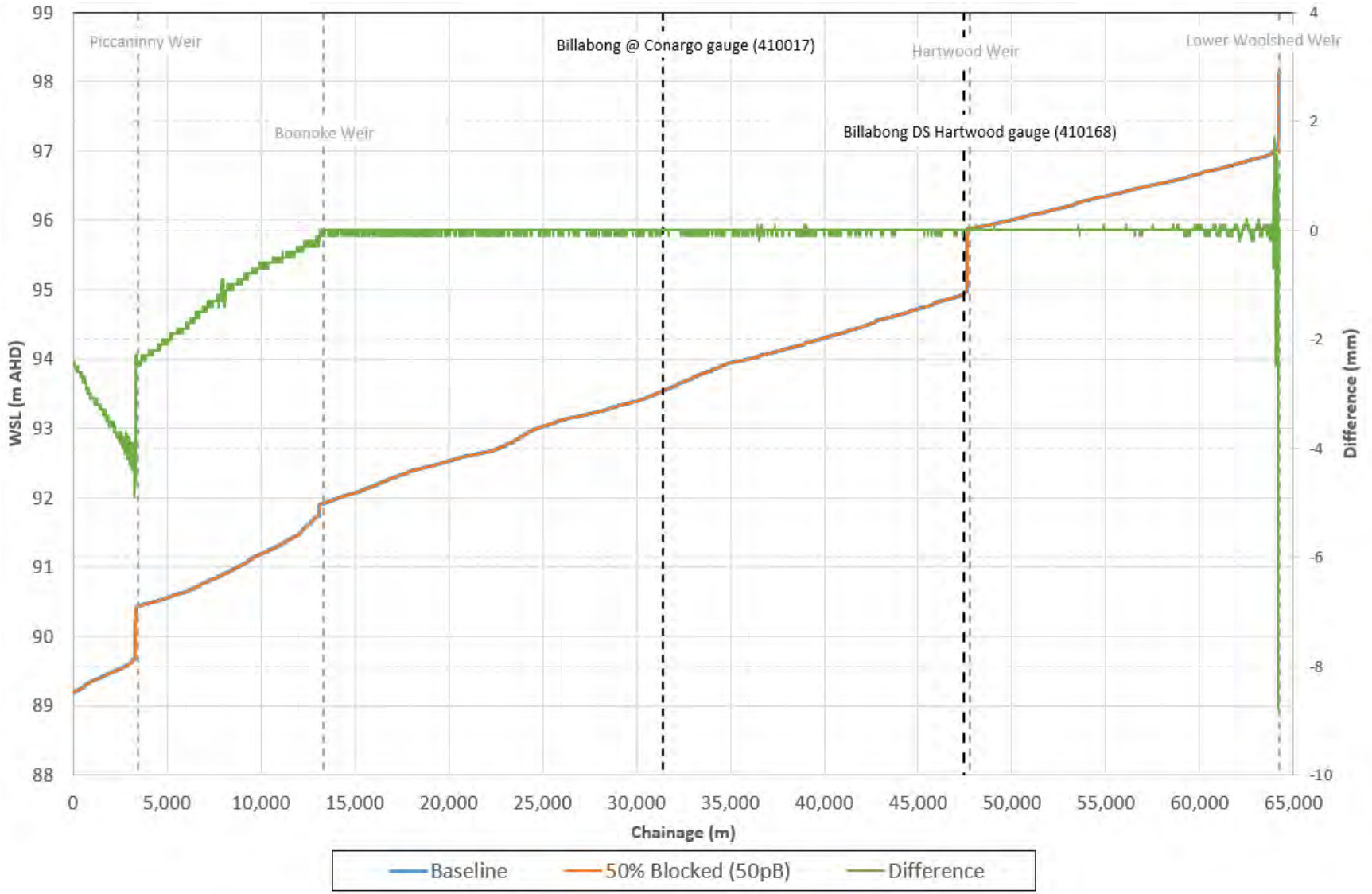


Figure 5-8: Blockage WSL comparison along Billabong Creek

5.2.8 Parry's Weir Crest level

As DCCEEW and Water NSW have no control over the operation of Parry's Weir, a sensitivity run to test the impact of the assumed crest level of the modelled weir was undertaken to determine the potential impact on flows in Billabong Creek and Forest Creek. This sensitivity involved the following scenarios, which are also shown graphically on Figure 5-9:

- Baseline – model in which the crest level of Parry's Weir was set to 95.549 m AHD based on the weighted average dropboard level from the 2010/11 survey of structures on Forest Creek (see further discussion in 'Model Structures' section).
- Sensitivity run – model in which the crest level of Parry's Weir was set to 94.3 m AHD based on the sill level from the 2010/11 survey of structures on Forest Creek (see further discussion in 'Model Structures' section)

This change resulted in the impact presented in Table 5-8 and Figure 5-10 for flow and WSL respectively (an afflux map is also presented in Appendix C). These results show that Parry's Weir crest has the following impact on results:

- Minimal change in flow with a peak change of less than ±3.6 ML/day at all locations.
- Negligible changes in WSL along the thalweg of Billabong Creek with an average difference of less than -0.1 mm (with a range of -8.3 mm to +2.7 mm).
- Afflux plot shows similar results to the long-section, with the vast majority of the Study Area showing minimal difference (±10 mm).

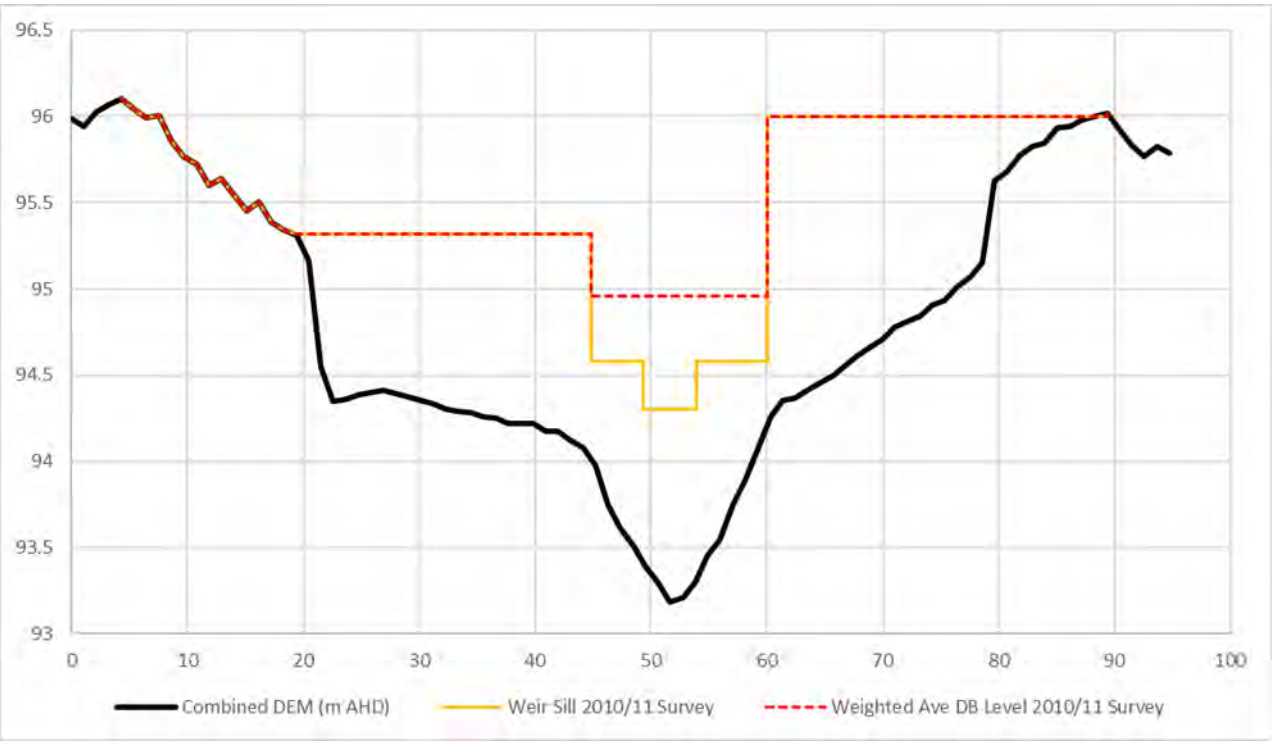


Figure 5-9: Modleled Parry Weir's Cross Section

Table 5-8: Flow change at key locations due to Parry's Weir crest

Location	Flow (ML/day)		
	Sill Level	Weighted average drop board level (baseline)	Difference (Still - Baseline)
Flow Yanco Creek @ Waraki (41000209) [YNC_147]	1,283	1,279	3.6
Flow Billabong Creek @ DS Hartwood (410168) [BC_073]	1,425	1,426	-0.5
Flow Billabong Creek @ Conargo (410017) [BC_074]	2,830	2,830	-0.4
Flow Billabong Creek @ Boonoke Weir [BC_013]	2,730	2,730	-0.4
Flow DS Piccaninny Weir [BC_017]	3,022	3,022	-0.2
Flow DS Parry's Weir [FC_018]	652.8	652.3	0.5
Flow US Warriston Weir [FC_US_WW]	356.8	356.6	0.2
Flow Piccaninny Creek DS offtake [PC_013a]	296.0	295.8	0.2

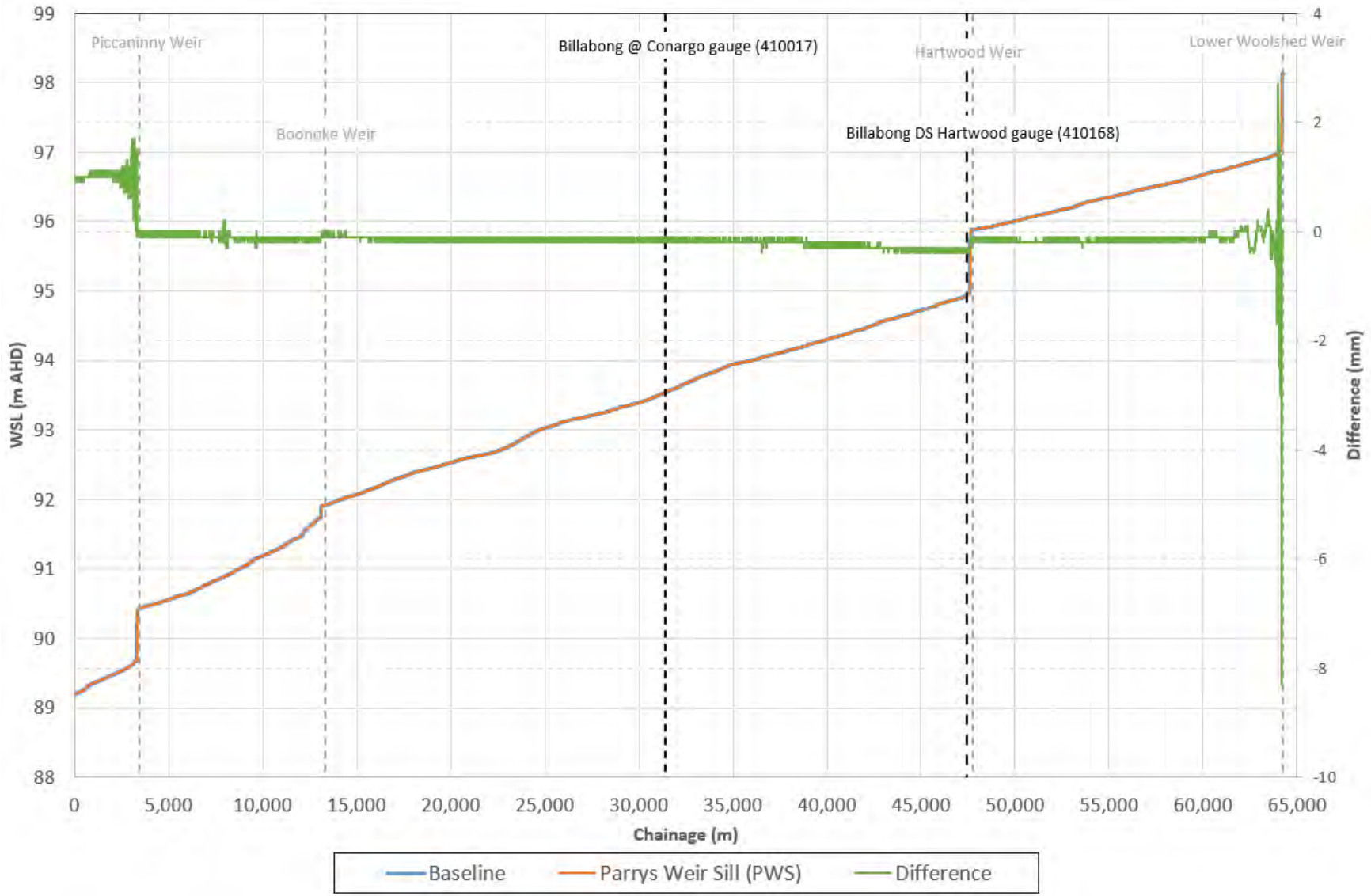


Figure 5-10: Parry's Weir Cret Level WSL comparison along Billabong Creek

5.2.9 TUFLOW HPC Control Number Factor

The impact of TUFLOW's HPC Control Numbers was tested by adding the following command to the Tuflow Control File (or *.tcf) to reduce the three control numbers by a factor of 0.5:

"Control Number Factor == 0.5"

This resulted in the control numbers being reduced as follows:

- Nu = Courant Number = 1.0 x 0.5 = 0.50
- Nc = Wave Celerity = 1.0 x 0.5 = 0.50
- Nd = Diffusion = 0.3 x 0.5 = 0.15

This change did not require any other modifications to model inputs and resulted in the impact presented in Table 5-9 and Figure 5-11 for flow and WSL respectively (an afflux map is also presented in Appendix C). These results show that control number factor has the following impact on results.

- Minimal change in flow with a peak change of -23 ML/day (or around 1% of total flow) at all locations.
- Minor changes in WSL along the thalweg of Billabong Creek with an average difference of less than -4.6 mm (with a range of -9.4 mm to +2.6 mm).
- Afflux plot shows similar results to the long-section, with the vast majority of the Study Area showing minimal difference (±10 mm), except for –
    - Breakaway flow via Browns Creek west of Willurah Road, which shows a reduction of up to around 150 mm.
    - Flow in Billabong Creek just downstream of where Back Creek breaks away in higher events, which shows an increase of up to around 160 mm.
    - Flow in Forest Creek downstream of Conargo Road, which shows increase of up to 60 mm

Table 5-9: Flow change at key locations due to TUFLOW Control Numbers

Location	Flow (ML/day)		
	0.5 Factor	Baseline	Difference (0.5 Factor - Basline)
Flow Yanco Creek @ Waraki (41000209) [YNC_147]	1,265	1,279	-14.0
Flow Billabong Creek @ DS Hartwood (410168) [BC_073]	1,426	1,426	0.0
Flow Billabong Creek @ Conargo (410017) [BC_074]	2,808	2,830	-22.4
Flow Billabong Creek @ Boonoke Weir [BC_013]	2,711	2,730	-19.4
Flow DS Piccaninny Weir [BC_017]	3,004	3,022	-18.7
Flow DS Parry's Weir [FC_018]	652.3	652.3	0.0
Flow US Warriston Weir [FC_US_WW]	356.6	356.6	0.0
Flow Piccaninny Creek DS offtake [PC_013a]	295.8	295.8	0.0

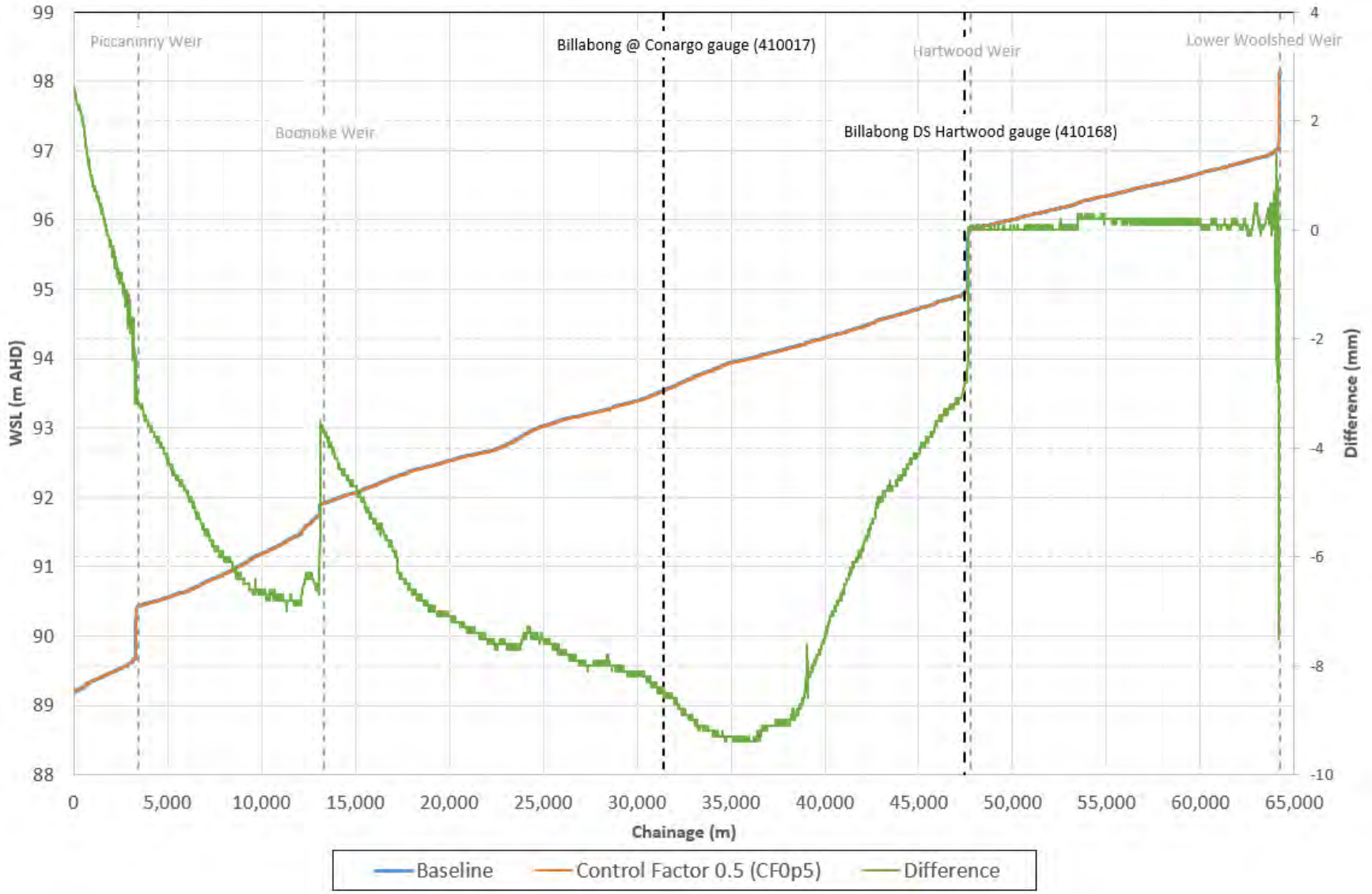


Figure 5-11: TUFLOW Control Numbers WSL comparison along Billabong Creek

5.2.10 Forest Creek Block Bank (FCBB) and Hartwood Weir Crest Level

Due to some uncertainty regarding the historic use of drop boards at Hartwood Weir and some discrepancies in the reported crest level of Forest Creek Block Bank (FCBB), the impact of the assumed crest level for both of these structures was tested for a range of combinations using the August 2021 – October 2021 calibration period. The combination of tested crest levels is described in Table 5-10 and the modelled cross-section is presented in Figure 5-12 and Figure 5-13.

Table 5-10: Hartwood Weir and Forest Creek Block Bank Crest Level Combinations

Scenario	Minimum Hartwood Weir Crest Level (m AHD)	Minimum Forest Creek Block Bank Crest Level (m AHD)
1	95.28	96.28
2	95.28	95.92
3	95.28	95.64*
4	95.08	95.64*
5	94.85	95.64*
6	94.69*	95.64*
Note: * indicates that these levels are the lowest possible based on available information for the crest at these locations		

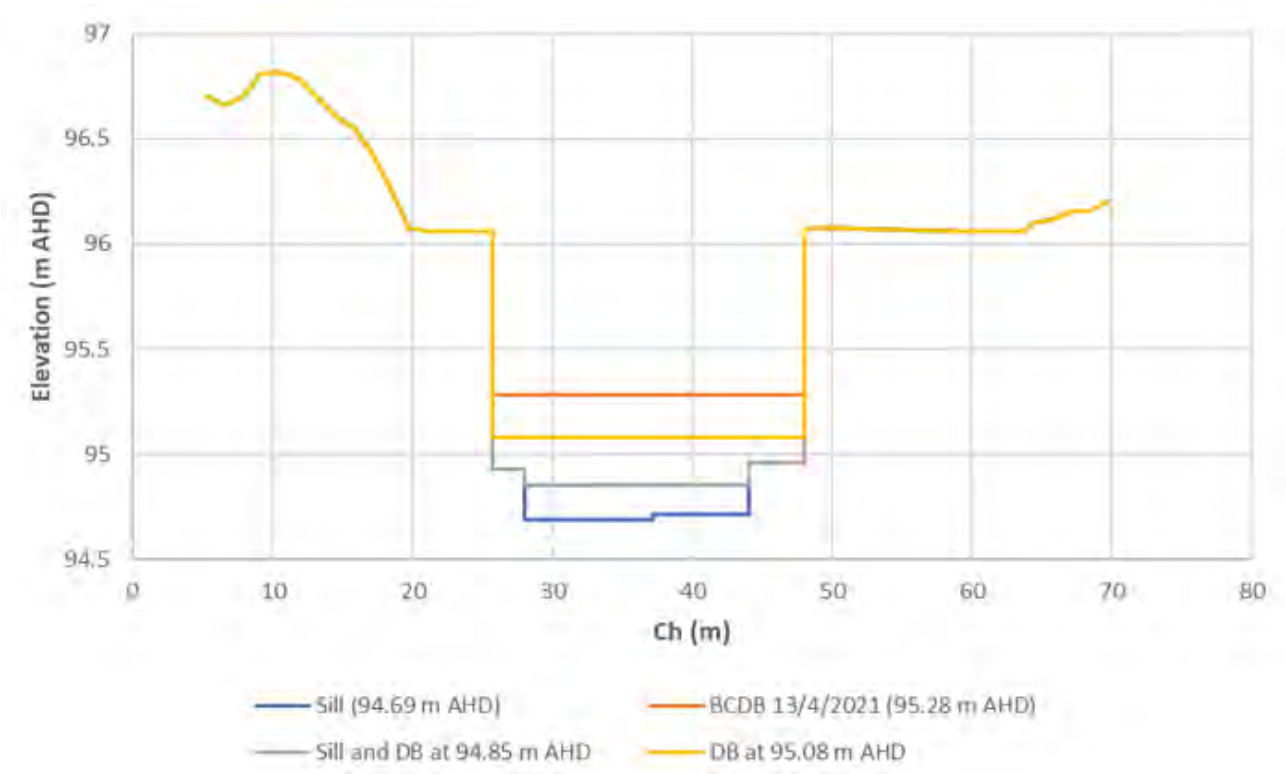


Figure 5-12: Hartwood Weir 1D modelled cross-section

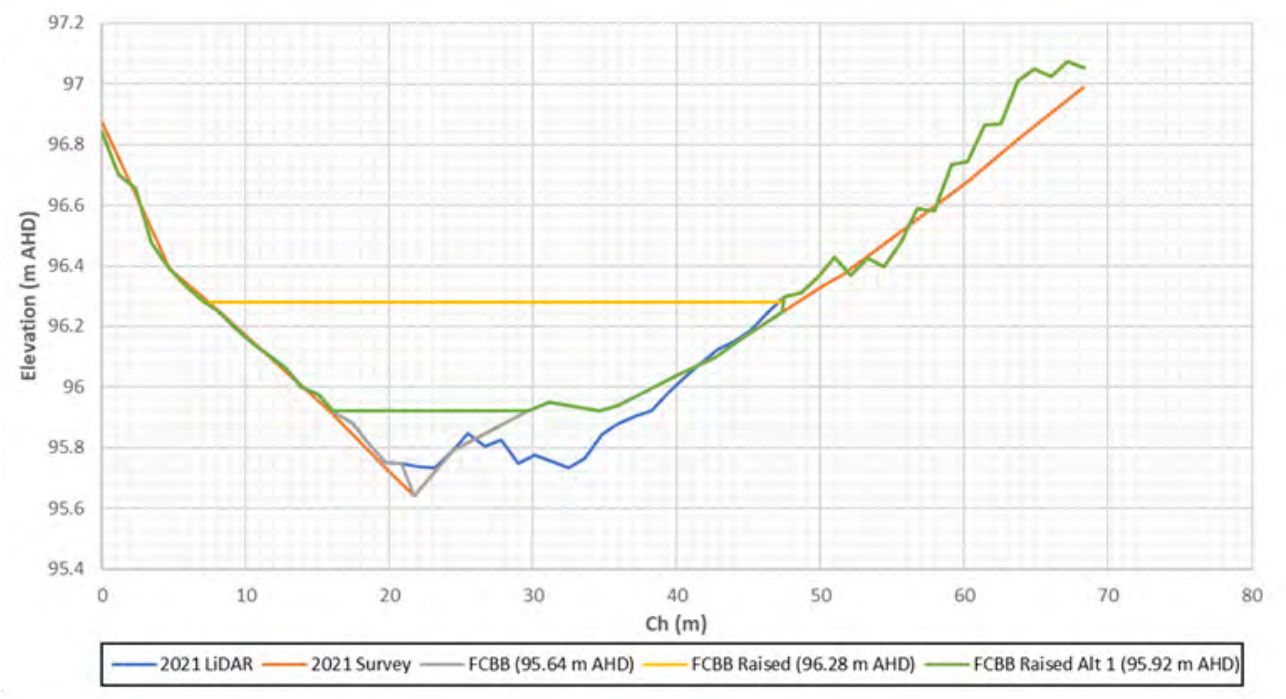


Figure 5-13: Forest Creek Block Bank 1D modelled cross-section

This impact of these changes was assessed based on comparing modelled results to gauge results at the following gauges during the August 2021 – October 2021 event:

- Billabong Creek @ DS Hartwood (410168);
- Billabong Creek @ Conargo (410017); and
- Forest Creek at Warriston Weir (410148).

The operation of Forest Creek Offtake (FCO) was represented as an extraction from Billabong Creek and inflow to the offtake channel based on 'Forest Creek at Offtake (41010309)' gauge results for the same period as the modelled event. The outcome of this assessment is presented in Table 5-11 and Table 5-12 for flow and WSL respectively. These results show that matching peak flows and WSL at the gauges is quite sensitive to the assumed levels at Hartwood Weir and Forest Creek Block Bank. However, anecdotal data based on observations by the NSW DCCEEW staff from recent flow events (starting August 2022) has suggested that the 95.64 m AHD level at Forest Creek Block Bank is likely to be the most representative of actual elevations at this point in time (this is summarised in email correspondence dated 28/02/2022).

Table 5-11: Impact of assumed crest levels on peak flow at gauges for August 2021 - October 2021 event

Location	**Flow (ML/day)**							**Difference in flow compared to gauge (ML/day)**					
Scenario	*-*	*1*	*2*	*3*	*4*	*5*	*6*	*1*	*2*	*3*	*4*	*5*	*6*
Hartwood Weir Crest (m AHD)	*Gauge Result*	*95.28*	*95.28*	*95.28*	*95.08*	*94.85*	*94.69*	*95.28*	*95.28*	*95.28*	*95.08*	*94.85*	*94.69*
Forest Creek Block Bank Crest (m AHD)		*96.28*	*95.92*	*95.64*	*95.64*	*95.64*	*95.64*	*96.28*	*95.92*	*95.64*	*95.64*	*95.64*	*95.64*
Billabong Creek @ DS Hartwood (410168)	1873	1880	1531	1475	1579	1665	1715	6	-343	-398	-295	-208	-159
Billabong Creek @ Conargo (410017)	2356	2389	2052	1999	2099	2180	2227	33	-304	-357	-258	-176	-129
Forest Creek at Warriston Weir (410148)	180	115	215	228	201	175	162	-66	35	48	20	-5	-18

Table 5-12: Impact of assumed crest levels on peak WSL at gauges for August 2021 - October 2021 event

Location	**Flow (ML/day)**							**Difference in WSL compared to gauge (mm)**					
Scenario	*-*	*1*	*2*	*3*	*4*	*5*	*6*	*1*	*2*	*3*	*4*	*5*	*6*
Hartwood Weir Crest (m AHD)	*Gauge Result*	*95.28*	*95.28*	*95.28*	*95.08*	*94.85*	*94.69*	*95.28*	*95.28*	*95.28*	*95.08*	*94.85*	*94.69*
Forest Creek Block Bank Crest (m AHD)		*96.28*	*95.92*	*95.64*	*95.64*	*95.64*	*95.64*	*96.28*	*95.92*	*95.64*	*95.64*	*95.64*	*95.64*
Billabong Creek @ DS Hartwood (410168)	95.41	95.22	94.95	94.90	94.99	95.05	95.10	-197	-465	-511	-427	-360	-315
Billabong Creek @ Conargo (410017)	93.31	93.34	93.18	93.16	93.21	93.25	93.27	32	-126	-153	-103	-62	-39
Forest Creek at Warriston Weir (410148)	92.36	92.36	92.46	92.47	92.45	92.42	92.41	-4	98	110	85	60	47

5.2.11 Flood Impacts – Unsteady Hydrograph vs Steady State for 1% AEP

Due to some uncertainty regarding the shape (and therefore volume) of the adopted hydrograph for the flood impact assessment, a sensitivity run where the 1% AEP was run as a steady state model with a flow rate equal to the peak from the unsteady hydrograph model. To allow the model to reach approximate steady state conditions the model was run for an extended period compared to the unsteady hydrograph model to allow any floodplain storage to fill up and flow to reach one of the models downstream boundaries.

This change did not require any other modifications to model inputs and resulted in the impact presented in Table 5-13 and for flow and WSL respectively (an afflux map is also presented in Appendix C). These results show that adopting a nominal hydrograph, relative to a steady state model has the following impact on results.

- Generally minimal change in flow with an average change in peak flow of around +18 ML/day when Billabong Creek was dominant and +38 ML/day when Yanco Creek was dominant. The range of changes is however broader, with flow changes ranging from -491 ML/day to +343 ML/day on the locations compared across scenarios with both creeks dominant. The largest changes occur in flows leaving the Hartwood weir pool due to the infinite volume of the steady state hydrograph generating a higher tailwater on Forest Creek due to filling up the floodplain to the controlling level set by the flow rate and hence directing flow away from Forest Creek (namely by reducing capacity of Forest Creek Offtake) and down Billabong Creek.

- Minor changes in WSL along the thalweg of Billabong Creek with an average difference of around +4 mm (with a range of -0.14 mm to +8.9 mm) when Billabong Creek was dominant and around +6 mm (with a range of 0 mm to 13.6 mm) when Yanco Creek was dominant.

- Afflux plot shows similar results to the long-section, with the vast majority of the Study Area showing minimal difference (±15 mm), except for a some relatively small localised locations on breakaway or ponded flow paths off Billabong Creek, Forest Creek and Piccaninniny Creek where storage is filled up further in the steady-state scenario and a the breakaway flow path along Lingum Creek (which appears to be volume driven due to consisting of a series of ponded areas).

These results were as expected considering the fact that the steady state models have infinite volume and will engage and/or fill up additional floodplain areas that may result in greater tailwater levels at some key structures or locations through the model.

Table 5-13 Flow change at key locations in 1% AEP due to adopting steady state versus unsteady hydrograph model

Location [PO ID]	1% AEP Billabong Dominant Flow (ML/day)			1% AEP Yanco Dominant Flow (ML/day)		
	Steady State at peak flow rate	Unsteady Hydrograph (baseline)	Difference (Steady State - Baseline)	Steady State at peak flow rate	Unsteady Hydrograph (baseline)	Difference (Steady State - Baseline)
Yanco Ck DS Inflow [YC_Inflow_wFP]	6,650	6,650	0	14,312	14,388	-76
Yanco Ck DS Lignum Ck [YNC_069_wFP]	6,637	6,576	61	13,688	13,628	60
Lignum Ck [LC_001]	16	7	9	655	646	9
Yanco Ck wFP 4 km US Wilsons Anabranch Offtake [YNC_076_wFP]	6,637	6,575	62	13,687	13,627	60
Yanco Ck wFP 4 km DS Waraki Gauge [YNC_086_wFP]	6,632	6,580	52	13,689	13,635	54
Yanco Ck wFP 25 km US BC confluence [YNC_102]	6,542	6,466	76	12,384	12,344	40
Yanco Ck wFP 8 km US BC confluence [YNC_110_wFP]	6,652	6,533	119	14,344	14,242	102
Billabong Ck DS Inflow [BC_Inflow_wFP]	10,886	10,899	-13	9,075	9,097	-22
Billabong Ck 4 km US Forest Ck [BC_051_wFP]	10,887	10,876	11	9,072	9,086	-14
Billabong Ck US Hartwood Weir [BC_004_wFP]	7,020	7,010	10	5,697	5,704	-7
Billabong Ck 11 km DS Hartwood Weir [BC_005_wFP]	5,344	5,330	14	5,426	5,340	86

Location [PO ID]	1% AEP Billabong Dominant Flow (ML/day)			1% AEP Yanco Dominant Flow (ML/day)		
	Steady State at peak flow rate	Unsteady Hydrograph (baseline)	Difference (Steady State - Baseline)	Steady State at peak flow rate	Unsteady Hydrograph (baseline)	Difference (Steady State - Baseline)
Billabong Ck US YC confluence [BC_065_wFP]	5,345	5,331	14	5,326	5,276	**50**
Billabong Ck DS YC confluence [BC_019_wFP]	13,667	13,545	122	20,034	19,750	**284**
Billabong Ck at Conargo Gauge [BC_074_wFP]	13,672	13,519	153	20,040	19,697	**343**
Box Ck Nth [BoxCk_001]	2,020	1,989	31	3,224	3,161	**63**
Billabong Ck DS Box Ck [BC_010]	11,610	11,488	122	16,404	16,154	**250**
Billabong Ck 6 km DS Boonoke Weir [BC_015_wFP]	7,895	7,842	53	9,836	9,720	**116**
Billabong Ck 8 km DS Piccaninny Weir [BC_DS_Out]	9,106	9,056	50	10,473	10,390	**83**
Back Ck [BackCk_Out_wFP]	1,141	1,084	57	2,984	2,844	**140**
FCBB [DS_FCBB]	3,065	3,062	3	2,673	2,677	**-4**
FCO Gates [B142.00_LG*]	292	743	-451	330	821	**-491**
FCO Weir [B142.00_LW*]	190	190	0	174	174	**0**
Forest Ck 3km DS Conargo Rd [FC_014]	3,867	3,862	5	3,374	3,370	**4**
Forest Ck breakaway to BC [FC_BWY]	1,561	1,558	3	1,250	1,244	**6**

Location [PO ID]	1% AEP Billabong Dominant Flow (ML/day)			1% AEP Yanco Dominant Flow (ML/day)		
	Steady State at peak flow rate	Unsteady Hydrograph (baseline)	Difference (Steady State - Baseline)	Steady State at peak flow rate	Unsteady Hydrograph (baseline)	Difference (Steady State - Baseline)
Forest Ck DS breakaway [FC_015]	2,305	2,304	1	2,124	2,126	-2
Forest Ck 1km US Drivers Weir [FC_023]	2,305	2,291	14	2,125	2,111	14
Forest Ck 4km DS Quiamong Weir [FC_035]	2,305	2,288	17	2,124	2,099	25
Forest Creek 1km US FCRR [FC_007]	1,903	1,887	16	1,790	1,749	41
Forest Creek 1km US FCRR FPN (incl. PC) [FC_007_FP]	1,442	1,433	9	1,398	1,374	24
Forest Creek US Warriston Weir [FC_US_WW]	2,060	2,042	18	1,976	1,929	47
Forest Ck FPN (btw FC & PC) [FC_011]	11	18	-7	-7	11	-18
Forest Ck Outflow [FC_WP20_Inflow]	2,052	2,031	21	2,003	1,952	51
Forest Ck FPS Outflow [FCFP_WP20_Inf]	438	431	7	419	397	22
FCRR 1D Culvert Flow [P0.1_LC*]	17	82	-65	17	82	-65
FCRR 2D Overtopping Flow [FCRR_Full]	97	95	2	82	75	7
Piccaninny Ck DS FCRR [PC_014]	1,274	1,267	7	1,219	1,199	20

Location [PO ID]	**1% AEP Billabong Dominant Flow (ML/day)**			**1% AEP Yanco Dominant Flow (ML/day)**		
	Steady State at peak flow rate	Unsteady Hydrograph (baseline)	Difference (Steady State - Baseline)	Steady State at peak flow rate	Unsteady Hydrograph (baseline)	Difference (Steady State - Baseline)
Piccaninny Ck US WCR [PC_009_wFP]	2,351	2,307	44	3,621	3,518	**103**
Browns Ck FPN Outflow [BrC_N_FP1_Out]	181	175	6	375	361	**14**
Browns Ck Outflow [BrCk_Extreme_Out]	2,132	2,116	16	2,576	2,548	**28**
Browns Ck FPS Outflow [BrC_Sth_FP_Out]	1,175	1,134	41	2,600	2,520	**80**
Sheepwash Creek Outflow [SWC_001_wFP]	1,315	1,297	18	1,980	1,938	**42**

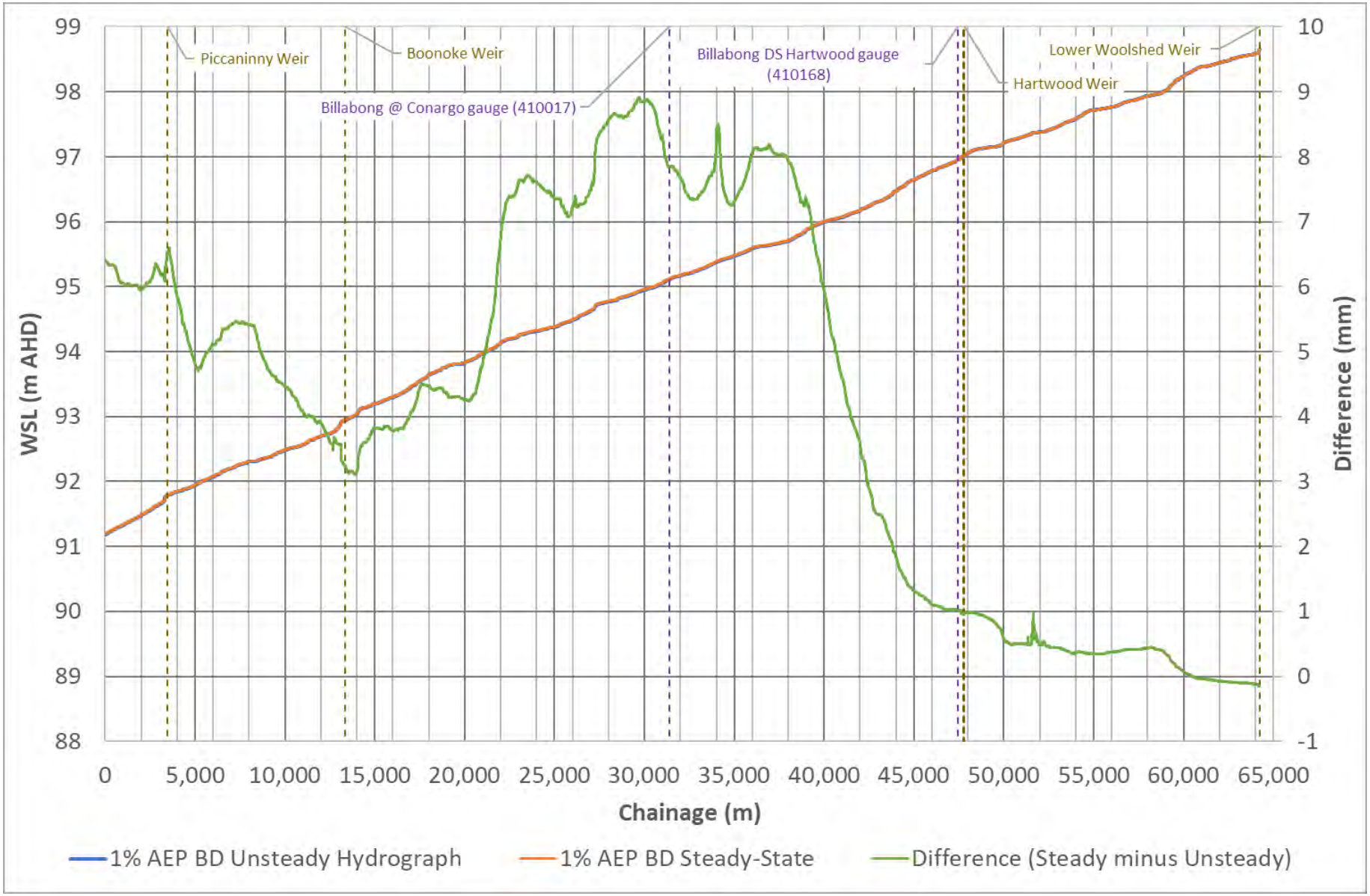


Figure 5-14 Steady State versus Unsteady Model WSL comparison along Billabong Creek for 1% AEP event where Billabong Creek is dominant

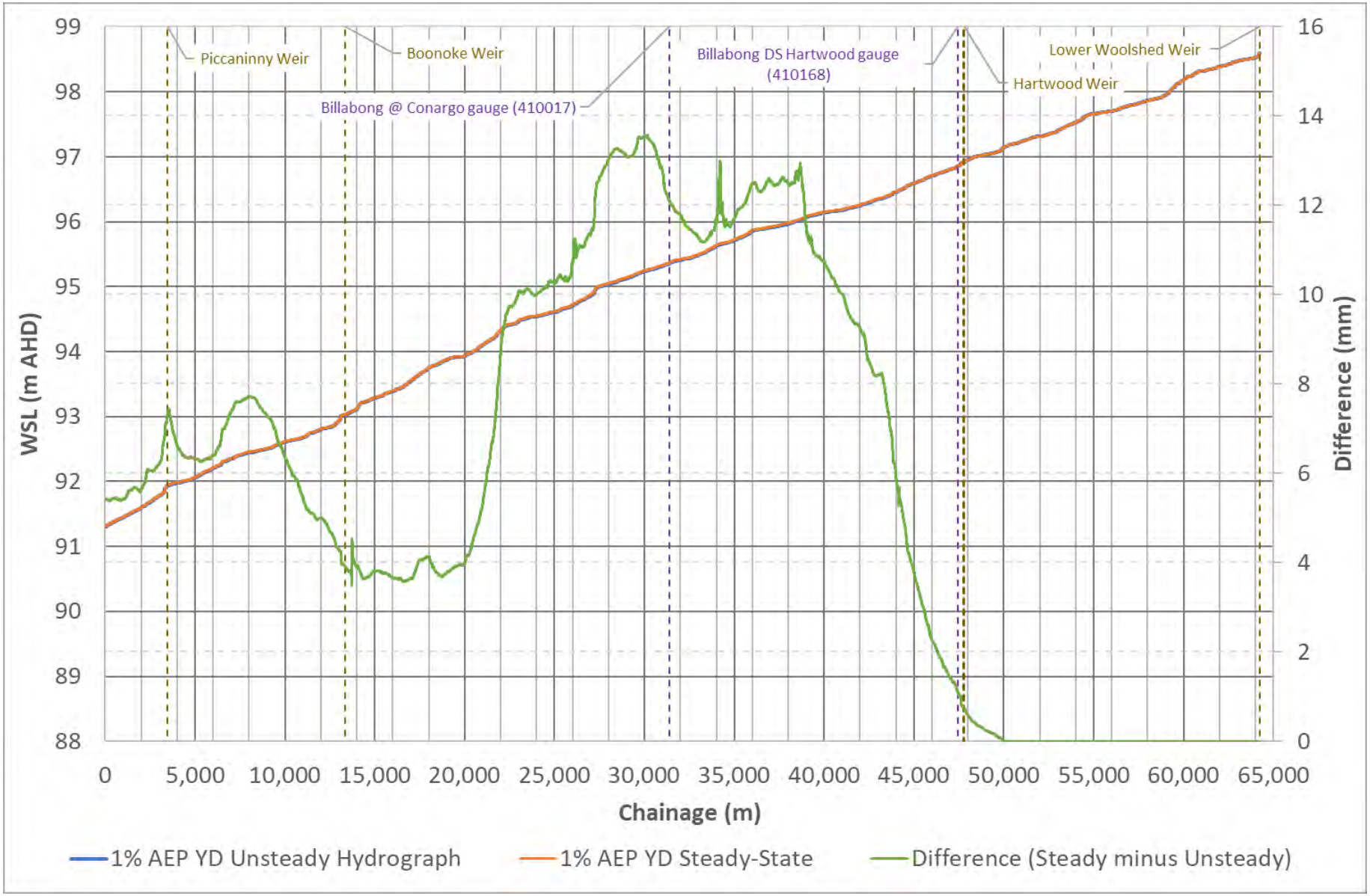


Figure 5-15 Steady State versus Unsteady Model WSL comparison along Billabong Creek for 1% AEP event where Yanco Creek is dominant

5.2.12 Conclusion

The above analysis has tested the models sensitivity to a number of model parameters and found that the results are generally within +/- 300mm with the direction of change in all tests being as expected. The results show that the most sensitive parameters are as follows in order of impact:

- Grid size, particularly in terms of flows at some key flow split locations – the impact of this can however be addressed through “calibration”;
- Catchment roughness (or Manning’s ‘n’);
- Assumed crest level at Forest Creek Block Bank (FCBB) and Hartwood Weir; and
- Followed by volumetric losses.

The key spatial locations identified as being sensitive to certain variables (excluding grid size, catchment roughness and volumetric losses that had more widespread impacts) were as follows:

- The area of breakaway flow via Browns Creek west of Willurah Road.
- Billabong Creek between downstream boundary and around where flow breaks away via Back Creek in higher events.
- Forest Creek between downstream boundary and just upstream of Conargo Road.
- Wilsons Anabranch and adjacent section of Yanco Creek.

This testing demonstrates that the model is preforming as expected with no unusual changes in results to reasonable parameter alterations. The adopted parameters are considered reasonable based on the results of the calibration and validation exercise outlined in Section 5.3. The analysis also highlights that catchment roughness is the appropriate calibration parameter. Some variables that will require consideration prior to scenario modelling are:

- Minimum Hartwood Weir and Forest Creek Block Bank (FCBB) crest levels.
- Parry’s Weir crest level.
- The need to model bridge over top of Quiamong Weir.

The assumptions regarding these variables for calibration and model scenarios are discussed in the relevant section of the report.

5.3 Calibration and Validation

5.3.1 Overview

The purpose of model calibration is to demonstrate that the model can reproduce recorded events and to refine model parameterisation and topography. Calibration is achieved by comparing the outputs from the model against known water levels and flood extents for historic events. Calibration helps to improve the accuracy of model results. Whereas the purpose of model validation is to test the performance of the calibrated hydraulic model against historic flow events and provide a level of confidence in the performance of the model. Ideally, more recent events will be tested as these will best reflect current instream and floodplain conditions.

With regards to model calibration and/or validation, ideally both gauge and imagery data should be considered. The gauge data will assist in the calibration of instream parameters, whilst the observation data will assist in the calibration/validation of model floodplain roughness parameterisation and topographical edits.

The following criteria are generally used to determine the suitability of historical events to use for calibration or validation:

- The availability, completeness and quality of rainfall, river flow and flood level event data.
- The amount of reliable historical flood information data available.
- The variability of events – preferably events would cover the range of flow rates of interest.

For this study, recorded streamflow data and aerial imagery of the selected calibration events were available to use for calibration and/or validation purposes. Furthermore, the availability of recent 1 m LiDAR survey flown during the September 2021 calibration event allowed for a detailed calibration of the model.

As discussed in the 'Data' and 'Modelling Approach' sections of the report the following events, have been chosen to perform model calibration and/or validation for the stated purposes:

- Rating Curve (RC) - a scenario where a ramped hydrograph was run to compare model performance to the rating curves at key gauges within the study area and to other know levels based on flood information.
- August 2017 (01/08/17 to 10/09/17) – low flow event to check model performance for in-bank flows.
- August 2021 (01/07/21 to 10/09/21) – initial high flow calibration event with some out-of-bank flows, but due to uncertainty around presence of drop boards at Hartwood Weir and the actual minimum crest elevation of Forest Creek this ultimately formed a verification run. Additional data was captured for the 2022 event to reduce these uncertainties.
- September 2021 (11/09/21 to 09/10/21) – initial second high flow calibration event with some out-of-bank flows, but due to uncertainty around presence of drop boards at Hartwood Weir and the actual minimum crest elevation of Forest Creek this ultimately formed a verification run.
- October 2021 (10/10/21 to 10/11/2021) – initial validation modelling event, which due to uncertainty around presence of drop boards at Hartwood Weir and the actual minimum crest elevation of Forest Creek ultimately formed a verification run.
- August 2022 (01/08/2022 to 30/12/2022) – high flow calibration/validation event, with reliable information regarding drop board status at Hartwood Weir, FCO operations and understanding of minimum crest elevation at Forest Creek Block Bank.

Low flow gauge data was used to assist in the calibration of instream parameters, whilst high flow gauge data was used to assist in the calibration of instream and floodplain roughness parameterisation. The peak flow and stages for the events chosen are described in Table 5-14 below.

Four gauges within the Hartwood model area have been chosen for calibration (and validation) purposes. Recorded streamflow and water level were utilised during calibration for the following gauges:

- 410168 Billabong Creek DS Hartwood Weir
- 410017 Billabong Creek at Conargo (Puckawidgee)
- 41010309 Forest Creek at Offtake
- 410148 Forest Creek at Warriston Weir

Inflow hydrographs for each calibration and validation event were derived from gauges to model inflow boundaries on Yanco Creek and Billabong Creek. The Yanco Creek model inflow boundary used flows from gauge 410169 (Yanco Creek at Yanco Bridge), which is located close to the position of the inflow boundary. The Billabong Creek model inflow boundary used flows from gauge 410016 (Billabong Creek at Jerilderie), which is located approximately 65 km upstream of the inflow boundary. Due to the location of gauge 410016, flows recorded at this gauge were shifted based on analysis of flows between this gauge and gauge 410168 (Billabong Creek DS Hartwood Weir), as well as the results from WP17. This resulted in the flows at gauge 410016 being shifted forward 60 hours (or 2.5 days), which means due to the offset in timing between flows on Billabong Creek and Yanco Creek the flows applied on Billabong Creek are based on flows beginning on 29/07/17 at 12:00 PM and flows on Yanco Creek are based on flows beginning on 01/08/17 at 0:00 AM.

Recorded streamflow at gauge 41010309 (Forest Creek at Offtake) was used to derive an inflow into Forest Creek at the offtake. This transfer of flow from Billabong Creek was represented as a 2D_SA polygons either side of the Forest Creek offtake, one representing an inflow and the other an extraction of the same flow based on recorded flows. This approach was adopted during calibration to reduce uncertainty and errors in relation to the operational condition(s) applied on Forest Creek Offtake as the Water NSW rules indicate operation only when flow downstream of Hartwood Weir is greater than 1200 ML/day, but the supplied operational data between 2015 and 2021 suggests much more frequent and variable operations (see Figure 5-16).

Table 5-14: Calibration and validation gauge data

Event	410168 Billabong Creek DS Hartwood Weir		410017 Billabong Creek at Conargo (Puckawidgee)		41010309 Forest Creek at Offtake		410148 Forest Creek at Warriston Weir	
	Peak Flow (ML/d)	Peak Stage (m AHD)	Peak Flow (ML/d)	Peak Stage (m AHD)	Peak Flow (ML/d)	Peak Stage (m AHD)	Peak Flow (ML/d)	Peak Stage (m AHD)
Aug 2017	501	93.98	886.1	92.35	116	95.34	62	92.26
Aug 2021	1,873	95.41	2356	93.31	275	95.88	181	92.36
Sep 2021	1,742	95.31	1,742	93.13	2812	95.92	184	92.37
Oct 2021	1,721	95.29	2,249	93.26	274	95.91	167	92.35
Aug 2022	4,971	97.07	13,263	95.25	1,024	97.49	2,521	93.17

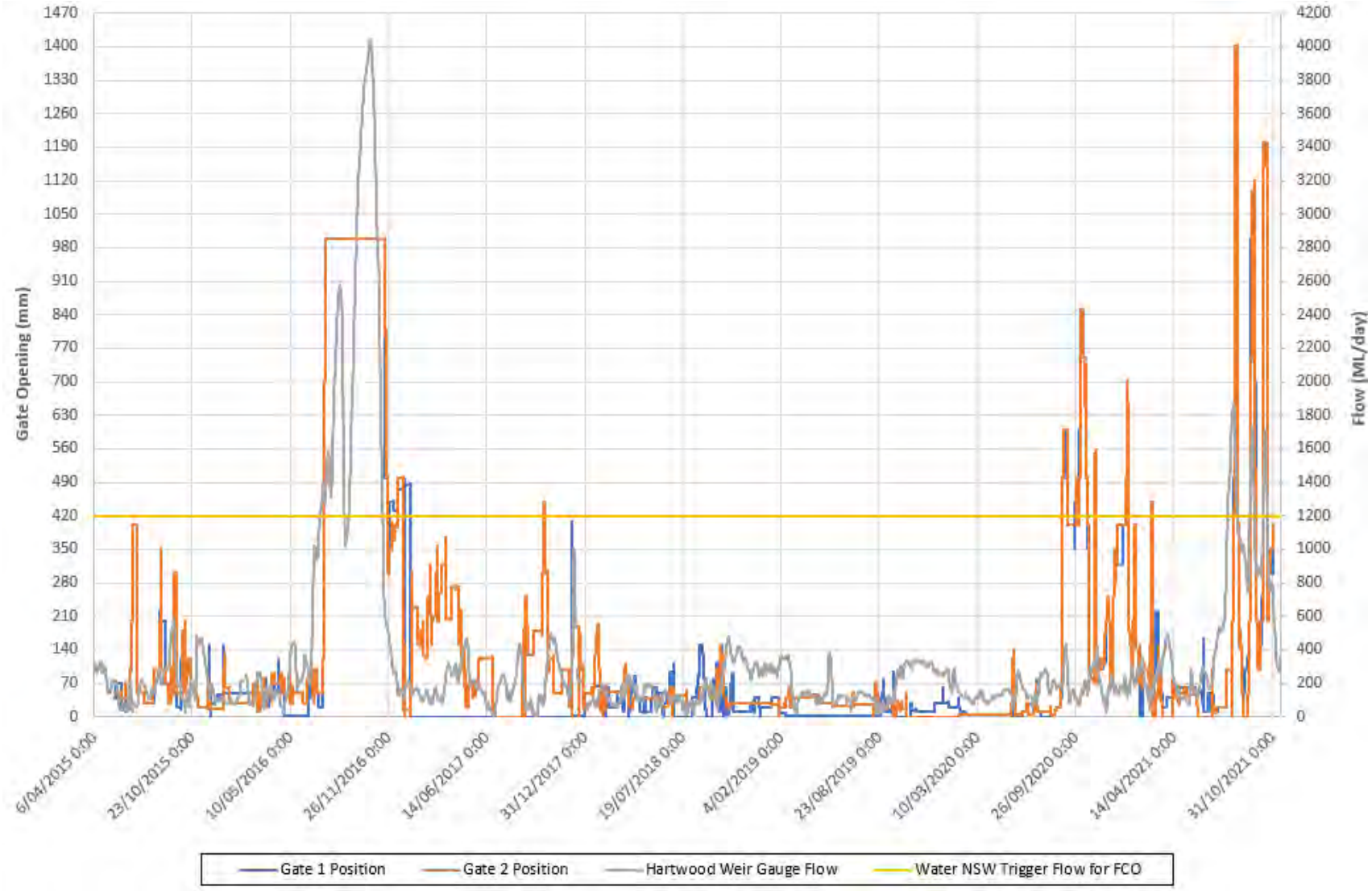


Figure 5-16: Operational Data for Forest Creek Offtake

5.3.2 Rating curves

Figure 5-17, Figure 5-18 and Figure 5-19 present the rating curve derived from modelling results plotted against the current rating curve listed for the Billabong Ck DS Hartwood Weir (410168), Billabong Creek at Conargo (410017) and Forest Creek at Warriston Weir (410148) gauges respectively. These plots show the following key results:

- Within the approximate scenario design flow range of 1,300 ML/day to 2,600 ML/day on Billabong Creek the model represents the rating curve at 410168 (Billabong Creek @ DS Hartwood) to within + 12 mm and - 150 mm.

- Within the approximate scenario design flow range of 1,800 ML/day to 3,400 ML/day on Billabong Creek the model represents the rating curve at 410017 (Billabong Creek @ Conargo) to within + 70 mm and - 33 mm.

- Within the flow range of 100 ML/day to 300 ML/day on Forest Creek the model represents the rating curve at 410148 to within + 42 mm and + 90 mm.Build-up of debris near the water level sensor

It is worth noting that there is a degree of uncertainty associated with the observed rating curves for non-standard structures or natural channels. Ratings curves are typically based on a “best-fit” of observed water level and flow data captured during events at the gauge. There are many factors which constribute to the uncertainy in rating tables including:

- Hysteresis of the flood wave

- Tolerances on water level recording mechanism

- Changes in atmospheric pressure which can affect water level pressure sensors

- Build-up of debris near the water level sensor

- Changes in rating over time

Considering this, the model is considered fairly representative of the three gauges within the Study Area.

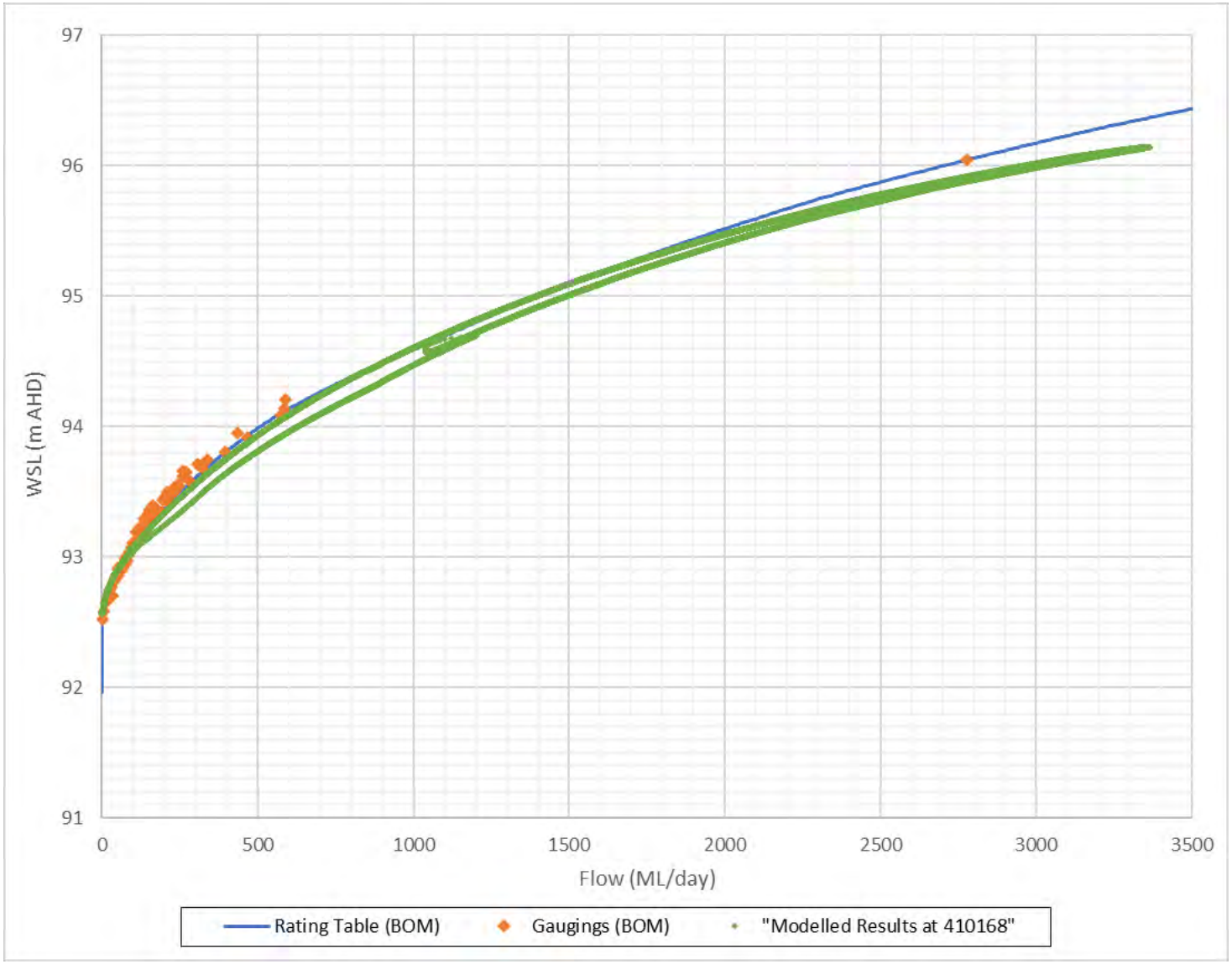


Figure 5-17: Billabong Creek DS of Hartwood Rating Curve

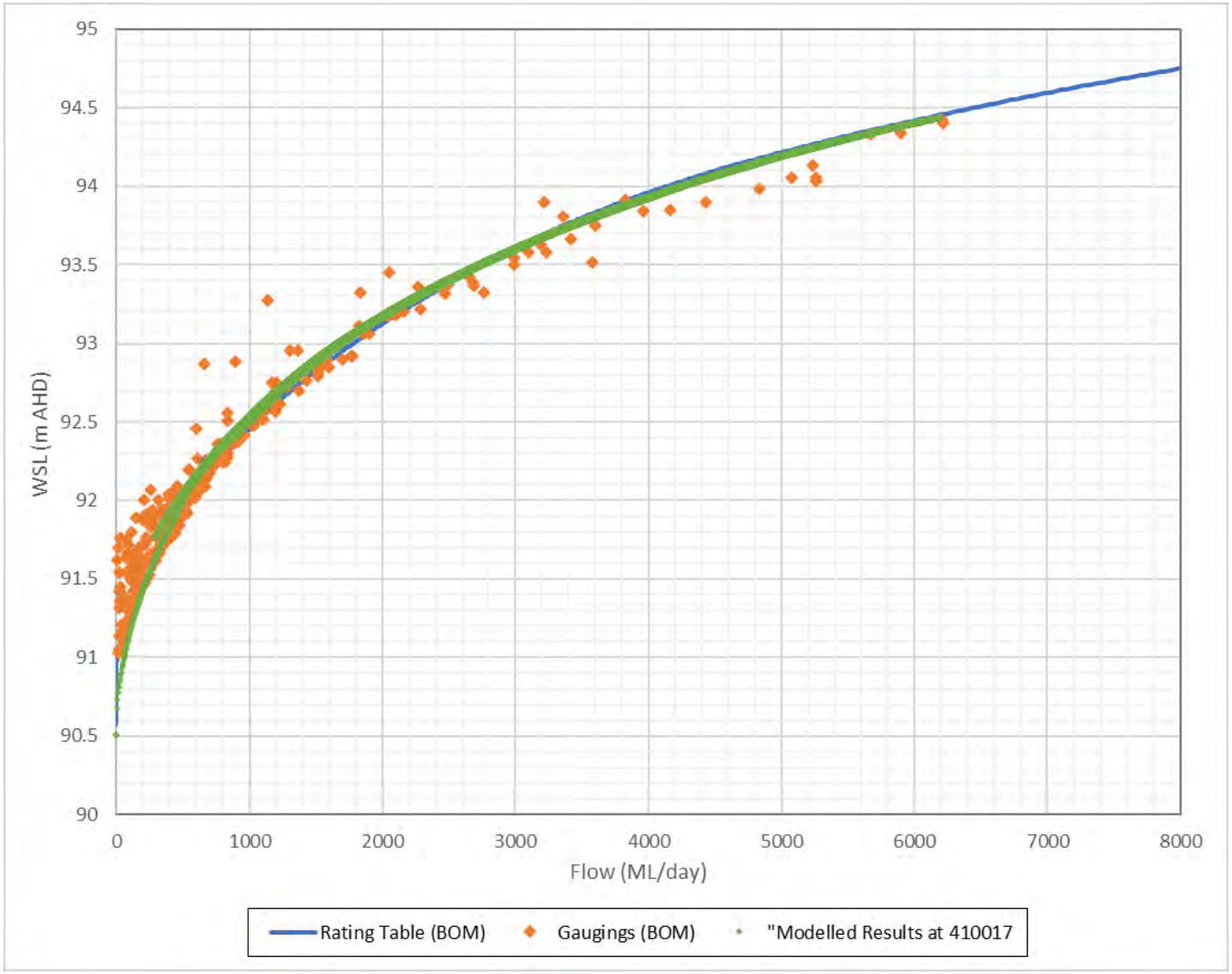


Figure 5-18: Billabong Creek at Conargo (Puckawidgee) Rating Curve

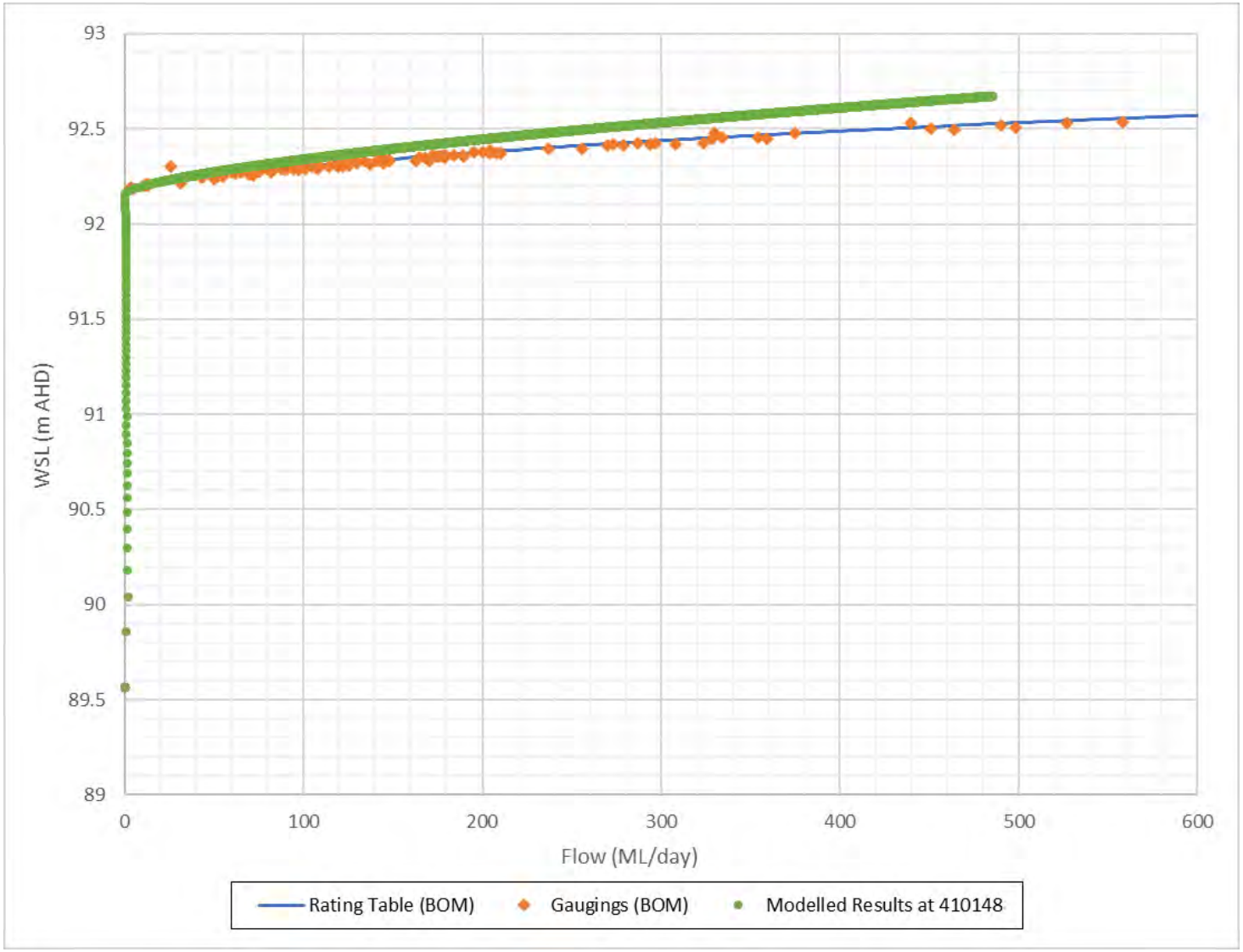


Figure 5-19: Forest Creek at Warriston Weir Rating Curve

5.3.3 August 2017 Event

The August 2017 calibration event was modelled using the inflow hydrographs extracted from the Yanco Creek at Yanco Bridge (410169) and Billabong Creek at Jerilderie (410016) gauges. The raw hydrographs extracted from the gauges consisted of streamflow data that appeared to jump between recordings and consisted of "wobbles". A moving average data analysis was applied to the raw recorded gauge data to smooth out the hydrographs and reduce uncertainty in modelling results.

This calibration event is a low flow event that occurs between 01/08/17 to 10/09/17, where the maximum observed discharge at Yanco Bridge was 575.4 ML/day and the maximum discharge at Jerilderie was 499.4 ML/day. Figure 5-20 below shows a comparison of gauged flow data and model flow results extracted at each gauge location. Similarly, Figure 5-21 presents a comparison of gauged water level data and model water level results.

The results presented in Figure 5-20 show that modelled peak flows match the timing and magnitude of the gauged peak flows well, with Table 5-15 showing peaks to be within ±20 ML/day (or within around 2 % of the gauge flow). The "falling limb" of modelled flow results on Billabong Creek are higher than those recorded at the gauges. Losses as a result of irrigation throughout the model area have not been included in calibration modelling (refer to 'Modelling Approach' section above) and is a likely explanation for higher flows on the receding limb.

The modelled water level results, presented in Figure 5-21, provide a good fit to the observed data during the peaks of the flow event with Table 5-15 showing a difference of less than -120 mm at the peak. As expected, modelled water level results during the "falling limb" of the event, have been overestimated along Billabong Creek due to the higher flows. Difference in modelled water level and observed water level at the gauge location DS of Hartwood Weir reaches a maximum of approximately 380 mm, while the typical difference is approximately 100 mm. Similarly, the maximum difference between water level results and observed data at Conargo is 450 mm, while the typical difference is approximately 200 mm. These larger differences occur on the falling limb and differences in peak water level are well within the target -/+250mm calibration range as shown in Figure 5-21. There are few discrepancies between the water level results along Forest Creek at Warriston Weir and the gauged data at this location, providing a very good fit to the observed water level.

Table 5-15: August 2021 difference between peak TUFLOW calibration results and gauge data

Event	410168 Billabong Ck DS Hartwood Weir		410017 Billabong Ck @ Conargo (Puckawidgee)		410148 Forest Creek @ Warriston Weir	
	Difference in Peak Flow (ML/d)	Difference in Peak Stage (m)	Difference in Peak Flow (ML/d)	Difference in Peak Stage (m)	Difference in Peak Flow (ML/d)	Difference in Peak Stage (m)
Aug 2017	20.4	-0.114	10.1	0.081	-15.8	-0.003

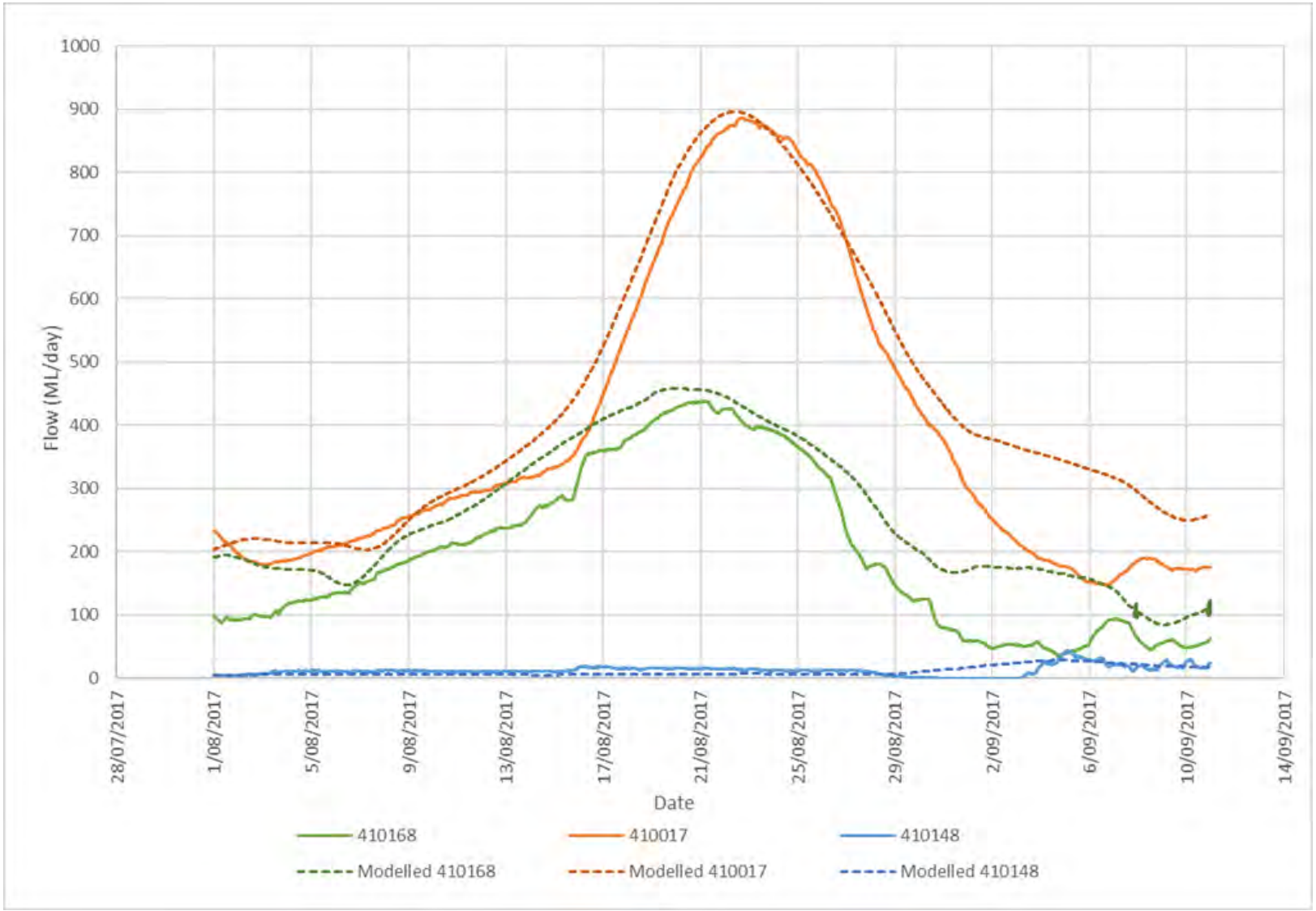


Figure 5-20: Gauge data time and flow comparison for August 2017 calibration event

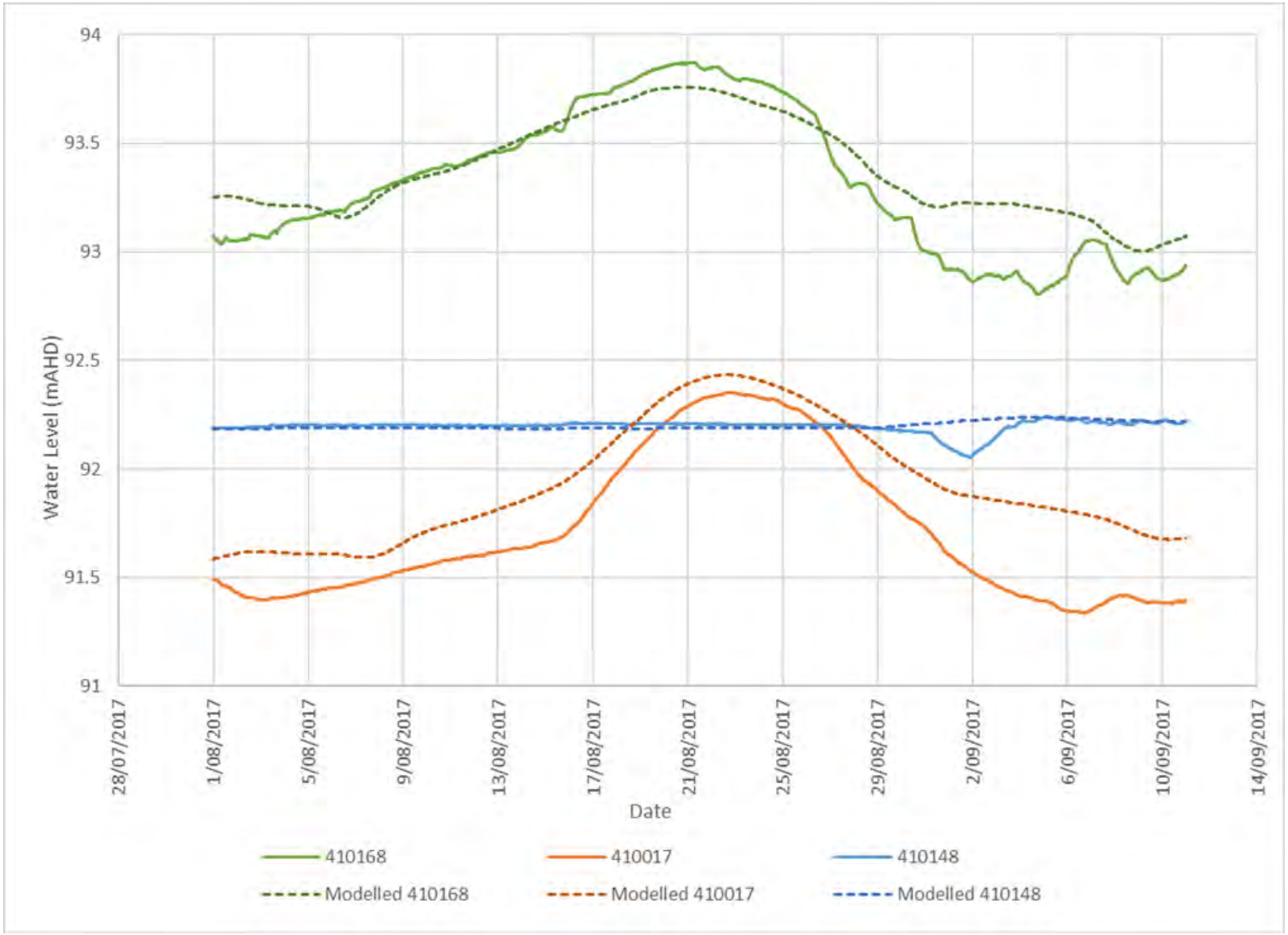


Figure 5-21: Gauge data water level comparison for August 2017 calibration event

Table 5-16 and Table 5-17 below provides statistical information about the modelled flow and water level results, respectively, in relation to the observed gauge data. Performance ratings of results have been defined by the criteria outlined in (Moriasi, 2007). From this analysis it can be concluded that:

- Flow results at the Conargo gauge (410017), provide a very good fit to the observed data.
- Flow results at the Gauge DS of Hartwood Weir are shown to be mostly good, however show an unsatisfactory fit (on PBIAS) to the gauge data with an overestimate of flow.
- Modelled flow at Warriston Weir is a good (on PBIAS) and unsatisfactory (on NSE) fit to the data. It should be noted that although the statistical analysis results for the flow at Warriston Weir indicate that the modelled flow and observed data are a poor match, the magnitude of flow at this gauge is very low and water level at this location provides a good fit with few deviations from the observed water level.
- The statistics generated for water level show that the results at:
    - The Conargo gauge (410017) provide a very good fit.
    - Gauge DS of Hartwood Weir (410168) provide an acceptable fit.
    - Warriston Weir (410148) provide a poor fit.

Table 5-16: August 2017 Flow Statistics

Statistic	410168 Billabong Ck DS Hartwood Weir	410017 Billabong Ck @ Conargo (Puckawidgee)	410148 Forest Creek @ Warriston Weir
PBIAS %	30.5	13.8	-14.8
NSE	0.71	0.9	-0.34
r	0.97	0.97	0.35
R2	0.94	0.95	0.13
KGE	0.67	0.84	0.34
VE	0.69	0.85	0.43

Table 5-17: August 2017 Water Level Statistics

Statistic	410168 Billabong Ck DS Hartwood Weir	410017 Billabong Ck @ Conargo (Puckawidgee)	410148 Forest Creek @ Warriston Weir
PBIAS %	0.1	0.2	0
NSE	0.79	0.49	-0.54
r	0.95	0.96	-0.14
R2	0.91	0.91	0.02
KGE	0.67	0.81	-0.21
VE	1	1	1

Note on Statistics

The statistics presented in calibration statistics tables are:

- PBIAS - Percent Bias is the percentage difference in the area under the curve or mass
- NSE - Nash-Sutcliffe Efficiency (-Inf <= NSE <= 1). One indicates a perfect fit and 0 the average of the observed series and less than 0 is worse than the average.
- r - Pearson Correlation coefficient (-1 <= r <= 1)
- R2 - Coefficient of Determination (0 <= R2 <= 1) - Gives the proportion of the variance of one variable that is predictable from the other variable
- KGE Kling-Gupta efficiency between sim and obs (0 <= KGE <= 1)
- VE Volumetric efficiency between sim and obs (-Inf <= VE <= 1). One indicates a perfect fit and 0 the average of the observed series

5.3.4 August 2021 Event

The August 2021 calibration event was modelled using the inflow hydrographs extracted from the Yanco Creek at Yanco Bridge (410169) and Billabong Creek at Jerilderie (410016) gauges. This calibration event is a high flow event with a peak that occurs between 01/07/21 to 10/09/21, where the maximum observed discharge at Yanco Bridge was 1,360 ML/day and the maximum discharge at Jerilderie was 2,153 ML/day. Figure 5-22 below shows a comparison of gauged flow data and model flow results extracted at each gauge location. Similarly, Figure 5-23 presents a comparison of gauged water level data and model water level results.

Initial calibration modelling found it difficult to match the flows recorded at the gauge DS of Hartwood Weir, with model persistently resulting in lower flows, falling short of the gauge by approximately 300 ML/d at peak flows. Moreover, flows at the gauge at Warriston Weir were being overestimated in modelling results. Several model iterations, which included adjusting roughness and operational conditions of gates at Forest Creek Offtake, were undertaken to increase flows at and around Hartwood Weir. However, none of these changes managed to address the differences in modelled versus gauge results. The only other factor that could really influence the calibration results in the required manor was changes to the assumed crest level at Hartwood Weir and/or Forest Creek Block Bank (FCBB). Due to the limited and/or conflicting data some testing of the assumed crest level at these locations was undertaken and is summarised in the proceeding 'Sensitivity' section of the report. One scenario, in which FCBB was raised to an average level across the channel (96.28 m AHD) generated results that calibrated well in terms of timing and magnitude (particularly on the rising limb, with some underestimates on the falling limb). However, as there was no evidence to support this increase in elevations, this outcome was only reported as a sensitivity test on Figure 5-22 and Figure 5-23. Subsequent discussion with WaterNSW indicated that Hartwood Weir was operated differently to what had been assumed in this model. These assumption on the operation of Hartwood Weir were incorporated into the 2022 Calibration run (see below).

The two sets of model results presented in Figure 5-22 and Figure 5-23 together with the differences in peaks shown in Table 5-18, suggest that there is too much flow being diverted down Forest Creek rather than continuing along Billabong Creek if Forest Creek Block Bank is not raised. As discussed in the 'Sensitivity' section of this report, as anecdotal evidence suggests the minimum crest elevation from survey is appropriate at Forest Creek Block Bank there are only two other ways to increase flow at Billabong Creek downstream of Hartwood Weir - these are to either increase the inflow on Billabong Creek or lower the weir pool level via extractions to reduce flows overtopping FCBB.

Table 5-18: Difference between peak TUFLOW calibration results and gauge data

Event	410168 Billabong Ck DS Hartwood Weir		410017 Billabong Ck @ Conargo (Puckawidgee)		410148 Forest Creek @ Warriston Weir	
	Difference in Peak Flow (ML/d)	Difference in Peak Stage (mm)	Difference in Peak Flow (ML/d)	Difference in Peak Stage (mm)	Difference in Peak Flow (ML/d)	Difference in Peak Stage (mm)
Aug 2021	-398.5	--512	-356.8	-154	47.7	110
Aug 2021 – Sensitivity check with FCBB raised to 96.28 m AHD	6.4	-197	32.6	32	-65.9	-4

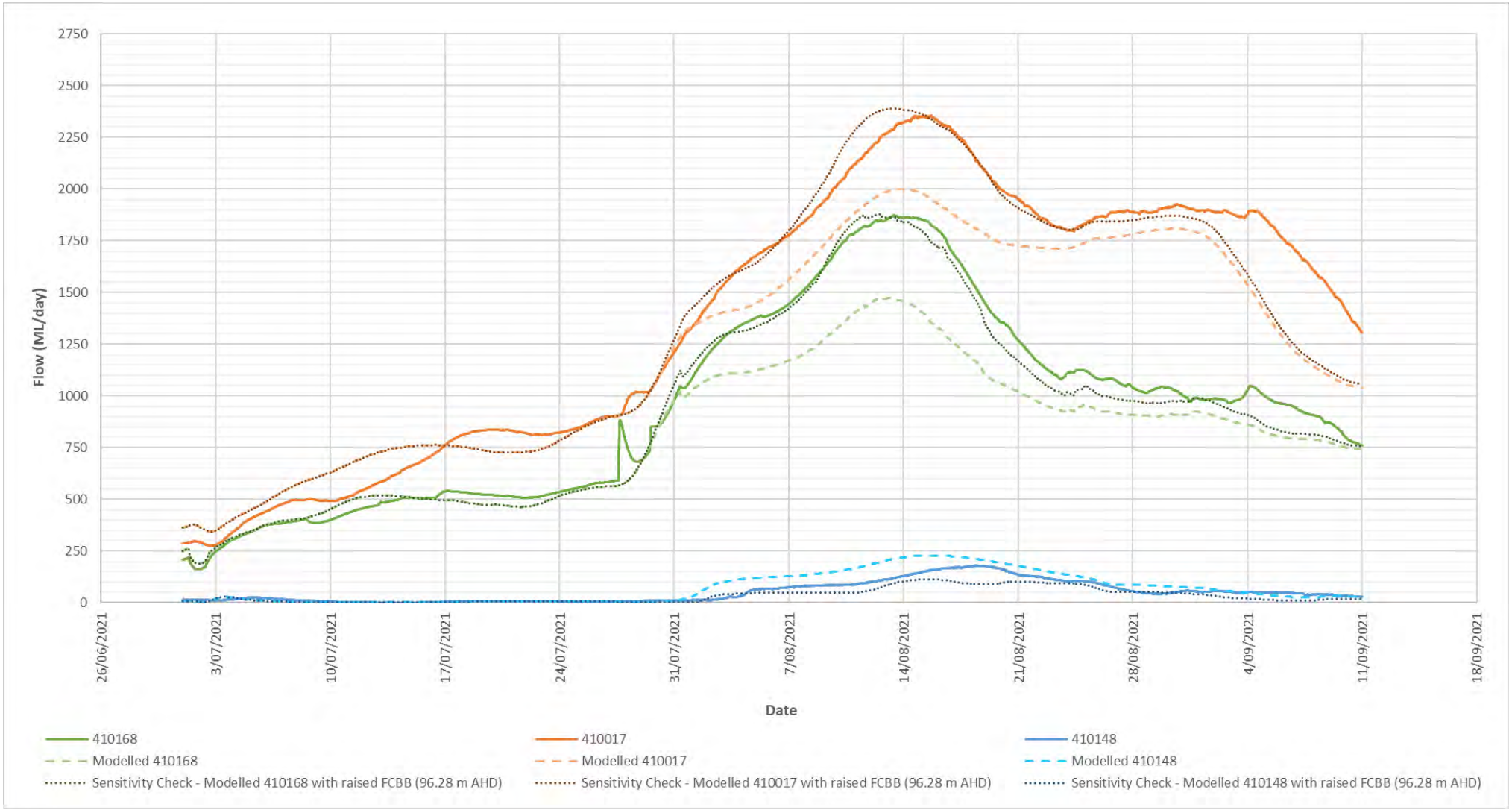


Figure 5-22: Gauge data time and flow comparison for August 2021 calibration event

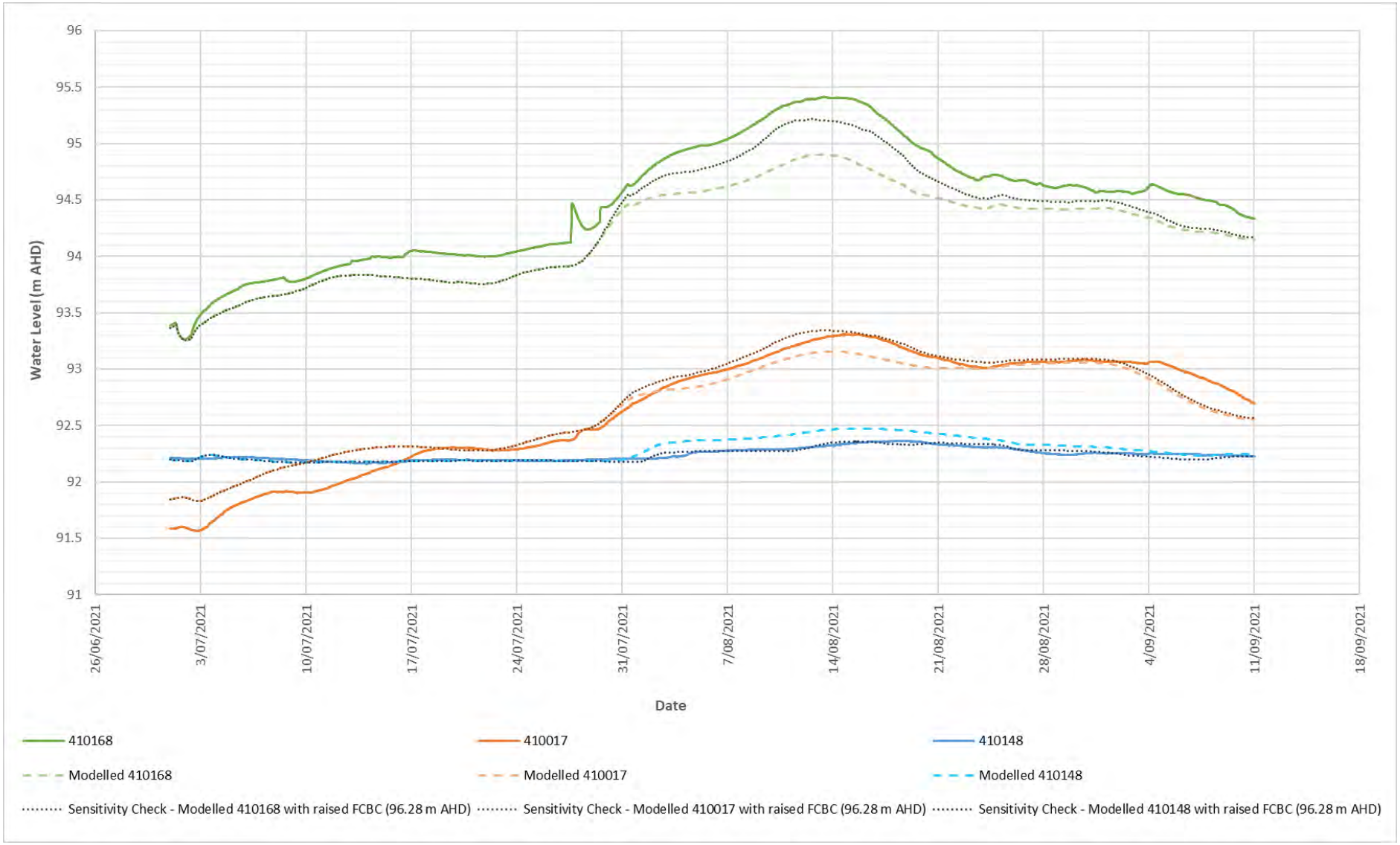


Figure 5-23: Gauge data water level comparison for August 2021 calibration event

Reliable irrigation extraction data was not readily available to test the potential impact of this mechanism to alter the Billabong Creek/Forest Creek flow split. However, given the magnitude and timing of the event in question it is unlikely substantial extractions would be underway and the fact that the results show an underestimate on the falling limb give greater credibility to the potential for missing inflows.

The potential source of additional inflows was discussed with NSW DCCEEW and investigated by comparing peak flows at 'Billabong Creek @ Jerilderie (410016)' and the combined flow from 'Billabong Creek @ DS Hartwood (410168)' and 'Forest Creek at Offtake (41010309)'. The results of this investigation are shown in Figure 5-24, which highlights the fact that peak flows at Jerilderie are sometimes less than or very similar to the combined flow at Hartwood Weir and FCO (albeit delayed by 48 hours due to the travel time). This comparison fails to include flows that would overtop FCBB and any pumped extractions (although likely minor), which could add to the number of occurrences where the flow into the model exceeds the flow recorded at Jerilderie. This indicates that there may be additional inflow downstream of the Jerilderie gauge and/or that some flow may bypass the Jerilderie gauge. Examination of Satellite imagery, shows that both additional sources of inflow are possible as illustrated by the flood behaviour presented in Figure 5-25. The annotated Sentinel image in this figure of recent flooding from 17/10/2022 around Jerilderie shows:

- The introduction of an additional inflow source from Wangamong Creek (shown by the yellow dashed arrows offset from the flow path on Figure 5-25), which has its own catchment and is the outlet for a number of irrigation escapes in the area, including Berrigan Creek Escape. This watercourse enters the Billabong Creek downstream of Jerilderie.

- A possible avenue for flows to bypass the Jerilderie gauge via travelling overland to south-west upstream of Newell Highway and re-joining Billabong Creek via Wangamong Creek (see dashed magenta arrow offset from possible flow path on Figure 5-25).

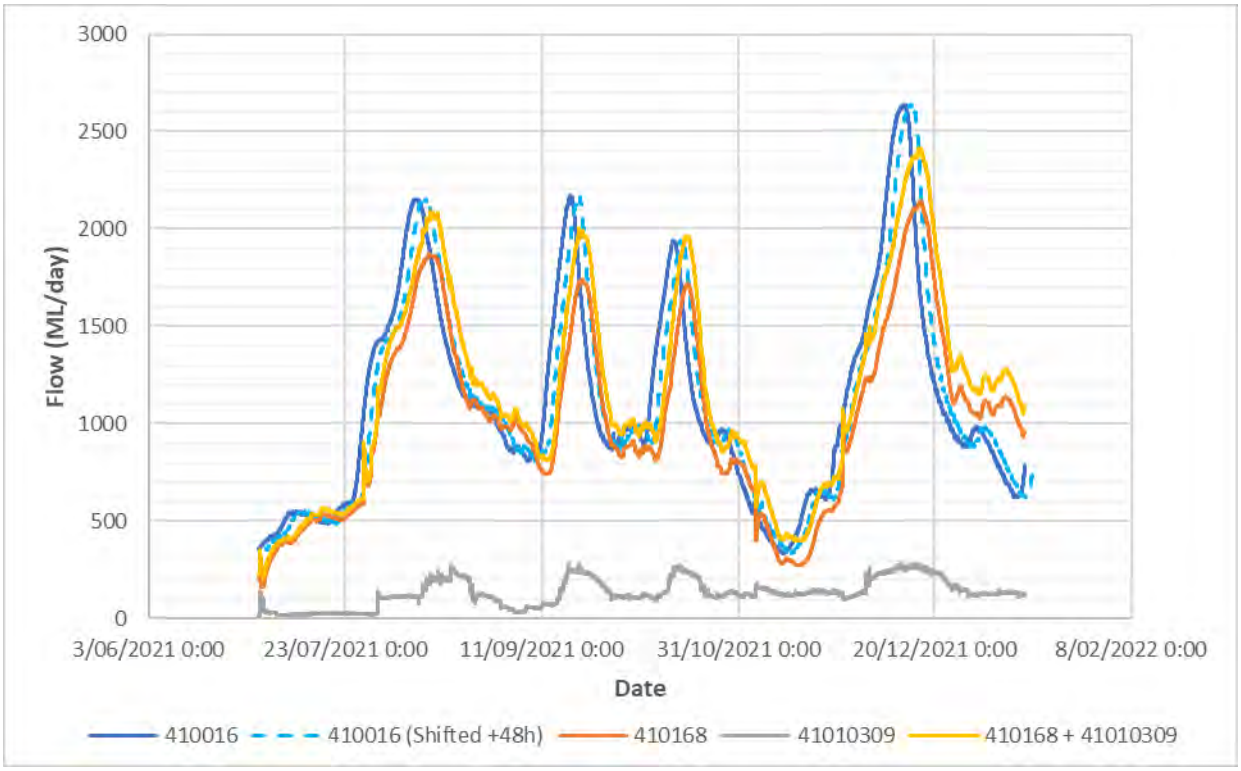


Figure 5-24: Comparison of gauge data around Billabong Creek Inflow (Jun 2021 - Feb 2022)



Figure 5-25: Flood behaviour around Billabong Creek @ Jerilderie (410016)' Gauge – 17/10/2022 Sentinel Image with False Colour (urban) filter [https://apps.sentinel-hub.com/sentinel-playground – accessed 31/11/2022].
Note: The Yellow arrows show Wangamong bypassing Jerilderie and the magenta arrow shows flows leaving Billabong Creek into Wangamong Creek.

5.3.5 September 2021 Event

The September 2021 calibration event was modelled using the inflow hydrographs extracted from the Yanco Creek at Yanco Bridge (410169) and Billabong Creek at Jerilderie (410016) gauges. This calibration event is a high flow event with a peak that occurs between 11/09/21 to 09/10/21, where the maximum observed discharge at Yanco Bridge was 1,000 ML/day and the maximum discharge at Jerilderie was 2173 ML/day.

Similar to the results discussed for the August 2021 event, the September 2021 flow and water level results presented in Figure 5-26 and Figure 5-27 respectively, show that without artificially increasing flows in Billabong Creek by raising Forest Creek Block Bank the model will under estimate levels and flows on Billabong Creek and overestimate flows and levels on Forest Creek. Table 5-19 compares the peak flow and WSL at the gauges within the Study Area and shows that it is likely we are missing some inflows to the model, for the same a reasons as discussed for 'August 2021 Event'. As with the August 2021 event, this argument is supported by the fact that when FCBB was artificially raised the falling limb of the hydrograph was underestimated on Billabong Creek.

Table 5-19: September 2021 Difference between peak TUFLOW calibration results and gauge data

Event	410168 Billabong Ck DS Hartwood Weir		410017 Billabong Ck @ Conargo (Puckawidgee)		410148 Forest Creek @ Warriston Weir	
	Difference in Peak Flow (ML/d)	Difference in Peak Stage (mm)	Difference in Peak Flow (ML/d)	Difference in Peak Stage (mm)	Difference in Peak Flow (ML/d)	Difference in Peak Stage (mm)
Sept 2021	-270.1	-433	-299.1	-121	44.0	107
Sept 2021 – Sensitivity check with FCBB raised to 96.28 m AHD	92.0	-140	64.5	68	-63.5	-0.2

The availability of 1m LiDAR data for most of the study area and high-resolution aerial imagery, which was captured during the 2021 September calibration event has allowed for a much more detailed assessment of model performance for this event. Given the results of the gauge comparisons, this assessment was undertaken on the sensitivity run with an artificially raised Forest Creek Block Bank. The modelled flood extents for this date have been compared against the corresponding imagery, providing a good match to the observed extents. A summary of this analysis in the form of a long-section and series of cross-sections across the Study Area are presented in Figure 5-28 - Figure 5-35. These generally show good alignment with the LiDAR, except for the Hartwood Weir pool (overestimating levels) and downstream of Piccaninny Weir (underestimating levels). These results add weight to the argument that the inflow in Billabong Creek based on the Jerilderie gauge was too low and raising Forest Creek Block Bank artificially lifts the Hartwood Weir pool

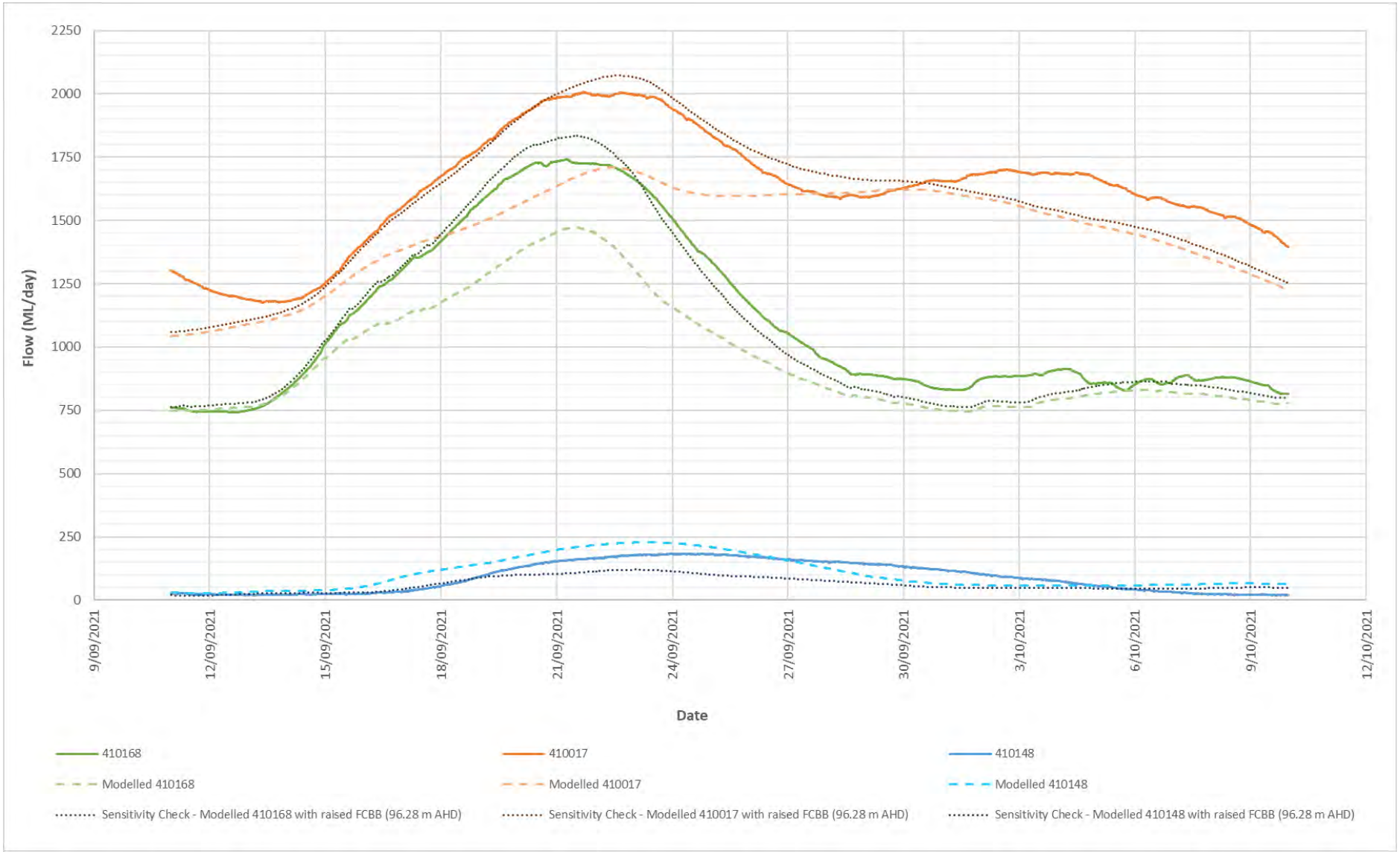


Figure 5-26: Gauge data time and flow comparison for September 2021 calibration event

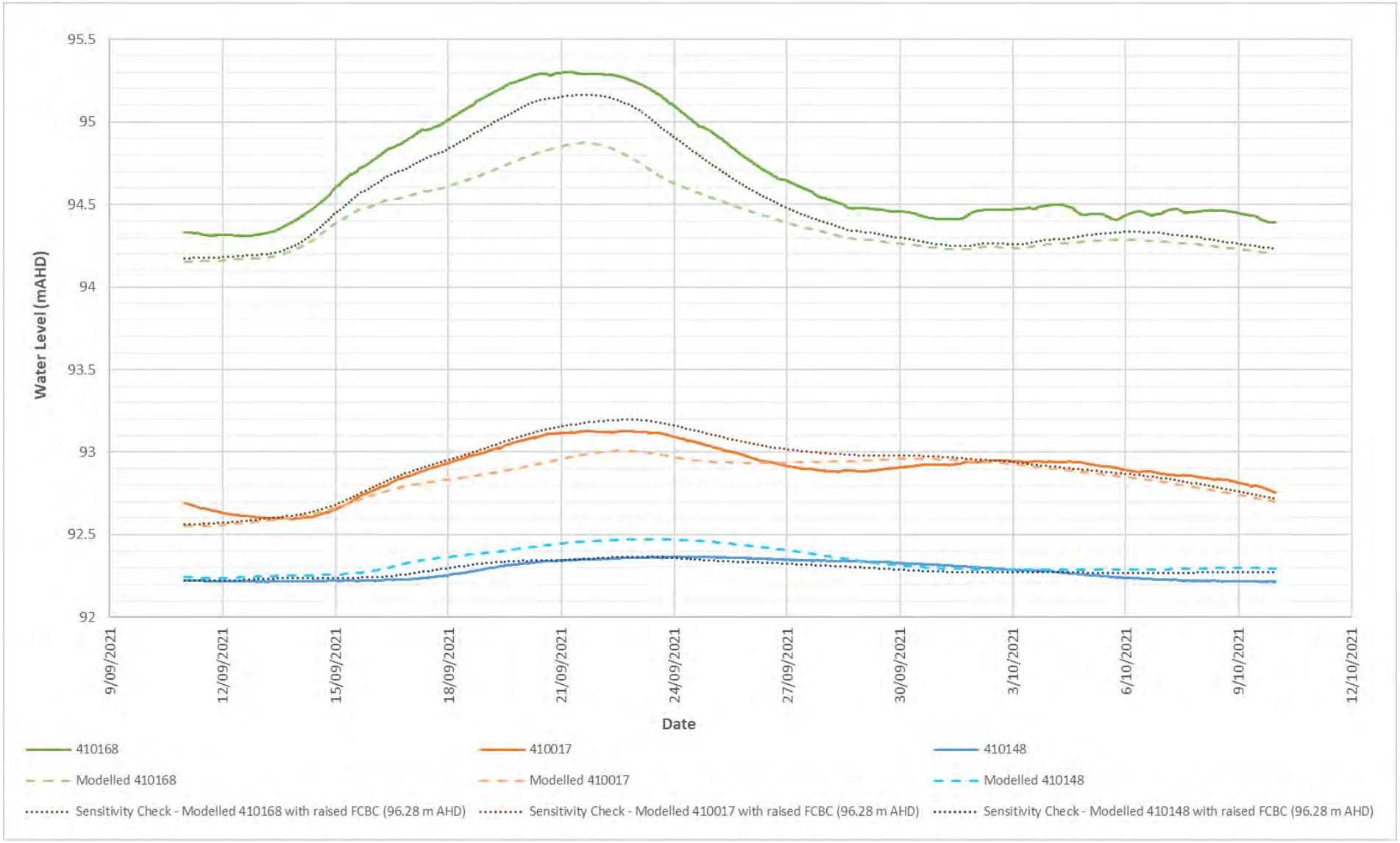


Figure 5-27: Gauge data water level comparison for September 2021 calibration event

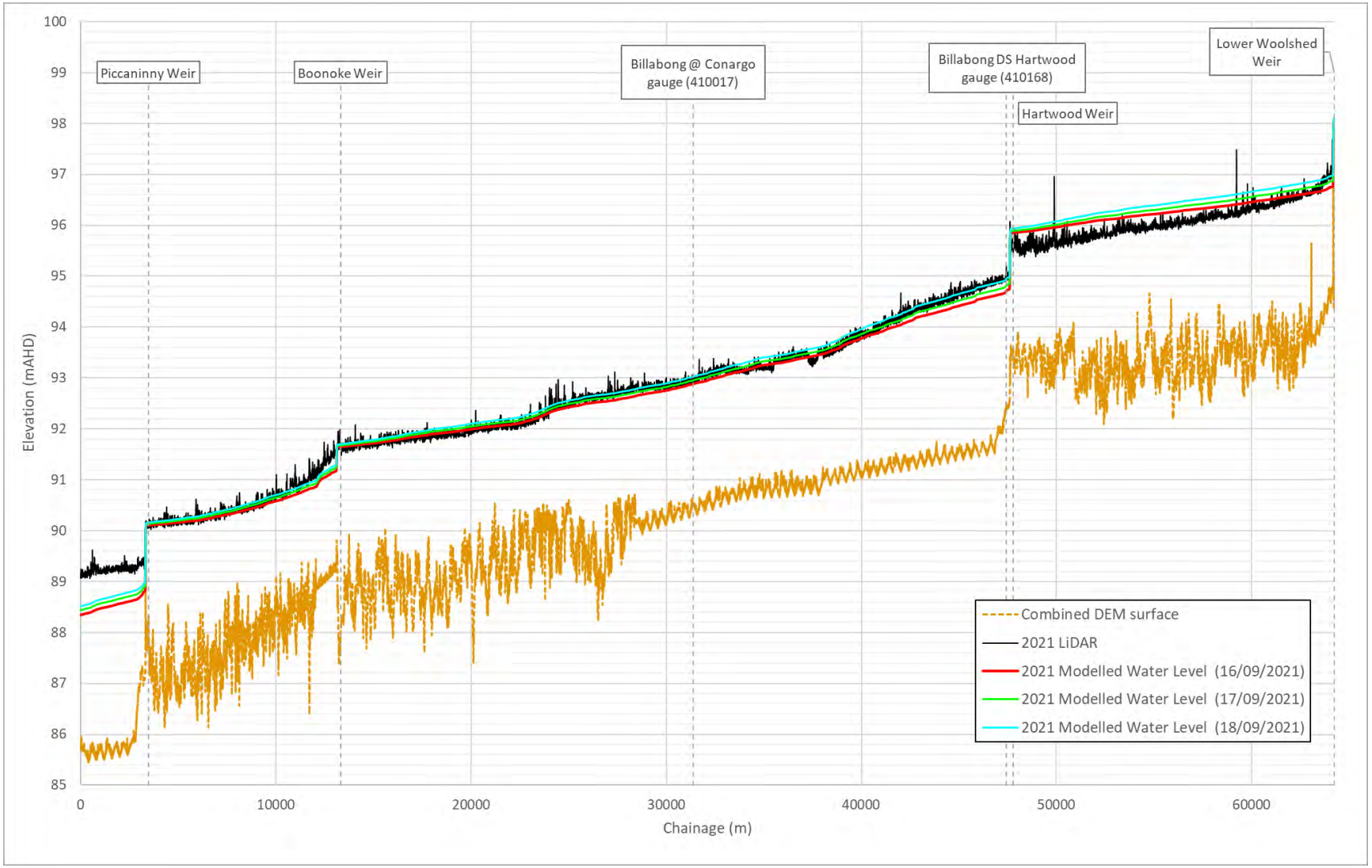


Figure 5-28: Longitudinal-section profile representing the September 2021 1m LiDAR data and the modelled peak water level for the 16th September, 17th September and 18th of September

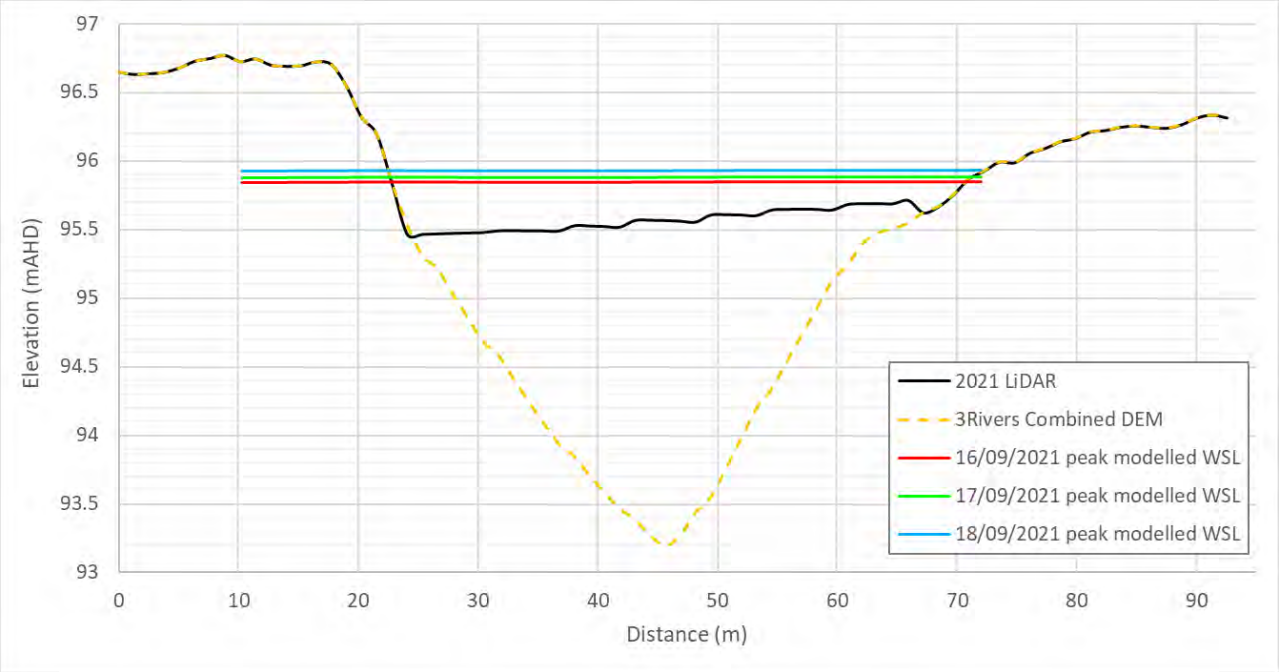


Figure 5-29: Upstream of existing Hartwood Weir cross section comparing 2021 LiDAR and modelled water levels

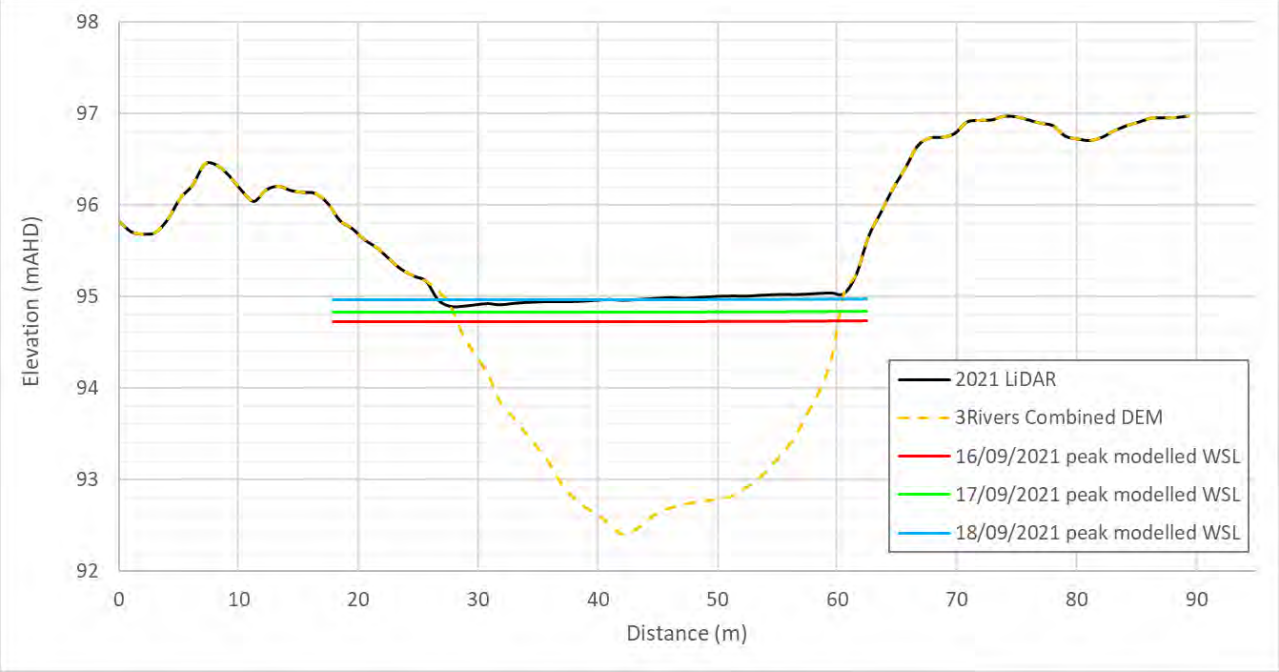


Figure 5-30: Billabong DS of Hartwood gauge (410168) cross section comparing 2021 LiDAR and modelled water levels

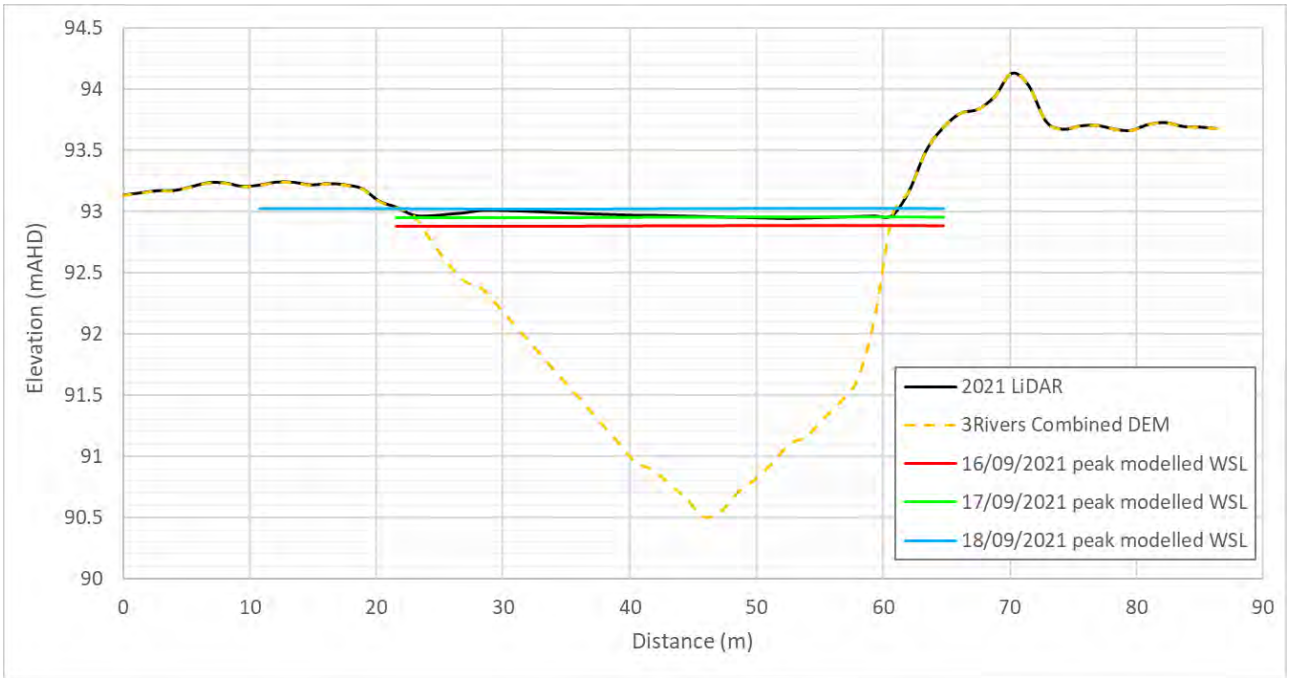


Figure 5-31: Billabong at Conargo Gauge (410017) cross section comparing 2021 LiDAR and modelled water levels

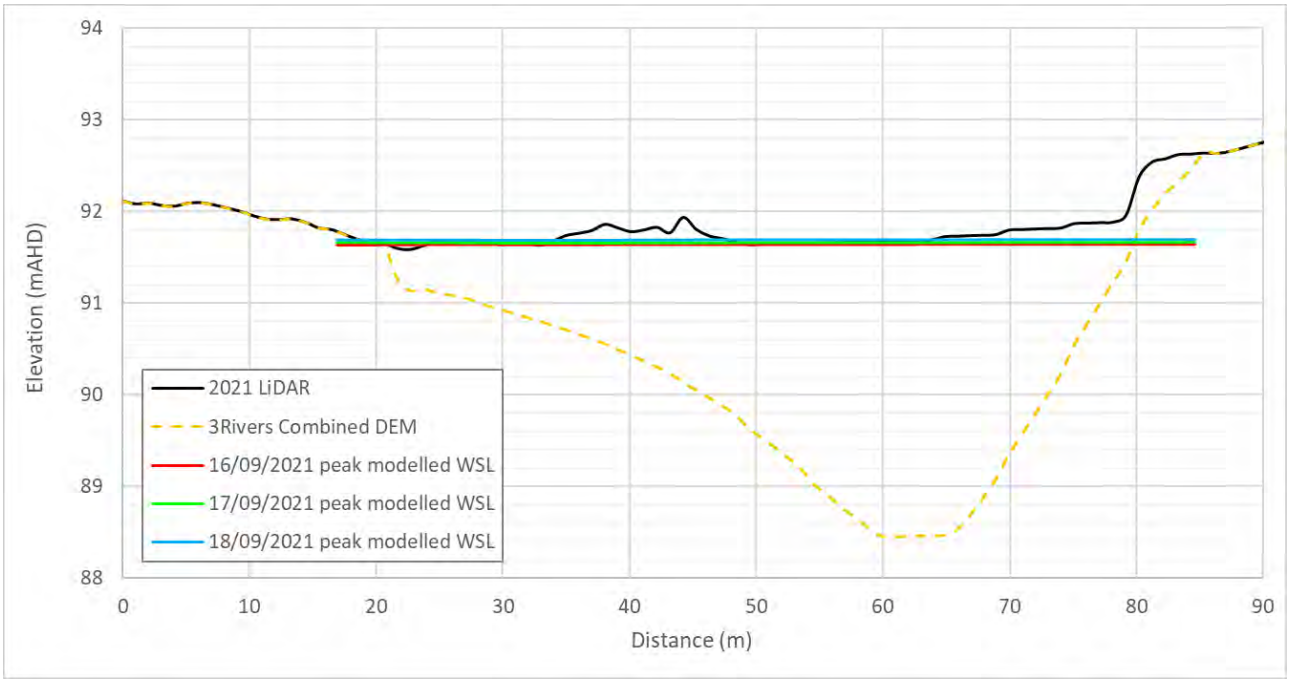


Figure 5-32: Upstream of Boonoke Weir cross section comparing 2021 LiDAR and modelled water levels

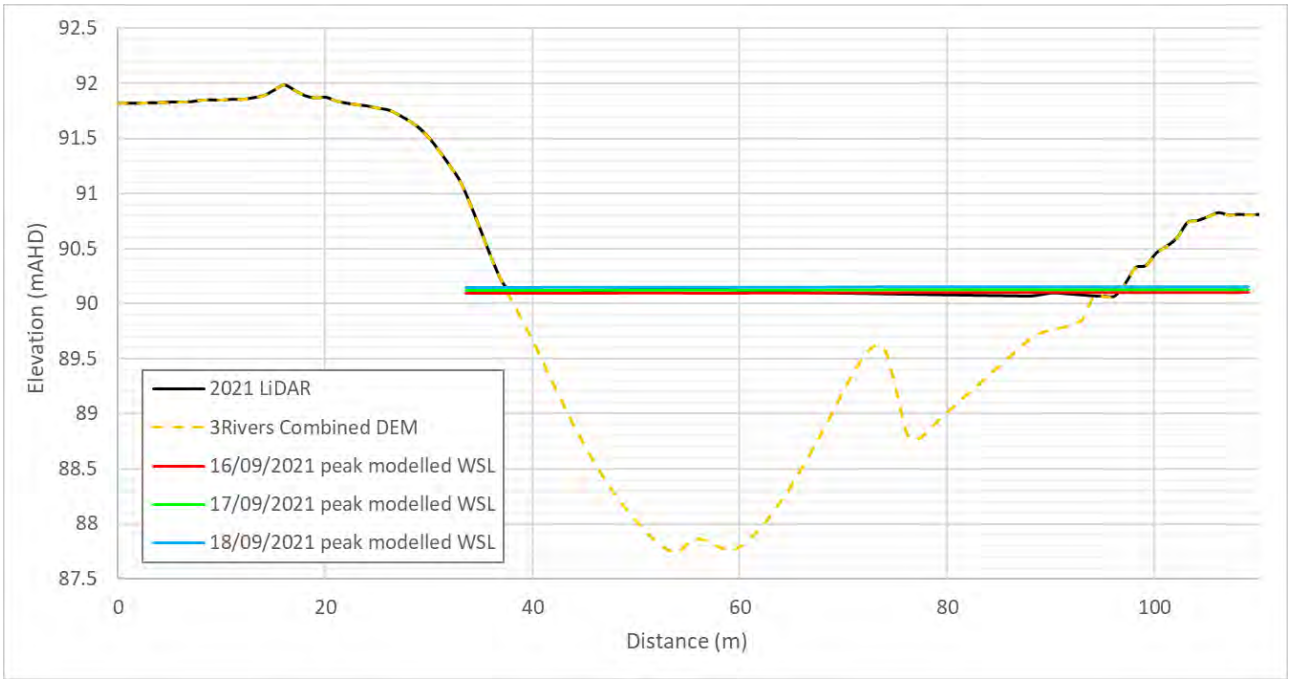


Figure 5-33: Upstream of Piccaninny Weir cross section comparing 2021 LiDAR and modelled water levels

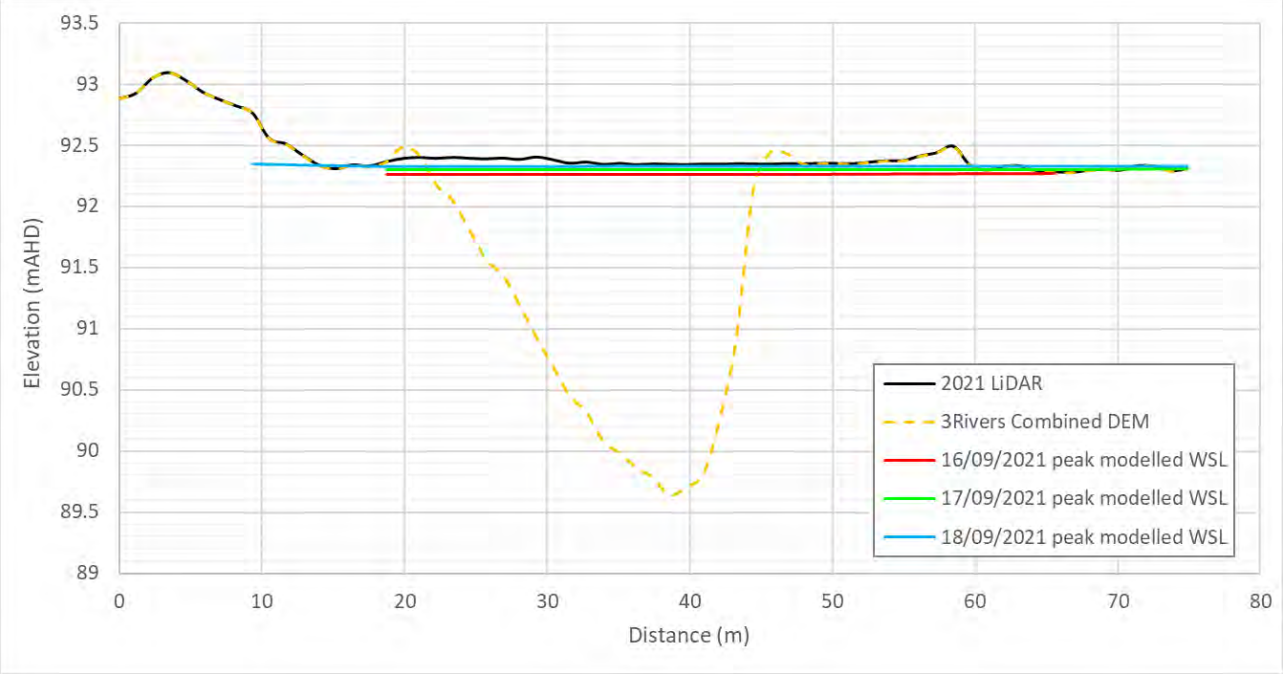


Figure 5-34: Upstream of Warriston Weir cross section comparing 2021 LiDAR and modelled water levels

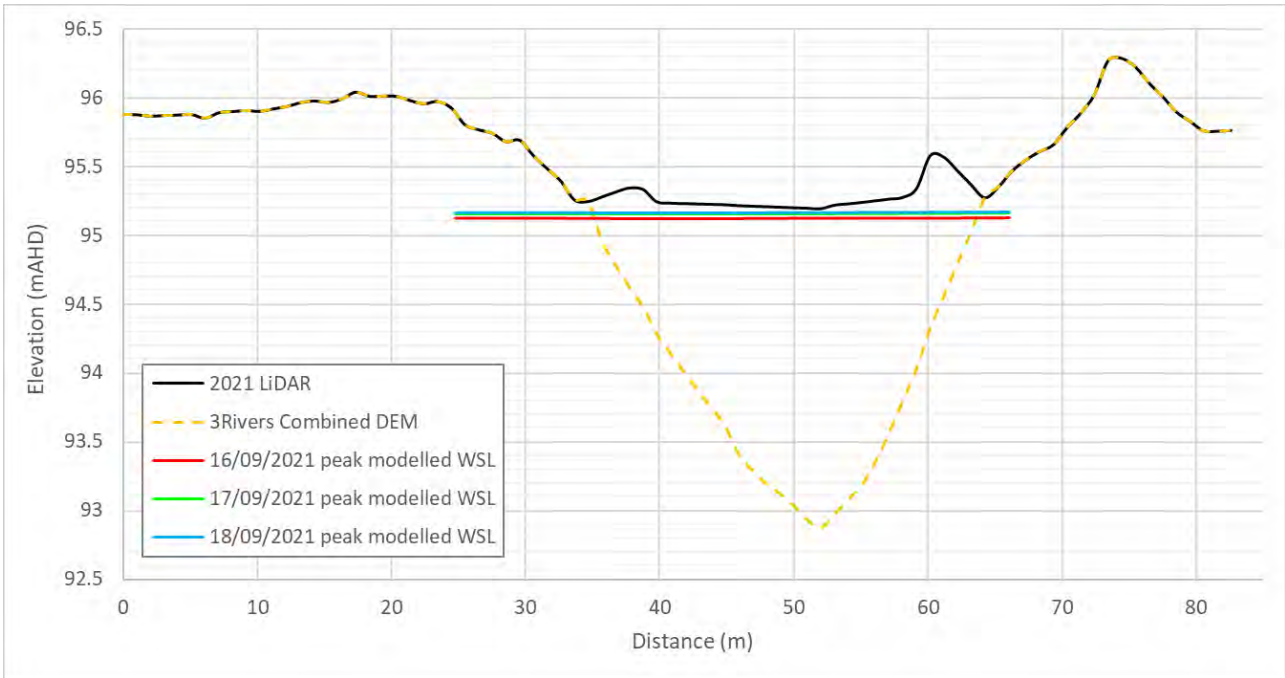


Figure 5-35: Upstream of Parry's Weir cross section comparing 2021 LiDAR and modelled water levels

5.3.6 October 2021 Event

The October 2021 flow event was modelled using the inflow hydrographs extracted from the Yanco Creek at Yanco Bridge (410169) and Billabong Creek at Jerilderie (410016) gauges. This validation event is a high flow event that occurs between 10/10/21 to 10/11/21, where the maximum observed discharge at Yanco Bridge was 1013 ML/day and the maximum discharge at Jerilderie was 1937 ML/day.

Similar to the results discussed for the August and September 2021 event, the October 2021 flow and water level results presented in Figure 5-36 and Figure 5-37 respectively show that without artificially increasing flows in Billabong Creek by raising Forest Creek Block Bank the model will under estimate levels and flows on Billabong Creek and overestimate flows and levels on Forest Creek. Table 5-20 compares the peak flow and WSL at the gauges within the Study Area and shows that it is likely we are missing some inflows to the model, for the same a reasons as discussed for 'August 2021 Event'. This argument is again supported by the fact that when FCBB was artificially raised the falling limb of the hydrograph was underestimated on Billabong Creek.

Table 5-20: October 2021 Difference between peak TUFLOW calibration results and gauge data

Event	410168 Billabong Ck DS Hartwood Weir		410017 Billabong Ck @ Conargo (Puckawidgee)		410148 Forest Creek @ Warriston Weir	
	Difference in Peak Flow (ML/d)	Difference in Peak Stage (mm)	Difference in Peak Flow (ML/d)	Difference in Peak Stage (mm)	Difference in Peak Flow (ML/d)	Difference in Peak Stage (mm)
Oct 2021	-416.2	-529	-365.7	-150	40.0	100
Oct 2021 – Sensitivity check with FCBB raised to 96.28 m AHD	-51.0	-227	-14.8	20	-59.0	-2.2

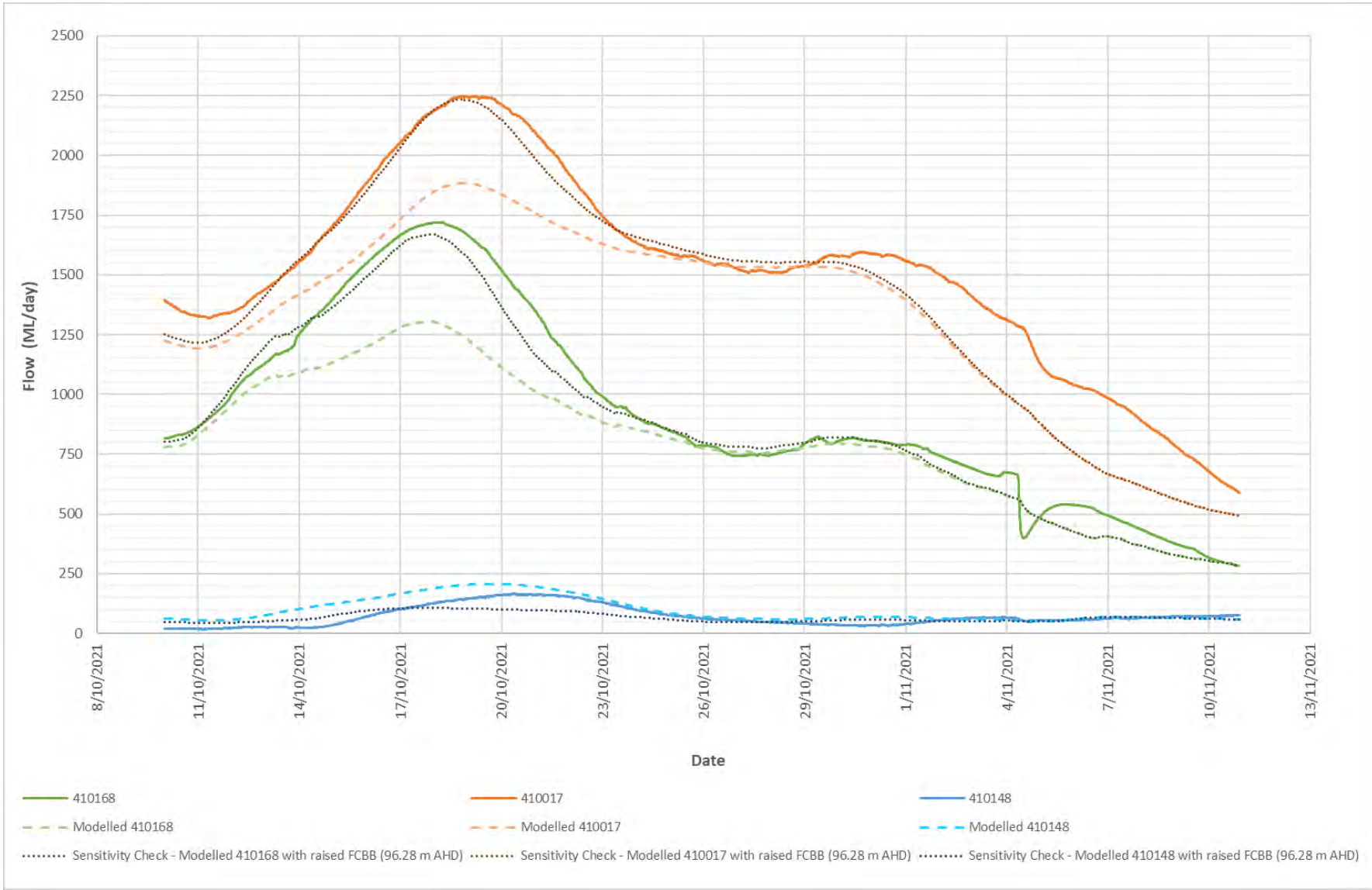


Figure 5-36: Gauge data time and flow comparison for October 2021 validation event

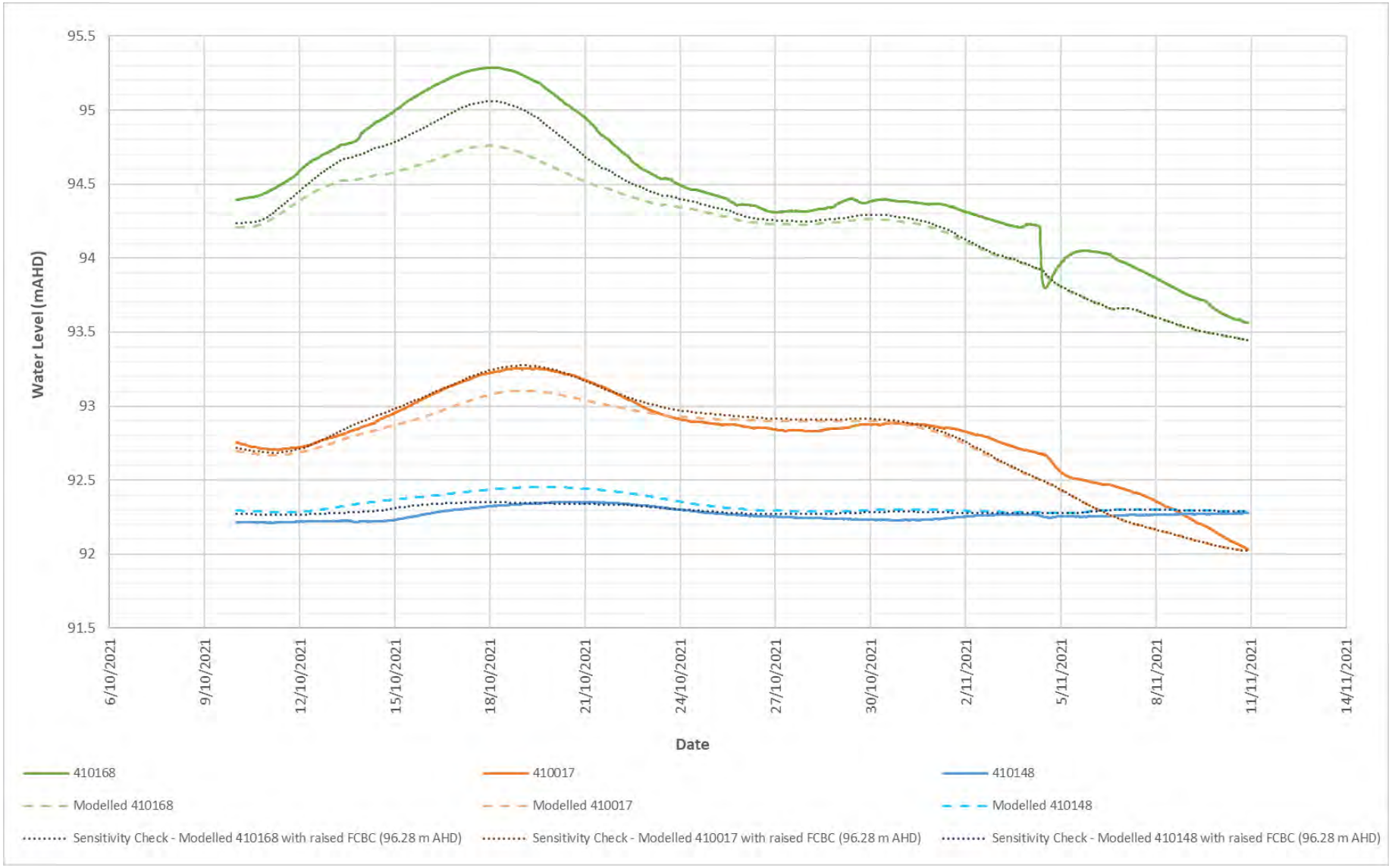


Figure 5-37: Gauge data water level comparison for October 2021 validation event

5.3.7 August 2022 Event

The full August 2022 flow event was remodelled as an additional validation event as part of the current Study to confirm models performance against a large flood event where the flow split between Billabong Creek and Forest Creek from the Hartwood Weir pool was well understood. The final modelling for this event had the following characteristics:

- A flow period from 2 June 2022 to 31 December 2022, which incorporates the full rise and fall of the event on both Yanco Creek and Billabong Creek (previously this event was ongoing and hadn't completely peaked).
- An inflow hydrograph extracted from the Yanco Creek at Yanco Bridge (410169) gauge (which was based on a reviewed rating following the completion of the August 2022 event) and a second generated inflow on Billabong Creek based on combining recorded flows at 'Billabong Creek @ DS Hartwood (410168)' and 'Forest creek at Offtake (41010309)' gauge data with a simulated flow over Forest Creek Block Bank based on previous hydraulic model results (rather than recorded flows at 'Billabong Creek @ Jerilderie (410016)' gauge). This revised approach to the Billabong Creek inflows was needed due to an underestimate of inflows found with the initial calibration/validation results discussed above due to bypassing of flow at Jerilderie. This was especially important with this recent event as shown in Figure 5-38, which shows that the combined Hartwood and FCO flow is sometimes higher than Jerilderie if this was shifted 48 hours forward (approximate travel time between Jerilderie and the inflow on Billabong Creek, which is around halfway to the 'Billabong Creek @ DS Hartwood' gauge) and this excludes flows overtopping Forest Creek Block Bank that we know currently commence around DD. The adopted inflow hydrographs are presented in Figure 5-39.
- The adopted flow relationship for flows overtopping Forest Creek Block Bank (FCBB) relative to flows on Billabong Creek downstream of Hartwood weir is presented in Figure 5-40.
- Hartwood Weir set to sill level based on advice from WaterNSW that they removed all boards prior to this event and confirmation that Forest Creek Block Bank has a minimum elevation of 95.64 m AHD based on anecdotal evidence of overtopping from the early stages of this event.
- Infiltration losses based on proposed RRC Flow Scenario soil classifications, which have losses applied as follows:
    - Jerilderie to Hartwood (and Forest Creek) = 0.25 mm/hr
    - Yanco Bridge to Conargo = 0.75 mm/h
    - Conargo to Wanganella = 1 mm/hr
- Modelling of extended warm up period based on gauge data to establish more realistic antecedent conditions – which included 500 hours of ramp up from median flow rates on both Yanco Creek and Billabong Creek, 500 hours at a constant gauge rate and around 2 months (or 1440 hours) of additional gauge data prior to the modelled event.

Figure 5-39 presents the modelled hydrographs for the event, which had a few peaks and troughs before a main peak in mid-November. The inflow on Yanco Creek peaked at around 11,050 ML/day on 17/11/2022, which was a few days earlier than the inflow on Billabong Creek that peaked on 22/11/2022 at around 9,267 ML/day.

Figure 5-41 and Figure 5-42 below show a comparison of gauged and model results for flow and water level respectively. The results presented in Figure 5-41 show that modelled peak flows match the timing and magnitude of the gauged peak flows reasonably well on Billabong Creek, with The modelled water level results, presented in Figure 5-42, provide a reasonable fit to the observed data during the peaks of the flow event with **Table** 5-21 showing a difference **of** around up to -310 mm at the peak. The shape of the water level on Billabong Creek downstream of Hartwood (410168) from the model matches that of the gauge very well, but the magnitude is generally underestimated by around 150 mm. The magnitude of the modelled water level at Billabong Creek at Conargo (410017) and Forest Creek at Warriston Weir (410148) match the gauge better, but as with the flow these occur a bit earlier than recorded at the gauge.

Table 5-21 showing peaks to be within ±212 ML/day (or around 3%) of the gauge flows. The shape of the hydrograph is also reasonably represented on Forest Creek, but flows are generally slightly underestimated. The model appears to match results on Billabong Creek downstream of Hartwood Weir (410168) the best, followed by Billabong Creek at Conargo (410017) and then Forest Creek at Warriston Weir (410148). The fit at the latter two gauges is likely due to modelled results being a bit earlier than recorded at the gauge and/or the fact that the flow rates for this event are well past any gaugings at the site.

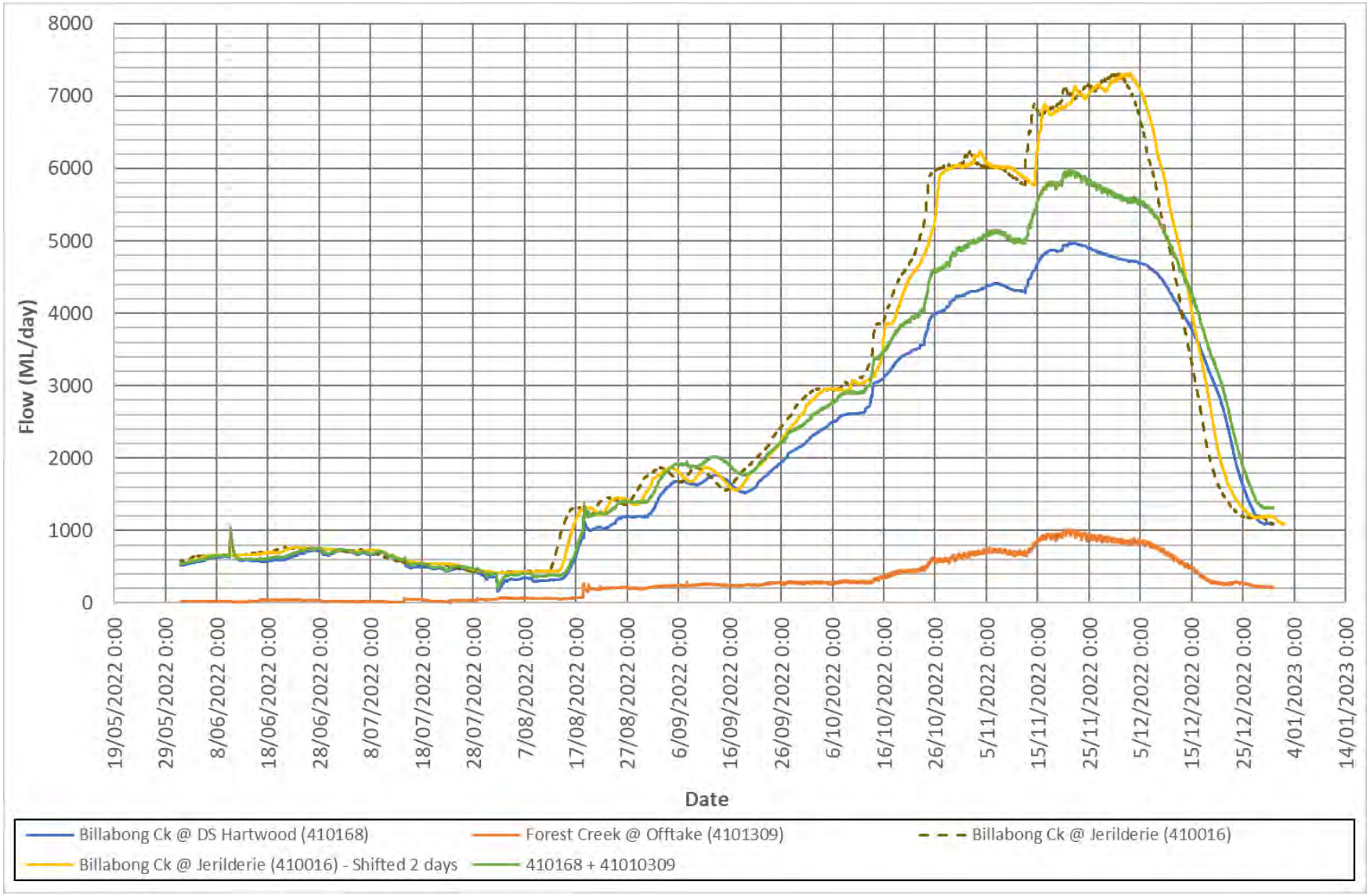


Figure 5-38: Comparison of gauge data around Billabong Creek Inflow (Jul 2022 – Dec 2022)

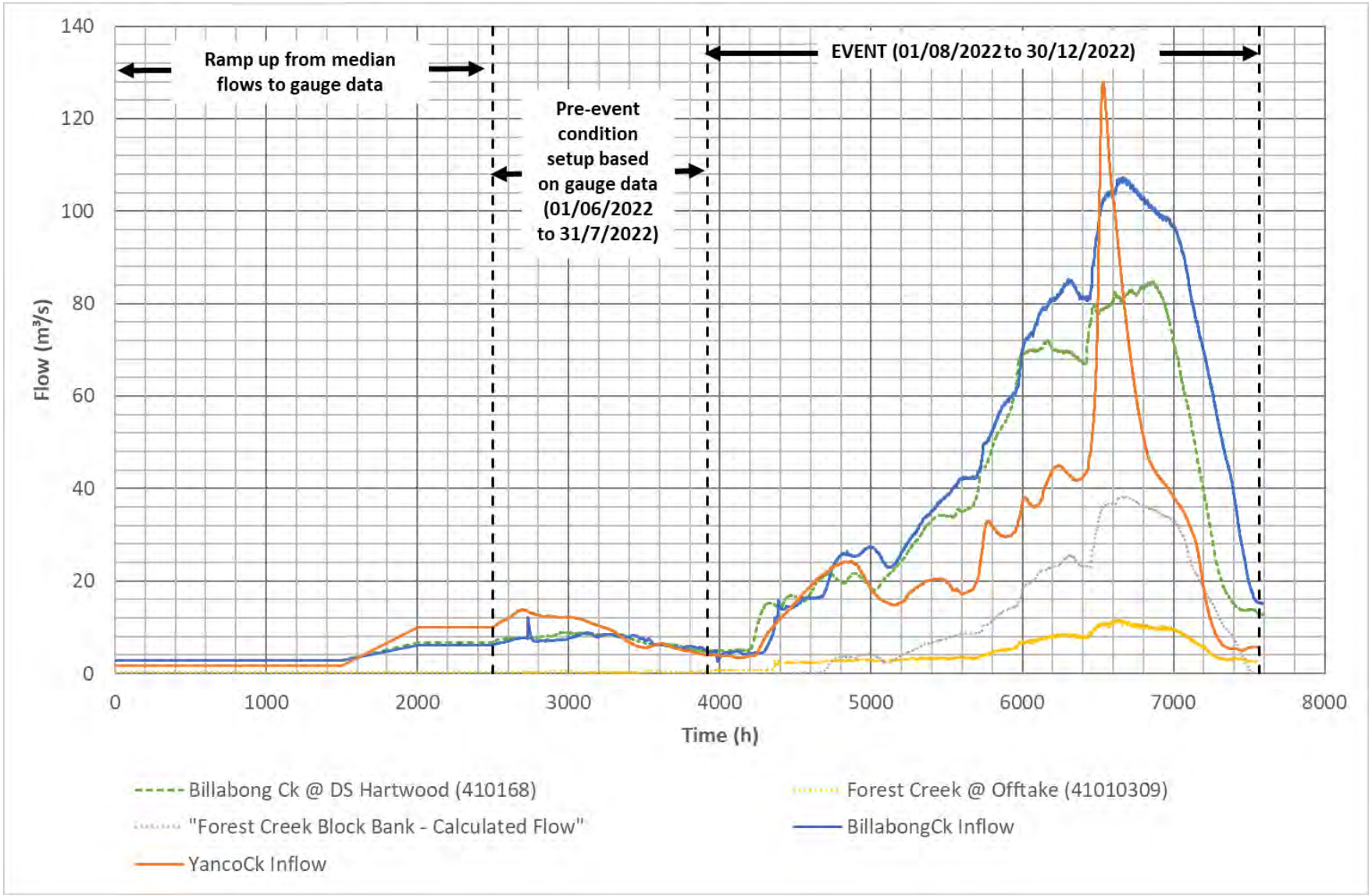


Figure 5-39: Inflow hydrographs for August 2022 Event (01/08/2022 to 01/10/2022) & warmup period

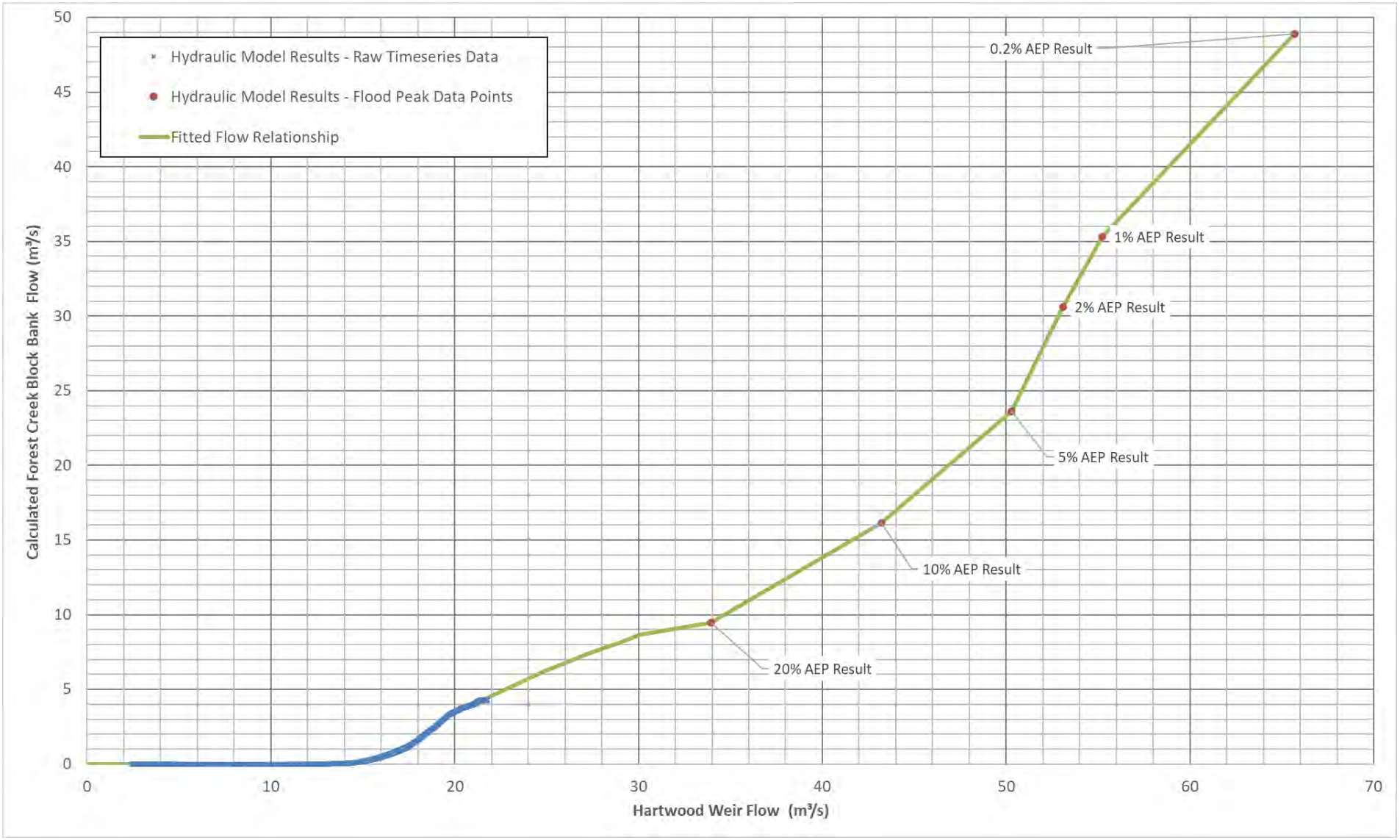


Figure 5-40: Adopted flow relationship between Forest Creek Block Bank and Hartwood Weir

The modelled water level results, presented in Figure 5-42, provide a reasonable fit to the observed data during the peaks of the flow event with Table 5-21 showing a difference of around up to -310 mm at the peak. The shape of the water level on Billabong Creek downstream of Hartwood (410168) from the model matches that of the gauge very well, but the magnitude is generally underestimated by around 150 mm. The magnitude of the modelled water level at Billabong Creek at Conargo (410017) and Forest Creek at Warriston Weir (410148) match the gauge better, but as with the flow these occur a bit earlier than recorded at the gauge.

Table 5-21: August 2022 Difference between peak TUFLOW calibration results and gauge data

Event	410168 Billabong Ck DS Hartwood Weir		410017 Billabong Ck @ Conargo (Puckawidgee)		410148 Forest Creek @ Warriston Weir	
	Difference in Peak Flow (ML/d)	Difference in Peak Stage (mm)	Difference in Peak Flow (ML/d)	Difference in Peak Stage (mm)	Difference in Peak Flow (ML/d)	Difference in Peak Stage (mm)
Aug 2022	76.3	-310	-211.7	-170	-837.5	-300

Table 5-22 and Table 5-23 below provides statistical information about the modelled flow and water level results, respectively, in relation to the observed gauge data. Performance ratings of results have been defined by the criteria outlined in (Moriasi, 2007). From this analysis it can be concluded that:

- Flow results at the Conargo gauge (410017), provide a very good fit to the observed data.
- Flow results at the Gauge DS of Hartwood Weir, provide a very good fit to the observed data.
- Modelled flow at Warriston Weir is a very good fit for NSE and satisfactory fit for PBIAS.
- The statistics generated for water level show that the results at:
    - The Conargo gauge (410017) provided a very good fit.
    - Gauge DS of Hartwood Weir (410168) provided a very good fit.
    - Warriston Weir (410148) provided a satisfactory fit.

The performance of the model was also assessed spatially by comparing the flood extent generated by the model to the Sentinel satellite imagery captured on the 01/12/2022, which was the clearest day closest to the peak inflows in the model. The results of this comparison are presented in Figure 5-43 and Figure 5-44, which show that the model generally matches the areas captured as wet in the satellite imagery very well. This provides additional confidence that the model is performing well and is appropriate for modelling across a range of events.

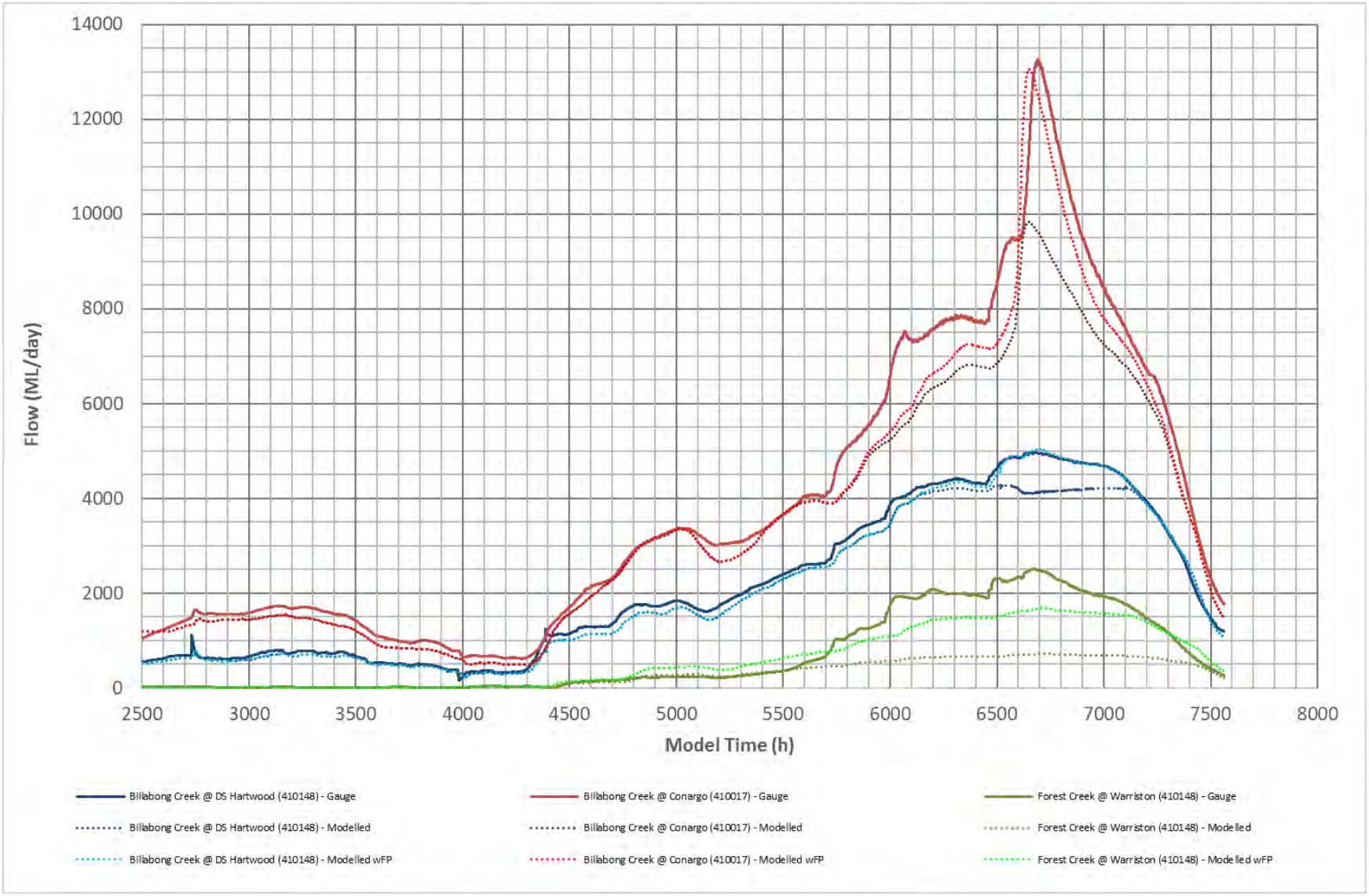


Figure 5-41: Gauge data flow comparison for August 2022 calibration/validation event



Figure 5-42: Gauge data water level comparison for August 2022 calibration/validation event

Table 5-22: August 2022 Flow Statistics

Statistic	410168 Billabong Ck DS Hartwood Weir	410017 Billabong Ck @ Conargo (Puckawidgee)	410148 Forest Creek @ Warriston Weir
PBIAS %	-3.8	-8.3	-14.8
NSE	0.99	0.97	0.87
r	1	0.99	0.97
R2	0.99	0.97	0.87
KGE	0.96	0.9	0.68
VE	0.96	0.91	0.72

Table 5-23: August 2022 Water Level Statistics

Statistic	410168 Billabong Ck DS Hartwood Weir	410017 Billabong Ck @ Conargo (Puckawidgee)	410148 Forest Creek @ Warriston Weir
PBIAS %	-0.2	-0.1	0
NSE	0.97	0.99	0.86
r	1	1	0.95
R2	0.97	0.99	0.86
KGE	0.95	0.93	0.76
VE	1	1	1

Note on Statistics

The statistics presented in calibration statistics tables are:

- PBIAS - Percent Bias is the percentage difference in the area under the curve or mass
- NSE - Nash-Sutcliffe Efficiency (-Inf <= NSE <= 1). One indicates a perfect fit and 0 the average of the observed series and less than 0 is worse than the average.
- r - Pearson Correlation coefficient (-1 <= r <= 1)
- R2 - Coefficient of Determination (0 <= R2 <= 1) - Gives the proportion of the variance of one variable that is predictable from the other variable
- KGE Kling-Gupta efficiency between sim and obs (0 <= KGE <= 1)
- VE Volumetric efficiency between sim and obs (-Inf <= VE <= 1). One indicates a perfect fit and 0 the average of the observed series

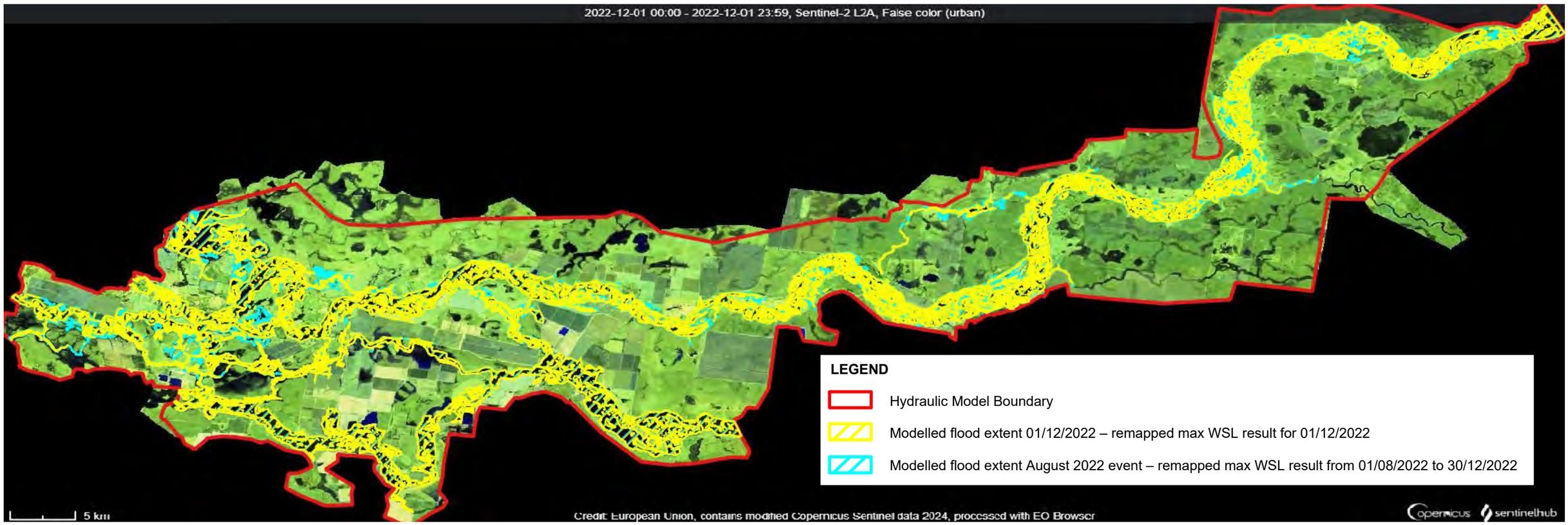


Figure 5-43: Comparison of model flood extent to Sentinel satellite imagery on 01/12/2022 with False Colour (urban) filter across entire Hartwood model area for RRC Study [https://apps.sentinel-hub.com/eo-browser/?zoom=11&lat=-35.27001&lng=145.40268&themeId=DEFAULT-THEME&visualizationUrl=https%3A%2F%2Fservices.sentinel-hub.com%2Fogc%2Fwms%2Fbd86bcc0-f318-402b-a145-015f85b9427e&datasetId=S2L2A&fromTime=2022-12-01T00%3A00%3A00.000Z&toTime=2022-12-01T23%3A59%3A59.999Z&layerId=4-FALSE-COLOR-URBAN&demSource3D=%22MAPZEN%22– accessed 22/02/2024].



Figure 5-44: Comparison of model flood extent to Sentinel satellite imagery on 01/12/2022 with False Colour (urban) filter around the Hartwood weir pool area [https://apps.sentinel-hub.com/eo-browser/?zoom=14&lat=-35.34037&lng=145.29805&themeId=DEFAULT-THEME&visualizationUrl=https%3A%2F%2Fservices.sentinel-hub.com%2Fogc%2Fwms%2Fbd86bcc0-f318-402b-a145-015f85b9427e&datasetId=S2L2A&fromTime=2022-12-01T00%3A00%3A00.000Z&toTime=2022-12-01T23%3A59%3A59.999Z&layerId=4-FALSE-COLOR-URBAN&demSource3D=%22MAPZEN%22– accessed 22/02/2024].

.

5.3.8 Conclusion

The results presented in this section have shown that the model performs reasonably well under a range of flow scenarios and is therefore considered appropriate for use in the current Study to assess the impact of the proposed Hartwood Regulator independently, as well as cumulatively with other SDLAM works within the Study Area.

6. Proposed Model Setup

6.1 Overview of changes

The proposed model has had the following new proposed structures added or updated for the design case:

- Hartwood Regulator.
- Forest Creek Return Regulator.
- Wilsons Anabranch Offtake.

Details of how these structures have been added to the model are summarised in the proceeding sections and are based on the design as of mid-October 2023 and the following design drawings relevant at that time:

- Hartwood Regulator – marked up version of the "DE19-823-YCM2-DE-CV-DRG" drawing set from 9/10/2023.
- Forest Creek Return Regulator – a copy of the "DE19-823-YCM4-DE-CV-DRG" drawing set from 20/01/2023.
- Wilsons Anabranch Offtake – a copy of the "DE19-823-YCM3D-DE-CV-DRG-SET" drawing set from 20/01/2023.

Key assumptions for all the structures that were agreed with DCCEEW (pers comm D. Clarke email dated 15/06/2023) for use in the impact assessment are also summarised in Appendix D.

6.2 Hartwood Regulator Design

The proceeding sections outline the model changes that have been included in one or more of the proposed scenario model simulations associated with the works at Hartwood Weir, the location of which is presented in Figure 6-1.

6.2.1 Proposed regulator structure

As per the Concept Design the proposed Hartwood Weir has been shifted approximately 70 m downstream of the existing structure and has now been designed to include the following elements to control the passing flow and level of the weir pool:

- A fishway section to allow fish passage on the western bank– which is being modelled in detail in CFD but has been included in the hydraulic model as an arbitrary link (an operational pump or "PO" element in TUFLOW) that will pass a constant flow of 20 ML/day.
- A gated section of weir that can be controlled to pass operational and/or environmental flows, whilst maintaining a weir pool level – this section consists of five (5) by 2.02 m wide lay flat gates with a sill level of 92.7 m AHD (modelled as a sharp crested weir or "WR" channel in TUFLOW with a 5 x multiplier to represent the multiple gates).
- A fixed crest section of weir that will block off the remainder of the channel to maintain the weir pool – this section consists of a rectangular shape broad crested weir with a crest level of 95.84 m AHD and a width of 20.5 m (modelled as a broad crested weir or "WW" channel with a user-defined cross-section in TUFLOW).

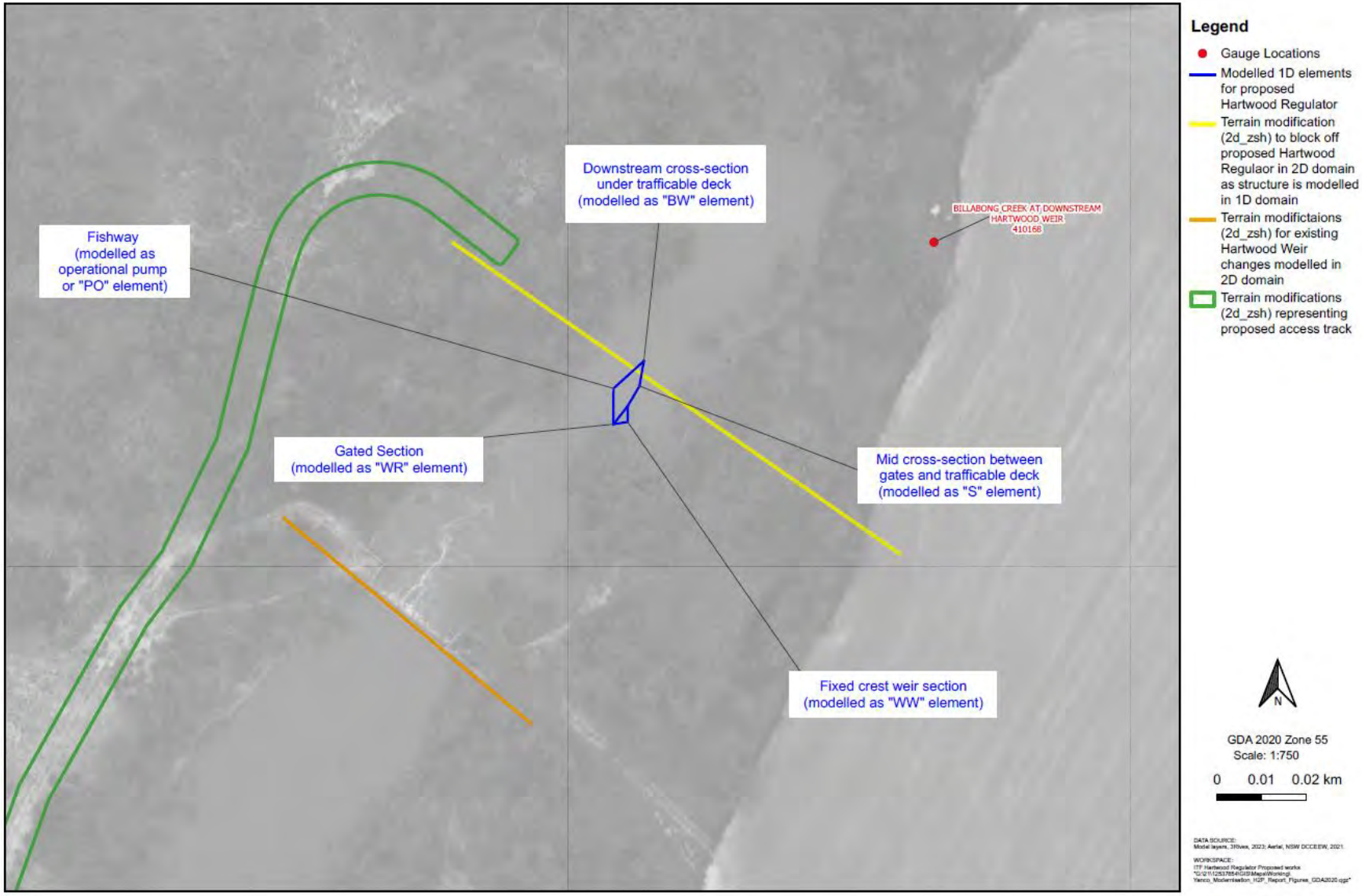


Figure 6-1 Location of works associated with proposed new Hartwood Weir Regulator

- The proposed structure will also include the following works around Hartwood Weir will also include the following:
    - A maintenance gantry over the fishway and gated/fixed crest portions of the proposed weir – this has not currently been modelled to allow gates and fixed crest weir to be represented as weirs within TUFLOW and was considered acceptable as it is unlikely to substantially affect results due to its nominated soffit level of 97.1 m AHD (the impact will particularly be minor for the operational flows and more frequent events up to and including the 1% AEP).
    - A stilling basin downstream of the gates and weir (modelled as a 1D channel or "S" type channel in TUFLOW with a user-defined cross-section).
    - A transition back to natural channel to facilitate fish passage, which also has a trafficable deck over it to allow for maintenance of the structure (this was modelled as a bridge-weir combination or "BW" element in TUFLOW). This trafficable deck was modelled with an upstream soffit of 96.1 m AHD, a deck thickness of 800 mm and a 3% crossfall – meaning that the overall obstruction to flow is 944 mm.
    - An access track from trafficable deck connecting back up to Conargo Road – the alignment has been adopted from the Concept Design and the level has been set to be a nominal 300 mm above the ground surface.

The general cross-section of the obstruction of the proposed weir is presented in Figure 6-2, which shows the sill level of the structure at three locations through the proposed structure – upstream cross-section (representing fishway, gates and fixed crest weir), mid cross-section (representing the stilling basin downstream of gates and weir) and downstream cross-section (representing the transition back to existing terrain under the trafficable deck).

The gated section of the upstream cross-section has been modelled as follows under the various flow scenarios:

- Minimum Operational Flow or "MinOF" (25 ML/day) – target flow is passed through fishway (20 ML/day) and one of the five gates (5 ML/day), which were set to be open as follows (the remaining four gates were fully closed and set to a level of 95.84 m AHD to match the fixed crest weir height) -
    - Minimum Operating Level or "MinOL" (a weir pool level of 95.28 m AHD) – the open gate has been set to have a crest level of 95.22 m AHD based on a weir calculation for opening, target flow rate and target upstream level.
    - Maximum Operating Level or "MaxOL" (a weir pool level of 95.44 m AHD) – the open gate has been set to have a crest level of 95.38 m AHD based on a weir calculation for opening, target flow rate and target upstream level.
    - Full Supply Level or "FSL" (a weir pool level of 95.74 m AHD) – the open gate has been set to have a crest level of 95.68 m AHD based on a weir calculation for opening, target flow rate and target upstream level.

- Maximum Operational Flow or "MaxOF" (500 ML/day) – target flows is passed through fishway (20 ML/day) and three of the five gates (480 ML/day), which were set to be open as follows (the remaining two gates were fully closed and set to a level of 95.84 m AHD to match the fixed crest weir height) -
    - Minimum Operating Level or "MinOL" (a weir pool level of 95.28 m AHD) – the open gates have been set to have a crest level of 95.11 m AHD based on a weir calculation for opening, target flow rate and target upstream level.
    - Maximum Operating Level or "MaxOL" (a weir pool level of 95.44 m AHD) – the open gates have been set to have a crest level of 94.81 m AHD based on a weir calculation for opening, target flow rate and target upstream level.
    - Full Supply Level or "FSL" (a weir pool level of 95.74 m AHD) – the open gates have been set to have a crest level of 94.65 m AHD based on a weir calculation for opening, target flow rate and target upstream level.
- Flood flows (50% AEP to PMF) – all five gates are fully opened in advance of event based on proposed operating rules and understanding of likely flows based upstream gauges. As per the design, the fully open state of the gates has been assumed to match the sill of 92.7 m AHD for modelling purposes.

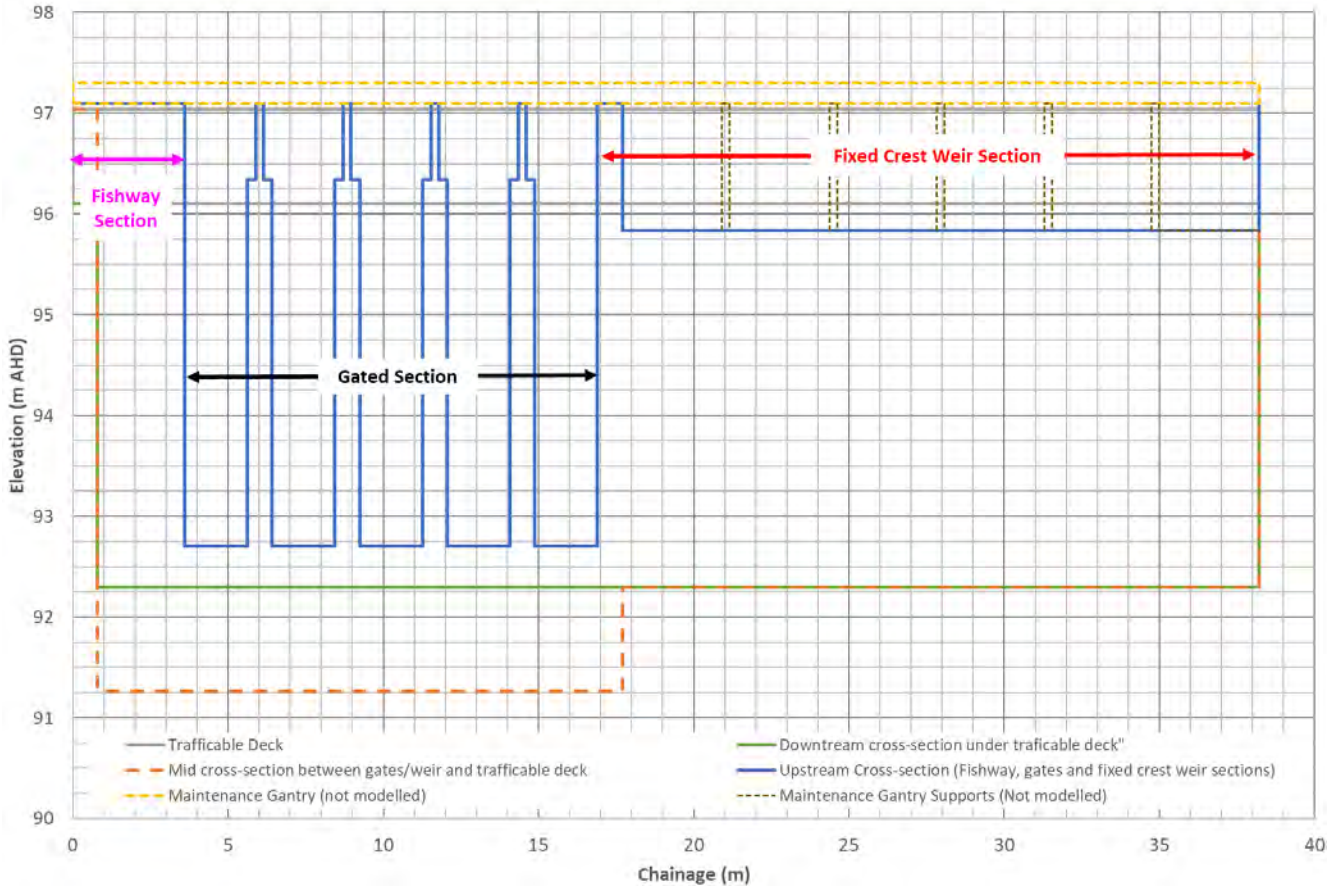


Figure 6-2 Proposed Hartwood Weir Cross-section

This structure was predominately modelled as 1D elements as shown on Figure 6-1 ,but an additional terrain model was read in locally to represent the transition from existing terrain to the structure as shown in Figure 6-3.

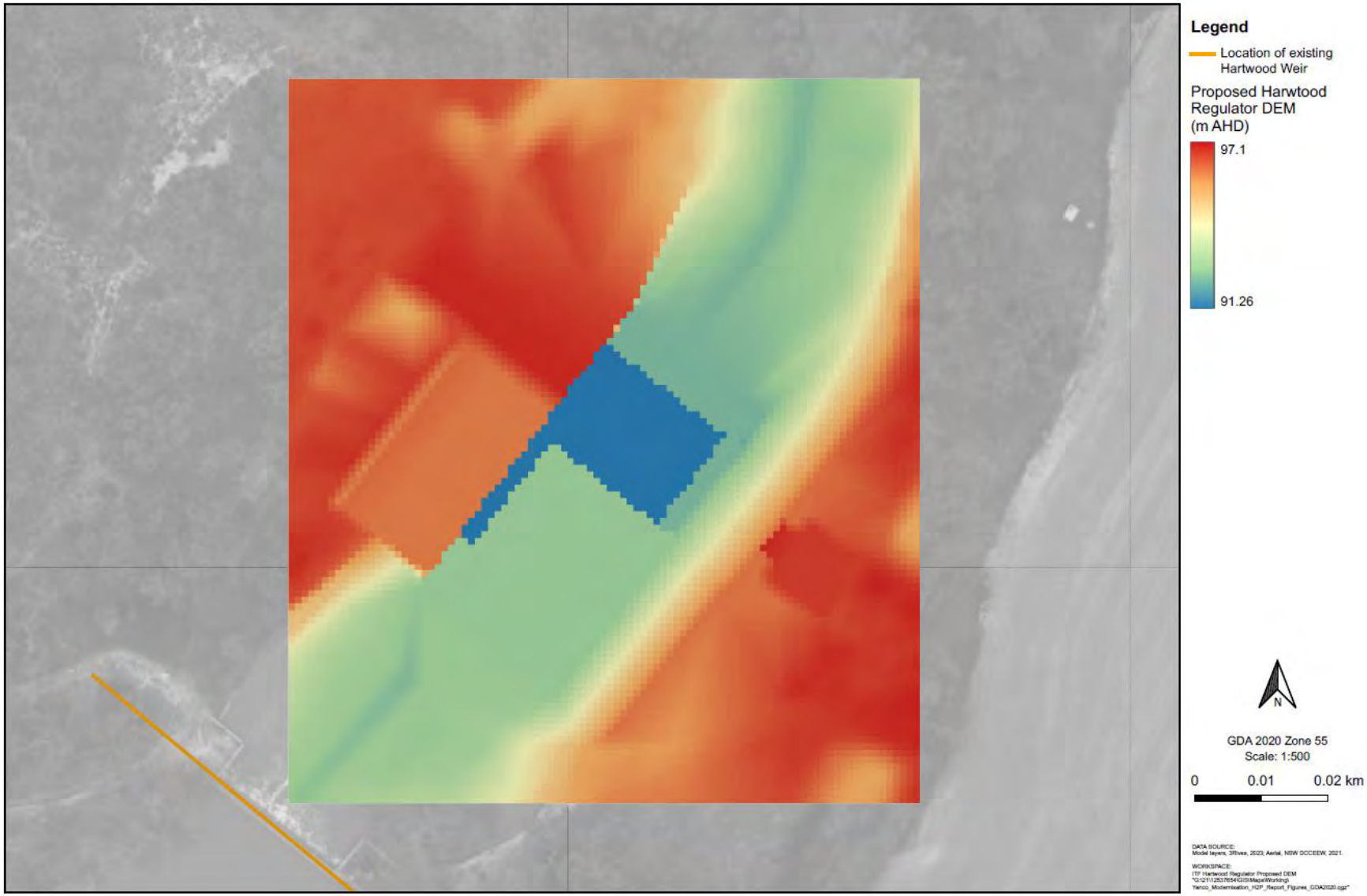


Figure 6-3 Modelled proposed local DEM – transition from exiting to proposed terrain

6.2.2 Existing regulator structure

To allow the proposed structure to control the weir pool most effectively, in consultation with the design team it was agreed that the existing Hartwood Weir structure will be partially removed. Given that the extent of this removal was not fully known, it was conservatively assumed that the weir would be removed between the abutments within the channel – the adopted cross-section for proposed conditions is presented in Figure 6-4.

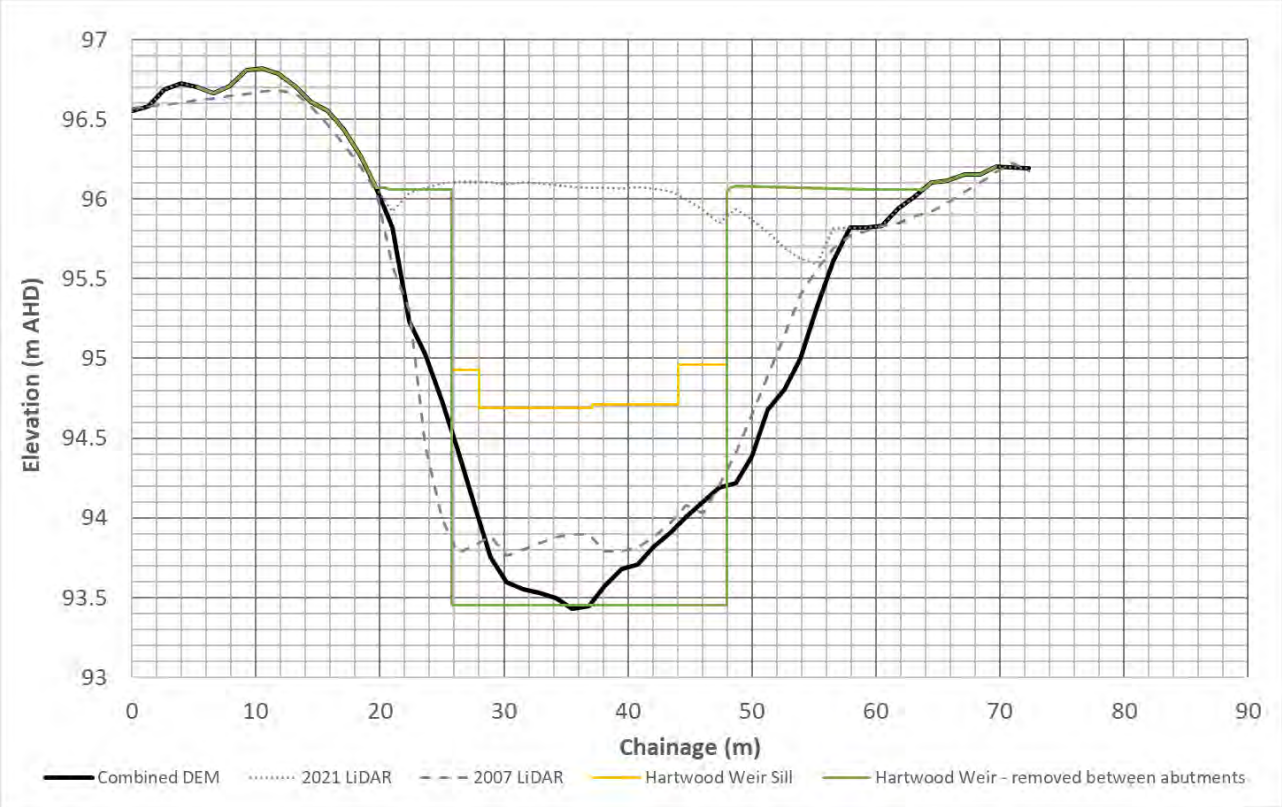


Figure 6-4 Modelled changes to existing Hartwood Weir in "proposed" modelling conditions

6.2.3 Access Track

The modelling has also included a nominal access track along the alignment shown in Figure 6-5, with the following characteristics based on the design teams understanding of the purpose and use of this access track at the time of modelling:

- Embankment height of 300 mm above natural surface, with minor adjustments to this to tie in with trafficable deck design at Hartwood Weir and the existing road formation at Conargo Road.
- A top width of around 5.9 m before grading back down to natural surface.

6.2.4 Forest Creek Offtake (FCO) Operations

Based on the proposed operating rules, the FCO structure was operated as follows under the various flow scenarios:

- Minimum Operational Flow or "MinOF" (25 ML/day) – modelled as an extraction from Billabong Creek and inflow to channel downstream of FCO with a constant flow rate equal to the minimum baseflow requirements for "Forest Creek @ Offtake (41010309)" (see discussion in Section 4.7)
- Maximum Operational Flow or "MaxOF" (500 ML/day) – modelled as an extraction from Billabong Creek and inflow to channel downstream of FCO with a constant flow rate equal to the minimum baseflow requirements for "Forest Creek @ Offtake (41010309)" (see discussion in Section 4.7).
- Flood flows (50% AEP to PMF) – modelled as a 1d_nwk element with both sluice gates fully raised in advance of event based on understanding of likely flows based upstream gauges.



Figure 6-5 Modelled access track alignment at Hartwood Weir

6.3 Forest Creek Return Regulator Design

As per the concept design and minor amendments, the proposed Forest Creek Return Regulator has been modelled with the following components:

- Replacement of existing drainage through block bank with a lay-flat gate structure upstream of a 1.2 m x 1.2 m box culvert (RCBC) with an invert level of 91.00 m AHD.
- Adjustment of block bank to have a fixed crest of 93.00 m AHD and a trapezoidal spillway with a lower crest of 92.80 m AHD and a width of 10.30 m.
- Gate operated in accordance with following operating principles -
    - Operational flows – Minimise spills over Warriston Weir (i.e. target 0 ML/day)
    - Flood flows – variable operation based on following staged rules related to flows passing Warriston Weir
        1. Warriston Weir flow ⩽ 500 ML/day = Minimum flow requirements on Piccaninny Creek (1 ML/day) - assumes unregulated flow scenario so want to maximise environmental water downstream of Warriston Weir (using environmental water).
        2. Warriston Weir flow ⩽ 1,000 ML/day = operate in downstream control at 50 ML/day (the design flow rate of the structure).
        3. Warriston Weir flow > 1,000 ML/day = regulator gate to be fully opened (assumed to match sill level of 91.00 m AHD for modelling purposes).

An extract from the design drawings showing the change to the block bank is presented in Figure 6-6, which shows some minor increases and decreased across the entire length and the addition of a spillway (or preferential overtopping path).



Figure 6-6 Forest Creek Return Regulator Cross-section (dotted line represents the existing surface) [extracted from "DE19-823-YCM4-DE-CV-DRG-0012" drawing dated 26/08/2022]

6.4 Wilsons Anabranch Offtake Design

As per the concept design and minor amendments, the proposed Wilsons Anabranch Offtake has been modelled with the following components:

- Replacement of existing drainage through block bank with a lay-flat gate structure upstream of a 1.2 m x 1.2 m box culvert (RCBC) with an invert level of 98.20 m AHD.
- Adjustment of the block bank to have a fixed crest level of 100.00 m AHD for a width of around 25.4 m before transition back to existing terrain with a 1 in 10 slope (overall width of works is around 30 m).
- Gate operated in accordance with following operating principles -
    - Operational flows – gate assumed closed (will only be open if delivering environmental water to Wilsons Anabranch)
    - Flood flows - gate fully lowered (assumed to match sill level of 98.20 m AHD for modelling purposes) in advance of event based on understanding of likely flows based upstream gauges.

An extract from the design drawings showing the change to the block bank is presented in Figure 6-7, which shows a general decrease and hence formalisation of an overtopping section of the block bank.

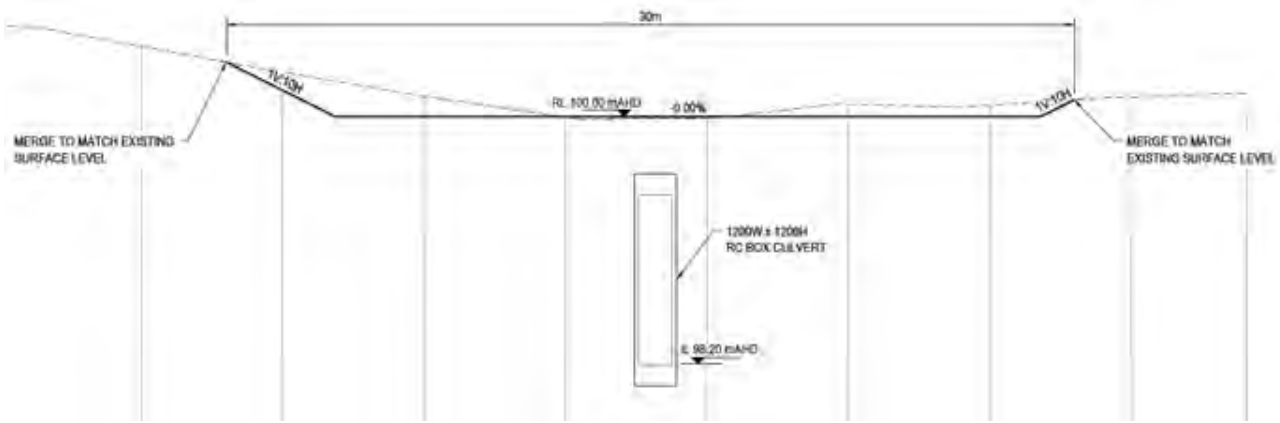


Figure 6-7 Wilsons Anabranch Offtake Cross-section (dotted line represents the existing surface) [extracted from "DE19-823-YCM3D-DE-CV-DRG-0012" drawing dated 10/11/2022]

6.5 Design changes not included in modelling

Since the modelling setup above was established, the design has progressed and has had the following changes around the proposed Hartwood Regulator:

- Trafficable deck soffit raised to be 200 mm above 5% AEP flood level.
- Bridge deck thickness and bridge piers altered based on a progressed structural design.
- Access track altered to have a floodway at existing terrain level where it crosses existing high flow overland bypass of Hartwood Weir.
- Existing weir is to be fully removed down to sill of structure, including abutments, and the banks will be graded to tie in with the current terrain in area.

It is envisaged that these changes will only have local effects on the magnitude of the flood impact and are unlikely to materially affect the general impact assessment outcome. This has been supported by initial testing of trafficable deck and bridge changes showing minimal change in outcomes to those presented in this report. In addition, some of these changes, particularly modifications to the access track, may actually reduce the nominated impact.

7. Results

The assessment of impacts have been separated into the “Operational Flow” and “Flood Flow” scenarios, with results compared in terms of the following to address the Secretary’s Environmental Assessment Requirements (SEARS):

- Flow.
- Afflux (or change in Water Surface Level, WSL).
- Hydraulic categorisation.
- Flood hazard.
- Velocity.

The above variables have been compared at the locations presented in Figure 7-1, which labels the modelled Print Out (PO) lines and points used to assess the impact of the proposed works across the Study Area. The impact of Hartwood Regulator has also been compared with and without the other works (Forest Creek Return Regulator and Wilsons Anabranch Offtake) for select scenarios to understand if there are any cumulative impacts. Given the focus on Hartwood Regulator, the results focus on the "Billabong Dominant” flood flow scenarios, although the general trend in impacts are consistent to those for the “Yanco Dominant” ones.

7.1 Cumulative versus Hartwood Weir Works Only

The results for models run with all the proposed works and Hartwood Weir works only were compared and it was found that the works are effectively independent, with only insignificant changes in the following locations based on the results in Appendix E:

- On Forest Creek and Piccaninny Creek around proposed works on Forest Creek Return Regulator, which are quite localised for the operational flow scenarios and larger AEP events where operations of the proposed structure do not affect flows being diverted into Piccaninny Creek.

- On Yanco Creek and through Wilsons Anabranch around proposed upgrades to Wilsons Anabranch Offtake in the flood flow scenarios when the offtake is opened. The extent of change is most in 5% AEP when increased size of culvert alters distribution of flow the most, with less changes in both 20% AEP and 1% AEP.

- A few very localised changes in flood scenarios where redistributed flows have just inundated some areas slightly more due to back flooding.

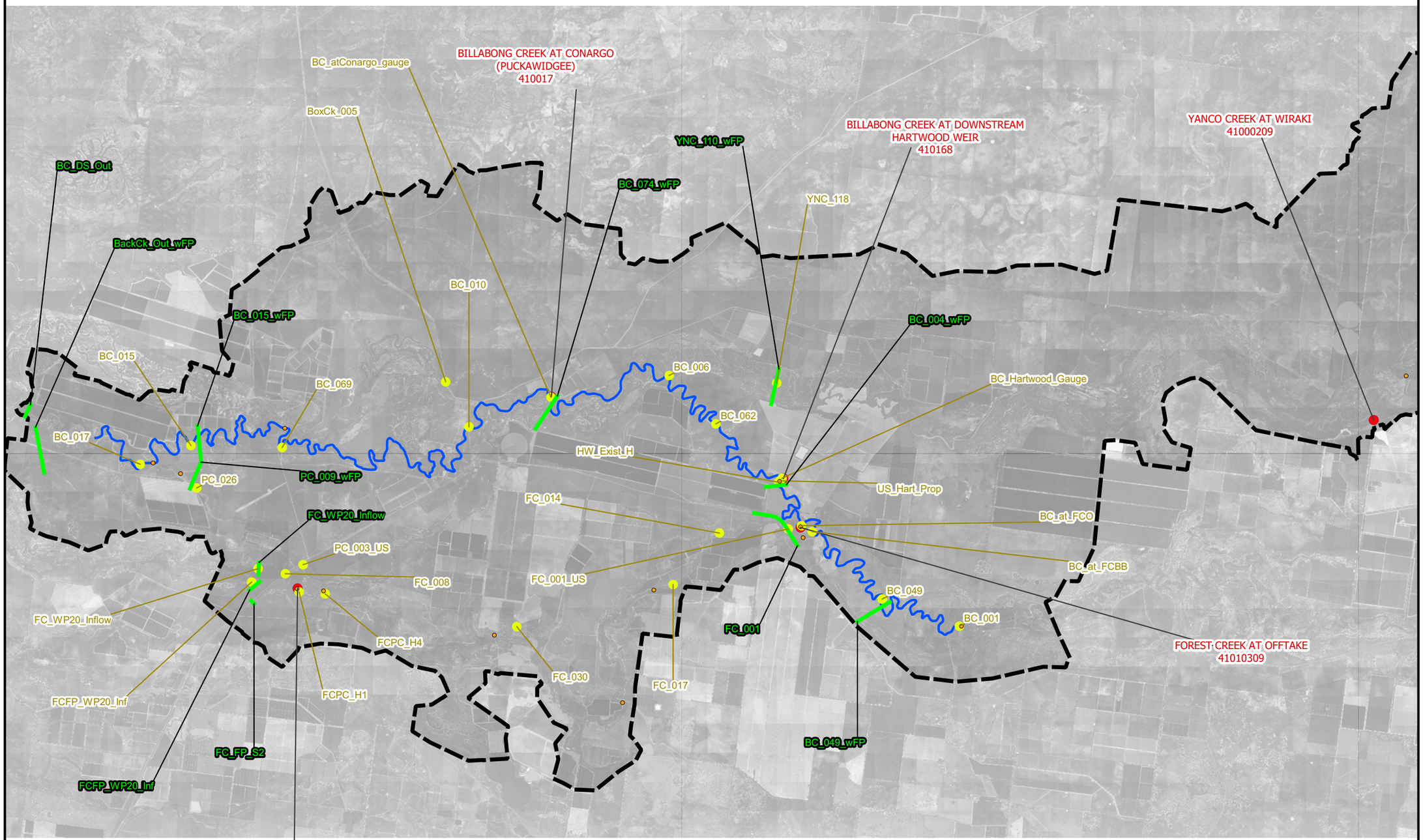
- A minor area within the Hartwood weir pool in 1% AEP flood event, but this change was a reduction of less than 13 mm.

As a result of these findings, the remaining results are based on a proposed scenarios that incorporated all the proposed SDLAM works within the Study Area (i.e. Hartwood Regulator that include modifications to the existing Hartwood Weir, upgrades to the Forest Creek Return Regulator and upgrades to Wilsons Anabranch Offtake).

7.2 Operational Flow Scenarios

7.2.1 Flow

A summary of flows for “Existing” and “Proposed” under the modelled operational flow regimes are presented in Table 7-1, which shows that in general there is no change to the operational flows within the Study Area with flows throughout remaining unaffected by the proposed works.



Legend

- Hydraulic Model Boundary
- Modelled significant structures
- Gauge Locations
- Print out locations (2d_po) for flow comparison
- Print out locations (2d_po) for WSL comparison
- Billabong Creek thalweg for compariosn

N

GDA 2020 Zone 55
Scale: 1:125,000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023;
Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Impact Assessment Comparison Locations
"G:\21\125376541GIS\Maps\Working\
Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure 7-1: Impact Assessment Comparison Locations

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Table 7-1 Flow Comparison for Operational Flow Scenarios

Location	PO ID	Flow (ML/day) at comparison locations [Flow difference relative to "Existing" conditions]							
		Maximum Operating Flow (MaxOF) – 500 ML/day passing Hartwood Weir or Hartwood Regulator				**Minimum Operating Flow (MinOF) –** 25 ML/day passing Hartwood Weir or Hartwood Regulator			
		Existing	Proposed with Hartwood Pool at Full Supply Level (FSL)	Proposed with Hartwood Pool at Maximum Operating Level (MaxOL)	Proposed with Hartwood Pool at Minimum Operating Level (MinOL)	Existing	Proposed with Hartwood Pool at Full Supply Level (FSL)	Proposed with Hartwood Pool at Maximum Operating Level (MaxOL)	Proposed with Hartwood Pool at Minimum Operating Level (MinOL)
Yanco Creek approx. 8.3 km upstream of confluence with Billabong Creek	YNC_110_wFP	99	99 [0]	99 [0]	99 [0]	25	25 [0]	25 [0]	25 [0]
Billabong Creek approx. 6.35 km upstream of where Forest Creek breaks away from Billabong Creek	BC_049_wFP	510	510 [0]	510 [0]	510 [0]	35	35 [0]	35 [0]	35 [0]
Billabong Creek at around Hartwood Weir (includes channel and full floodplain flow)	BC_004_wFP	500	500 [0]	500 [0]	500 [0]	25	25 [0]	25 [0]	25 [0]
Billabong Creek at around "Billabong Creek @ Conargo (410017)" gauge (includes channel and floodplain flow)	BC_074_wFP	599	599 [0]	599 [0]	599 [0]	50	50 [0]	50 [0]	50 [0]
Billabong Creek approx. 3.45 km upstream of confluence with Piccaninny Creek	BC_015_wFP	599	599 [0]	599 [0]	599 [0]	50	50 [0]	50 [0]	50 [0]
Billabong Creek approx. 7.65 km downstream of confluence with Piccaninny Creek (includes mostly channel flow only)	BC_DS_Out	608	608 [0]	608 [0]	608 [0]	60	60 [0]	60 [0]	60 [0]

Forest Creek at Conargo Road just downstream of where Forest Creek Offtake channel joins	FC_001	10	10 [0]	10 [0]	10 [0]	10	10 [0]	10 [0]	10 [0]
Forest Creek flow approx. 0.9 km downstream of Conargo Road crossing (includes mostly channel flow only)	FC_WP20_Inflow	0	0 [0]	0 [0]	0 [0]	0	0 [0]	0 [0]	0 [0]
Piccaninny Creek and floodplain flow approx. 0.55 km upstream of Wanganella-Conargo Road (includes channel and floodplain flow)	PC_009_wFP	10	10 [0]	10 [0]	10 [0]	10	10 [0]	10 [0]	10 [0]

7.2.2 Afflux

A summary of the WSL impacts between “Existing” and “Proposed” are presented spatially in Appendix F, which presents afflux maps across entire Study Area, and Figure 7-2 & Figure 7-3, which presents a long section plot along Billabong Creek from just upstream of Lower Woolshed Weir to just downstream of “Billabong Creek @ Conargo (410017)” gauge. The actual WSL in both scenarios, as well as the afflux or differences at some key locations are also presented numerically in Table 7-2. These results collectively show the following key outcomes:

- Upstream of existing Hartwood Weir for the MaxOF the weir pool shows –
    - A WSL increased by between around 70 - 200 mm when control is set to FSL.
    - A WSL decreased by between around 50 – 150 mm when control is set to MaxOL.
    - A WSL decreased by between around 100 – 300 mm when the control is set to MinOL.
    - These results are expected given the changes in target operational levels.
- Upstream of existing Hartwood Weir for the MinOF scenario the weir pool shows –
    - A general increase in WSL of just over 400 mm when control is set to FSL.
    - A general increase in WSL of just over 100 mm when control is set to MaxOL.
    - A general decrease in WSL of around 40 mm when the control is set to MinOL.
    - These results are expected given the changes in target operational levels.
- Significant increased WSL (around 1.3 – 3 m) between the existing and proposed structures due to moving the weir pool control downstream in proposed scenarios. This is a consequence of relocating the structure.
- An increase in WSL of up to just below 100 mm within weir pool upstream of Warriston Weir and in Piccanninny Creek upstream of Conargo Road in all scenarios.
- No real changes in WSL elsewhere within the Study Area. In particular, the township of Conargo does not experience any change outside of Billabong Creek and only changes of less than ±10 mm within the channel.

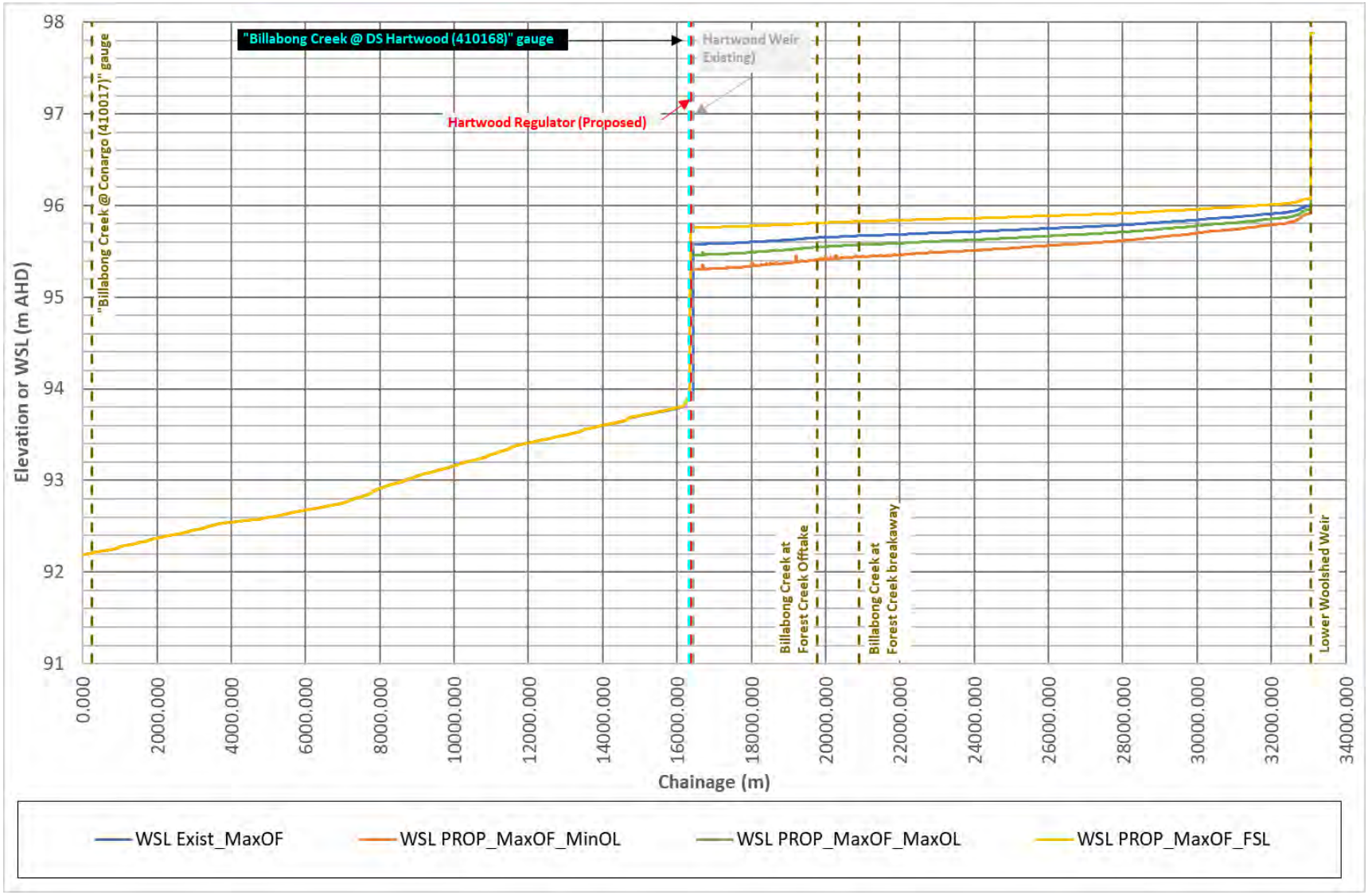


Figure 7-2 "Proposed" and "Existing" WSL comparison along Billabong Creek for Maximum Operating Flow (MaxOF) of 500 ML/day at Hartwood Regulator

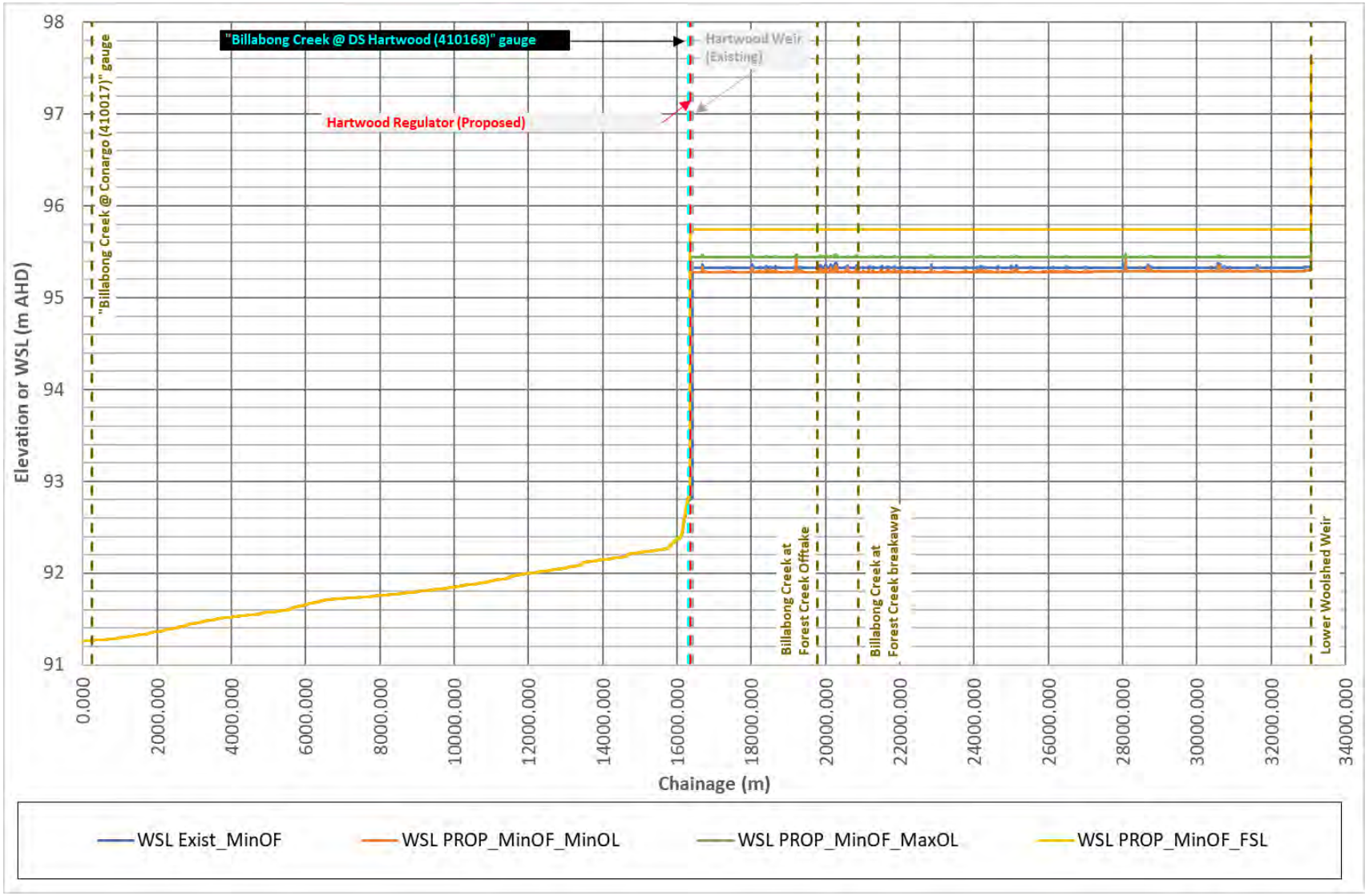


Figure 7-3 "Proposed" and "Existing" WSL comparison along Billabong Creek for Minimum Operating Flow (MinOF) of 25 ML/day at Hartwood Regulator

Table 7-2 WSL Comparison for Operational Flow Scenarios

Location Description	PO_ID	WSL (m AHD) at comparison location [Afflux or "Proposed" WSL minus "Existing" WSL]							
		Maximum Operating Flow (MaxOF) – 500 ML/day passing Hartwood Weir or Hartwood Environmental Water Regulator				**Minimum Operating Flow (MinOF) –** 25 ML/day passing Hartwood Weir or Hartwood Environmental Water Regulator			
		Existing	Proposed with Hartwood Pool at Full Supply Level (FSL)	Proposed with Hartwood Pool at Maximum Operating Level (MaxOL)	Proposed with Hartwood Pool at Minimum Operating Level (MinOL)	Existing	Proposed with Hartwood Pool at Full Supply Level (FSL)	Proposed with Hartwood Pool at Maximum Operating Level (MaxOL)	Proposed with Hartwood Pool at Minimum Operating Level (MinOL)
Yanco Creek approx. 8.3 km upstream of confluence with Billabong Creek	YNC_118	92.902	92.902 [0]	92.902 [0]	92.902 [0]	92.459	92.459 [0]	92.459 [0]	92.459 [0]
Billabong Creek just downstream of Lower Woolshed Weir	BC_001	95.998	96.07 [72]	95.951 [-47]	95.908 [-90]	95.333	95.742 [409]	95.446 [113]	95.294 [-39]
Billabong Creek approx. 6.1 km upstream of where Forest Creek breaks away from Billabong Creek	BC_049	95.77	95.89 [120]	95.68 [-90]	95.581 [-189]	95.322	95.74 [418]	95.441 [119]	95.281 [-41]
Billabong Creek at around where Forest Creek breaks away from Billabong Creek	BC_at_FCBB	95.67	95.812 [142]	95.557 [-113]	95.426 [-244]	95.321	95.74 [419]	**95.44** [119]	95.28 [-41]
Billabong Creek at Forest Creek Offtake	BC_at_FCO	95.65	95.796 [146]	95.533 [-117]	95.395 [-255]	95.321	95.74 [419]	95.44 [119]	95.28 [-41]
Billabong Creek just upstream of existing Hartwood Weir	HW_Exist_H	95.578	95.743 [165]	95.443 [-135]	95.284 [-294]	95.32	95.74 [420]	95.44 [120]	95.279 [-41]
Billabong Creek just upstream of proposed Hartwood Environmental Water Regulator	US_Hart_Prop	93.899	95.74 [1841]	95.44 [1541]	95.28 [1381]	92.818	95.739 [2921]	95.44 [2622]	95.28 [2462]
Billabong Creek at around "Billabong Creek @ DS Hartwood 410168" gauge	BC_Hartwood_Gauge	93.886	93.887 [1]	93.888 [2]	93.888 [2]	92.793	92.792 [-1]	92.791 [-2]	92.792 [-1]
Billabong Creek approx. 4.75 km upstream of confluence with Yanco Creek	BC_062	93.347	93.347 [0]	93.347 [0]	93.347 [0]	91.955	91.955 [0]	91.953 [-2]	91.954 [-1]
Billabong Creek at approx. confluence with Yanco Creek	BC_006	92.735	92.735 [0]	92.735 [0]	92.735 [0]	91.717	91.717 [0]	91.716 [-1]	91.716 [-1]
Billabong Creek at around "Billabong Creek @ Conargo 410017" gauge	BC_atConargo_gauge	92.206	92.206 [0]	92.206 [0]	92.206 [0]	91.266	91.266 [0]	91.265 [-1]	91.265 [-1]
Billabong Creek upstream of Carrathool Rd	BC_010	91.943	91.943 [0]	91.943 [0]	91.943 [0]	91.214	91.214 [0]	91.213 [-1]	91.214 [0]
Billabong Creek upstream of Boonoke Bridge (approx. 1 km upstream of Boonoke Weir)	BC_069	91.434	91.434 [0]	91.434 [0]	91.434 [0]	91.197	91.197 [0]	91.197 [0]	91.197 [0]
Billabong Creek approx. 3.1 km upstream of confluence with Piccaninny Creek	BC_015	89.938	89.938 [0]	89.938 [0]	89.938 [0]	89.646	89.646 [0]	89.646 [0]	89.646 [0]

Location Description	PO_ID	WSL (m AHD) at comparison location [Afflux or "Proposed" WSL minus "Existing" WSL]							
		Maximum Operating Flow (MaxOF) – 500 ML/day passing Hartwood Weir or Hartwood Environmental Water Regulator				**Minimum Operating Flow (MinOF) –** 25 ML/day passing Hartwood Weir or Hartwood Environmental Water Regulator			
		Existing	Proposed with Hartwood Pool at Full Supply Level (FSL)	Proposed with Hartwood Pool at Maximum Operating Level (MaxOL)	Proposed with Hartwood Pool at Minimum Operating Level (MinOL)	Existing	Proposed with Hartwood Pool at Full Supply Level (FSL)	Proposed with Hartwood Pool at Maximum Operating Level (MaxOL)	Proposed with Hartwood Pool at Minimum Operating Level (MinOL)
Billabong Creek approx. 0.5 km downstream of Piccaninny Weir	BC_017	88.004	88.004 [0]	88.004 [0]	88.004 [0]	86.811	86.811 [0]	86.81 [-1]	86.811 [0]
Forest Creek just upstream of Conargo Road (downstream of where Forest Creek Offtake channel joins)	FC_001_US	94.79	94.79 [0]	94.79 [0]	94.79 [0]	94.79	94.79 [0]	94.79 [0]	94.79 [0]
Forest Creek approx. 3.6 km upstream of Parrys Weir (adjacent to brekaway flow path to north-west)	FC_014	94.788	94.788 [0]	94.788 [0]	94.788 [0]	94.788	94.788 [0]	94.788 [0]	94.788 [0]
Forest Creek approx. 0.8 km upstream of Parrys Weir	FC_017	94.787	94.787 [0]	94.787 [0]	94.787 [0]	94.787	94.787 [0]	94.787 [0]	94.787 [0]
Forest Creek approx. 1.1 km upstream of Quiamong Weir	FC_030	93.458	93.458 [0]	93.458 [0]	93.458 [0]	93.458	93.458 [0]	93.458 [0]	93.458 [0]
Forest Creek at approx. location where Piccaniny Creek return flow channel breaks away from Forest Creek	FCPC_H4	92.086	91.955 [-131]	91.955 [-131]	91.955 [-131]	92.086	91.955 [-131]	91.955 [-131]	91.955 [-131]
Forest Creek approx. 0.1 km upstream of Warriston Weir	FCPC_H1	92.086	91.955 [-131]	91.955 [-131]	91.955 [-131]	92.086	91.955 [-131]	91.955 [-131]	91.955 [-131]
Piccaninny Creek upstream of Conargo Rd downstream of where Piccaniny Creek return flow channel joins Piccaninny Creek	PC_003_US	91.425	91.508 [83]	91.508 [83]	91.508 [83]	91.425	91.508 [83]	91.508 [83]	91.508 [83]
Piccaninny Creek approx. 0.8 km upstream of Wangenalla-Conargo Road	PC_026	90.738	90.738 [0]	90.738 [0]	90.738 [0]	90.738	90.738 [0]	90.738 [0]	90.738 [0]

7.2.3 Flood Hazard

A summary of the flood hazard characteristics in the "Existing" and "Proposed" scenarios are presented spatially in Appendix F, which presents maps of this across entire Study Area based on NSW's "Flood Hazard: Flood Risk Management Guideline FB03" document and Australian Rainfall and Runoff 2019 (ARR2019) – which are defined in Figure 7-4. A comparison of the distribution of the categories within the proposed Hartwood Regulator pool are presented in Figure 7-5 and Figure 7-6 for the MaxOF and MinOF flow scenarios respectively. These results collectively show the following key outcomes:

- As per the afflux trends, there has been the following changes in overall extents:
    - For MaxOF an increase in inundation of around 5% when weir pool control is set to FSL, and a decrease of just over 3% and 10% when the weir pool control is set to MaxOL and MinOL respectively.
    - For MinOF an increase in inundation of around 31% and 10% when weir pool control is set to FSL and MaxOL respectively, and a decrease of around 2.5% when the weir pool control is set to MinOL.
- There has only been some redistribution of hazard categories, with the following trends likely centred around changes in extent and the shifting of the weir pool control downstream:
    - With changes of up to around ±2% for H1, H2 and H5 categories and around ±8% for H3 and H4 categories for the MaxOF flow scenario.
    - With changes of up to around ±1% for H2 and H5 categories and around ±12% for H1, H3 and H4 categories for the MinOF flow scenario.

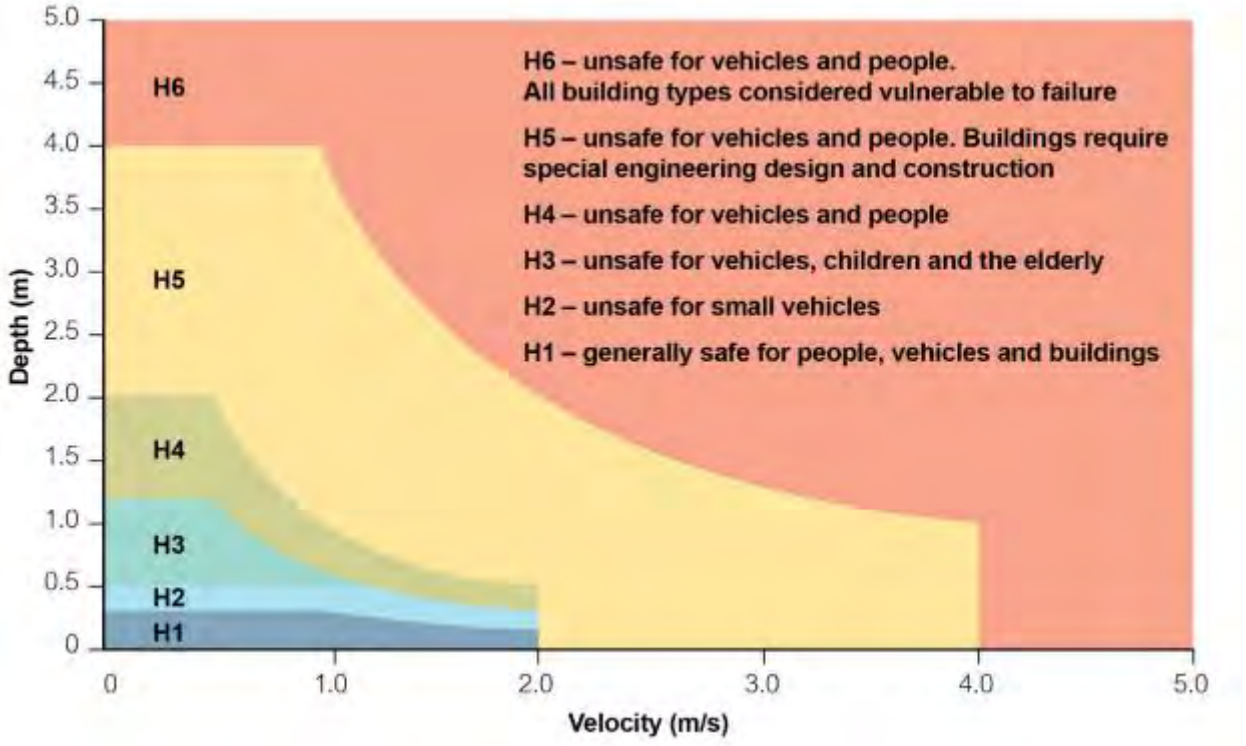


Figure 7-4 General flood hazard vulnerability curve (copy of Figure 1 from "Flood Hazard: Flood Risk Management Guideline FB03" – NSW DCCEEW, 2023)

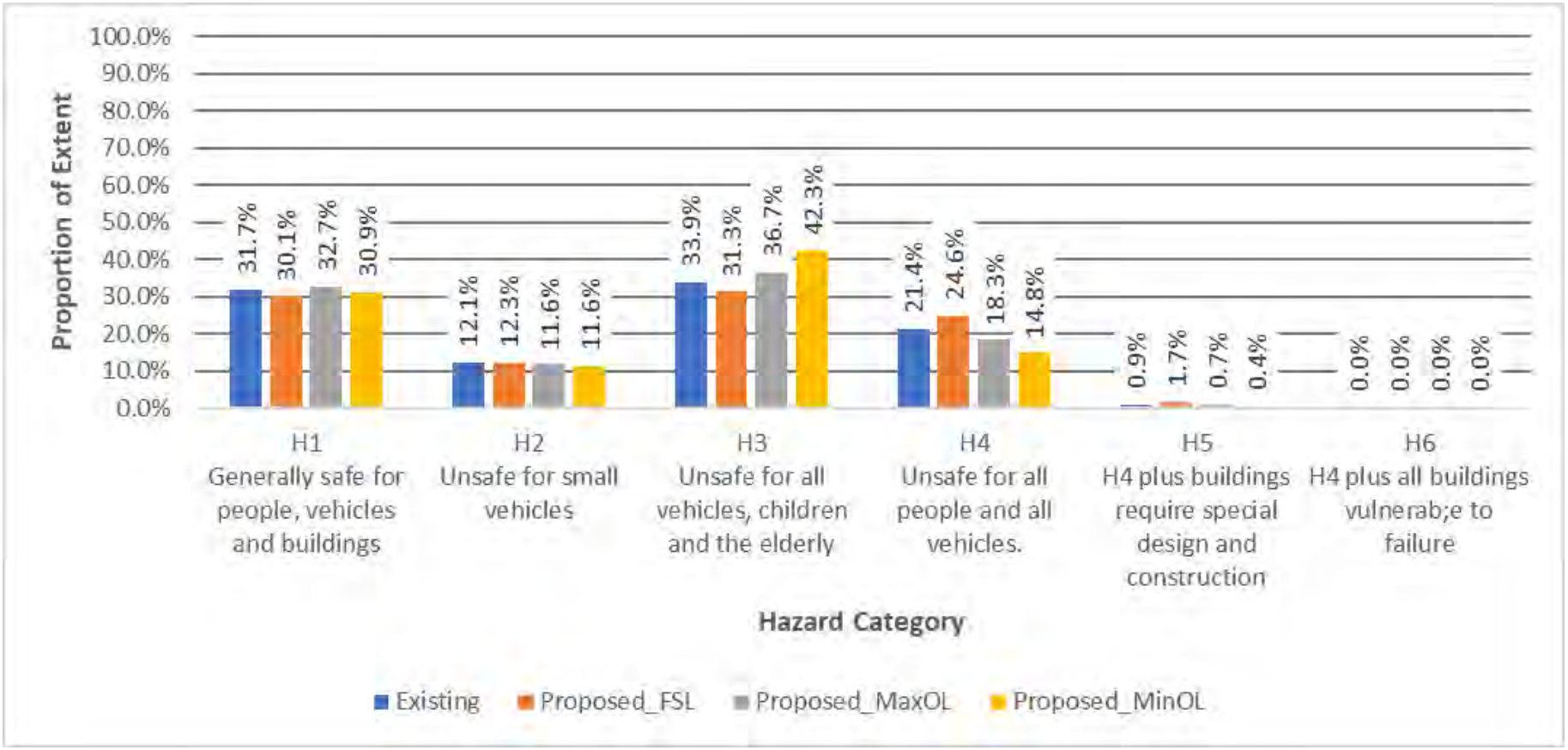


Figure 7-5 Hazard category distribution comparison for "Proposed" and "Existing" scenarios with MaxOF of 500 ML/day at Hartwood Regulator

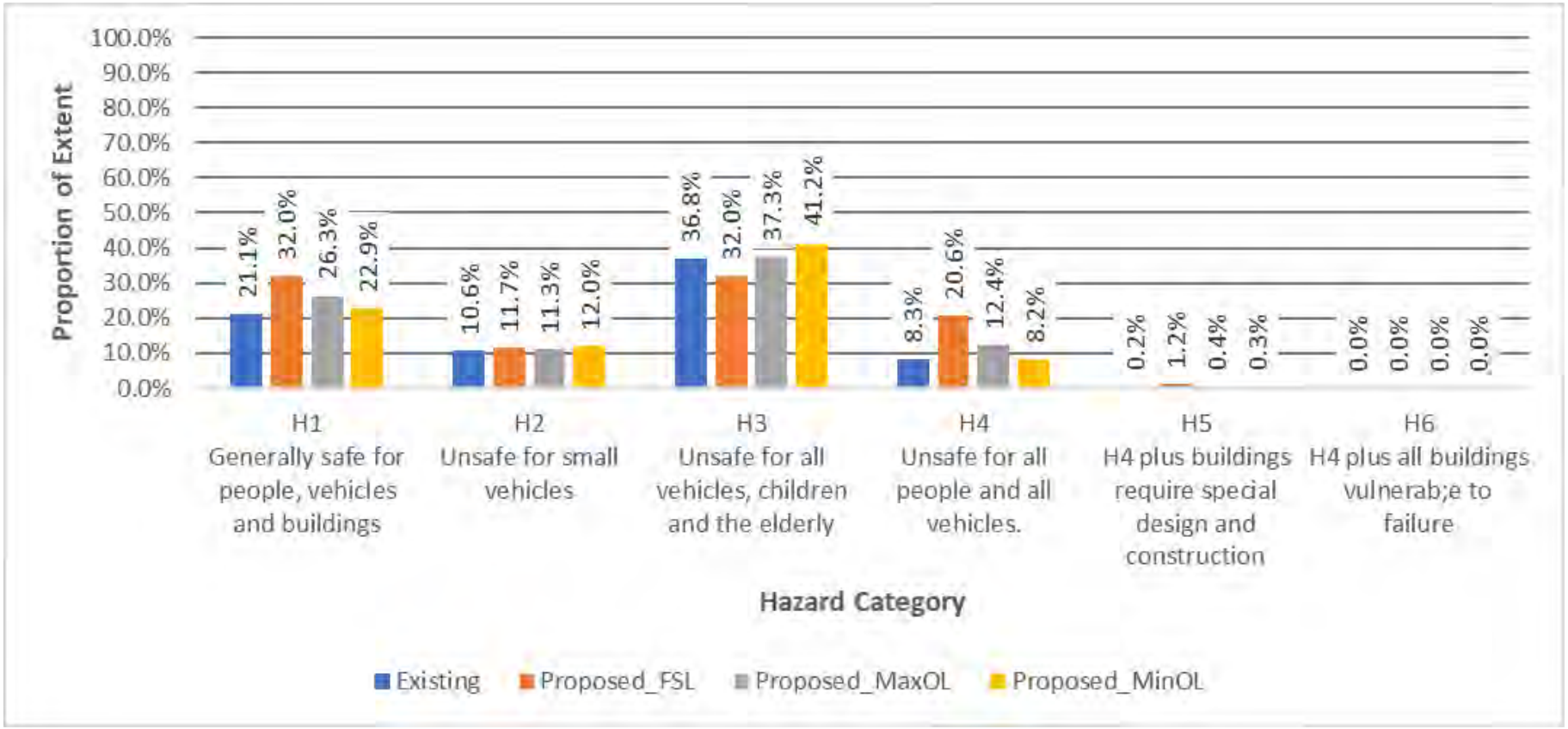


Figure 7-6 Hazard category distribution comparison for "Proposed" and "Existing" scenarios with MinOF of 25 ML/day at Hartwood Regulator

7.2.4 Velocity

A summary of the velocity characteristics in the "Existing" and "Proposed" scenarios are presented spatially in Appendix F, which presents maps across entire Study Area of the velocity distribution based on the fish habitat categorisation in Table 7-3. A comparison of the distribution of the categories within the proposed Hartwood Regulator pool are presented in Figure 7-7 and Figure 7-8 for the MaxOF and MinOF flow scenarios respectively. These results collectively shows there has been some redistribution of hazard categories, with the following trends centred around changes in extent and the shifting of the weir pool control downstream (see Figure 7-9 and Figure 7-10 for a long-section comparison of velocity along Billabong Creek):

- With changes of up to around ±8% for "backwater", "weir pool", "slow flowing" and "moderate flowing" velocity categories no real change in other categories for the MaxOF flow scenario.
- With changes of up to around ±2% for "backwater" and "weir pool" velocity categories and no real change in other categories for the MinOF flow scenario.

Table 7-3 Velocity Categorisation based on fish habitat

Fish Habitat	Water Velocity (m/s)
Backwaters	0.00 to 0.03
Weir pools	0.03 to 0.10
Slow flowing	0.10 to 0.17
Moderate flowing	0.17 to 0.30
Fast flowing	0.30 to 0.50
Very fast	>0.50

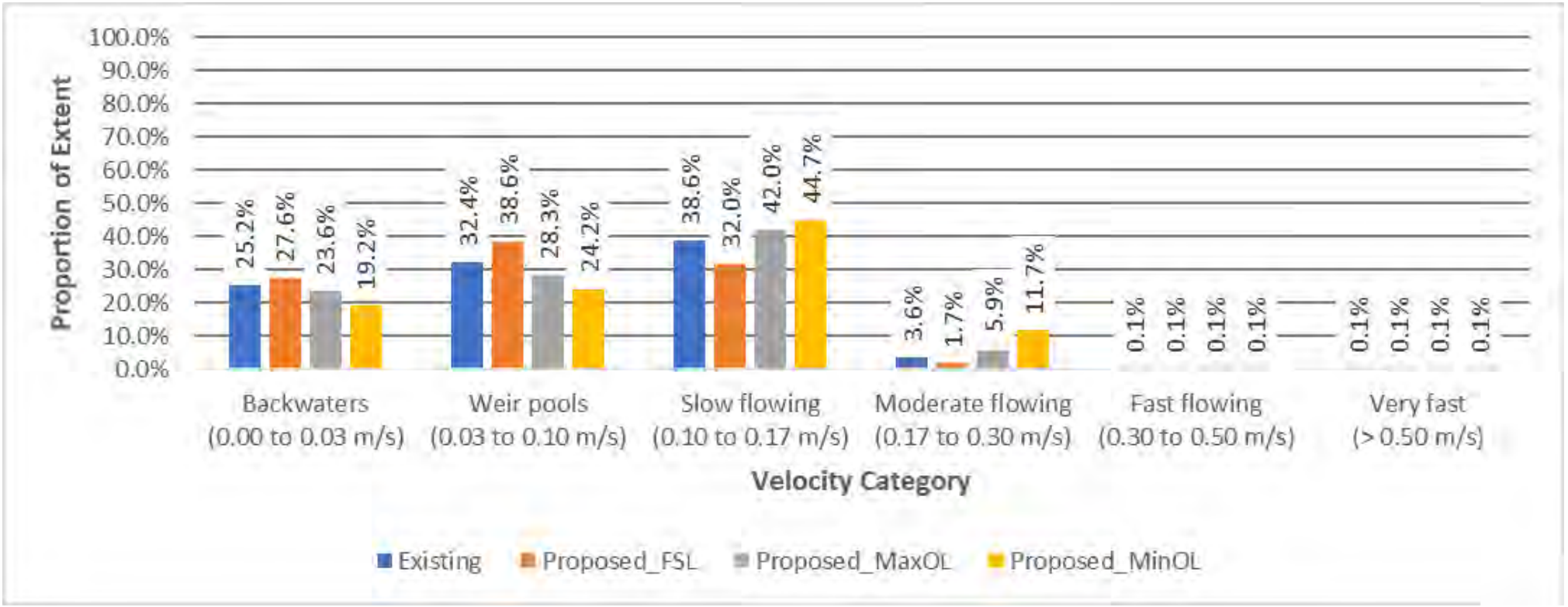


Figure 7-7 Velocity category distribution comparison for "Proposed" and "Existing" scenarios with MaxOF of 500 ML/day at Hartwood Regulator

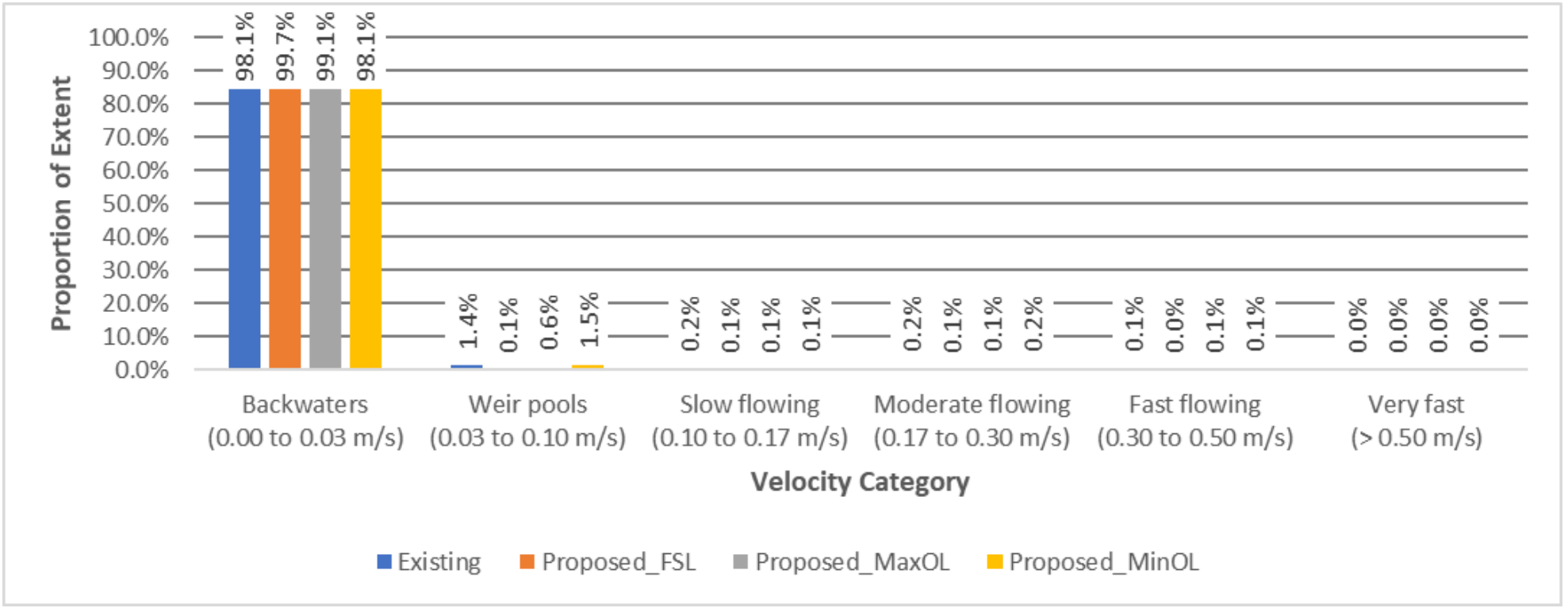


Figure 7-8 Velocity category distribution comparison for "Proposed" and "Existing" scenarios with MinOF of 25 ML/day at Hartwood Regulator

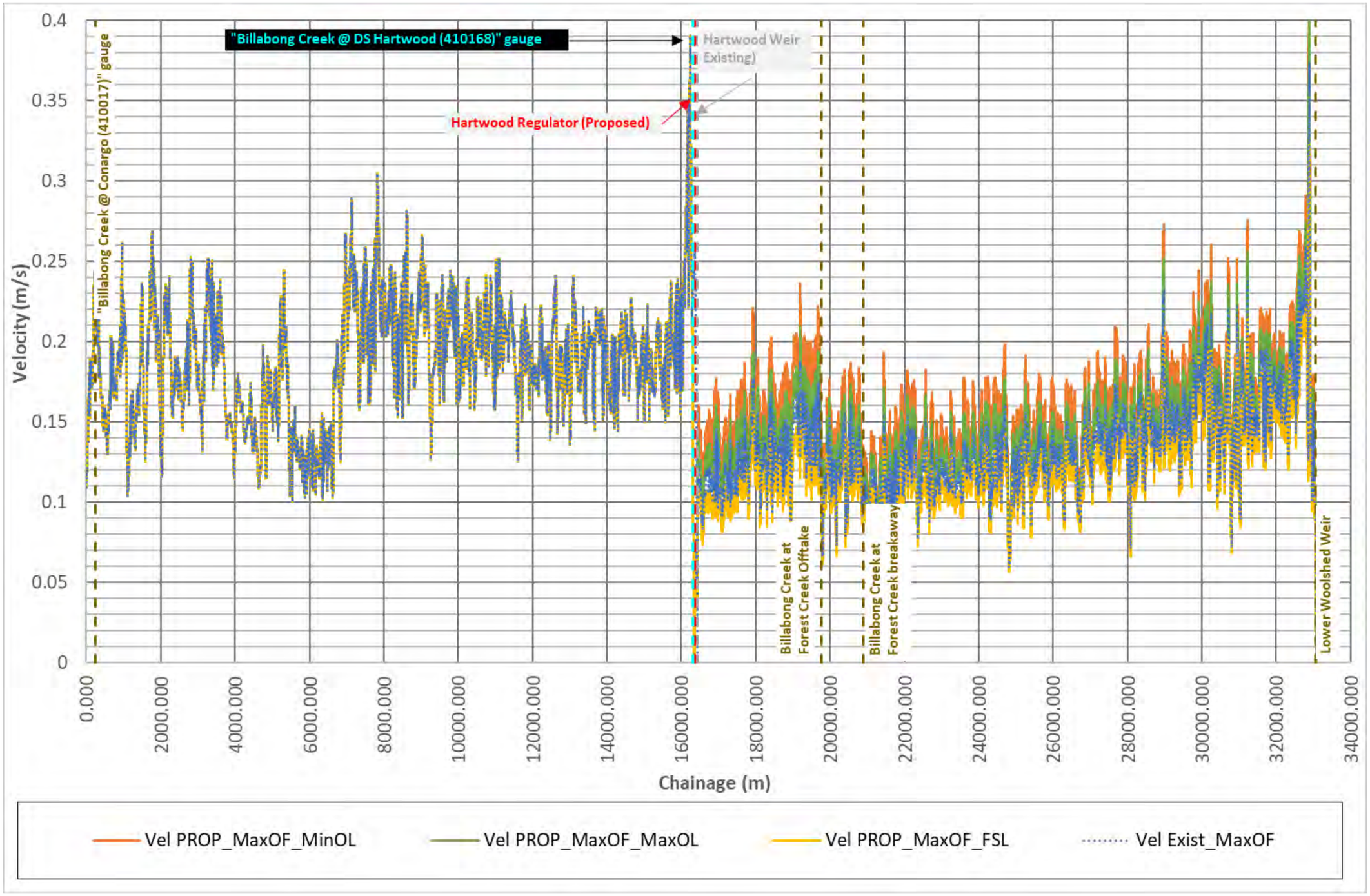


Figure 7-9 "Proposed" and "Existing" Velocity comparison along Billabong Creek for Maximum Operating Flow (MaxOF) of 500 ML/day at Hartwood Regulator

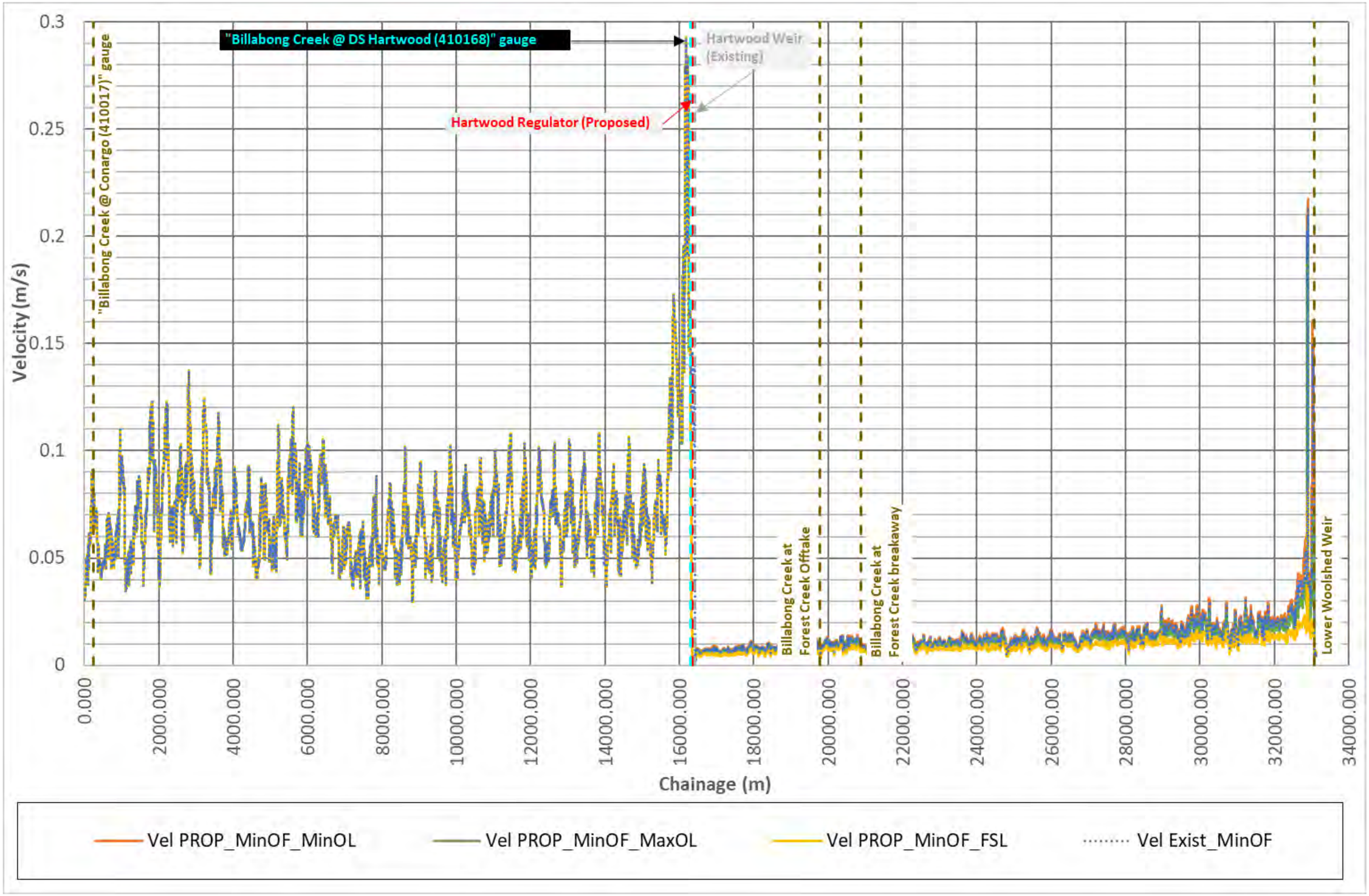


Figure 7-10 "Proposed" and "Existing" Velocity comparison along Billabong Creek for MinOF of 25 ML/day at Hartwood Regulator

7.3 Flood Flow Scenarios

7.3.1 Flows

A summary of flows for "Existing" and "Proposed" under the modelled flood flow scenarios are presented in Table 7-4 for the 50% AEP to 1% AEP flood scenarios where Billabong Creek is dominant, which shows the following general trends based on the comparison locations:

- 50% (1 in 2) AEP – minor changes of less than 10 ML/day (or up to 2% of the "existing" flow), except where operations have redistributed flows down Billabong Creek rather Forest Creek from the Hartwood weir pool and along Forest Creek rather than Piccaninny Creek from Warriston Weir Pool, which have experienced changes in the order of 75 – 100 ML/day (or around +6% to -96% of the "existing" flow respectively). The large change on Forest Creek is not considered an issue as during unregulated flow events the aim is to maximise water continuing along Forest Creek, and only supply a nominal flow rate of 1 ML/day down Piccaninny Creek as per the operations plan.

- 20% (1 in 5) AEP – similar outcomes to 50% AEP with changes of less than 25 ML/day (or up to 2% of the "existing" flow), except where operations have redistributed flows down Piccaninny Creek rather than Forest Creek from Warriston Weir Pool, which have experienced changes of up to around 140 ML/day (or around +5% to -93% of the "existing" flow). The change on Forest Creek flows was again not considered an issue as it was the intention of the operations plan.

- 10% (1 in 10) AEP – same trend as 20% AEP, but with an altered magnitude of change. Most changes less than 15 ML/day (generally up to 1% of "existing" flow, except one location where this was 8%), but a changes of up to around 100 ML/day (or around +15% to -30% of the "existing" flow) where flow is redirected away from Forest Creek via Forest Creek Return Regulator sending more flow down Piccaninny Creek to Billabong Creek.

- 5% (1 in 20) AEP – minimal redistribution of flows with changes of up to only 20 ML/day (or around +2% to -4% of "existing" flow).

- 2% (1 in 50) AEP – similar trend to 5% AEP, with changes of up to only 18 ML/day (or around +0.9% to -0.3% of "existing" flow).

- 1% (1 in 100) AEP – similar trend to 5% and 2% AEP, with changes of up to only 27 ML/day (or around +0.7% to -0.4% of "existing" flow).

- > 1% AEP – generally slight redistribution of flow down Forest Creek rather than Billabong Creek from Hartwood weir pool and Forest Creek rather than Piccaninny Creek from Warriston weir pool, which has allowed more flow top pass down Yanco Creek upstream of confluence with Billabong Creek. Changes are in the order of ±2% of the "existing" flow.

Table 7-4 Flow Comparison for Flood Flow Scenarios

Flood Scenario	Model Condition & Variable	Location [PO ID]											
		Yanco Creek approx. 8.3 km upstream of confluence with Billabong Creek [YNC_110_wFP]	Billabong Creek approx. 6.35 km upstream of where Forest Creek breaks away from Billabong Creek [BC_049_wFP]	Billabong Creek at around Hartwood Weir (includes channel and full floodplain flow) [BC_004_wFP]	Billabong Creek at around "Billabong Creek @ Conargo (410017)" gauge (includes channel and floodplain flow) [BC_074_wFP]	Billabong Creek approx. 3.45 km upstream of confluence with Piccaninny Creek [BC_015_wFP]	Billabong Creek approx. 7.65 km downstream of confluence with Piccaninny Creek (includes mostly channel flow only) [BC_DS_Out]	Back Creek and floodplain flow south-east of above (some floodplain flow may bypass) [BackCk_Out_wFP]	Forest Creek at Conargo Road just downstream of where Forest Creek Offtake channel joins [FC_001]	Forest Creek flow approx. 0.9 km downstream of Conargo Road crossing (includes mostly channel flow only) [FC_WP20_Inflow]	Forest Creek floodplain flow approx. 0.9 km downstream of culverts under Conargo Road to south of Forest Creek [FCFP_WP20_Inf]	Forest Creek floodplain flow heading south-west along upstream face of Conargo Road to south of Forest Creek [FC_FP_S2]	Piccaninny Creek and floodplain flow approx. 0.55 km upstream of Wangenalla-Conargo Road (includes channel and floodplain flow) [PC_009_wFP]
50% (1 in 2) AEP	EXIST Flow (ML/day)	1076	1996	1472	2518	2364	2438	0	522	413	0	0	78
	PROP Flow (ML/day)	1077	1996	1557	2610	2439	2438	0	436	404	0	0	3
	Change in Flow (ML/day) [PROP - EXIST]	1	0	85	92	75	0	0	-86	-9	0	0	-75
20% (1 in 5) AEP Billabong Dominant	EXIST Flow (ML/day)	1079	3991	2802	3844	3414	3631	0	1183	900	27	0	239
	PROP Flow (ML/day)	1079	3990	2823	3868	3432	3804	0	1161	763	2	0	380
	Change in Flow (ML/day) [PROP - EXIST]	0	-1	21	24	18	173	0	-22	-137	-25	0	141
10% (1 in 10) AEP Billabong Dominant	EXIST Flow (ML/day)	2636	5585	3596	6122	4989	5559	143	1981	1135	100	0	719
	PROP Flow (ML/day)	2635	5584	3611	6137	4994	5661	155	1966	1051	70	0	827
	Change in Flow (ML/day) [PROP - EXIST]	-1	-1	15	15	5	102	12	-15	-84	-30	0	108
5% (1 in 20) AEP Billabong Dominant	EXIST Flow (ML/day)	2644	7089	4427	7032	5415	6153	222	2655	1486	211	0	963
	PROP Flow (ML/day)	2643	7089	4428	7033	5415	6170	224	2654	1474	202	0	983
	Change in Flow (ML/day) [PROP - EXIST]	-1	0	1	1	0	17	2	-1	-12	-9	0	20
2% (1 in 50) AEP Billabong Dominant	EXIST Flow (ML/day)	4277	9087	5728	9963	6594	7586	452	3354	1777	313	0	1447
	PROP Flow (ML/day)	4282	9087	5710	9948	6589	7592	453	3372	1780	312	0	1460
	Change in Flow (ML/day) [PROP - EXIST]	5	0	-18	-15	-5	6	1	18	3	-1	0	13
1% (1 in 100) AEP Billabong Dominant	EXIST Flow (ML/day)	6533	10888	7010	13519	7842	9056	1084	3863	2031	431	0	2307
	PROP Flow (ML/day)	6533	10887	6984	13492	7835	9058	1085	3888	2038	432	0	2316
	Change in Flow (ML/day) [PROP - EXIST]	0	-1	-26	-27	-7	2	1	25	7	1	0	9

0.5% (1 in 200) AEP Billabong Dominant	EXIST Flow (ML/day)	10396	13048	8647	18914	9592	10403	2874	4400	2370	504	1	3686
	PROP Flow (ML/day)	10395	13049	8609	18876	9584	10403	2873	4438	2382	505	1	3694
	Change in Flow (ML/day) [PROP - EXIST]	-1	1	-38	-38	-8	0	-1	38	12	1	0	8
0.3% (1 in 300) AEP Billabong Dominant	EXIST Flow (ML/day)	14232	14686	9880	23876	11130	11317	4714	4800	2712	545	3	4922
	PROP Flow (ML/day)	14234	14687	9831	23817	11120	11317	4707	4847	2774	547	3	4921
	Change in Flow (ML/day) [PROP - EXIST]	2	1	-49	-59	-10	0	-7	47	62	2	0	-1
0.2% (1 in 500) AEP Billabong Dominant	EXIST Flow (ML/day)	18835	16488	11223	29666	12714	12324	6609	5251	3257	561	7	6338
	PROP Flow (ML/day)	18840	16489	11162	29605	12708	12321	6605	5311	3276	563	7	6337
	Change in Flow (ML/day) [PROP - EXIST]	5	1	-61	-61	-6	-3	-4	60	19	2	0	-1
PMF	EXIST Flow (ML/day)	46923	50086	29730	60181	20633	18500	15934	15686	8833	7849	1395	16236
	PROP Flow (ML/day)	47830	50062	29327	60182	20656	18518	15958	15931	8881	7898	1401	16291
	Change in Flow (ML/day) [PROP - EXIST]	907	-24	-403	1	23	18	24	245	48	49	6	55

7.3.2 Afflux

A summary of the WSL impacts between "Existing" and "Proposed" are presented spatially in Appendix F, which presents afflux maps across entire Study Area, and Figure 7-11 and Figure 7-12, which present a long section plot along Billabong Creek from just upstream of Lower Woolshed Weir to just downstream of "Billabong Creek @ Conargo (410017)" gauge for the 50% AEP to 1% AEP and 1% AEP to PMF flood scenarios where Billabong Creek is dominant respectively. The actual WSL in both scenarios, as well as the afflux or differences at some key locations are also presented numerically in Table 7-5 and

Table 7-6. These results collectively show the following key outcomes (which exclude any local impacts associated with Wilsons Anabranch Offtake works on Yanco Creek as these are unrelated to works around Hartwood Regulator):

- 50% (1 in 2) AEP
  Due to altered operation and control levels at the Hartwood Regulator and Forest Creek Return Regulator, WSL have changed as follows in the "proposed" case relative to "existing" -
    - Decreased WSL in Hartwood weir pool that range from around 10 mm just downstream of Lower Woolshed Weir to around 400 mm just upstream of the existing weir (which as discussed in Section 6.2.2 is assumed partially removed in the "proposed case").
    - Increased WSL on Billabong Creek downstream of the proposed regulator, which reduces in magnitude from around 75 mm just near the regulator to just above 10 mm upstream of Piccaninny Weir.
    - Minor increases in WSL of up to 25 mm on lower parts of Yanco Creek due to increase tailwater levels on Billabong Creek.
    - Reduced WSL on Forest Creek due to a redistribution of flows from Hartwood weir pool that range from 140 mm upstream of Conargo Road near where Forest Creek Offtake channel joins to around 5 mm upstream of Warriston Weir. Downstream of Warriston Weir the WSL have been reduced by around 10 mm.
    - Significantly reduced WSL (greater than 250 mm in most areas) on Piccanninny Creek upstream of Conargo-Wanganella Road due to restricted flows entering creek via Forest Creek Return Regulator in "proposed" case.
    - There are also some minor localised areas of change through the study area where minor changes have allowed new or extended areas to be or not be engaged or ponded into.
    - Changes around the Conargo township are contained to the creek corridor with minor increases of around 30 – 40 mm.
- 20% (1 in 5) AEP
  Similar trends to 50% AEP on Billabong Creek, but opposite changes in Piccaninny Creek due to operation of Forest Creek Return Regulator. WSL have changed as follows in the "proposed" case relative to "existing" -
    - Decreased WSL in Hartwood weir pool that range from around 2 mm just downstream of Lower Woolshed Weir to around 50 mm just upstream of the existing weir (which is assumed partially removed in "proposed case").
    - Increased WSL on Billabong Creek downstream of the control that reduce in magnitude from around 30 mm just near the control to just above 10 mm at Boonoke Bridge (approx. 1 km upstream of Bonooke Weir). Downstream of Boonoke Bridge the WSL increases by more again due to increased flows entering Billabong Creek via Piccaninny Creek, with increases ranging from 10 mm at just downstream of Boonooke Weir to 80 mm downstream of Piccaninny Weir.

- Minor increases in WSL of up to 10 mm on lower parts of Yanco Creek due to increased tailwater levels on Billabong Creek.

- Reduced WSL of up to 10 mm on Forest Creek upstream of Quiamong Weir due to a redistribution of flows from Hartwood weir pool. Downstream of Quiamong Weir WSL levels decrease by increasing amounts up to around 40 mm upstream of Warriston Weir, and levels reduce further by up to around 90 mm after Warriston Weir due to more flows being directed into Piccaninny Creek from Warriston weir pool by the Forest Creek Return Regulator .

- Increased WSL on Piccanninny Creek upstream of Wanganella-Conargo Road due to more flows entering creek via Forest Creek Return Regulator in “proposed” case. Increases are around 200 mm upstream of Conargo Road and reduce in magnitude to around 50 mm upstream of Wanganella-Conargo Road.

- There are also some minor localised areas of change through the study area where minor changes have allowed new or extended areas to be or not be engaged or ponded into, but less than 50% AEP.

- 10% (1 in 10) AEP
  Similar trends to 20% AEP, but with reduced magnitude. WSL have changed as follows in the “proposed” case relative to “existing” –

  - Decreased WSL in Hartwood weir pool that range from around 1 mm where Forest Creek breaks away from Billabong Creek to around 20 mm just upstream of the existing weir (which is assumed partially removed in “proposed case”).

  - Minor increases in Billabong Creek downstream of the proposed regulator, which reduces in magnitude from around 12 mm just near the control to just below 10 mm at Boonoke Bridge. Downstream of Boonoke Bridge the WSL increases by more again due to increased flows entering Billabong Creek via Piccaninny Creek, with increases ranging from 5 mm at just downstream of Bonoooke Weir to just under 25 m downstream of Piccaninny Weir.

  - No real change in WSL (less than ±10 mm) on lower parts of Yanco Creek..

  - No real change in WSL (less than ±10 mm) on Forest Creek upstream of Quiamong Weir. Downstream of Quiamong Weir WSL levels decrease by increasing amounts from below 10 mm up to around 40 mm near offtake channel to Forest Creek Return Regulator upstream of Warriston Weir due to more flows being directed into Piccaninny Creek from Warriston weir pool by the Forest Creek Return Regulator. After Warriston Weir levels reduce up around 30 mm.

  - Increased WSL on Piccanninny Creek upstream of Wanganella-Conargo Road due to more flows entering creek via Forest Creek Return Regulator in “proposed” case. Increases are just over 100 mm upstream of Conargo Road and reduce in magnitude to around 15 mm upstream of Wanganella-Conargo Road.

  - There are also some minor localised areas of change through the study area where minor changes have allowed new or extended areas to be or not be engaged or ponded into, but less than 20% AEP.

- 5% (1 in 20) AEP
  Minimal impact on WSL with changes mostly ±10 mm range, except for the following areas that are unrelated to Hartwood Regulator works –

    - A reduction of up to around 20 mm in Warriston weir pool near offtake channel to Forest Creek Return Regulator.

    - An increased WSL on Piccaninny Creek of just over 15 mm upstream of Conargo Road.

- 2% (1 in 50) and 1% (1in 100) AEPs
  Same general trend as 5% AEP, except for slight impact in Hartwood weir pool and reduced imapct on Forest Creek and Piccaninny Creek due to Forest Creek Return Regulator works. The changes results were –

    - A local increase of just under 20 mm and around 20 mm in WSL in Hartwood Weir pool near existing weir in the 2% and 1% AEPs respectively.

    - A reduction of up to around 13 mm and 10 mm in Warriston weir pool near offtake channel to Forest Creek Return Regulator in 2% and 1% AEPs respectively.

    - Reduced impact to less than 10 mm on Piccaninny Creek upstream of Conargo-Wanganella Road due to more flows entering creek via Forest.

    - There were also some localised area of change through the study area where minor changes have allowed new or extended areas to be or not be engaged or ponded into with slightly more of these in 1% AEP event.

- > 1% AEP
  Same general trend as 1% AEP, with minimal impact or a change of less than ±10 mm in WSL across the area except for a local increase of around 20 mm in WSL in Hartwood Weir pool near the existing weir. There were also some localised area of change through the study area where minor changes have allowed new or extended areas to be or not be engaged or ponded into in all these events.

In terms of impact around Conargo township, it was found that in all events other than 50% AEP the changes were generally all very minor (±10 mm) and in the 50% AEP there were increased levels within the creek corridor only in the order of 30 – 40 mm

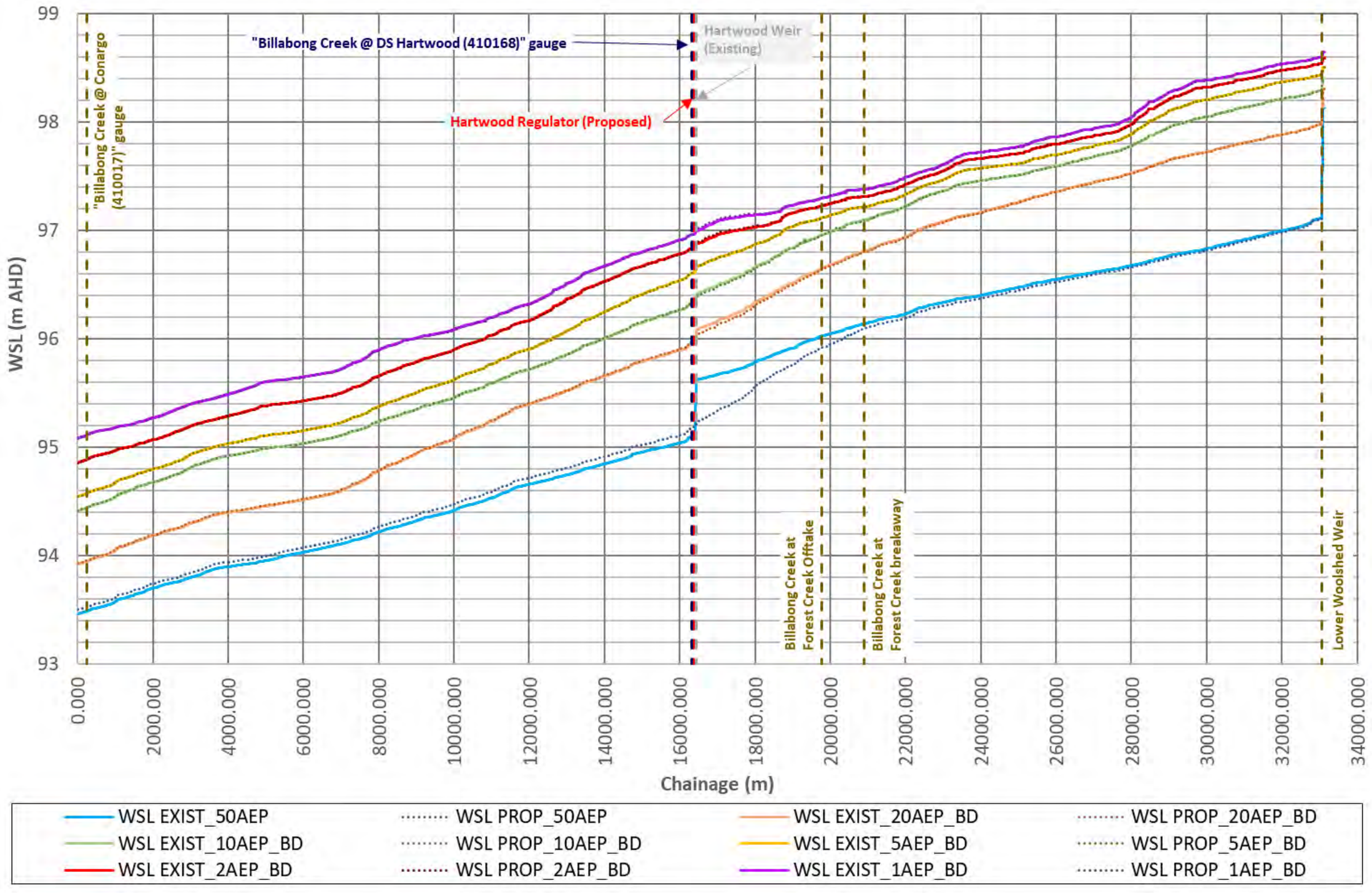


Figure 7-11 "Proposed" and "Existing" WSL comparison along Billabong Creek for 50% AEP to 1% AEP flood scenarios

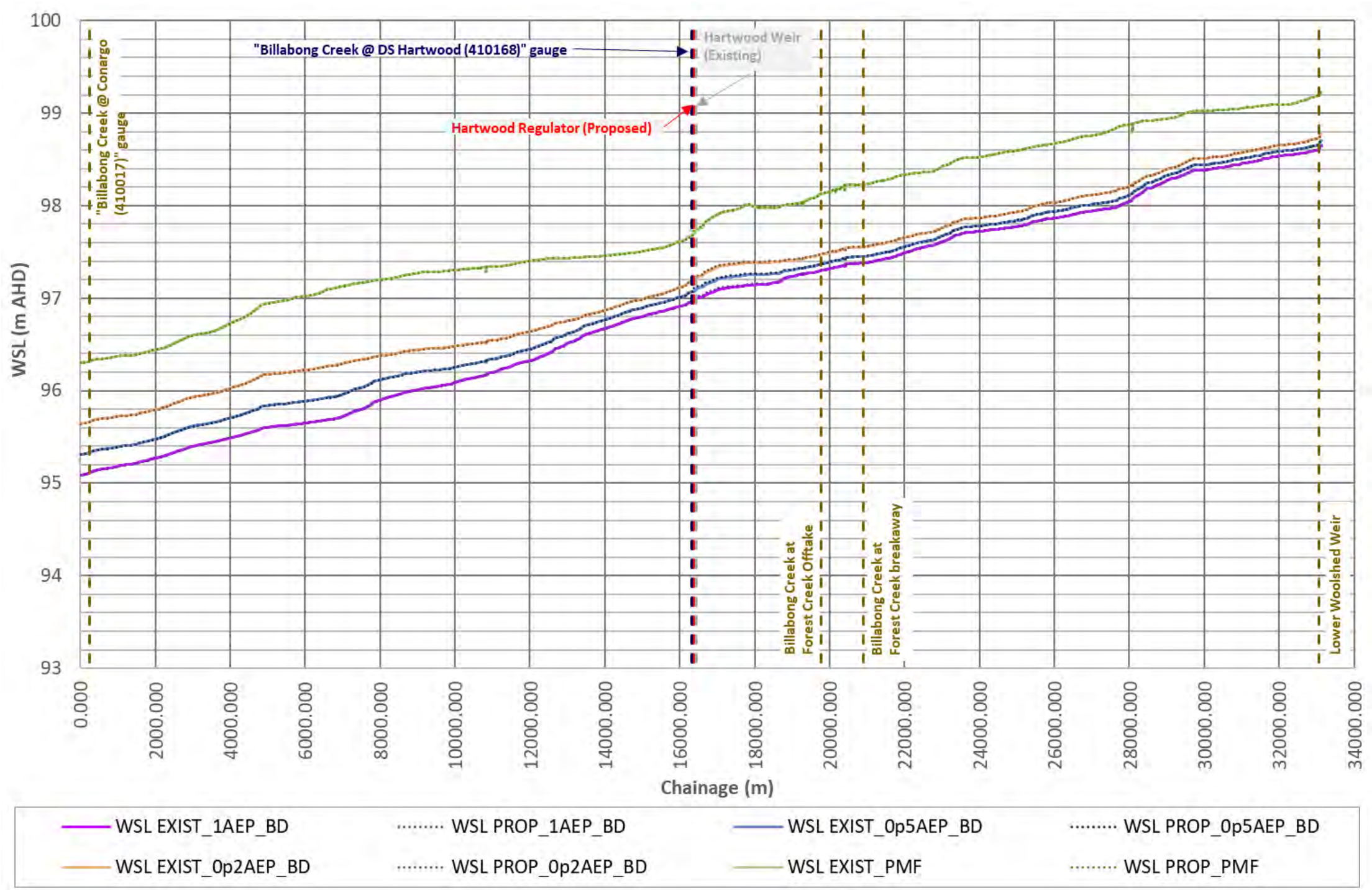


Figure 7-12 "Proposed" and "Existing" WSL comparison along Billabong Creek for 1% AEP to PMF flood scenarios

Table 7-5 WSL Comparison for 50% AEP to 1% AEP flood flow scenarios

Location Description	PO_ID	50% (1 in 2) AEP			20% (1 in 5) AEP			10% (1 in 10) AEP			5% (1 in 20) AEP			2% (1 in 50) AEP			1% (1 in 100) AEP		
		Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)
Yanco Creek approx. 8.3 km upstream of confluence with Billabong Creek	YNC_118	94.424	94.447	23	94.745	94.752	7	95.45	95.451	1	95.531	95.531	0	95.832	95.832	0	96.071	96.07	-1
Billabong Creek just downstream of Lower Woolshed Weir	BC_001	97.113	97.103	-10	97.979	97.977	-2	98.293	98.293	0	98.435	98.435	0	98.539	98.539	0	98.599	98.599	0
Billabong Creek approx. 6.1 km upstream of where Forest Creek breaks away from Billabong Creek	BC_049	96.625	96.604	-21	97.46	97.457	-3	97.697	97.697	0	97.796	97.796	0	97.885	97.885	0	97.953	97.953	0
Billabong Creek at around where Forest Creek breaks away from Billabong Creek	BC_at_FCBB	96.144	96.098	-46	96.811	96.803	-8	97.098	97.097	-1	97.22	97.221	1	97.314	97.316	2	97.381	97.383	2
Billabong Creek at Forest Creek Offtake	BC_at_FCO	96.032	95.928	-104	96.663	96.652	-11	96.968	96.965	-3	97.123	97.123	0	97.233	97.236	3	97.303	97.306	3
Billabong Creek just upstream of existing Hartwood Weir	HW_Exist_H	95.623	95.229	-394	96.086	96.041	-45	96.417	96.399	-18	96.667	96.669	2	96.877	96.895	18	96.999	97.019	20
Billabong Creek just upstream of proposed Hartwood Regulator	US_Hart_Prop	95.114	95.188	74	95.969	95.996	27	96.342	96.371	29	96.616	96.646	30	96.844	96.877	33	96.971	97.003	32
Billabong Creek at around "Billabong Creek @ DS Hartwood 410168" gauge	BC_Hartwood_ Gauge	95.106	95.177	71	95.959	95.971	12	96.33	96.338	8	96.604	96.608	4	96.835	96.837	2	96.961	96.962	1
Billabong Creek approx. 4.75 km upstream of confluence with Yanco Creek	BC_062	94.603	94.663	60	95.325	95.333	8	95.659	95.663	4	95.842	95.842	0	96.109	96.107	-2	96.261	96.26	-1
Billabong Creek at approx. confluence with Yanco Creek	BC_006	94.092	94.132	40	94.572	94.579	7	95.088	95.091	3	95.206	95.206	0	95.478	95.477	-1	95.697	95.695	-2
Billabong Creek at around "Billabong Creek @ Conargo 410017" gauge	BC_atConargo_ gauge	93.486	93.524	38	93.945	93.952	7	94.44	94.442	2	94.573	94.573	0	94.887	94.886	-1	95.111	95.109	-2
Billabong Creek upstream of Carrathool Rd	BC_010	93.155	93.191	36	93.586	93.593	7	94.046	94.048	2	94.17	94.17	0	94.48	94.479	-1	94.708	94.707	-1
Billabong Creek upstream of Boonoke Bridge (approx. 1 km upstream of Boonoke Weir)	BC_069	92.072	92.09	18	92.347	92.355	8	92.709	92.712	3	92.79	92.79	0	92.967	92.966	-1	93.078	93.078	0
Billabong Creek approx. 3.1 km upstream of confluence with Piccaninny Creek	BC_015	90.736	90.749	13	91.047	91.078	31	91.574	91.588	14	91.696	91.699	3	91.977	91.977	0	92.163	92.163	0
Billabong Creek approx. 0.5 km downstream of Piccaninny Weir	BC_017	89.639	89.639	0	90.332	90.409	77	91.002	91.025	23	91.136	91.139	3	91.41	91.411	1	91.63	91.63	0
Forest Creek just upstream of Conargo Road (downstream of where Forest Creek Offtake channel joins)	FC_001_US	95.971	95.83	-141	96.611	96.601	-10	96.875	96.871	-4	97.012	97.012	0	97.122	97.125	3	97.197	97.2	3

Location Description	PO_ID	50% (1 in 2) AEP			20% (1 in 5) AEP			10% (1 in 10) AEP			5% (1 in 20) AEP			2% (1 in 50) AEP			1% (1 in 100) AEP		
		Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)
Forest Creek approx. 3.6 km upstream of Parrys Weir (adjacent to brekaway flow path to north-west)	FC_014	95.724	95.596	-128	96.331	96.321	-10	96.504	96.502	-2	96.594	96.594	0	96.668	96.669	1	96.716	96.718	2
Forest Creek approx. 0.8 km upstream of Parrys Weir	FC_017	95.505	95.394	-111	96.044	96.034	-10	96.196	96.194	-2	96.269	96.269	0	96.323	96.324	1	96.354	96.355	1
Forest Creek approx. 1.1 km upstream of Quiamong Weir	FC_030	94.243	94.226	-17	94.32	94.317	-3	94.355	94.355	0	94.373	94.373	0	94.389	94.389	0	94.4	94.401	1
Forest Creek at approx. location where Piccaniny Creek return flow channel breaks away from Forest Creek	FCPC_H4	92.861	92.857	-4	93.04	93.002	-38	93.088	93.051	-37	93.113	93.094	-19	93.134	93.121	-13	93.154	93.144	-10
Forest Creek approx. 0.1 km upstream of Warriston Weir	FCPC_H1	92.585	92.58	-5	92.727	92.689	-38	92.787	92.762	-25	92.855	92.849	-6	92.909	92.908	-1	92.953	92.953	0
Forest Creek upstream of Conargo Rd downstream of Warriston Weir	FC_008	92	91.987	-13	92.469	92.378	-91	92.572	92.543	-29	92.666	92.663	-3	92.727	92.728	1	92.773	92.774	1
Forest Creek floodplain flow approx. 0.9 km downstream of culverts under Conargo Road to south of Forest Creek	FC_WP20_Inflow	91.839	91.828	-11	92.277	92.196	-81	92.368	92.344	-24	92.447	92.444	-3	92.5	92.5	0	92.541	92.542	1
Forest Creek floodplain flow approx. 0.9 km downstream of culverts under Conargo Road to south of Forest Creek	FCFP_WP20_Inf	-	-	-	91.93	91.839	-91	92.047	92.017	-30	92.132	92.128	-4	92.19	92.19	0	92.24	92.241	1
Piccaninny Creek upstream of Conargo Rd downstream of where Piccaniny Creek return flow channel joins Piccaninny Creek	PC_003_US	91.779	91.55	-229	92.191	92.401	210	92.803	92.915	112	92.957	92.973	16	92.991	92.998	7	93.013	93.018	5
Piccaninny Creek approx. 0.8 km upstream of Wangenalla-Conargo Road	PC_026	91.264	90.596	-668	91.928	91.978	50	92.03	92.045	15	92.06	92.061	1	92.109	92.111	2	92.179	92.18	1
Box Creek upstream of Willurah Rd (downstream of Box Creek break away from Billabong Creek near "Billabong Creek @ Conargo 410017" gauge)	BoxCk_005	92.938	92.971	33	93.218	93.216	-2	93.587	93.589	2	93.671	93.671	0	93.894	93.894	0	94.004	94.004	0

Table 7-6 WSL Comparison for 0.5% AEP to PMF flood flow scenarios

Location Description	PO_ID	0.5% (1 in 200) AEP			0.3% (1 in 300) AEP			0.2% (1 in 500) AEP			PMF		
		Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)	Existing WSL (m AHD)	Proposed WSL (m AHD)	Change in WSL (mm)
Yanco Creek approx. 8.3 km upstream of confluence with Billabong Creek	YNC_118	96.311	96.31	-1	96.473	96.472	-1	96.634	96.633	-1	97.482	97.491	9
Billabong Creek just downstream of Lower Woolshed Weir	BC_001	98.653	98.653	0	98.689	98.689	0	98.725	98.725	0	99.187	99.188	1
Billabong Creek approx. 6.1 km upstream of where Forest Creek breaks away from Billabong Creek	BC_049	98.024	98.025	1	98.074	98.074	0	98.125	98.125	0	98.771	98.772	1
Billabong Creek at around where Forest Creek breaks away from Billabong Creek	BC_at_FCBB	97.45	97.453	3	97.5	97.504	4	97.554	97.558	4	98.225	98.229	4
Billabong Creek at Forest Creek Offtake	BC_at_FCO	97.373	97.377	4	97.424	97.428	4	97.478	97.484	6	98.13	98.136	6
Billabong Creek just upstream of existing Hartwood Weir	HW_Exist_H	97.104	97.124	20	97.165	97.184	19	97.223	97.242	19	97.733	97.754	21
Billabong Creek just upstream of proposed Hartwood Environmental Water Regulator	US_Hart_Prop	97.077	97.109	32	97.137	97.169	32	97.195	97.227	32	97.701	97.736	35
Billabong Creek at around "Billabong Creek @ DS Hartwood 410168" gauge	BC_Hartwood_ Gauge	97.067	97.066	-1	97.126	97.124	-2	97.183	97.18	-3	97.684	97.673	-11
Billabong Creek approx. 4.75 km upstream of confluence with Yanco Creek	BC_062	96.39	96.388	-2	96.479	96.477	-2	96.583	96.581	-2	97.364	97.37	6
Billabong Creek at approx. confluence with Yanco Creek	BC_006	95.934	95.933	-1	96.103	96.102	-1	96.274	96.272	-2	97.108	97.109	1
Billabong Creek at around "Billabong Creek @ Conargo 410017" gauge	BC_atConargo_ gauge	95.33	95.329	-1	95.494	95.492	-2	95.664	95.663	-1	96.317	96.317	0
Billabong Creek upstream of Carrathool Rd	BC_010	94.937	94.936	-1	95.103	95.102	-1	95.262	95.261	-1	95.721	95.722	1
Billabong Creek upstream of Boonoke Bridge (approx. 1 km upstream of Boonoke Weir)	BC_069	93.158	93.158	0	93.205	93.205	0	93.253	93.252	-1	93.433	93.433	0
Billabong Creek approx. 3.1 km upstream of confluence with Piccaninny Creek	BC_015	92.297	92.297	0	92.376	92.376	0	92.441	92.441	0	92.687	92.687	0
Billabong Creek approx. 0.5 km downstream of Piccaninny Weir	BC_017	91.759	91.759	0	91.822	91.822	0	91.874	91.874	0	92.083	92.083	0
Forest Creek just upstream of Conargo Road (downstream of where Forest Creek Offtake channel joins)	FC_001_US	97.269	97.274	5	97.319	97.325	6	97.374	97.38	6	97.972	97.976	4
Forest Creek approx. 3.6 km upstream of Parrys Weir (adjacent to brekaway flow path to north-west)	FC_014	96.759	96.762	3	96.789	96.793	4	96.82	96.824	4	97.081	97.085	4
Forest Creek approx. 0.8 km upstream of Parrys Weir	FC_017	96.382	96.384	2	96.402	96.404	2	96.421	96.424	3	96.749	96.753	4
Forest Creek approx. 1.1 km upstream of Quiamong Weir	FC_030	94.411	94.411	0	94.419	94.42	1	94.426	94.427	1	94.668	94.674	6
Forest Creek at approx. location where Piccaniny Creek return flow channel breaks away from Forest Creek	FCPC_H4	93.173	93.166	-7	93.192	93.187	-5	93.223	93.221	-2	93.944	93.947	3
Forest Creek approx. 0.1 km upstream of Warriston Weir	FCPC_H1	92.992	92.993	1	93.031	93.036	5	93.085	93.087	2	93.767	93.77	3
Forest Creek upstream of Conargo Rd downstream of Warriston Weir	FC_008	92.826	92.827	1	92.872	92.88	8	92.939	92.941	2	93.562	93.564	2
Forest Creek floodplain flow approx. 0.9 km downstream of culverts under Conargo Road to south of Forest Creek	FC_WP20_Inflow	92.589	92.59	1	92.63	92.636	6	92.683	92.684	1	93.138	93.141	3
Forest Creek floodplain flow approx. 0.9 km downstream of culverts under Conargo Road to south of Forest Creek	FCFP_WP20_Inf	92.284	92.285	1	92.318	92.319	1	92.359	92.36	1	93.091	93.094	3
Piccaninny Creek upstream of Conargo Rd downstream of where Piccaniny Creek return flow channel joins Piccaninny Creek	PC_003_US	93.038	93.041	3	93.062	93.065	3	93.102	93.103	1	93.791	93.794	3
Piccaninny Creek approx. 0.8 km upstream of Wangenalla-Conargo Road	PC_026	92.274	92.274	0	92.351	92.351	0	92.426	92.426	0	92.791	92.792	1
Box Creek upstream of Willurah Rd (downstream of Box Creek break away from Billabong Creek near "Billabong Creek @ Conargo 410017" gauge)	BoxCk_005	94.109	94.109	0	94.174	94.173	-1	94.237	94.236	-1	94.911	94.91	-1

7.3.3 Flood Hazard

A summary of the flood hazard characteristics in the “Existing” and “Proposed” scenarios are presented spatially in Appendix G, which presents maps of this across entire Study Area based on hazard categories defined in NSW’s “Flood Hazard: Flood Risk Management Guideline FB03” document and Australian Rainfall and Runoff 2019 (ARR2019) – which are defined in Figure 7-4 in Section 7.2.3. A comparison of the distribution of the categories within the proposed Hartwood Regulator pool and a small section of Billabong Creek downstream are presented in Figure 7-13 for the 50% to 1% AEP flood flow scenarios. These results collectively show the distribution of hazard categories have not materially changed with changes across all AEPs ranging from between around +1.4% to -1.7%.

7.3.4 Velocity

A summary of the velocity flood hazard characteristics in the “Existing” and “Proposed” scenarios are presented spatially in Appendix G, which presents maps of this across entire Study Area based on the fish habitat categorisation in Table 7-3 in Section 7.2.4. A comparison of the distribution of the categories within the proposed Hartwood Regulator pool and a small section of Billabong Creek downstream are presented in Figure 7-14 for the 50% to 1% AEP flood flow scenarios. These results collectively show the distribution of velocity categories have changed slightly as expected with changes across all AEPs ranging from between around +4.3% to -2.67%. These changes largely relate to the altered position of the control and the operating rules that allow more flow through the structure in smaller events, which is partially demonstrated by the comparison of velocity along a long-section on Billabong Creek presented in Figure 7-15.

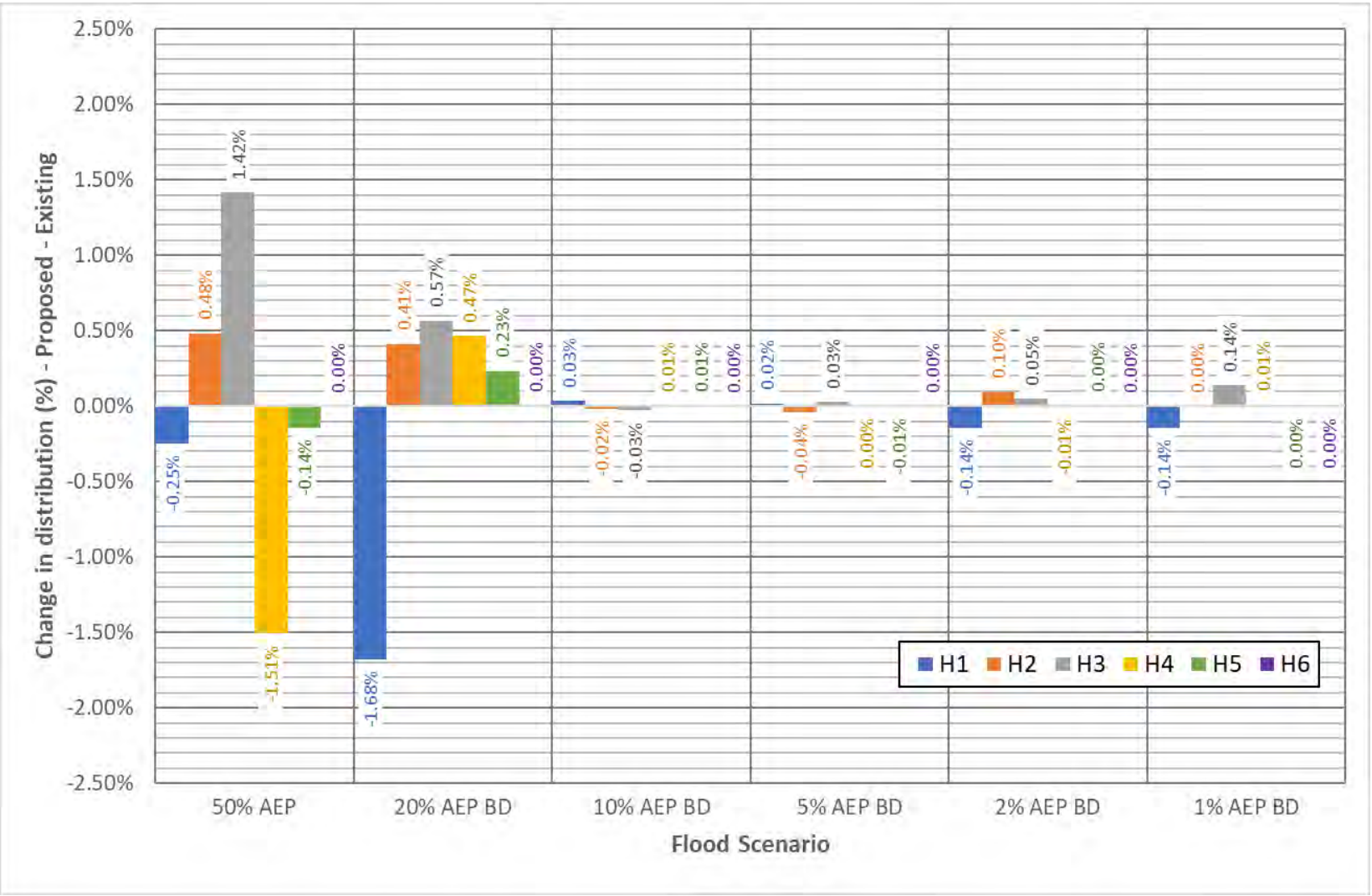


Figure 7-13 Hazard category distribution change for 50% AEP to 1% AEP flood scenarios where Billabong Creek is dominant

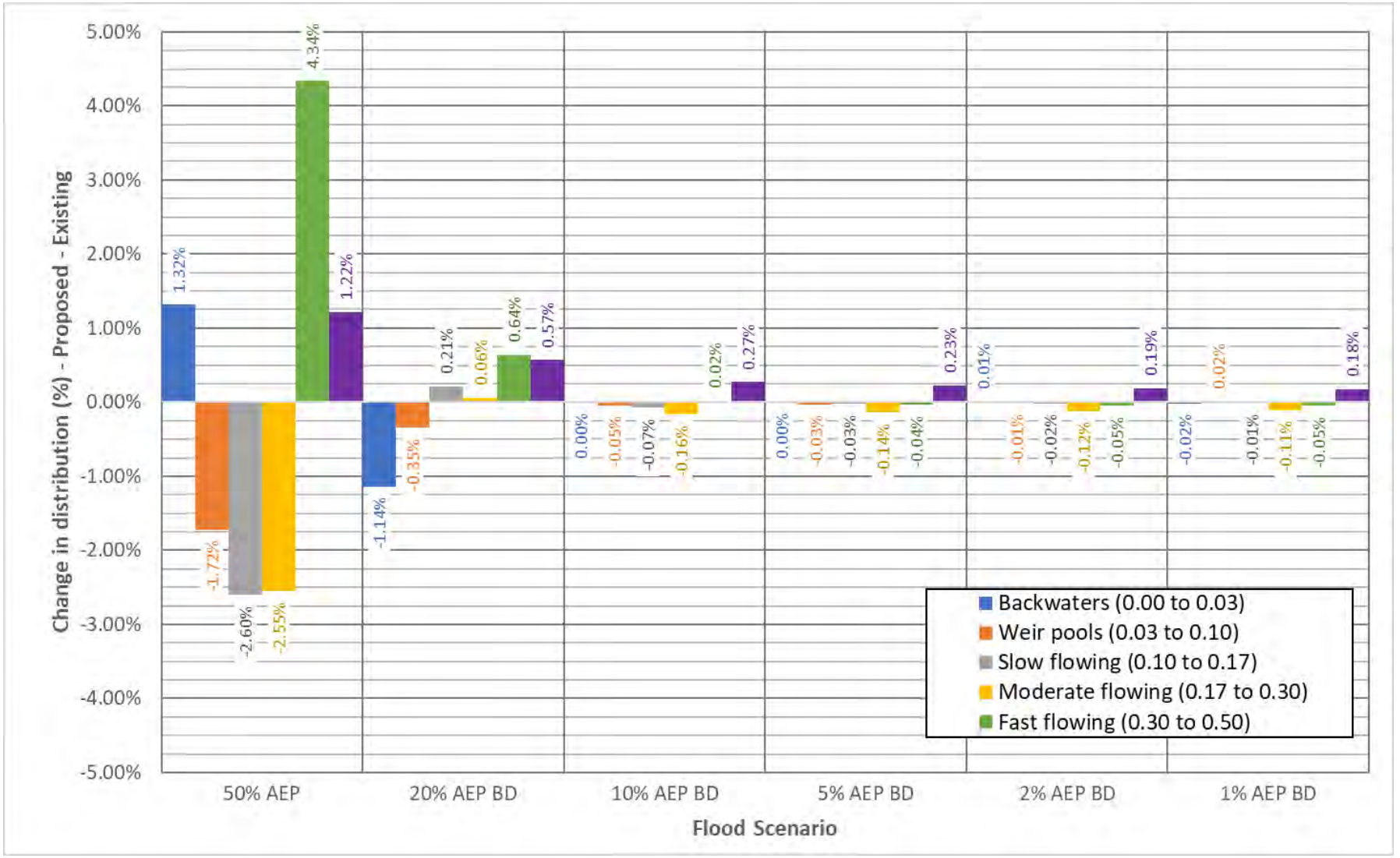


Figure 7-14 Velocity category distribution change for 50% AEP to 1% AEP flood scenarios where Billabong Creek is dominant

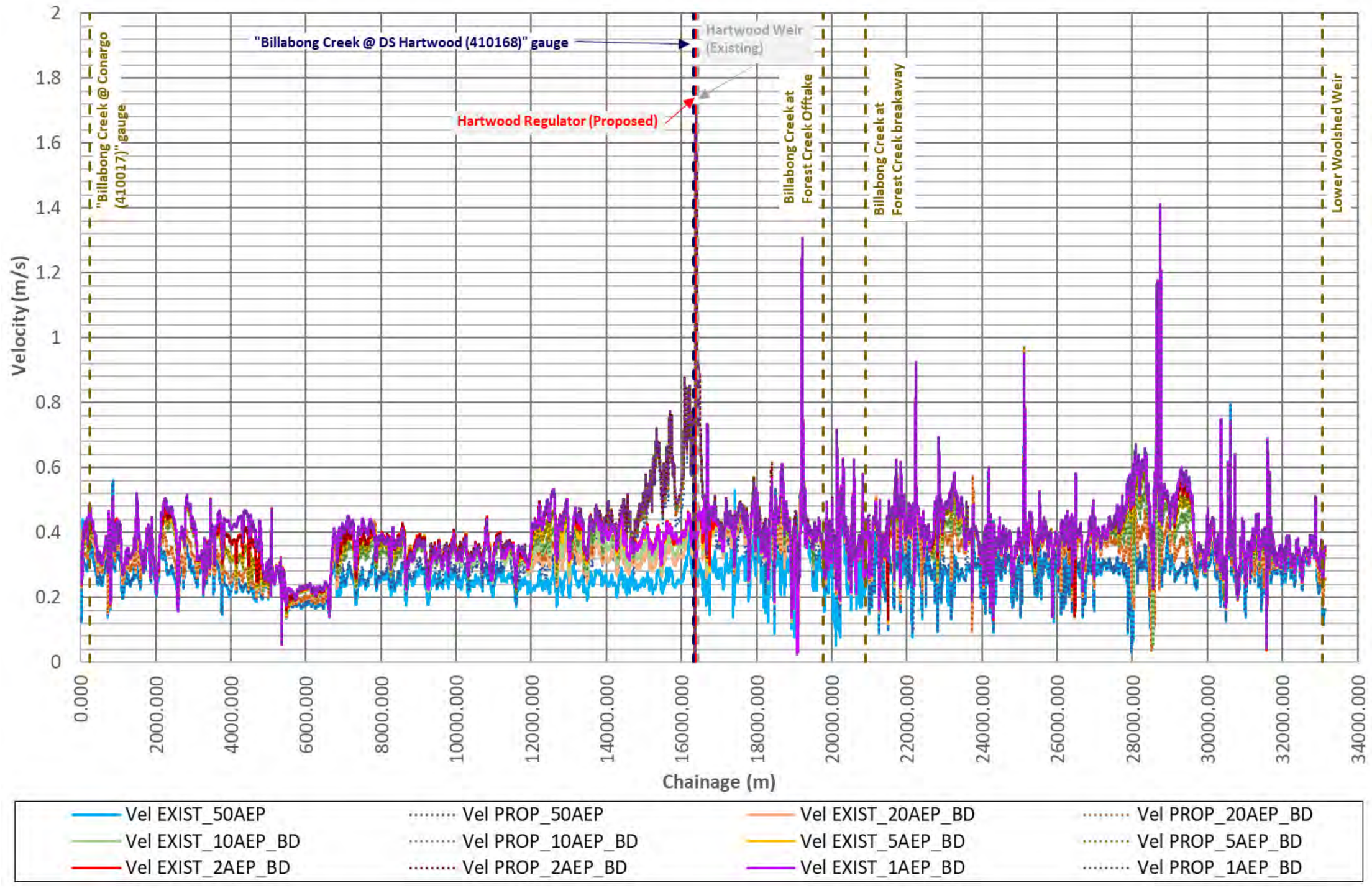


Figure 7-15 "Proposed" and "Existing" Velocity comparison along Billabong Creek for for 50% AEP to 1% AEP flood scenarios where Billabong Creek is dominant

7.4 Impact Conclusion

Based on the results presented it would appear that the proposed works at Hartwood Regulator do not have a significant impact on the flood characteristics of the Study Area, with changes experienced being as expected due to altering the location and level of the weir pool control – which is formed by the proposed regulator. Some impacts are also the result of current operational rules, particular in more frequent flood events when the gates are assumed fully opened as this allows flow to pass through at lower levels than previously. In larger (less frequent) flood events, where some flow bypasses the control structure the impact of the final design is also likely to be reduced with the intention of adding a ford crossing to the proposed access track on the western bank where an existing flood runner exists. As described above, there is some optimisation of the design and/or operations plan that may occur as part of the detailed design, but this is only likely to reduce the assessed impacts.

8. Limitations, assumptions and uncertainty

Developing a hydraulic model requires the application of simplifications and generalisations. As such a number of assumptions are made when building the model. This can lead to model uncertainties and subsequent limitations of the results

Although data collection prior to this model build has been extensive, there are still areas of uncertainty which may cause limitations to the accuracy of the model. The following elements have been identified as uncertainties, assumptions or limitations related to the development of this model:

- Many but not all floodplain structures were visited during the 3Rivers site visits and therefore assumptions were made to the size, elevation, and type of those structures. Localised flooding during the data collection phase also prevented measurements or survey being completed. Assumptions were made based on nearby structure information and LiDAR products. Most floodplain structures invert levels were also assumed based on LiDAR products and/or the measured height to crest.

- The high-resolution LIDAR products available in the area were collected when there was ponded water in the floodplain and assumptions have been made to ensure the flow paths are more representative of the dry channel. LiDAR products collected previously did not cover all areas of ponding.

- Soil losses were estimated based on typical infiltration rates and assumed minimal initial losses given the length of the modelled events and scenarios. Infiltration data for soils is very limited and can vary greatly depending on antecedent conditions, soil type and compaction for example. Without field sampling of the soil, infiltration rates will be an estimate.

- General modelling assumptions relate to the selection of various parameters within the model, for example, the roughness values used within the model. A programme of model proving was undertaken to understand any uncertainties associated with the choice of parameters and their impact upon model results. The full details of the model proving can be found within this report. In summary, the model was shown to be reasonably sensitive to changes in in-channel roughness, but generally insensitive to other parameters. Changes in in-channel roughness were found to have a substantial influence on the areas of inundation within the study area.

- As is typically the case with hydraulic model outputs, areas close to the upstream and downstream extents of a hydraulic model should be treated with caution and this is particularly important for areas where the models will not have had the spatial coverage to adequately develop to realistic inundation and flow mechanisms.

- In preparing this report, the authors have relied on information provided by other and publicly available information. Except where explicitly noted these data have not been independently verified or checked. This unverified information may contain errors and omissions which have caused errors or omissions in this report.

- The proposed works included in the “proposed” scenarios were based on designs at a specific point of time (see discussion in Section 5.3.8) and designs have progressed since this time. The changes are noted at the end of the discussion on the “Proposed Model Setup”, but are not considered to be significant or likely to alter the general findings of this Study.

- Due to the size of the Study Area, a relatively coarse grid with additional sampling for storage and conveyance characteristics via TUFLOW “sub-grid sampling” utility was adopted and considered appropriate. This means that variables such as velocity, hazard and bed shear stress are likely to be only generally representative and may over or under estimate actual values in localised locations (such as river bends and in and around structures represented in 1D).

9. Conclusion

The modelling described in this report is suitable for describing the current flood characteristics within the Study Area and for assessing the change or impact assessment as a result of the proposed Hartwood Regulator works. The model was shown to calibrate/validate reasonably well across the range of flow scenarios being assessed and is considered appropriate for undertaking the required impact assessment for the proposed Hartwood Regulator and other SDLAM works within the Study Area. The impact assessment found that the proposed works in and around the proposed Hartwood Regulator as described in Section 6.2 do not have a significant impact on the flood characteristics of the Study Area. The changes experienced were as expected due to altering the location and level of the weir pool control, which is formed by the proposed regulator, and could be reduced with alterations to operations plans in more frequent flood events when flow is in bank and/or a ford crossing on the proposed access track in larger flood events where flow was found to engage a flood runner on the western bank upstream of the existing weir.

10. References

3Rivers (2023a). Sustainable Diversion limits Adjustment Mechanism (SDLAM) – Work Package 19 – Yanco Bridge to Piccaninny Weir Model User Report. March, 2023.

3Rivers (2023b). Yanco Creek Modernisation Flood Frequency Analysis (DE19-823-YCM-DE-HY-MEM-0004)

DCCEEW (2021). Hydraulic Modelling Standard Specification V1.2, NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW)

DCCEEW (2023). Yanco Creek System Operations Plan – Yanco Creek Modernisation Project (Working Draft – 31 August 2023), NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW)

Appendix A. DEM Verification

Verification of the combined DEM for the bathymetric portion was undertaken by comparing combined DEM levels to known points:

- Yanco Creek System Bathymetric survey (SKM, 2008)
- Bathymetry Survey of Billabong Creek, Hartwood Weir (2008)
- 2021 Surveyed cross sections (S1099 Harwood Weir and Pump Site Survey 11.02.22 REV A)

The extent and locality of each data source is shown in Figure A1. The output of the DEM verification analysis for each source above is shown individually as Figure A2, Figure A3 and Figure A4 respectively due to the varying quantity of points in each source. The verification analysis was conducted by subtracting the produced combined DEM elevation (2022) from the surveyed height points by draping the Z values from the combined DEM raster in QGIS. These figures show that there is generally quite good agreement between the adopted data sources and the combined DEM, with differences being described below. The fit of the combined DEM to the WfR 2007 bathymetric data (Figure A2) and Hartwood Weir bathymetric data (Figure A3) also demonstrate a good fit with around 50 % – 60 % of data points within ± 50 mm and about 75% - 80% of data points within ± 100 mm.

The comparison to the survey cross sections (Figure A4) does not provide as strong agreement with the DEM. This can be explained by reference to Figure A5 - Figure A8, which show the location of and compare three 2021 surveyed cross-sections to the combined DEM. At the compared locations, the combined DEM is largely based on the Hartwood Weir bathymetric survey (2008) and/or 12D generated bathymetry. A comparison of sections A, B and C from the 2021 survey (the locations of which are shown in Figure A5) to the combined DEM and underlying terrain sources are presented in Figure A6, Figure A7 and Figure A8 respectively. These figures show that the 2021 surveyed cross sections have greater spatial detail of the bed elevation across the entire channel compared to the Hartwood Weir bathymetry (2008) points, which had a series of points that were processed to create a surface for the combined DEM. This difference in data sources resulted in the combined DEM cross sections being slightly offset to the 2021 surveyed ones as observed in the figures below. Although they are not aligned, the invert and cross-sectional area of the sections are quite similar with the combined DEM only underestimating the cross-sectional area by 10 - 17%. This variance in the cross-sectional area is based on the three available discrete cross-sections from the 2021 survey around Hartwood Weir. In comparison, the bathymetric surface produced from the Hartwood Weir bathymetry survey (2008) covers much more area of the channel and still provides good correlation to the 2021 surveyed cross sections. As such, the bathymetric surface adopted in the combined DEM is considered appropriate for the current purposes.

Eighteen Mile Dam
Wilson Anabranch Offtake
Boonoke Weir
Warriston Weir
Hartwood Weir
Forest Creek Offtake
Piccaninny Weir
Nine Mile Dam
Parry Weir
Forest Creek Block Bank
McCaughey Block Dam
Piccaninny Pipe Offtake & Regulator
Lower Woolshed Weir
Piccaninny Offtake
Quiamong Weir
Drivers Weir

Legend

- Hydraulic Model Boundary
- Modelled significant structures

DEM Data Sources

- 12d created bathymetry
- 2007 SKM Bathymetry
- 2008 Hartwoods Weir
- 2007 Lidar within 2021 Lidar area
- 2022/23 Survey DTM
- Wilsons Anabranch Terrain Shaping

Note:
Areas outside available data sources above were based on 2021 LiDAR

N

GDA 2020 Zone 55
Scale: 1:200,000

0 4 8 km

DATA SOURCE:
NSW Map Data, 2021; Model layers, 3Rives, 2023; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Adopted DEM Data Sources (AppA)
"G:\21\12537654\GIS\Maps\Working\Yanco_Modernisation_H2P_Report_Figures_GDA2020.qgz"

Yanco Creek Modernisation: Hydraulic Modelling – Hartwood Weir to Piccaninny Weir Study Area
Figure A1: Adopted data sources for modelled DEM

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein. This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

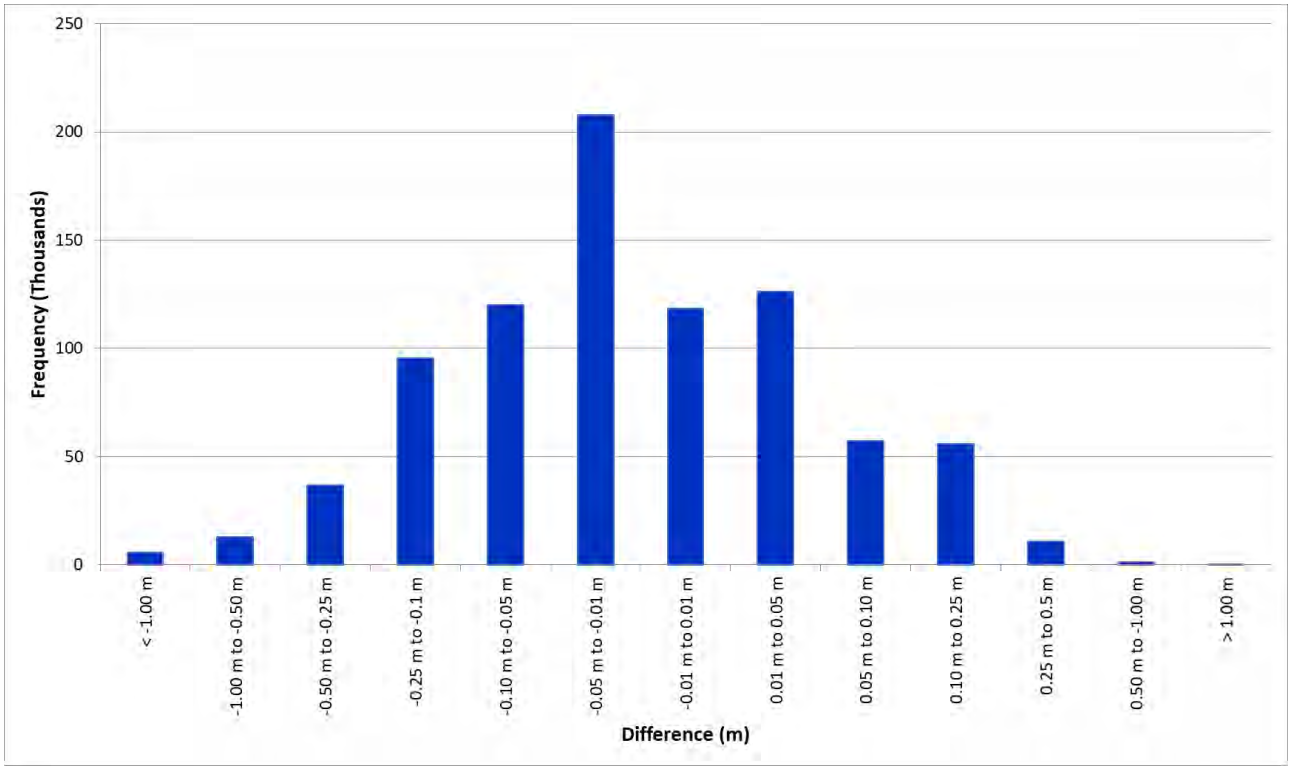


Figure A2: SKM 2008 Yanco Creek System Bathymetry Verification

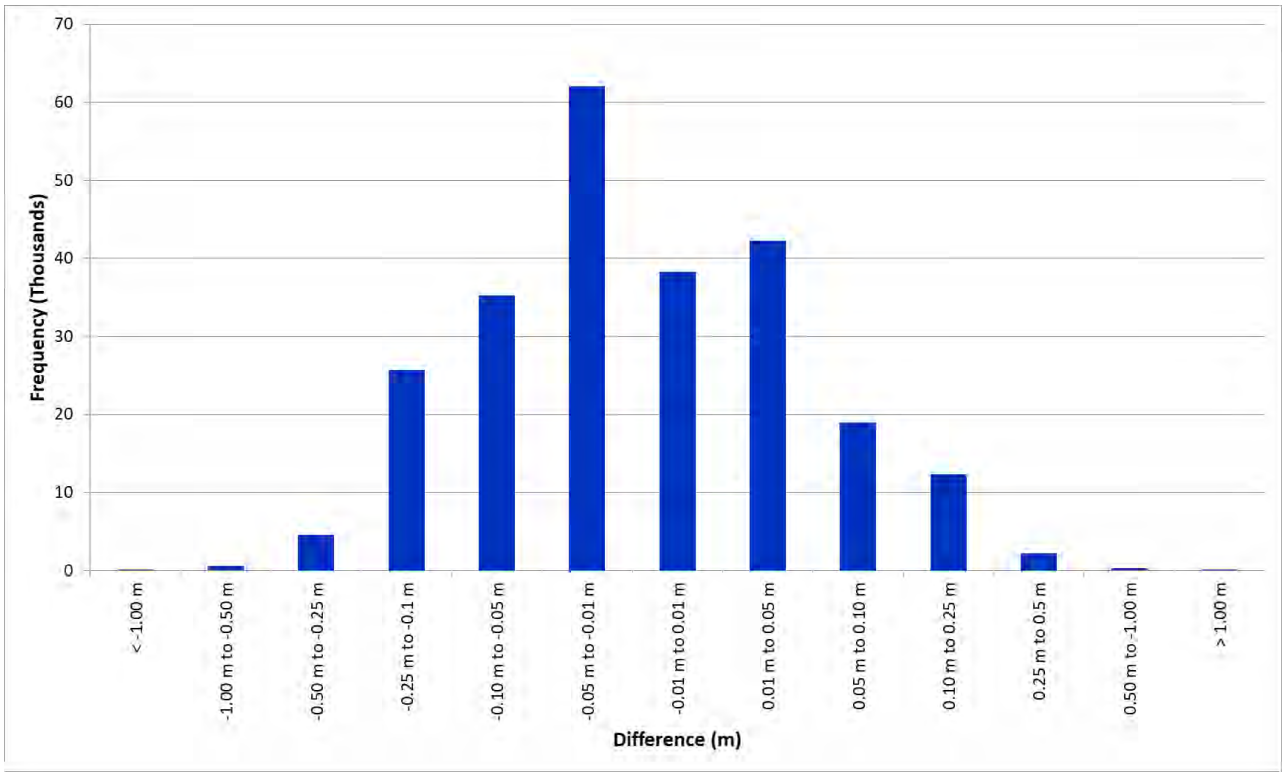


Figure A3: Bathymetry Survey of Billabong Creek, Hartwood Weir (2008) Verification

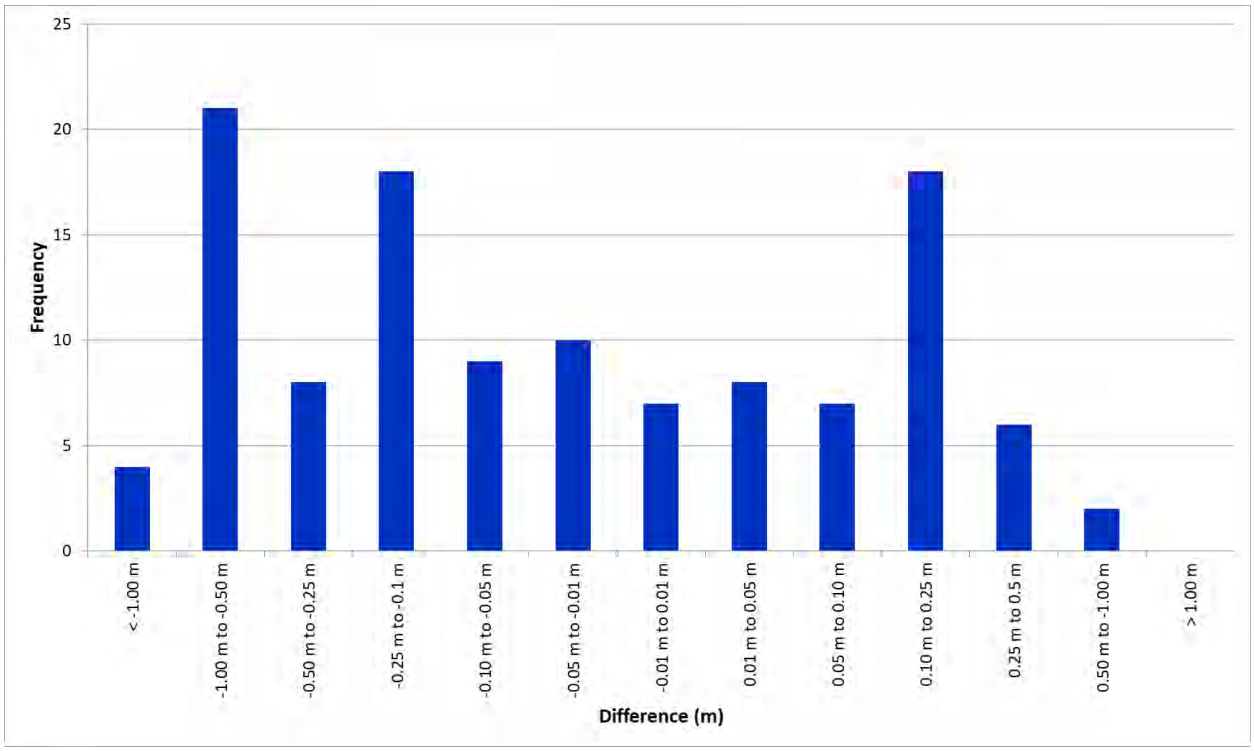


Figure A4: Hartwood Weir surveyed cross sections Verification

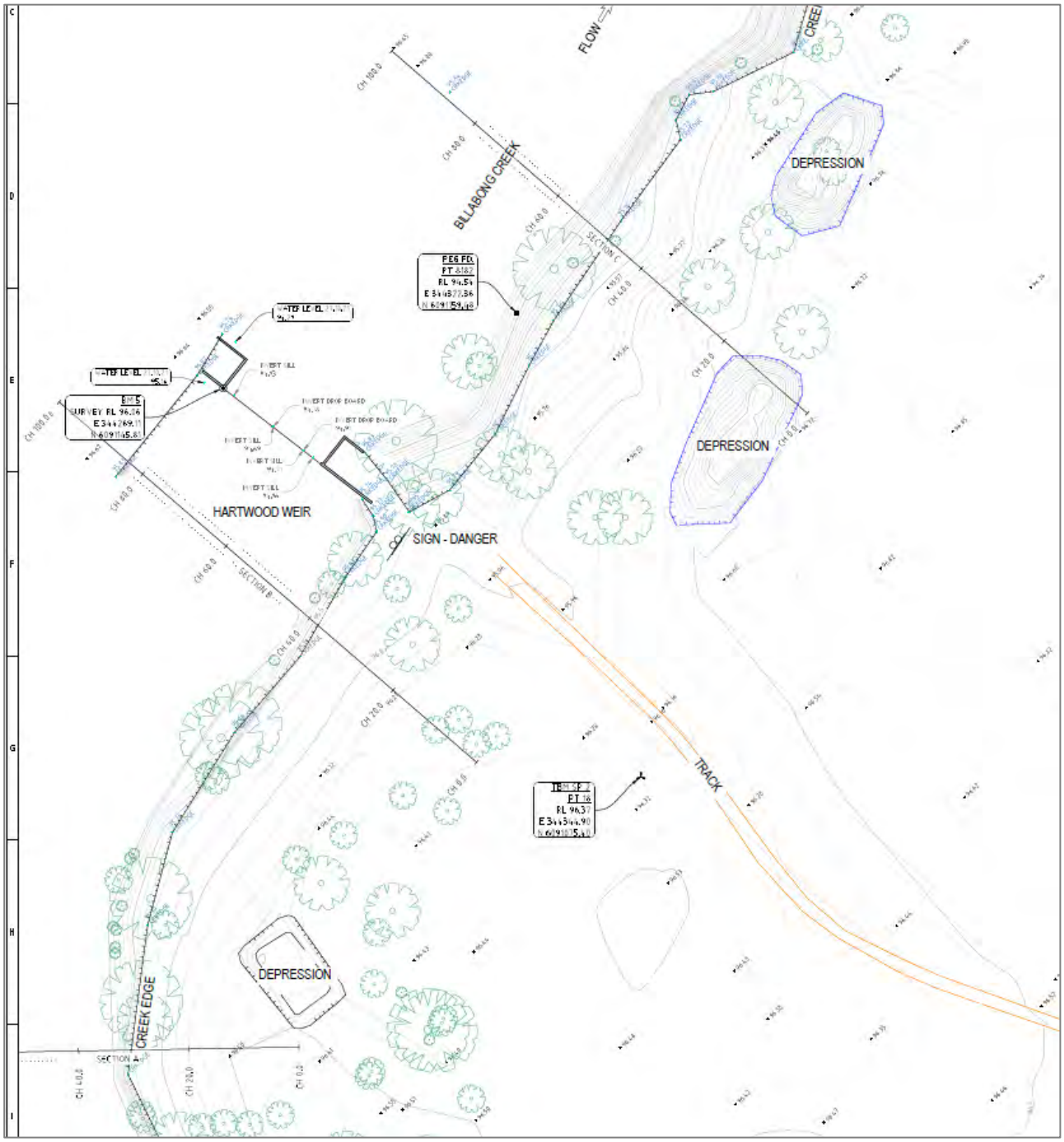


Figure A5: 2021 Surveyed cross section points (S1099 Hartwood Weir and Pump Site Survey Drawing No. 6435 Rev A, 2022)

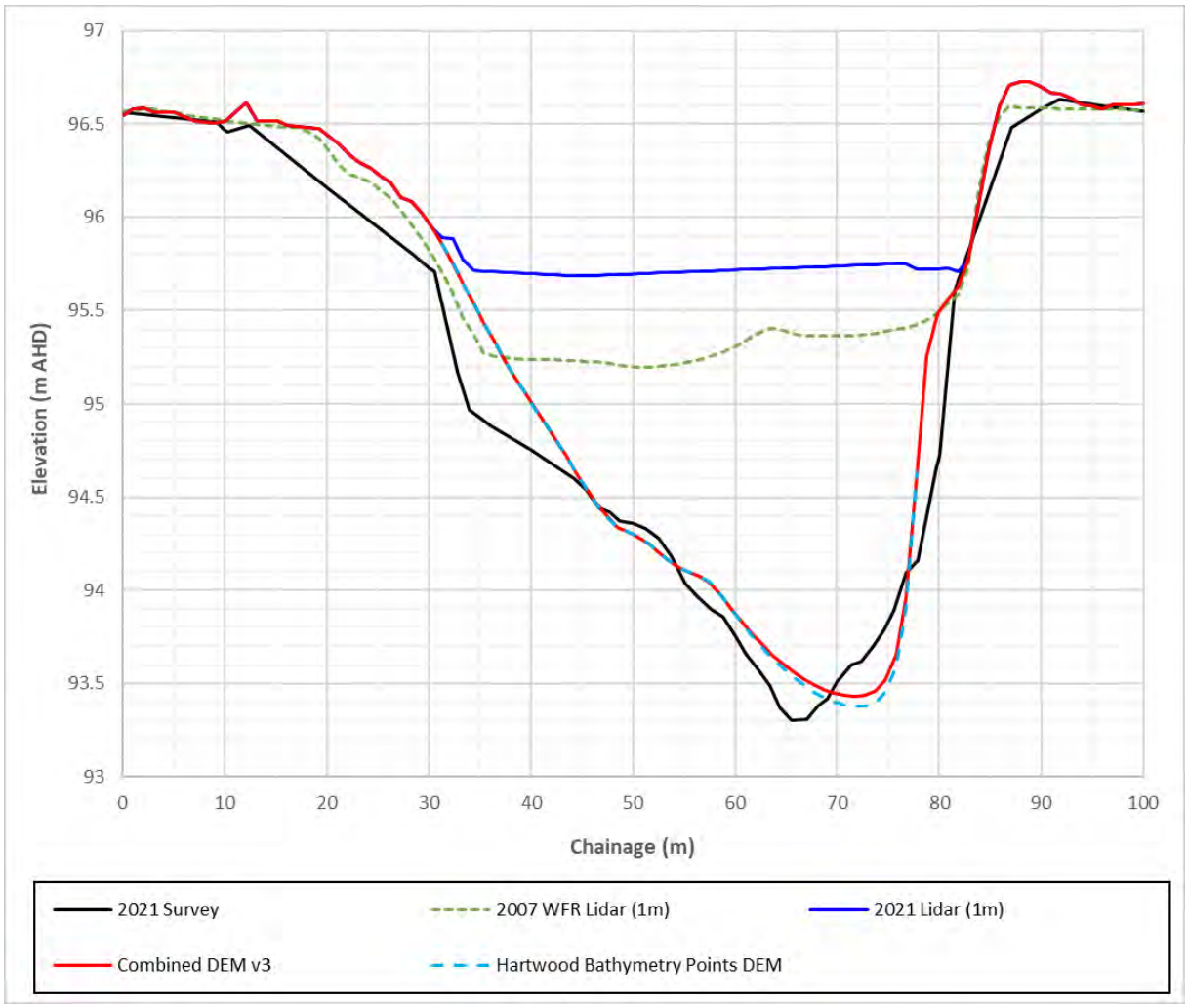


Figure A6: Comparison of data sources at Section A

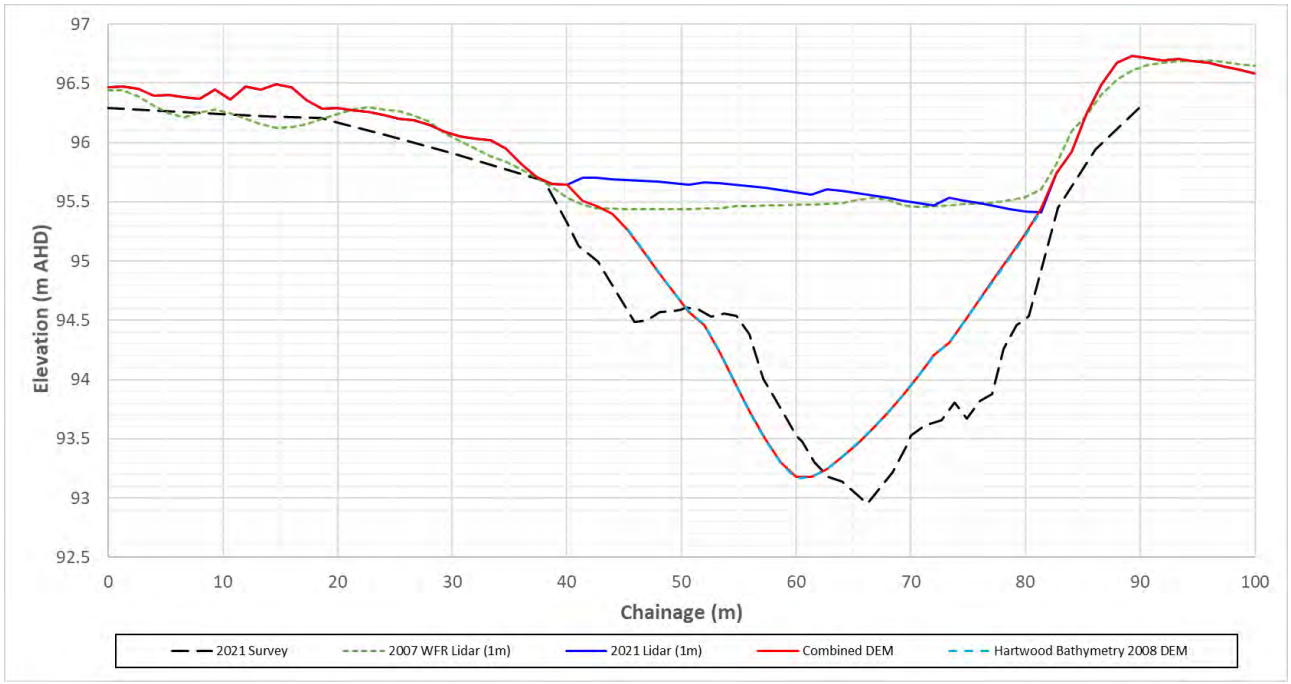


Figure A7: Comparison of data sources at Section B

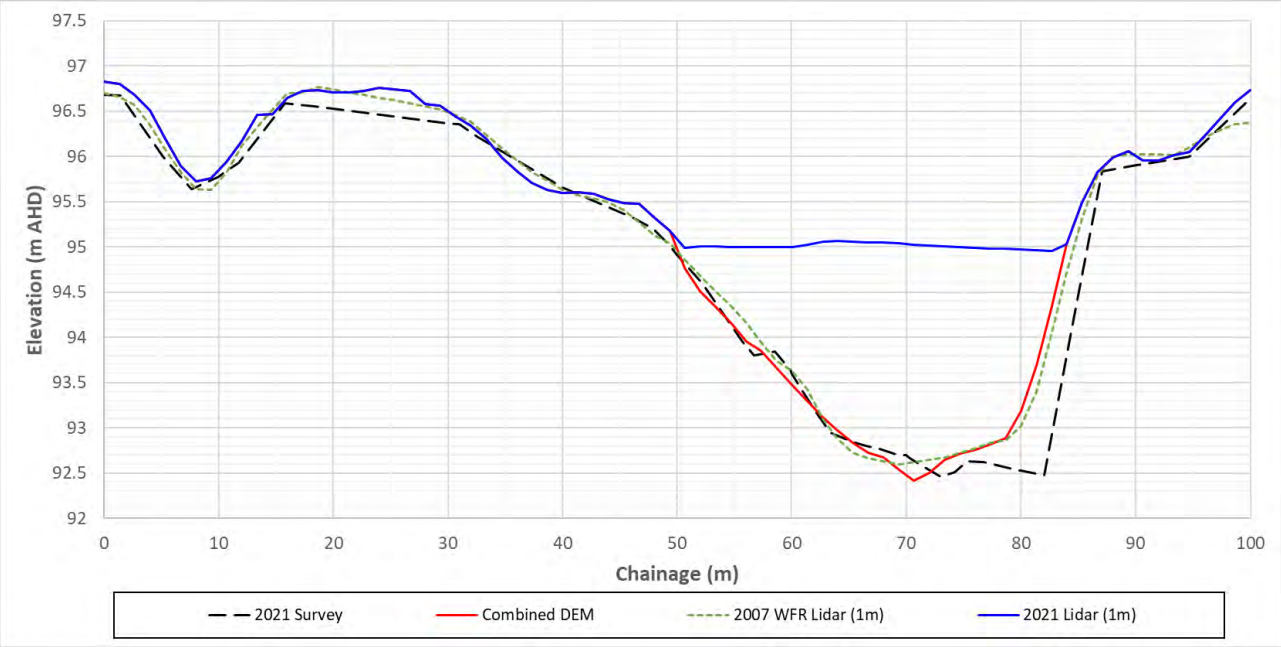
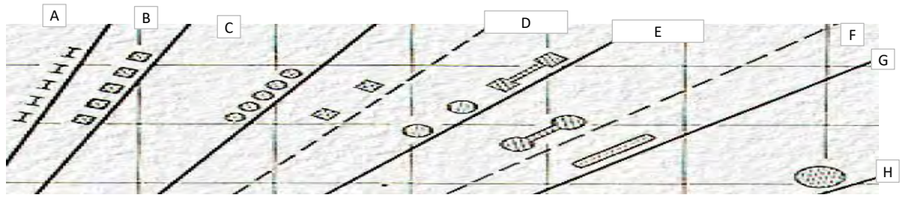


Figure A8: Comparison of data sources at Section C

Appendix B. Bridge loss calculation

BRIDGE LOSS CALCS FOR 2D_LFCSH

A	Row of I
B	Row of □
C	Row of ○
D	Two □
E	Two ○ OR Connected □
F	Connected ○
G	Single I
H	Single ○



Layer 1 FLC based on Bradley 1978

Bridge Name	*Pier Type*	*J (pier blockage)*	*ΔKp*	*Model Cell Size (m)*	*Bridge length - in direction of flow (m)*	*Cells to select in direction of flow (cells = cell side and centre in direction of flow)*	*Bridge length - in direction of flow as multiple of cells (m)*	*Bridge width - perpendicular to flow (m)*	*Bridge width in cells*	*Bridge width - in direction of flow as multiple of cells (m)*	*Peir Width (m)*	*Blocakge due to pier*	*Factored FLC*
Conargo Rd (Forest Ck)	B	0.026470588	0.126	16	9	1	16	34			0.9	0.026470588	0.007866
Access Bridge 12 over Billabong Creek	E	0.035714286	0.086	16	3	1	16	28			1	0.035714286	0.005366
Access Bridge 10 over Billabong Creek	E	0.02	0.045	16	7	1	16	30			0.6	0.02	0.045
Access Bridge DS of Kidman Way	C	0.032727273	0.110	16	4	1	16	55			1.8	0.032727273	0.006852
Wilsons Rd Crossing	B	0.019565217	0.086	16	8	1	16	46			0.9	0.019565217	0.086
Access Bridge over Yanco Creek	**B**	0.022727273	0.104	16	5	1	16	22			0.5	0.022727273	0.104
Carrathool Rd Crossing	B	0.015	0.066	16	7	1	16	20	**n/a**		0.3	0.015	0.004125
Boonoke Rd Bridge	B	0.041666667	0.216	16	6	1	16	48	**(2d_lfcsh represented**		2	0.041666667	0.216
Crossing over Forest Creek, DS of Drivers Weir	B	0.02	0.088	16	7	1	16	30	**as a line so losses**		0.6	0.02	0.0055
Crossing over Billabong, US of Lower Woolshed	E	0.022222222	0.051	16	6	1	16	45	**are not per m)**		1	0.022222222	0.051
Old bridge crossing Yanco Creek	E	0.077777778	0.211	16	4	1	16	45			3.5	0.077777778	0.211
Conargo Rd crossing DS of Forest Creek offtake	E	0.041666667	0.102	16	9	1	16	36			1.5	0.041666667	0.102
Crossing over Billabong Creek US of Piccaninny Weir	E	0.0225	0.052	16	3	1	16	40			0.9	0.0225	0.052
Yanco Bridge at Yanco Creek	E	0.033333333	0.080	16	9	1	16	60			2	0.033333333	0.080
Kidman Way Crossing	G	0.056603774	0.101	16	8	1	16	10.6			0.6	0.056603774	0.101
Quiamong Weir (Flood Scenarios Only)	A	0.015384615	0.085	16	5.4	1	16	19.5			0.3	0.015384615	0.085
Hartwood Regulator Mid_Xsect (Proposed Scenarios Only)	G	0	0.000	**Modelled as 1D channels**									0.000
Hartwood Regulator Trafficable Deck Xsect (Proposed Scenarios Only)	G	0.039544047	0.067										0.067

Layer 2 FLC adjustment required for 'PORTION' method

Bridge Name	*Layer Depths (m)*			*Target FLCs*			*Calculated FLCs at top of each layer if target values*			*Adjusted Layer 2 FLC*	*Calculated FLCs at top of each layer*		
	Layer 1	*Layer 2*	*Layer 3*	*Layer 1 (from above)*	*Layer 2*	*Layer 3*	*Layer 1*	*Layer 2*	*Layer 3*		*Layer 1*	*Layer 2*	*Layer 3*
Conargo Rd (Forest Ck)	0	0.7	1.2	0.126	1.5625	0	#DIV/0!	1.562500	0.575658	1.562500	#DIV/0!	1.5625	0.575658
Access Bridge 12 over Billabong Creek	0	0.5	0	0.086	1.5625	0	#DIV/0!	1.562500	1.562500	1.562500	#DIV/0!	1.5625	1.5625
Access Bridge 10 over Billabong Creek	0	0.9	0	0.045	1.5625	0	#DIV/0!	1.562500	1.562500	1.562500	#DIV/0!	1.5625	1.5625
Access Bridge DS of Kidman Way	0	0.4	1.5	0.110	1.5625	0	#DIV/0!	1.562500	0.328947	1.562500	#DIV/0!	1.5625	0.328947
Wilsons Rd Crossing	0	0.9	1	0.086	1.5625	0	#DIV/0!	1.562500	0.740132	1.562500	#DIV/0!	1.5625	0.740132
Access Bridge over Yanco Creek	0	0.9	0	0.104	1.5625	0	#DIV/0!	1.562500	1.562500	1.562500	#DIV/0!	1.5625	1.5625
Carrathool Rd Crossing	0	0.6	1	0.066	1.5625	0	#DIV/0!	1.562500	0.585938	1.562500	#DIV/0!	1.5625	0.585938
Boonoke Rd Bridge	0	0.7	1	0.216	1.5625	0	#DIV/0!	1.562500	0.643382	1.562500	#DIV/0!	1.5625	0.643382
Crossing over Forest Creek, DS of Drivers Weir	0	0.4	1	0.088	1.5625	0	#DIV/0!	1.562500	0.446429	1.562500	#DIV/0!	1.5625	0.446429
Crossing over Billabong, US of Lower Woolshed	0	0.9	0	0.051	1.5625	0	#DIV/0!	1.562500	1.562500	1.562500	#DIV/0!	1.5625	1.5625
Old bridge crossing Yanco Creek	0	0.9	1	0.211	1.5625	0	#DIV/0!	1.562500	0.740132	1.562500	#DIV/0!	1.5625	0.740132
Conargo Rd crossing DS of Forest Creek offtake	0	0.9	1	0.102	1.5625	0	#DIV/0!	1.562500	0.740132	1.562500	#DIV/0!	1.5625	0.740132
Crossing over Billabong Creek US of Piccaninny Weir	0	0.6	0.6	0.052	1.5625	0	#DIV/0!	1.562500	0.781250	1.562500	#DIV/0!	1.5625	0.78125
Yanco Bridge at Yanco Creek	0	0.8	0.8	0.080	1.5625	0	#DIV/0!	1.562500	0.781250	1.562500	#DIV/0!	1.5625	0.78125
Kidman Way Crossing	0	0.4	1	0.101	1.5625	0	#DIV/0!	1.562500	0.446429	1.562500	#DIV/0!	1.5625	0.446429
Quiamong Weir (Flood Scenarios Only)	0	0.7	0	0.085	1.5625	0	#DIV/0!	1.562500	1.562500	1.562500	#DIV/0!	1.5625	1.5625

FLCs applied to lfcsh objects for total structure FLC to be correctly calculated

Bridge Name	*'Whole cells' Length (m)*	*Factored Layer 1 FLC*	*Factored Layer 2 FLC*	*Factored Layer 3 FLC*		Method C Layer 2 FLC
Conargo Rd (Forest Ck)	1	**0.1259**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.1741**
Access Bridge 12 over Billabong Creek	1	**0.0859**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.2141**
Access Bridge 10 over Billabong Creek	1	**0.0450**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.2550**
Access Bridge DS of Kidman Way	1	**0.1096**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.1904**
Wilsons Rd Crossing	1	**0.0861**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.2139**
Access Bridge over Yanco Creek	1	**0.1040**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.1960**
Carrathool Rd Crossing	1	**0.0660**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.2340**
Boonoke Rd Bridge	1	**0.2158**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.0842**
Crossing over Forest Creek, DS of Drivers Weir	1	**0.0880**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.2120**
Crossing over Billabong, US of Lower Woolshed	1	**0.0508**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.2492**
Old bridge crossing Yanco Creek	1	**0.2113**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.0887**
Conargo Rd crossing DS of Forest Creek offtake	1	**0.1021**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.1979**
Crossing over Billabong Creek US of Piccaninny Weir	1	**0.0515**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.2485**
Yanco Bridge at Yanco Creek	1	**0.0797**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.2203**
Kidman Way Crossing	1	**0.1012**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.1988**
Quiamong Weir (Flood Scenarios Only)	1	**0.0846**	1.562500	**0**	LFCSH REPRESENTED AS LINE (APPLY FULL FLCs)	**0.2154**

Target Total FLC *0.3* *Adopted from max ratio for low set and min ratio for high set bridges as noted in TUFLOW release Notes*

TUFLOW DETAILS

Bridge Name	*Z*	*dz*	*Shape_Width*	*Shape_Options*	*L1_Obvert*	*L1_pBlockage*	*L1_FLC*	*L2_Depth*	*L2_pBlockage*	*L2_FLC*	*L3_Depth*	*L3_pBlockage*	*L3_FLC*
Conargo Rd (Frst Ck)	-99999			Method C	93	0	0.1259	0.7	100	0.1741	1.2	25	0
Access Bridge 12 over Billabong Creek	-99999			Method C	97.4	0	0.0859	0.5	100	0.2141	0	0	0
Access Bridge 10 over Billabong Creek	-99999			Method C	96.9	0	0.0450	0.9	100	0.2550	0	0	0
Access Bridge DS of Kidman Way	-99999			Method C	107.4	0	0.1096	0.4	100	0.1904	1.5	50	0
Wilsons Rd Crossing	-99999			Method C	105.9	0	0.0861	0.9	100	0.2139	1	40	0
Access Bridge over Yanco Creek	-99999			Method C	99.6	0	0.1040	0.9	100	0.1960	0	0	0
Carrathool Rd Crossing	-99999			Method C	95.7	0	0.0660	0.6	100	0.2340	1	50	0
Boonoke Rd Bridge	-99999			Method C	93.3	0	0.2158	0.7	100	0.0842	1	15	0
Crossing over Forest Creek, DS of Drivers Weir	-99999			Method C	95.3	0	0.0880	0.4	100	0.2120	1	10	0
Crossing over Billabong, US of Lower Woolshed	-99999			Method C	98.9	0	0.0508	0.9	100	0.2492	0	0	0
Old bridge crossing Yanco Creek	-99999			Method C	98.7	0	0.2113	0.9	100	0.0887	1	20	0
Conargo Rd crossing DS of Forest Creek offtake	-99999			Method C	97.5	0	0.1021	0.9	100	0.1979	1	50	0
Crossing over Billabong Creek US of Piccaninny Weir	-99999			Method C	91.5	0	0.0515* (applied as 0.0258)	0.6	100	0.2485	0.6	80	0
Yanco Bridge at Yanco Creek	-99999			Method C	109.8	0	0.0797	0.8	100	0.2203	0.8	25	0
Kidman Way Crossing	-99999			Method C	109	0	0.1012	0.4	100	0.1988	1	40	0
Quiamong Weir (Flood Scenarios Only)	-99999			Method C	94.46	1	0.0846	0.7	100	0.2154	0	0	0

Note: * indicates that although this FLC is higher that the one that was applied, the structure is away from the proposed works and was consistent between "Existing" and "Proposed" scenarios and is therefore unlilkely to influence the results presneted in this report.

Appendix C. Sensitivity afflux maps

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C1 - Sensitivity Testing: Model Grid Size - 8m grid model minus 16m grid model (Downstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_8mSGS)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C2 - Sensitivity Testing: Model Grid Size - 8m grid model minus 16m grid model (Upstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_8mSGS)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C3 - Sensitivity Testing: Downstream Boundary Slope - Double the baseline model assumption minus Baseline model (Downstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_DSBCSD)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C4 - Sensitivity Testing: Downstream Boundary Slope - Double the baseline model assumption minus Baseline model (Upstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_DSBCSD)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C5 - Sensitivity Testing: Downstream Boundary Slope - Half the baseline model assumption minus Baseline model (Downstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_DSBCSH)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C6 - Sensitivity Testing: Upstream Boundary Slope - Half the baseline model assumption minus Baseline model (Upstream)

Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_DSBCSH)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C7 - Sensitivity Testing: Catchment Roughness - Increase by 20% minus Baseline (Downstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_N102016_16mSGS_P20p)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C8 - Sensitivity Testing: Catchment Roughness - Increase by 20% minus Baseline (Upstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_N102016_16mSGS_P20p)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

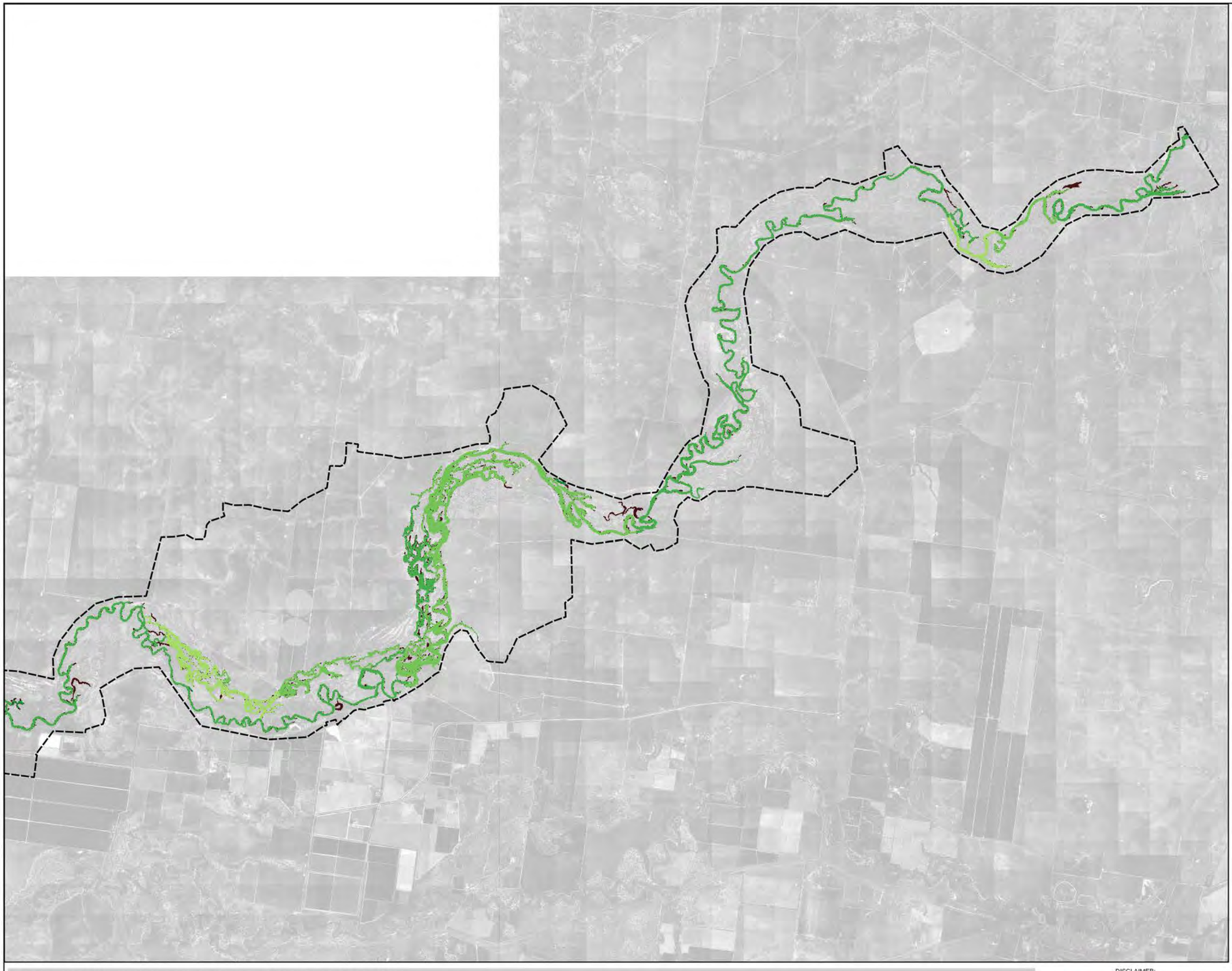
DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C9 - Sensitivity Testing: Catchment Roughness - Decrease by 20% minus Baseline (Downstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_N102016_16mSGS_M20p)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55

Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C10 - Sensitivity Testing: Catchment Roughness - Decrease by 20% minus Baseline (Upstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_N102016_16mSGS_M20p)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C11 - Sensitivity Testing: Volumetric Losses (VL) - Lower Bound VL minus Baseline VL (Downstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_VLL)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C12 - Sensitivity Testing: Volumetric Losses (VL) - Lower Bound VL minus Baseline VL (Upstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_VLL)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

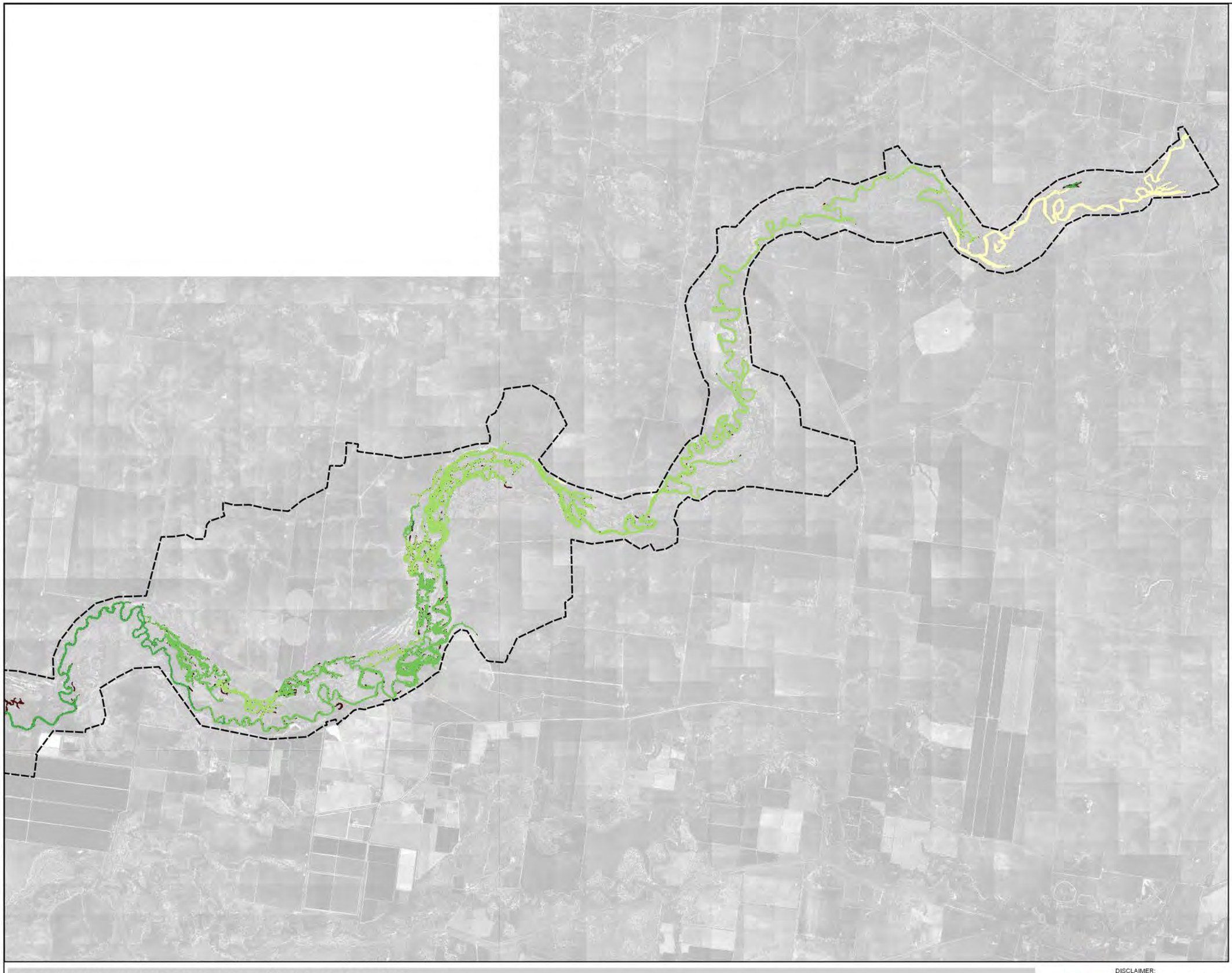
DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C13 - Sensitivity Testing: Volumetric Losses (VL) - Upper Bound VL minus Baseline VL (Downstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_VLU)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C14 - Sensitivity Testing: Volumetric Losses (VL) - Upper Bound VL minus Baseline VL (Upstream)

Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_VLU)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C15 - Sensitivity Testing: Structure Losses at Bridges - Layer 1 FLC increase 20% minus Baseline (Downstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_L102016_16mSGS_P20p)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C16 - Sensitivity Testing: Structure Losses at Bridges - Layer 1 FLC increase 20% minus Baseline (Upstream)

Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_L102016_16mSGS_P20p)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C17 - Sensitivity Testing: Structure Losses at Bridges - Layer 1 FLC decrease 20% minus Baseline (Downstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_L102016_16mSGS_M20p)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C18 - Sensitivity Testing: Structure Losses at Bridges - Layer 1 FLC decrease 20% minus Baseline (Upstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_L102016_16mSGS_M20p)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C19 - Sensitivity Testing: Pipe and Box Culvert Blockage - 50% Blockage minus Baseline model (with no blockage) (Downstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_50pB)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C20 - Sensitivity Testing: Pipe and Box Culvert Blockage - 50% Blockage minus Baseline model (with no blockage) (Upstream)

Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_50pB)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C21 - Sensitivity Testing: Parry's Weir Crest Level - Adopted sill level model minus Baseline model (weighted average dropboard level) (Downstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_PWS)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C22 - Sensitivity Testing: Parry's Weir Crest Level - Adopted sill level model minus Baseline model (weighted average dropboard level) (Upstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_PWS)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C23 - Sensitivity Testing: TUFLOW HPC Control Number Factor - Model with 0.5 factor applied minus Baseline model (Downstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_CF0p5)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 55
Scale 1: 105000

0 2 4 km

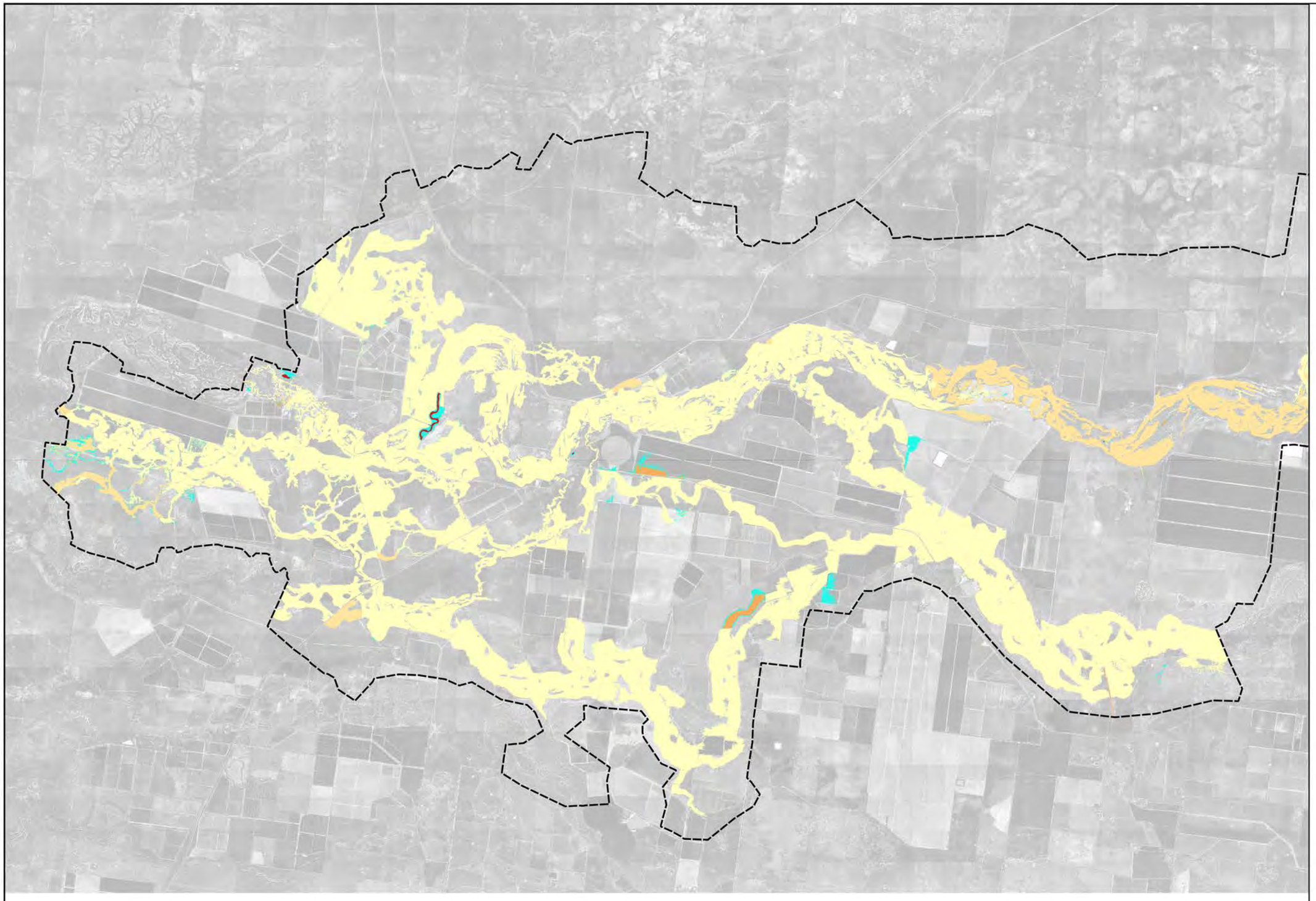
DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C24 - Sensitivity Testing: TUFLOW HPC Control Number Factor - Model with 0.5 factor applied minus Baseline model (Upstream)
Design Flow: Billabong Creek 2078 ML/d, Yanco Creek 1405 ML/d
(Model Run ID - YNC_WP19_A102016_16mSGS_CF0p5)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 56
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C25 - Sensitivity Testing: Steady versus Unsteady Inflows - Model with steady-state inflow applied minus model with unsteady inflow hydrograph (Upstream)
Design Flow: 1% AEP Billabong Dominant
(Model Run ID - YNC_WP19_B204007_Flood_16mSGS_Exist)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 57
Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C26 - Sensitivity Testing: Steady versus Unsteady Inflows - Model with steady-state inflow applied minus model with unsteady inflow hydrograph (Downstream)
Design Flow: 1% AEP Billabong Dominant
(Model Run ID - YNC_WP19_B204007_Flood_16mSGS_Exist)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 58
Scale 1: 105000

0 2 4 km

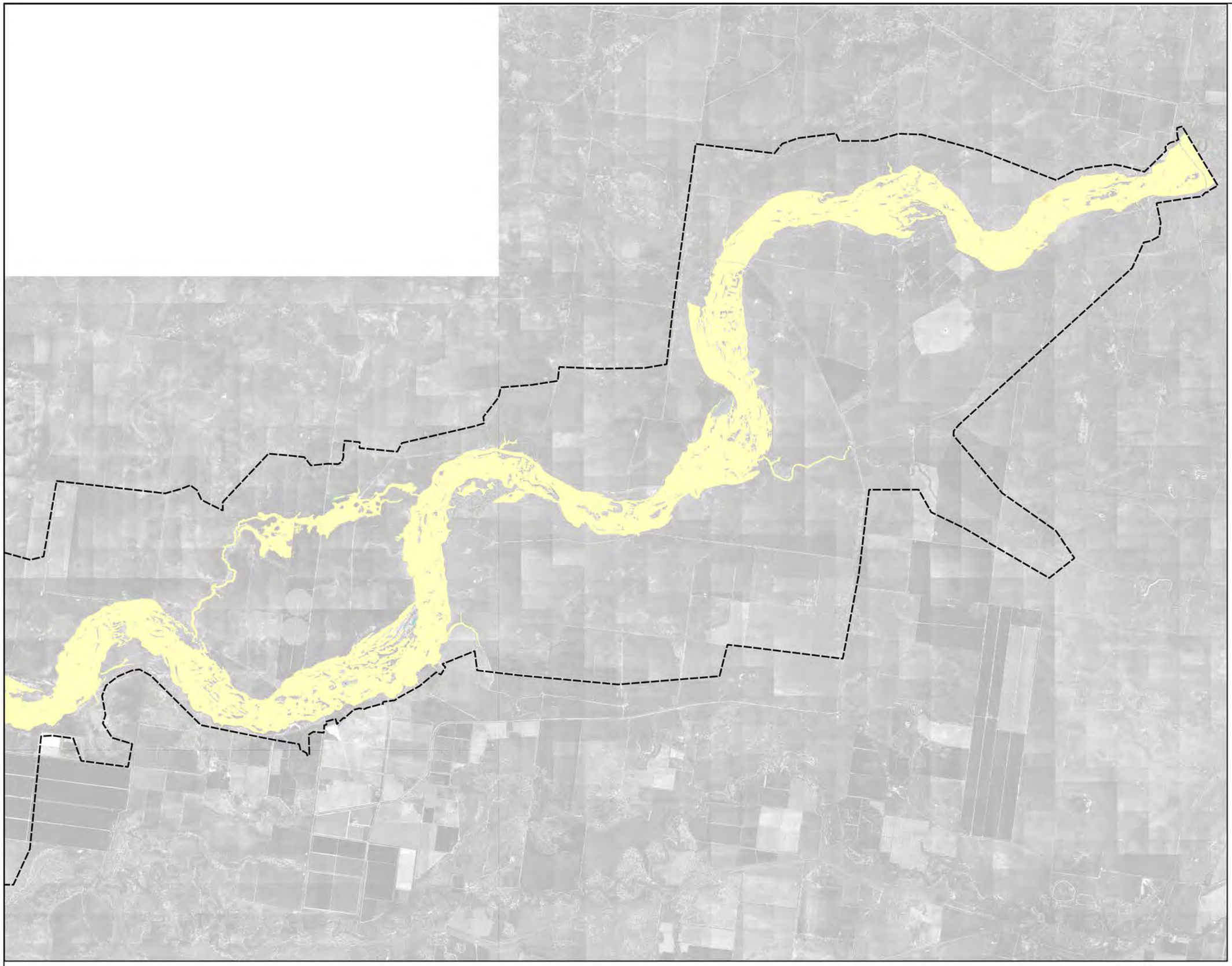
DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE C27 - Sensitivity Testing: Steady versus Unsteady Inflows - Model with steady-state inflow applied minus model with unsteady inflow hydrograph (Upstream)
Design Flow: 1% AEP Yanco Dominant
(Model Run ID - YNC_WP19_B204007_Flood_16mSGS_Exist)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Model Extent

Impact (m)

- <= -0.25
- <= -0.1 to -0.25
- <= -0.05 to -0.1
- <=-0.01 to -0.05
- <= -0.01 to 0.01
- <= 0.01 to 0.05
- <= 0.05 to 0.1
- <= 0.1 to 0.25
- >= 0.25
- Was wet now dry
- Was dry now wet

N

GDA 2020 Zone 59

Scale 1: 105000

0 2 4 km

DATA SOURCE:
NSW Map Data, 2021; Model layers and/or results, 3Rivers, 2022; Structures, Gauges and Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Sensitivity_Afflux_Maps
G:\21\12537654\GIS\Maps\Working\
AppC_Sensitivity_Afflux_Maps_v03.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator

FIGURE C28 - Sensitivity Testing: Steady versus Unsteady Inflows - Model with steady-state inflow applied minus model with unsteady inflow hydrograph (Downstream)

Design Flow: 1% AEP Yanco Dominant
(Model Run ID - YNC_WP19_B204007_Flood_16mSGS_Exist)

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Appendix D. Structure assumptions for Impact Assessment

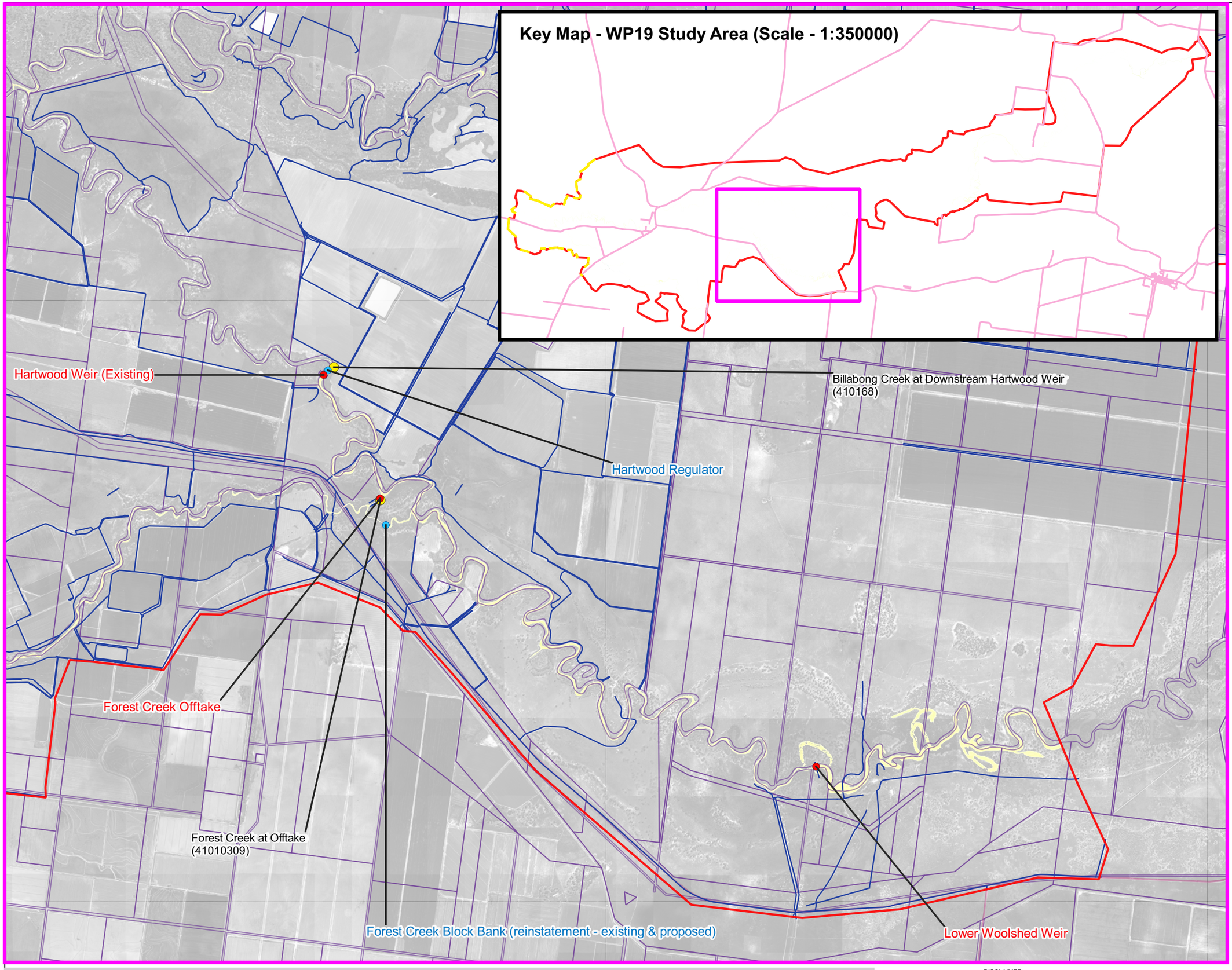
Table D1 – Consistent Assumptions for Key Structures in "Existing" and "Proposed" Scenarios

Scenario	Flow	Wilsons Anabranch Outlet Assumptions	Lower Woolshed Weir Crest (m AHD)	Forest Creek Offtake (FCO) Operation Assumptions [Assume sill of 93.59 m AHD based on 2023 survey]	Parry's Weir Crest (m AHD)	Drivers Weir Crest (m AHD)	Quiamong Weir Crest (m AHD)	Warriston Weir Crest (m AHD)	Bonooke Weir Crest (m AHD)	Piccaninny Weir Crest (m AHD)	Forest Creek Block Bank (FCBB) Crest (m AHD)
1a	MinOF (25 ML/day @ Hartwood - minimum base flow for Billabong Creek)	South - 0.45 m diameter RCP (black brute inner) North - 0.45 m diameter poly pipe (Also propose sensitivity with both these structure blocked for a select number of AEP events)	97.8 (assumes estimated sill based on terrain information and description in NSW Fisheries - Murray Weir Review)	Pass 10 ML/day (minimum base flow for Forest Creek)	94.959 (assumes weighted average dropboard level from 2010/11 survey)	93.893 (assumes weighted average dropboard level from 2010/11 survey)	93.42 (assumes weighted average dropboard level from 2010/11 survey)	92.17 (adopts sill from recent survey)	91.14 (assumes estimated sill based on terrain information, description in NSW Fisheries - Murray Weir Review, 2008 bathymetry and site inspection)	89.58 (assumes estimated sill based on 2021 survey and weir pool rating curve from SKM, 2007)	95.91 (based on reinstating existing block bank to a level to provide 100mm freeboard to MaxOL)
1b											
1c											
2a	MaxOFH (500 ML/day @ Hartwood)										
2b											
2c											
3	50% AEP			Fully Open (flows all have greater than 1200 ML/day passing Hartwood Weir - IWL also set based on gate being open in advance of flood)							
4	20% AEP										
5	10% AEP										
6	5% AEP										
7	2% AEP										
8	1% AEP										
9	0.5% AEP										
10	0.3% AEP										
11	0.2% AEP										
12	PMF										

Table D2 – Variable Assumptions for Key Structures in "Existing" and "Proposed" Scenarios

Scenario	Flow	Hartwood Weir						Forest Creek Returns		Wilsons Anabranch Offtake	
		Existing Harwtood Weir		Proposed Hartwood Weir							
		Existing	Proposed	Operations Assumptions [Weir Pool Level - m AHD]	# Active Gates	Gate Level (m AHD)	Fixed Crest Weir Level (m AHD)	Existing	Proposed Operation Assumptions (based on draft Operations Plan)	Existing (based on draft Operations Plan)	Proposed (based on draft Operations Plan)
1a	MinOF (25 ML/day @ Hartwood - minimum base flow for Billabong Creek)	Weir crest assumed to be at 95.28 m AHD (general shape based on 2021 survey with assumed weighted average dropboard level based on a regular scenario - calculated based on DPE observations 13/4/2022)	Remove weir between abutments to 93.5 m AHD	FSL [95.74]	1 (Gate passes 5 ML/day and fishway assumed to pass 20 ML/day)	95.68	95.84	0.68 m diameter culvert based on survey (US IL = 91.62 m AHD & DS IL = 91.77 m AHD)	Upstream control - assumes regulated flow so want to minimise spills over Warriston Weir. Minimum flow requirement (1 ML/day) and max flow of 50 ML/day still applies.	Closed (0.75 m RCP with DS gate) - also run with open	Closed (Lay flat gate US of 1.2 m x 1.2 m RCBC - gate sets maximum US WSL of 99.4 m AHD) - also run with open
1b				MaxOL [95.44]		95.38					
1c				MinOL [95.28]		95.22					
2a	MaxOFH (500 ML/day @ Hartwood)			FSL [95.74]	3 (Gates pass 480 ML/day and fishway assumed to pass 20 ML/day)	95.11					
2b				MaxOL [95.44]		94.81					
2c				MinOL [95.28]		94.65					
3	50% AEP	Weir crest assumed to be at sill level of 94.69 m AHD (based on 2021 survey)		Fully Open (IWL set based on gate being open in advance of flood)	5	92.7	95.84		Operation dependant on flow over Warriston Weir, as described below (based on revised operations plan): 1) Warriston Weir flow ≤ 500 ML/day = Minimum flow requirements on Piccaninny Creek (1 ML/day) - assumes unregulated flow scenario so want to maximise environmental water downstream of Warriston Weir (using environmental water). 2) Warriston Weir flow ≤ 1,000 ML/day = operate in downstream control at 50ML/day (the design flow rate of the structure) 3) Warriston Weir flow > 1,000 ML/day = regulator gate to be fully opened	Open (0.75 m RCP with DS gate)	Open (Lay flat gate US of 1.2 m x 1.2 m RCBC)
4	20% AEP										
5	10% AEP										
6	5% AEP										
7	2% AEP										
8	1% AEP										
9	0.5% AEP										
10	0.3% AEP										
11	0.2% AEP										
12	PMF										

Appendix E. Afflux Cumulative versus Hartwood Only



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

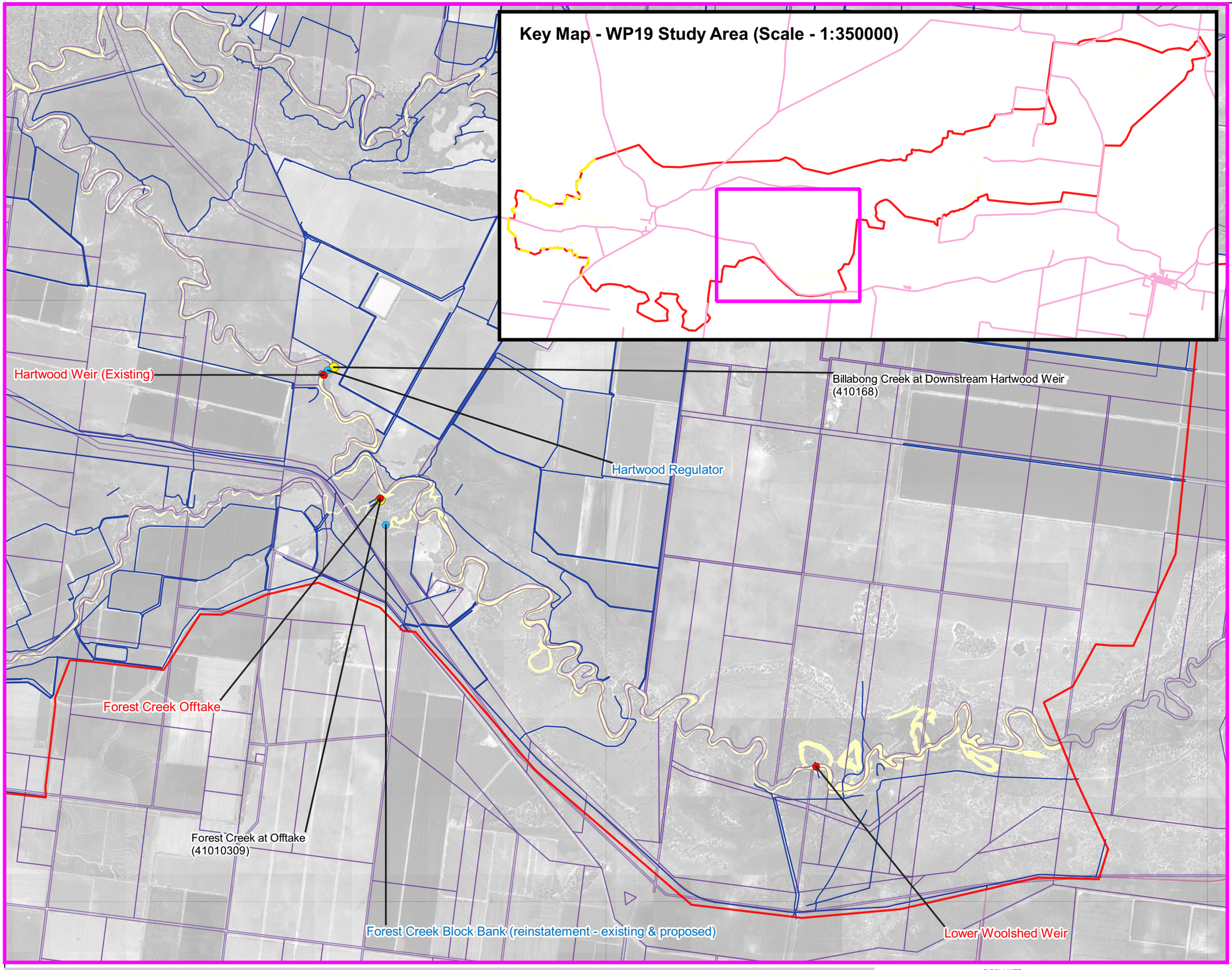
DATA SOURCE:
Properties, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Cumulative v HWO Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE E1 - Minimum Operating Flow (25 ML/day) Flood Impact Plot
"Proposed (Cumulative Works) at Minimum Operting Level" WSL - "Proposed (Hartwood Works Only) at Minimum Operting Level" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

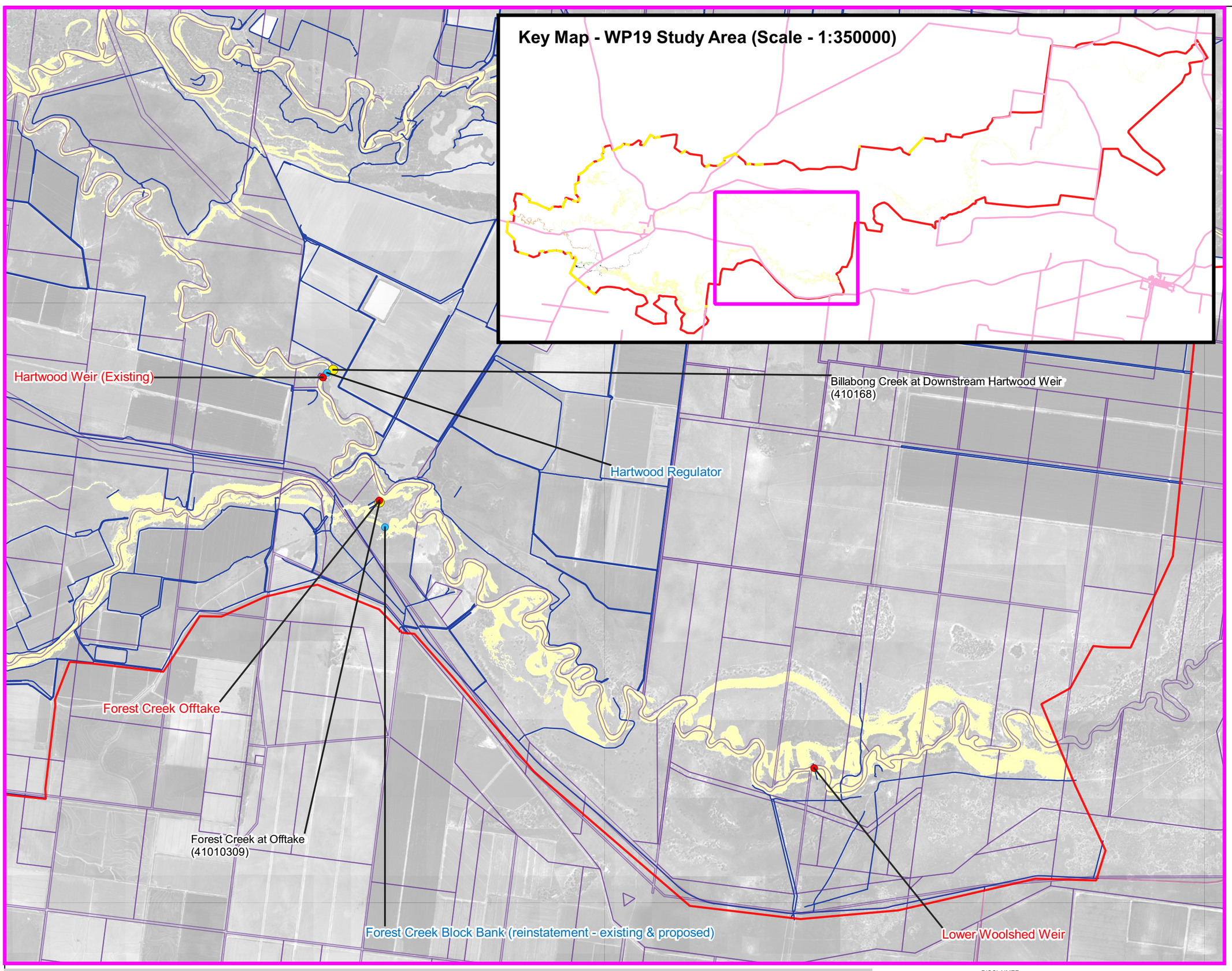
DATA SOURCE:
Properties, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Cumulative v HWO Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\
Appendix_EIS_Afflux_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE E2 - Maximum Operating Flow (500 ML/day) Flood Impact Plot
"Proposed (Cumulative Works) at Full Supply Level" WSL - "Proposed (Hartwood Works Only) at Full Supply Level" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

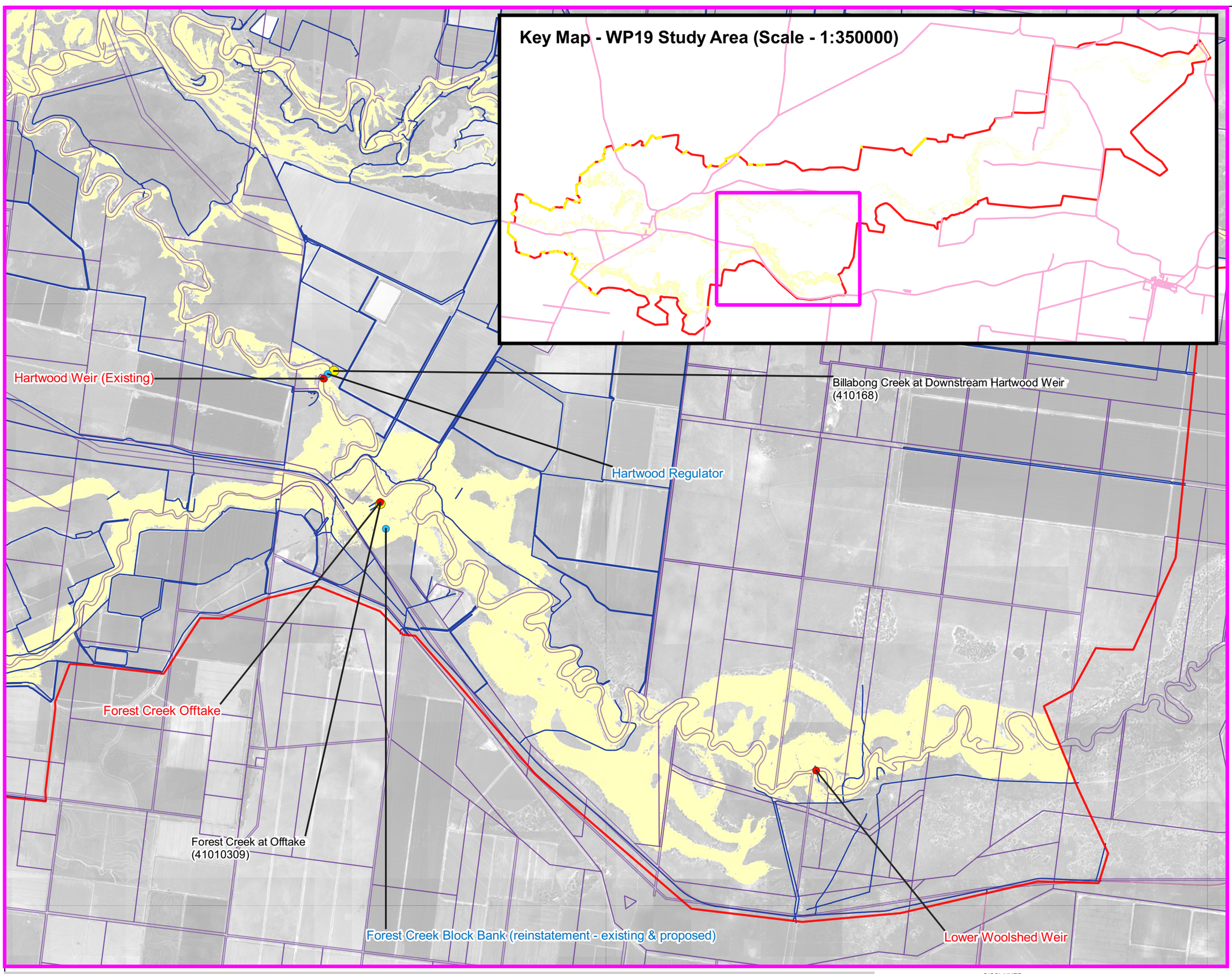
DATA SOURCE:
Properties, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Cumulative v HWO Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\
Appendix_EIS_Afflux_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE E3 - 20% AEP Billabong Dominant Flood Impact Plot
"Proposed (Cumulative Works)" WSL - "Proposed (Hartwood Works Only)" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

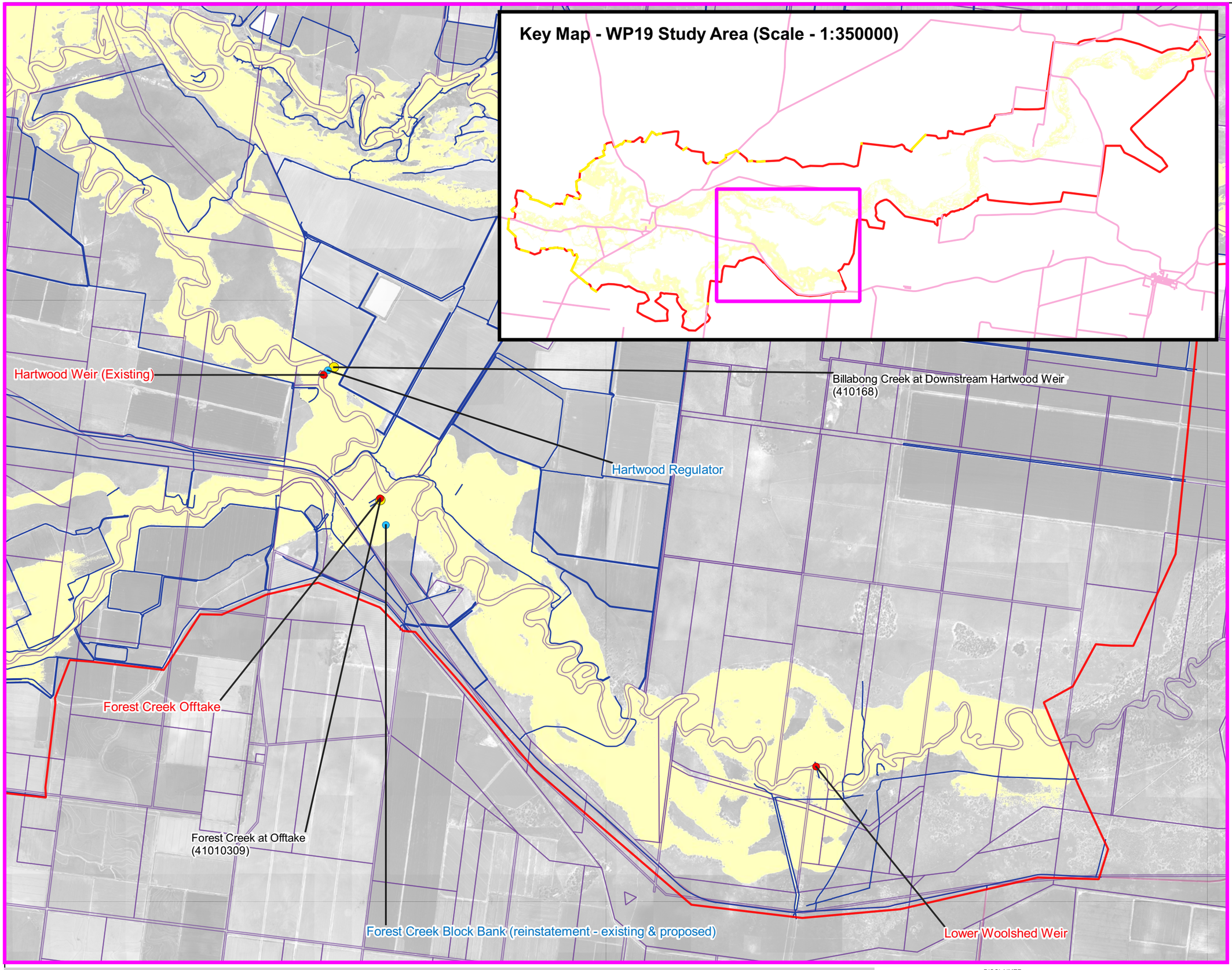
DATA SOURCE:
Properties, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Cumulative v HWO Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\
Appendix_EIS_Afflux_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE E4 - 5% AEP Billabong Dominant Flood Impact Plot
"Proposed (Cumulative Works)" WSL - "Proposed (Hartwood Works Only)" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Cumulative v HWO Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v01.qgz

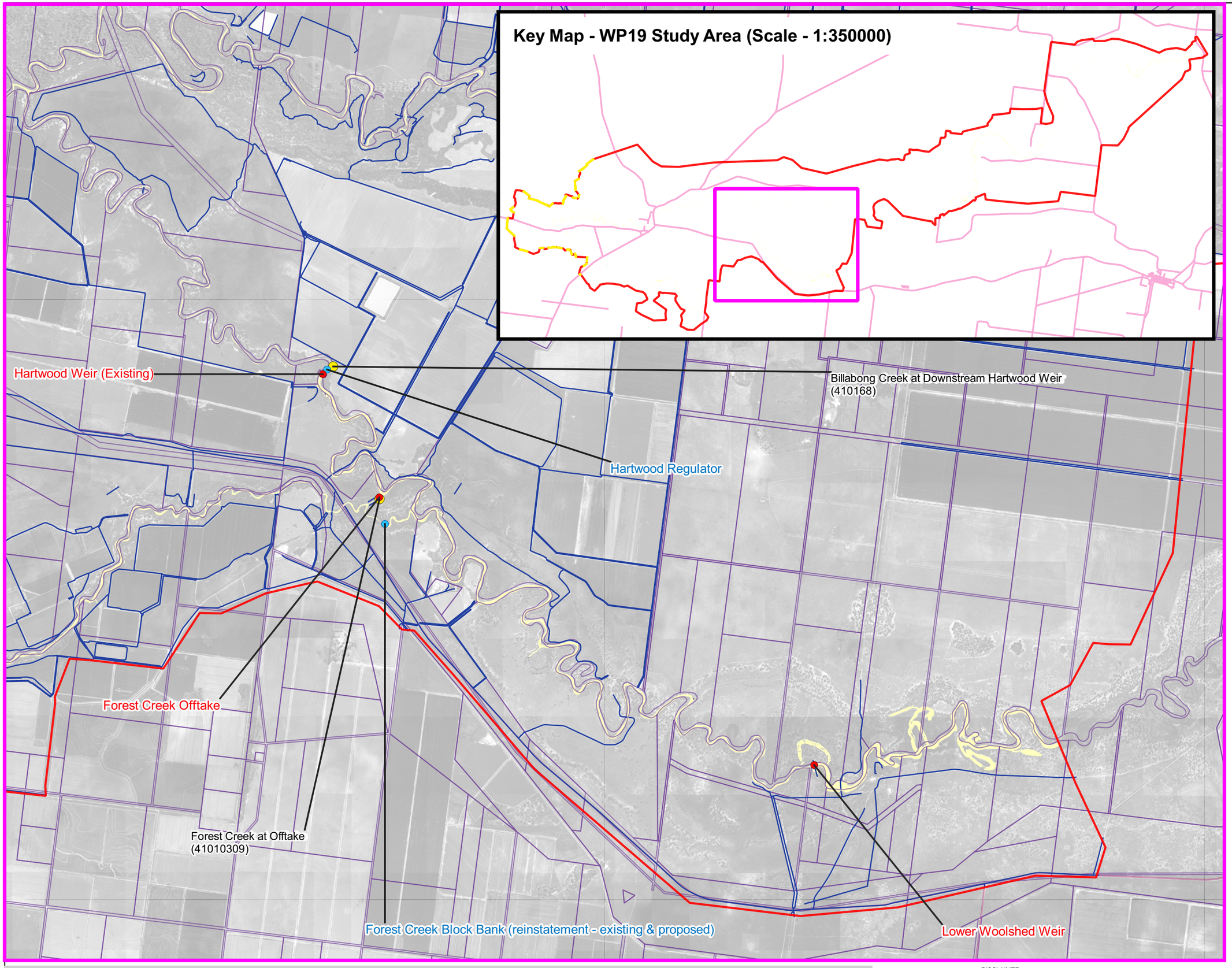
Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE E5 - 1% AEP Billabong Dominant Flood Impact Plot
"Proposed (Cumulative Works)" WSL - "Proposed (Hartwood Works Only)" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report – Hartwood Weir to Piccaninny Weir Study Area" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Appendix F. Impact Assessment – Operational Flow Scenarios

F1 Flood Impact Plots



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v02.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F1.1 - Minimum Operating Flow (25 ML/day) Flood Impact Plot
"Proposed at Minimum Operating Level" WSL - "Exisitng" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

F2 Depth Plots

Key Map - WP19 Study Area (Scale - 1:350000)

Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir
(410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake
(41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F2.1 - Minimum Operating Flow (25 ML/day) Depth Plot
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Key Map - WP19 Study Area (Scale - 1:350000)

Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir
(410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake
(41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

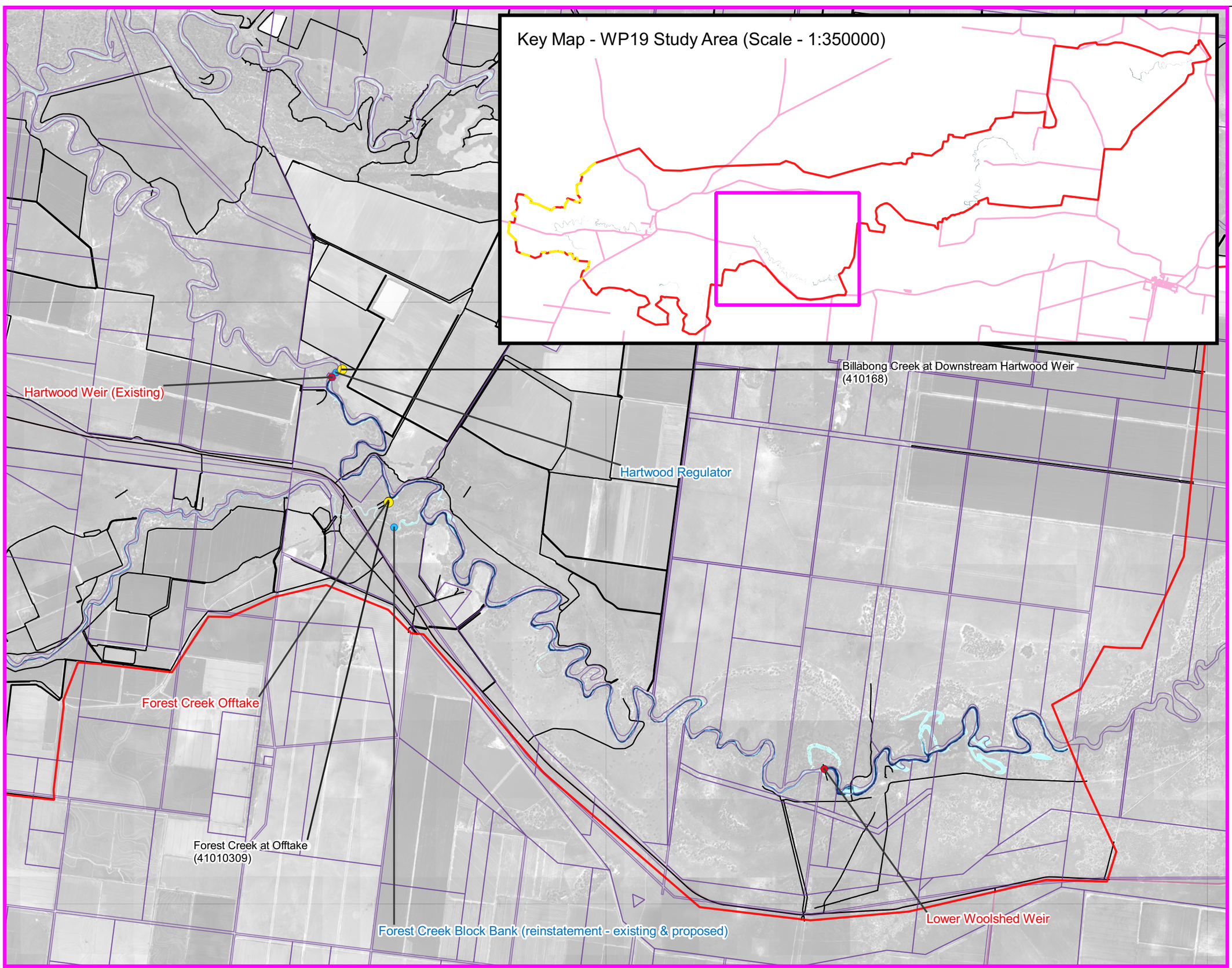
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F2.2 - Minimum Operating Flow (25 ML/day) Depth Plot
"Proposed at Minimum Operating Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F2.3 - Minimum Operating Flow (25 ML/day) Depth Plot
"Proposed at Maximum Operating Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Key Map - WP19 Study Area (Scale - 1:350000)

Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

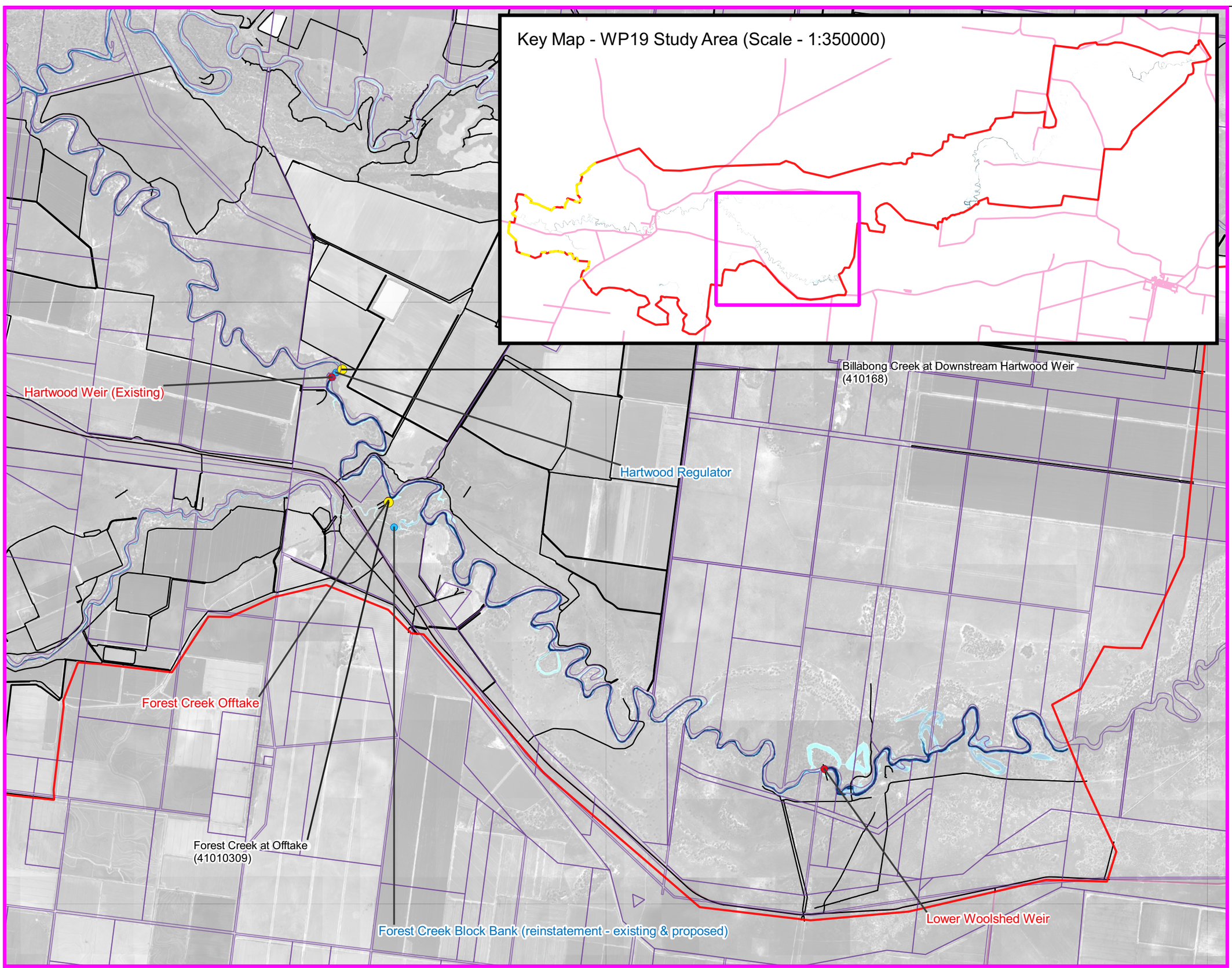
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F2.4 - Minimum Operating Flow (25 ML/day) Depth Plot
"Proposed at Full Supply Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F2.5 - Maximum Operating Flow (500 ML/day) Depth Plot
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Key Map - WP19 Study Area (Scale - 1:350000)

Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F2.6 - Maximum Operating Flow (500 ML/day) Depth Plot
"Proposed at Minimum Operating Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Key Map - WP19 Study Area (Scale - 1:350000)

Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F2.7 - Maximum Operating Flow (500 ML/day) Depth Plot
"Proposed at Maximum Operating Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Key Map - WP19 Study Area (Scale - 1:350000)

Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir
(410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake
(41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

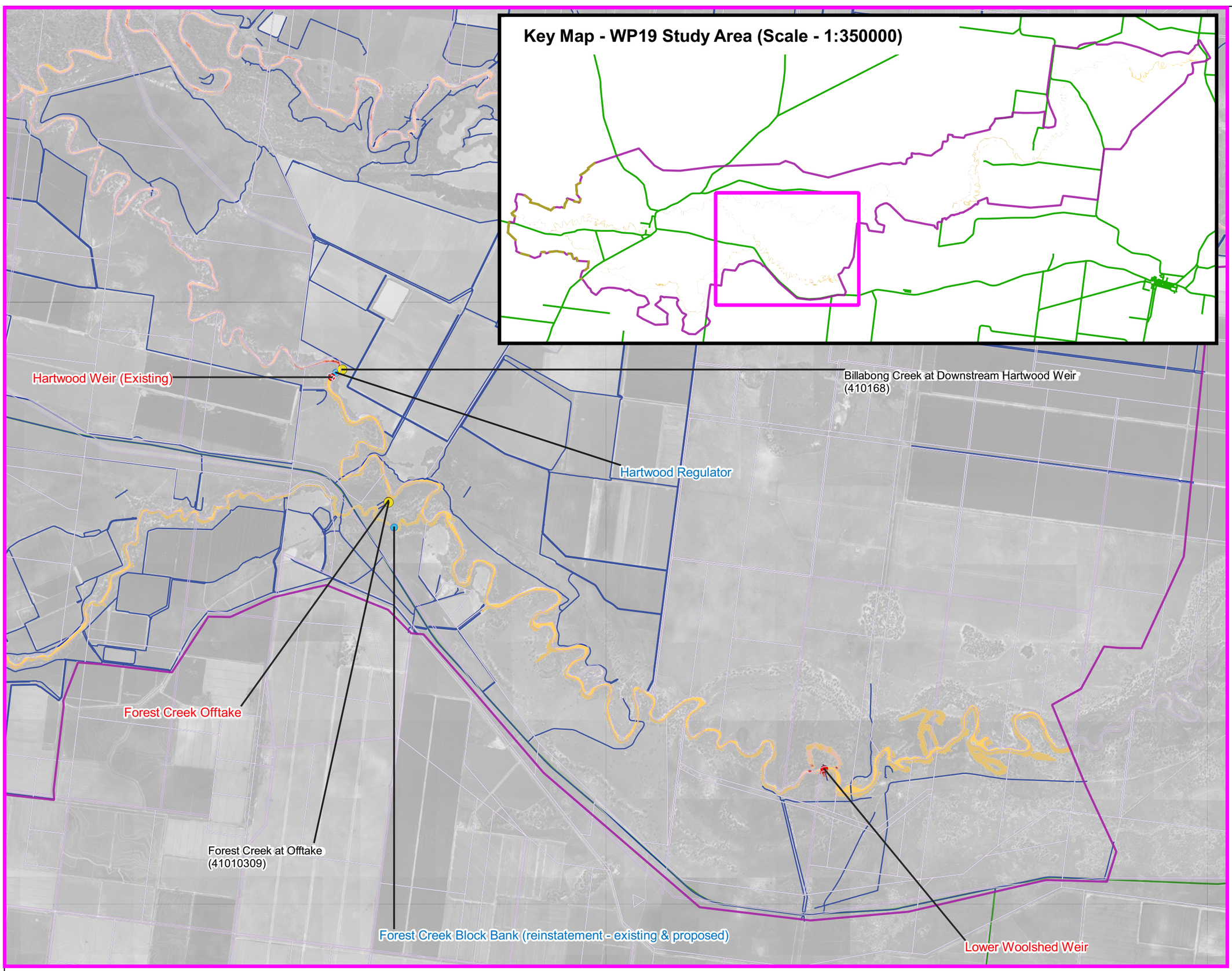
WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F2.8 - Maximum Operating Flow (500 ML/day) Depth Plot
"Proposed at Full Supply Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

F3 Velocity Plots



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

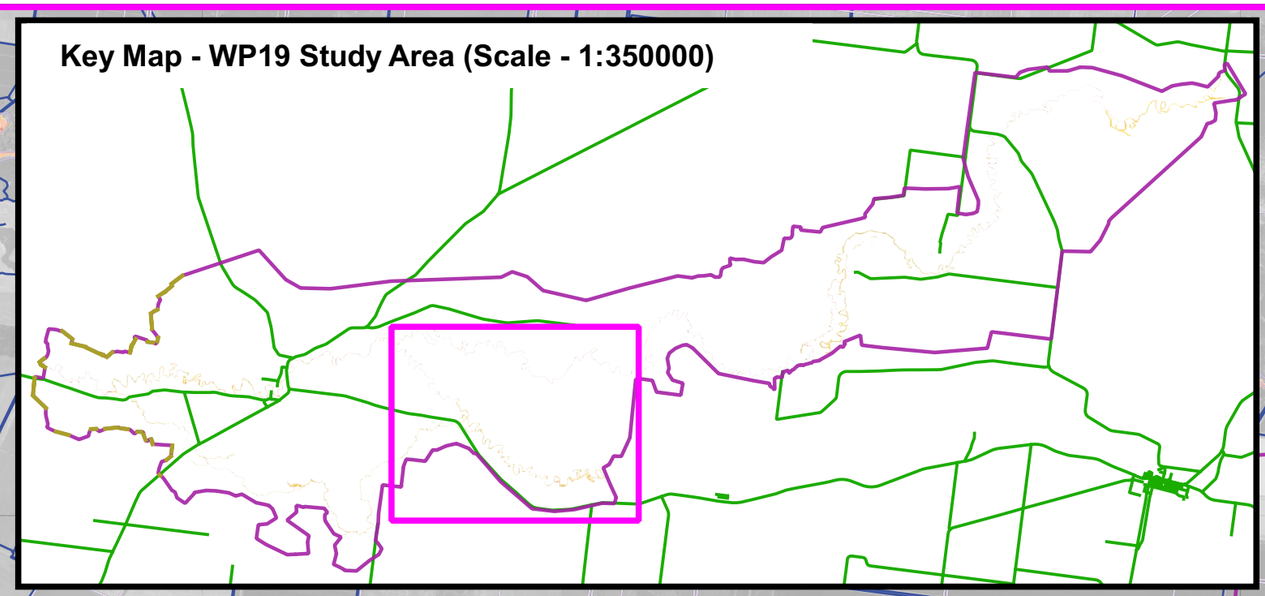
0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.
WORKSPACE:
Velocity Atlas Map Generator Operating flows G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Velocity_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F3.1 - Minimum Operating Flow (25 ML/day) Velocity Plot "Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

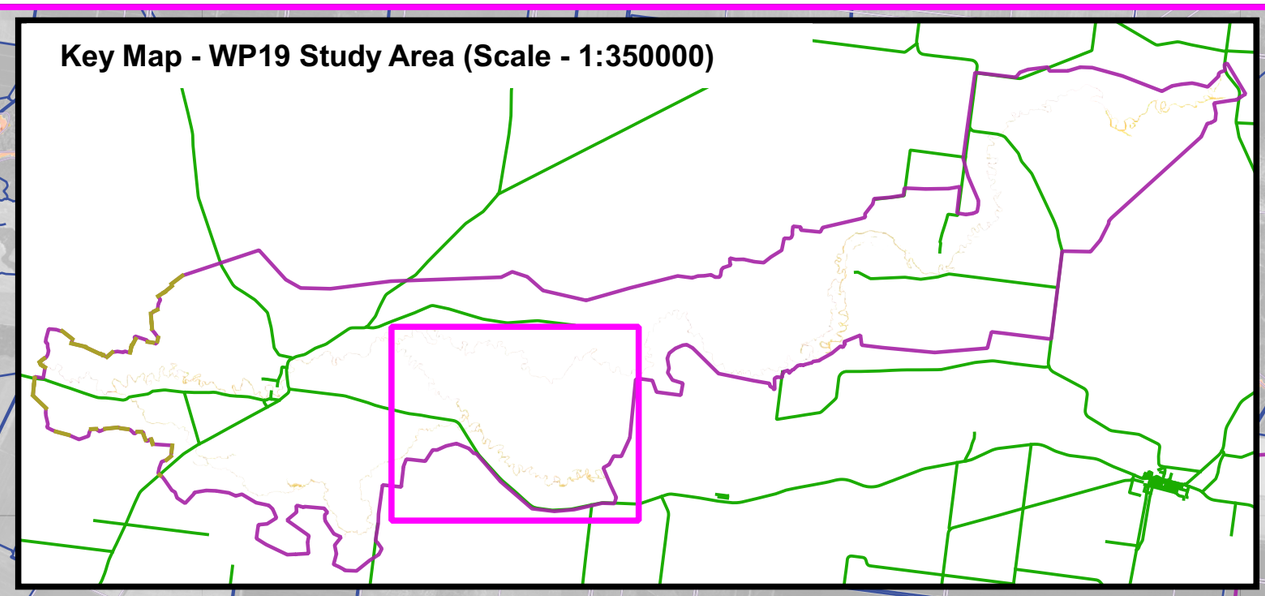
0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.
WORKSPACE:
Velocity Atlas Map Generator Operating flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Velocity_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F3.2 - Minimum Operating Flow (25 ML/day) Velocity Plot
"Proposed at Minimum Operating Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

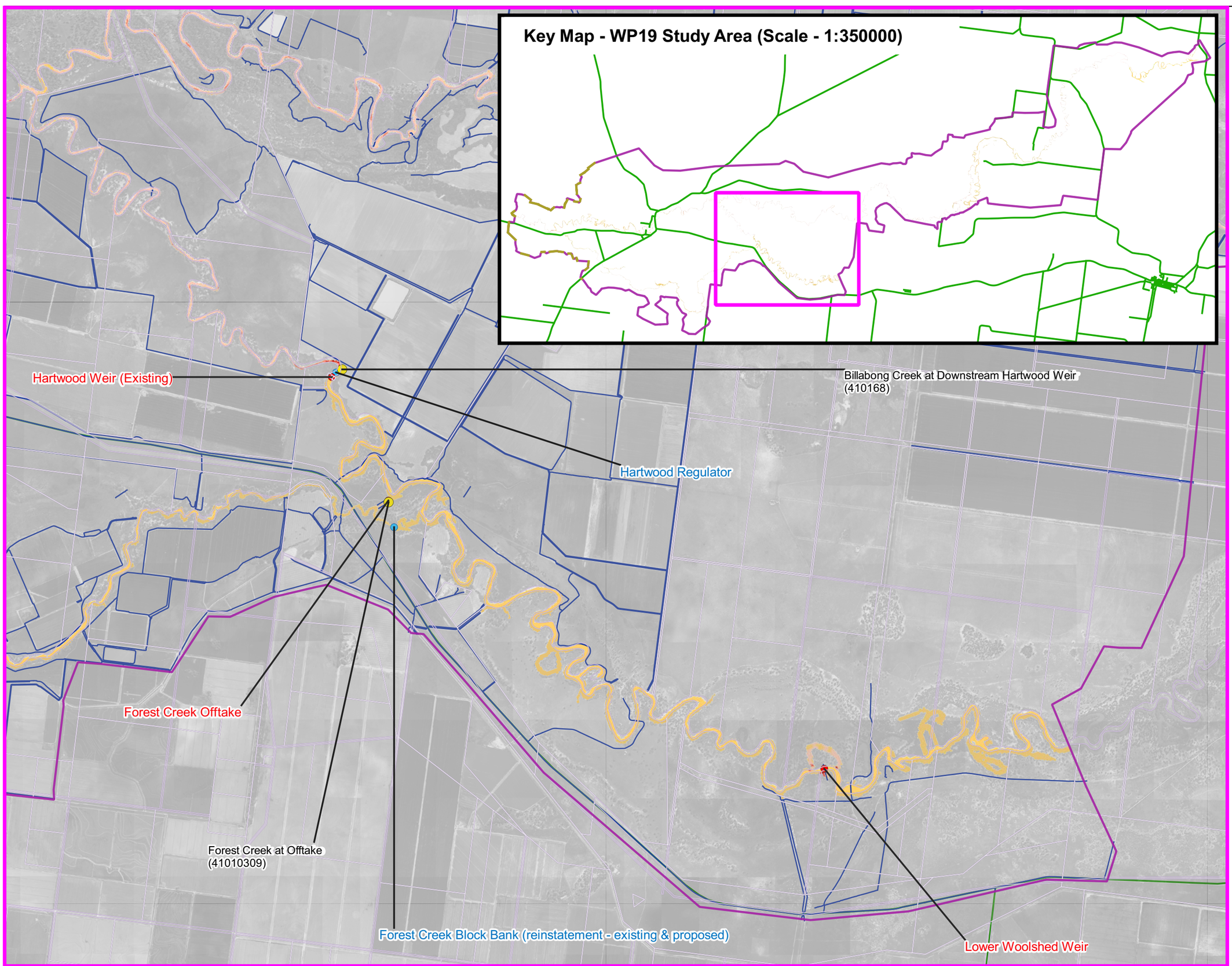
0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.
WORKSPACE:
Velocity Atlas Map Generator Operating flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Velocity_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F3.3 - Minimum Operating Flow (25 ML/day) Velocity Plot
"Proposed at Maximum Operating Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

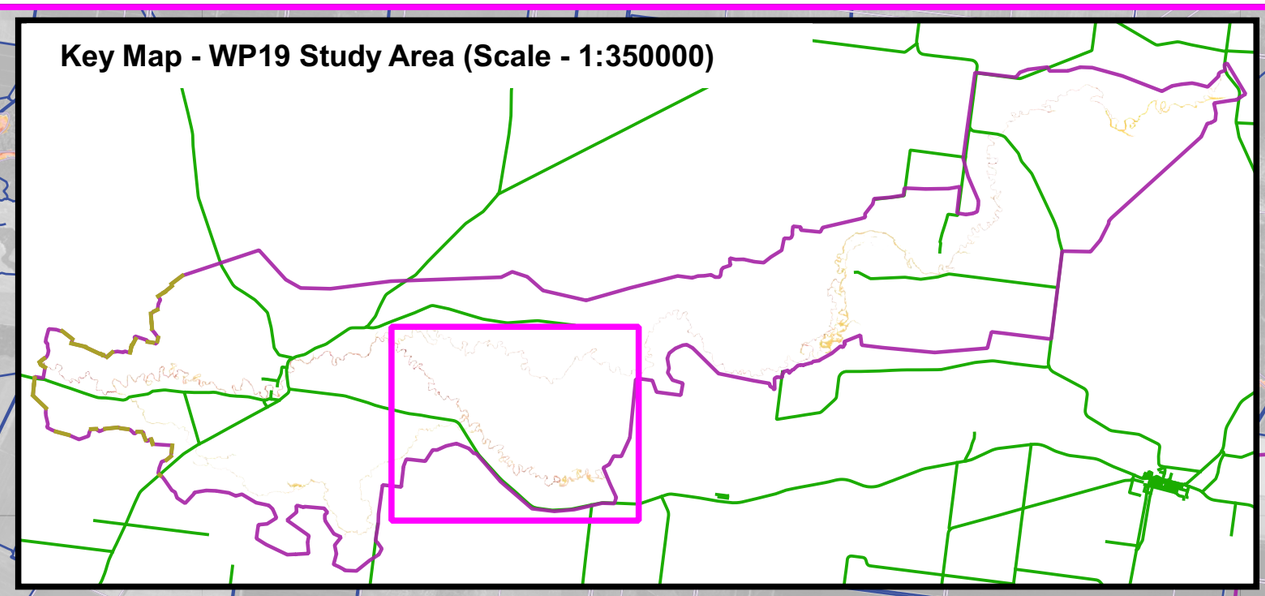
0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.
WORKSPACE:
Velocity Atlas Map Generator Operating flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Velocity_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F3.4 - Minimum Operating Flow (25 ML/day) Velocity Plot
"Proposed at Full Supply Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

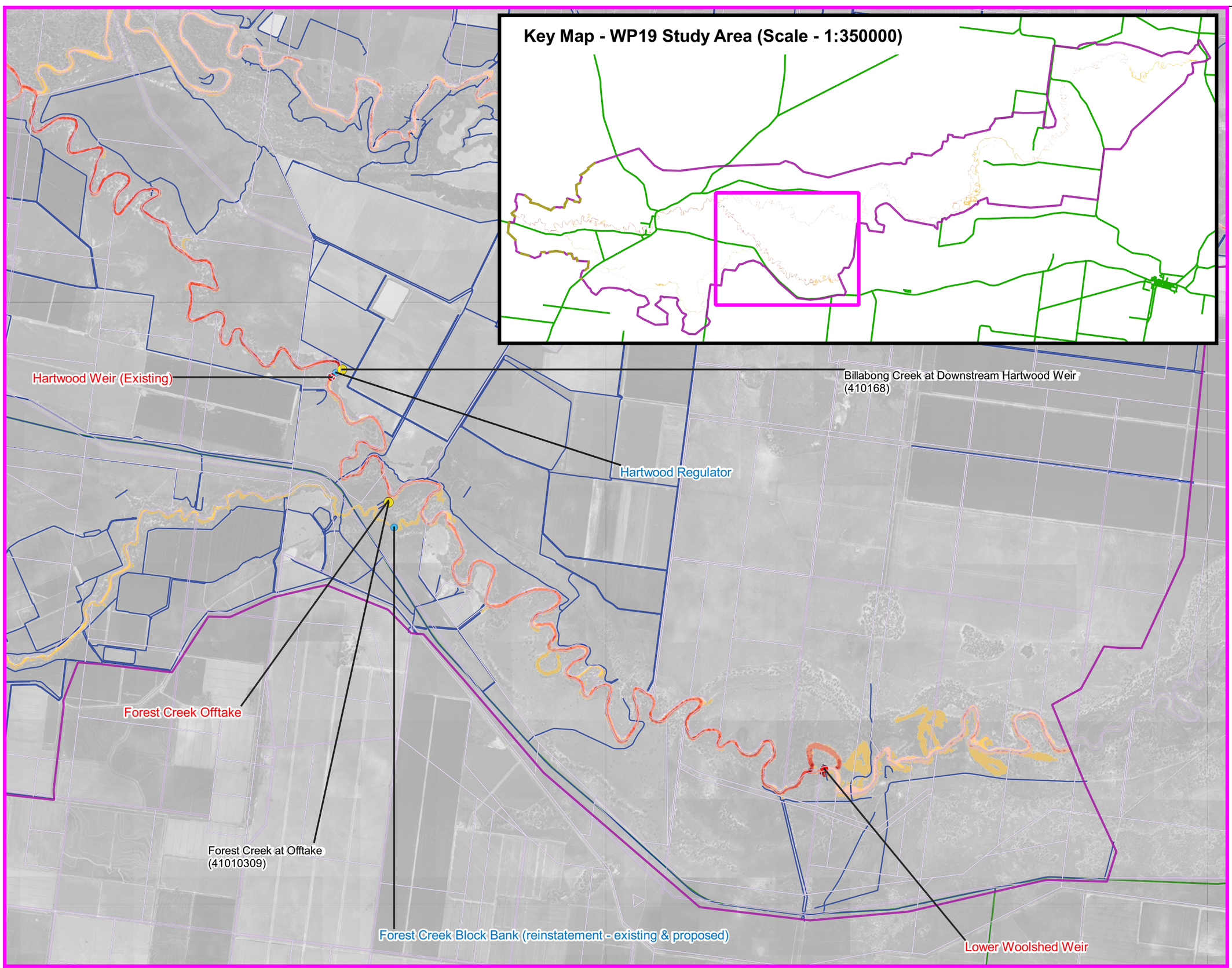
0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.
WORKSPACE:
Velocity Atlas Map Generator Operating flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Velocity_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F3.5 - Maximum Operating Flow (500 ML/day) Velocity Plot "Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

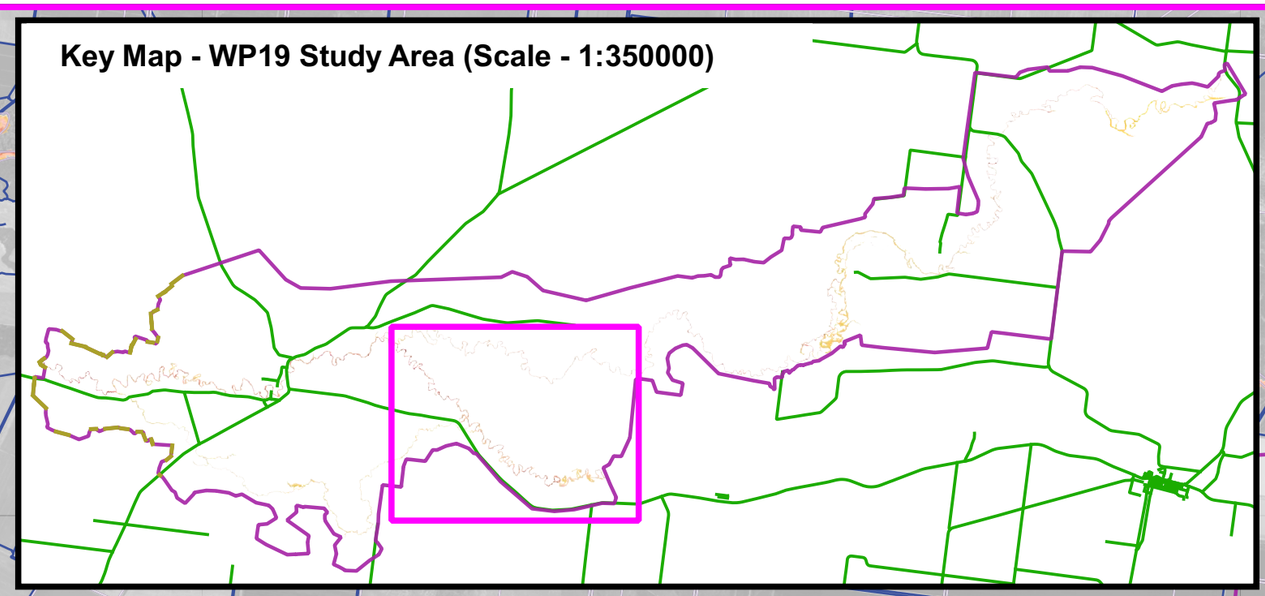
0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.
WORKSPACE:
Velocity Atlas Map Generator Operating flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Velocity_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F3.6 - Maximum Operating Flow (500 ML/day) Velocity Plot
"Proposed at Minimum Operating Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

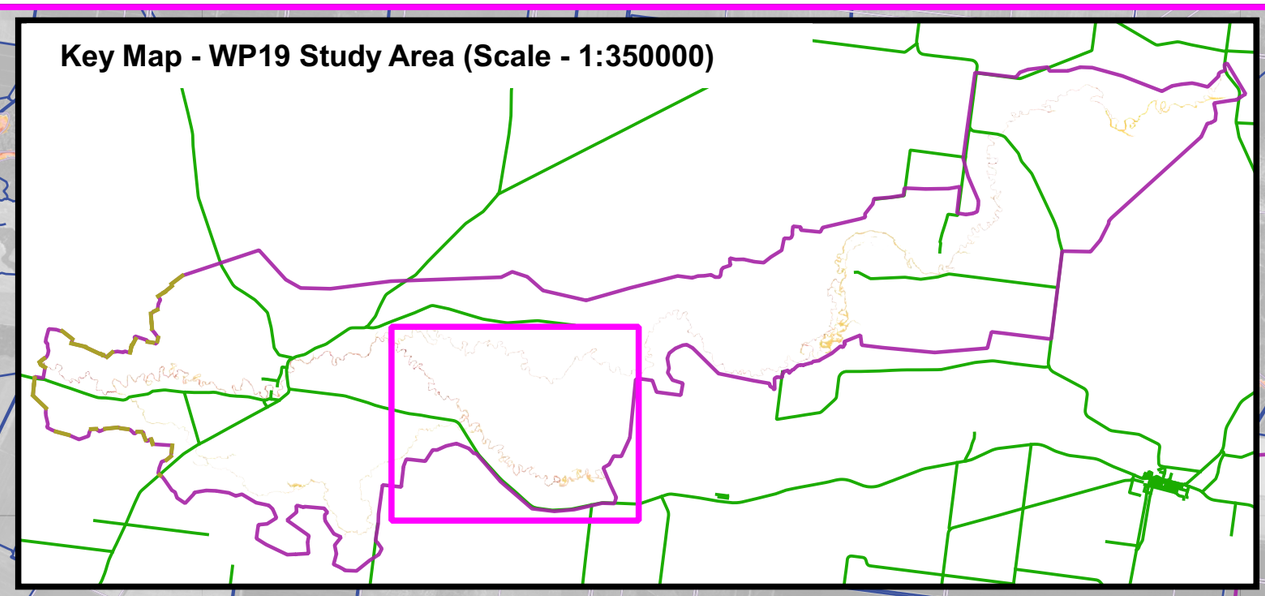
0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.
WORKSPACE:
Velocity Atlas Map Generator Operating flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Velocity_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F3.7 - Maximum Operating Flow (500 ML/day) Velocity Plot
"Proposed at Maximum Operating Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

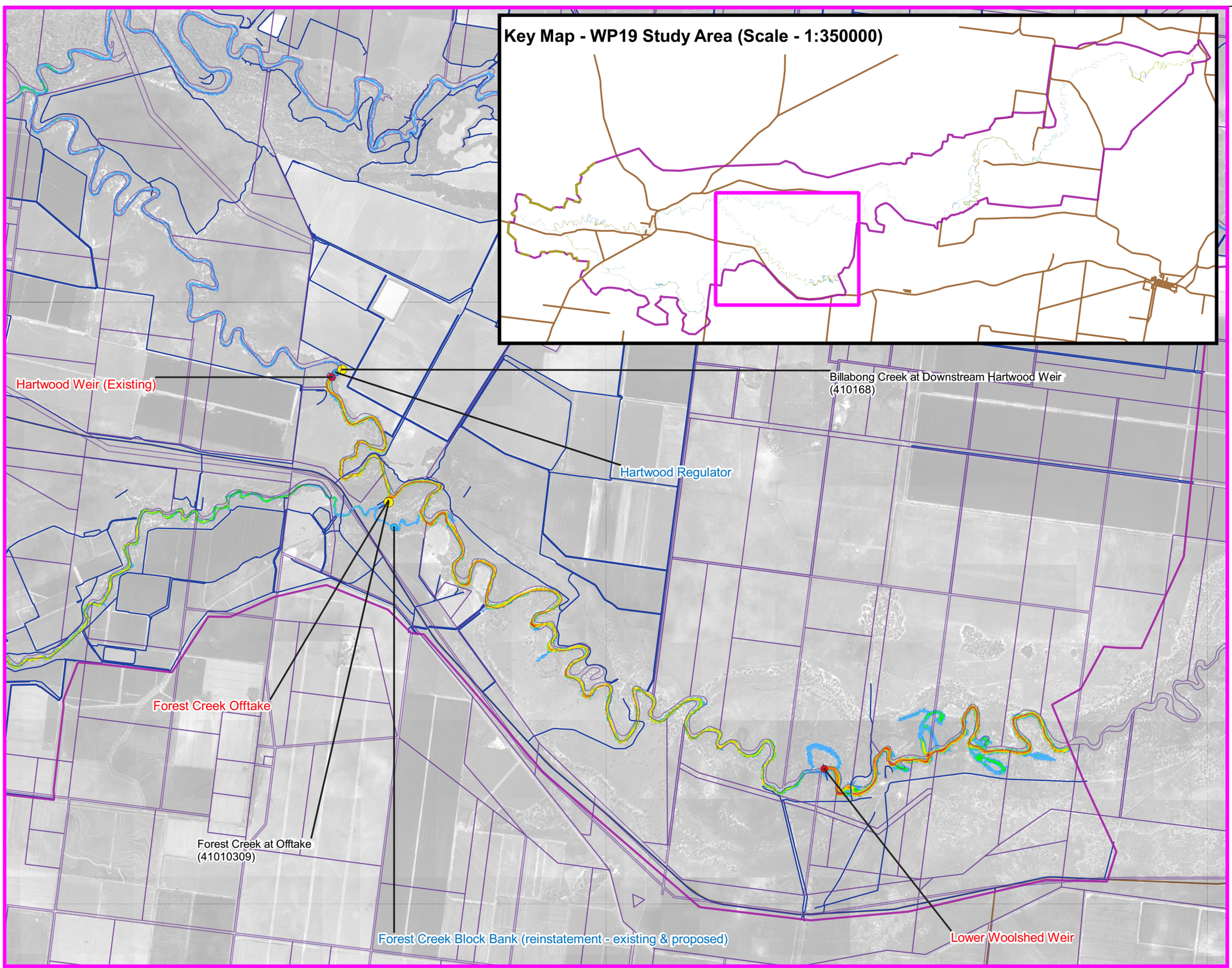
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.
WORKSPACE:
Velocity Atlas Map Generator Operating flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Velocity_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F3.8 - Maximum Operating Flow (500 ML/day) Velocity Plot "Proposed at Full Supply Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

F4 Hazard Category Plots



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Hazard Classification

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles, plus buildings require special design and construction
- H6 - Unsafe for people and vehicles, plus all building vulnerable to failure

N

GDA 2020 Zone 55

1:41000

0 1 2 km

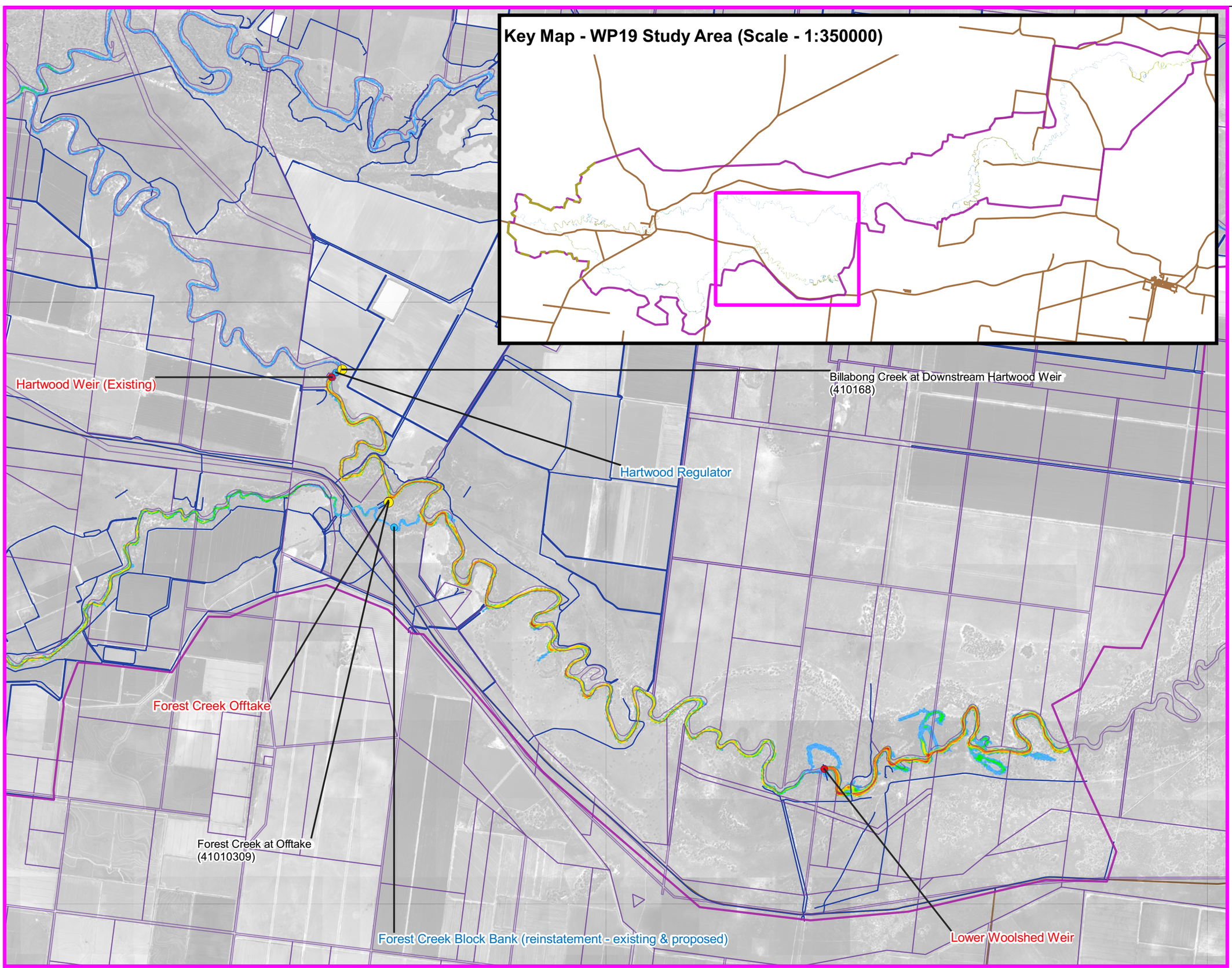
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F4.1 - Minimum Operating Flow (25 ML/day) Hazard Category Plot "Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Hazard Classification

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles, plus buildings require special design and construction
- H6 - Unsafe for people and vehicles, plus all building vulnerable to failure

N

GDA 2020 Zone 55

1:41000

0 1 2 km

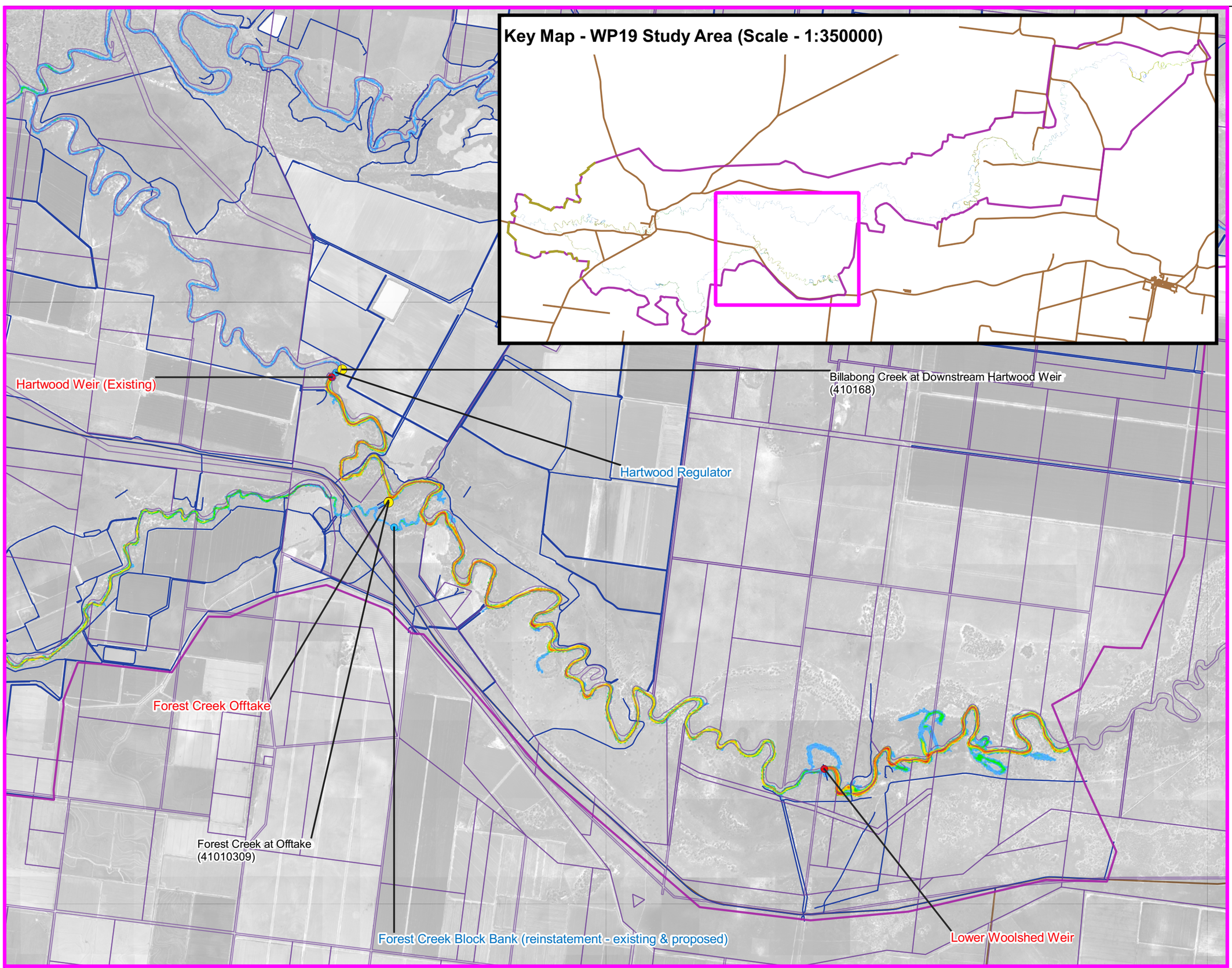
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F4.2 - Minimum Operating Flow (25 ML/day) Hazard Category Plot
"Proposed at Minimum Operating Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Hazard Classification

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles, plus buildings require special design and construction
- H6 - Unsafe for people and vehicles, plus all building vulnerable to failure

N

GDA 2020 Zone 55

1:41000

0 1 2 km

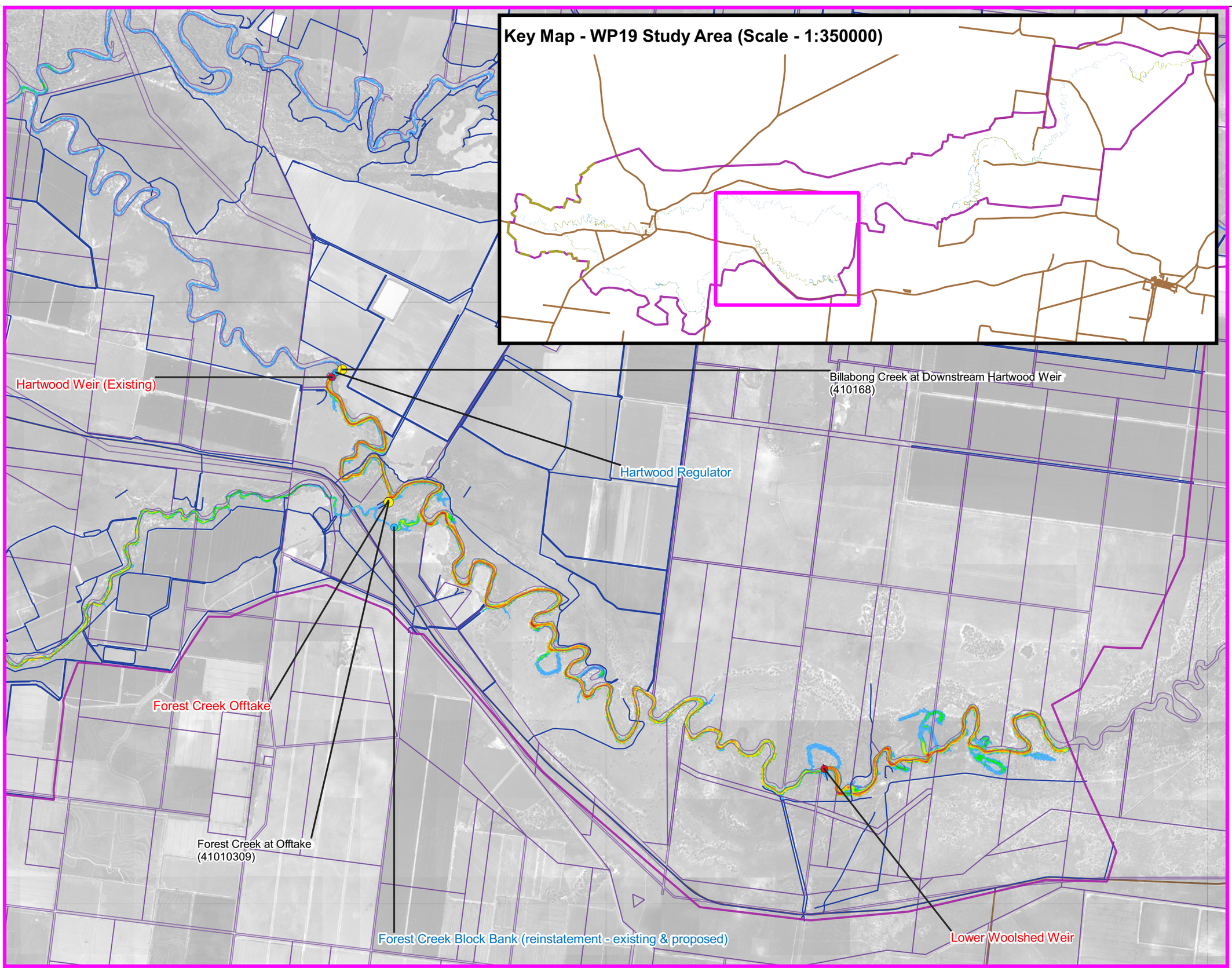
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F4.3 - Minimum Operating Flow (25 ML/day) Hazard Category Plot
"Proposed at Maximum Operating Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Hazard Classification

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles, plus buildings require special design and construction
- H6 - Unsafe for people and vehicles, plus all building vulnerable to failure

N

GDA 2020 Zone 55

1:41000

0 1 2 km

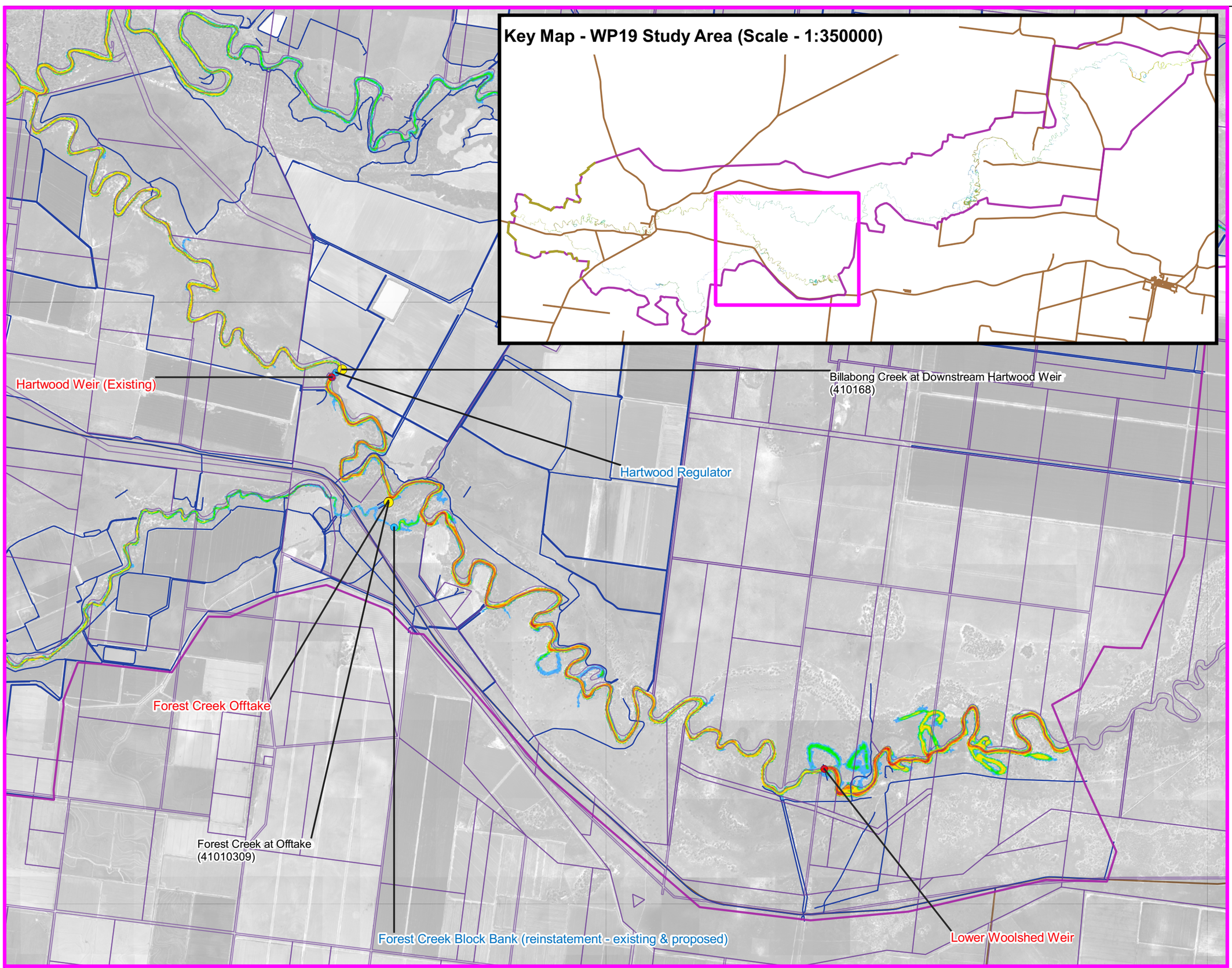
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F4.4 - Minimum Operating Flow (25 ML/day) Hazard Category Plot "Proposed at Full Supply Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Hazard Classification

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles, plus buildings require special design and construction
- H6 - Unsafe for people and vehicles, plus all building vulnerable to failure

N

GDA 2020 Zone 55

1:41000

0 1 2 km

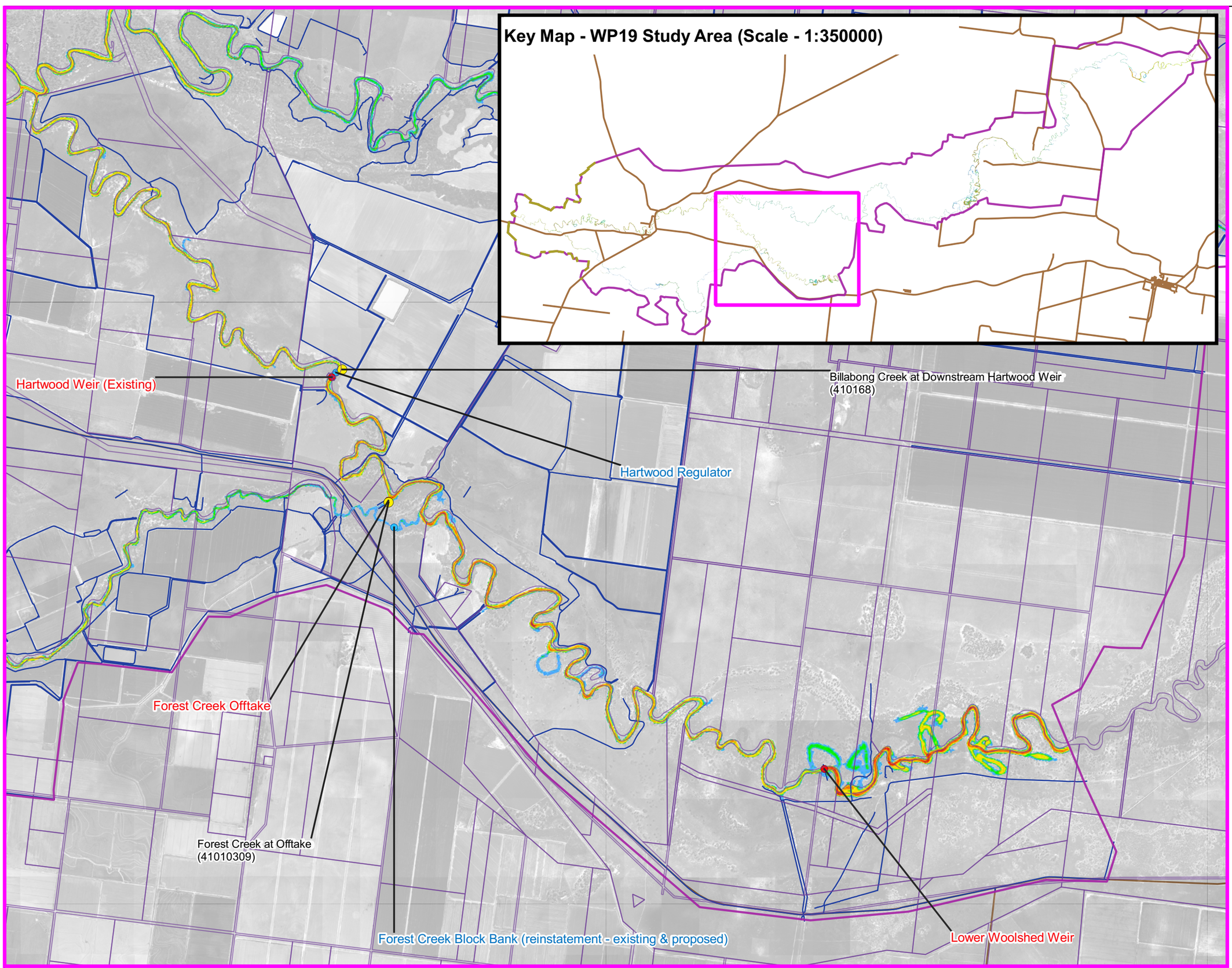
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F4.5 - Maximum Operating Flow (500 ML/day) Hazard Category Plot "Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Hazard Classification

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles, plus buildings require special design and construction
- H6 - Unsafe for people and vehicles, plus all building vulnerable to failure

N

GDA 2020 Zone 55

1:41000

0 1 2 km

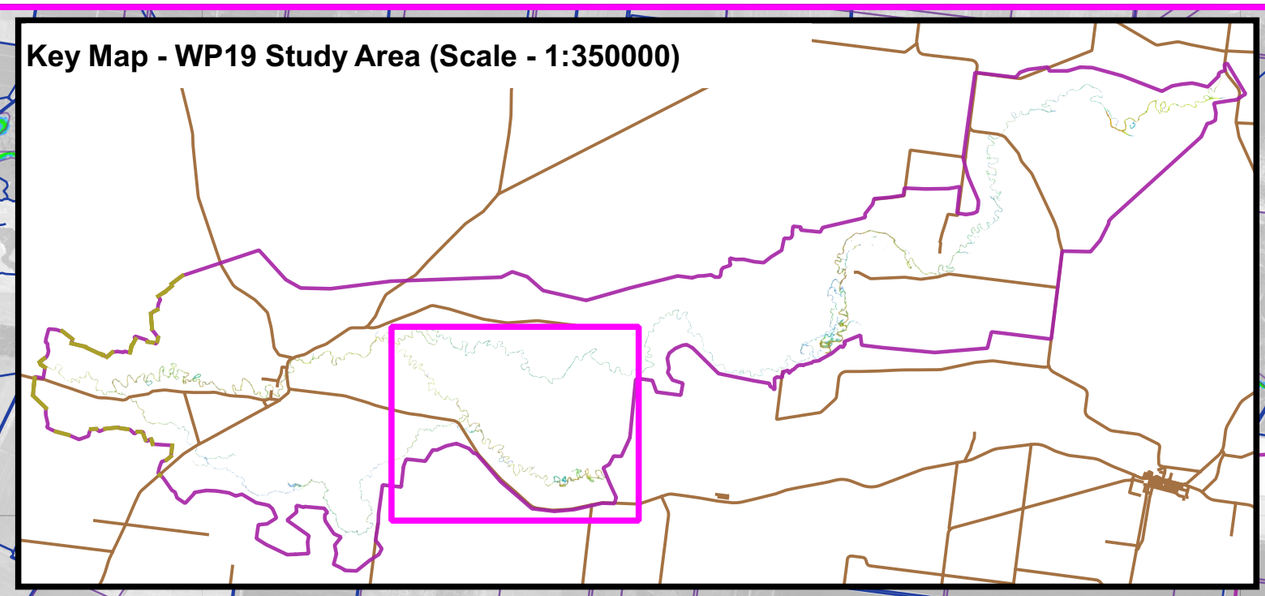
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F4.6 - Maximum Operating Flow (500 ML/day) Hazard Category Plot
"Proposed at Minimum Operating Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Hazard Classification

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles, plus buildings require special design and construction
- H6 - Unsafe for people and vehicles, plus all building vulnerable to failure

N

GDA 2020 Zone 55

1:41000

0 1 2 km

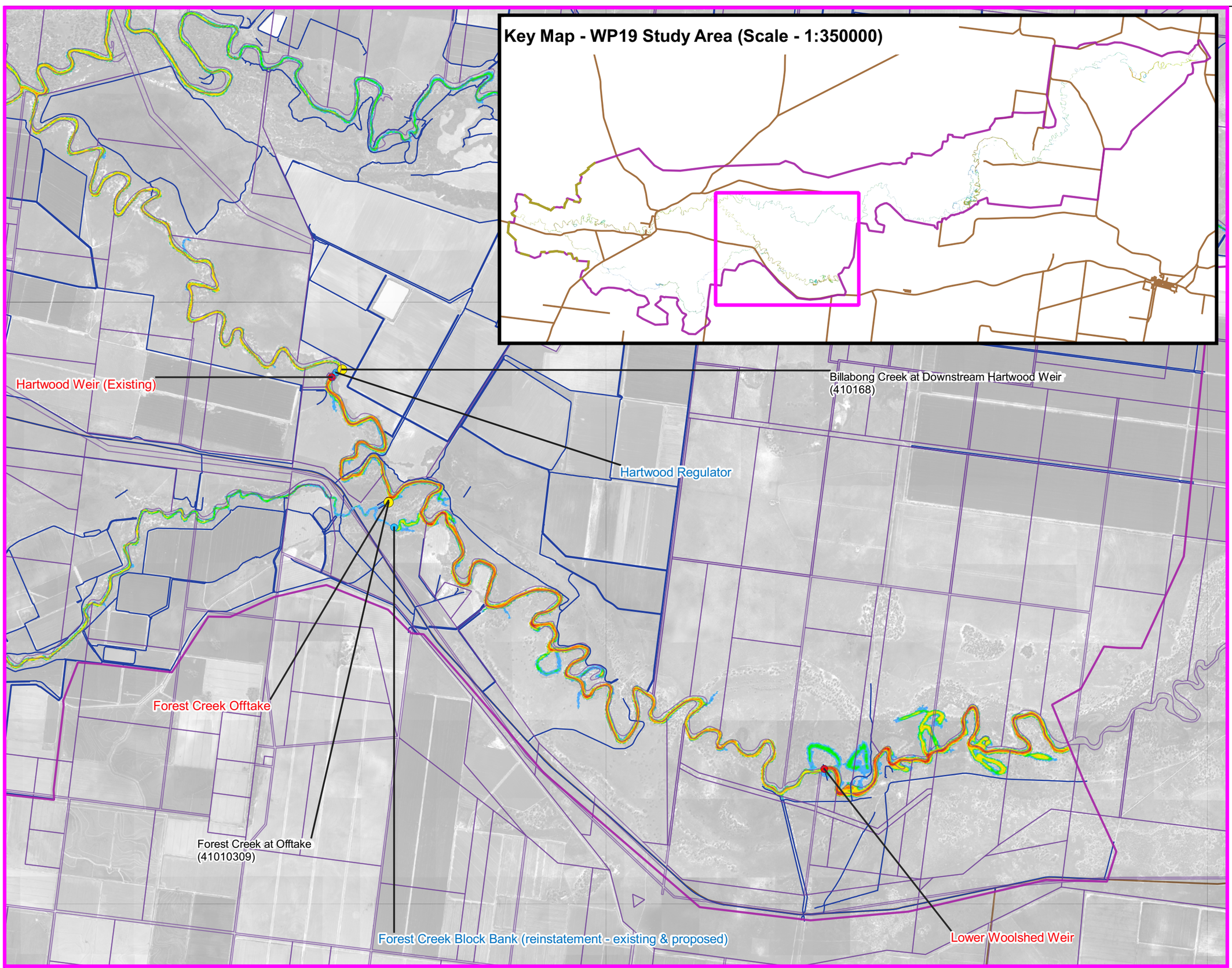
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F4.7 - Maximum Operating Flow (500 ML/day) Hazard Category Plot "Proposed at Maximum Operating Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Hazard Classification

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles, plus buildings require special design and construction
- H6 - Unsafe for people and vehicles, plus all building vulnerable to failure

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Operational Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

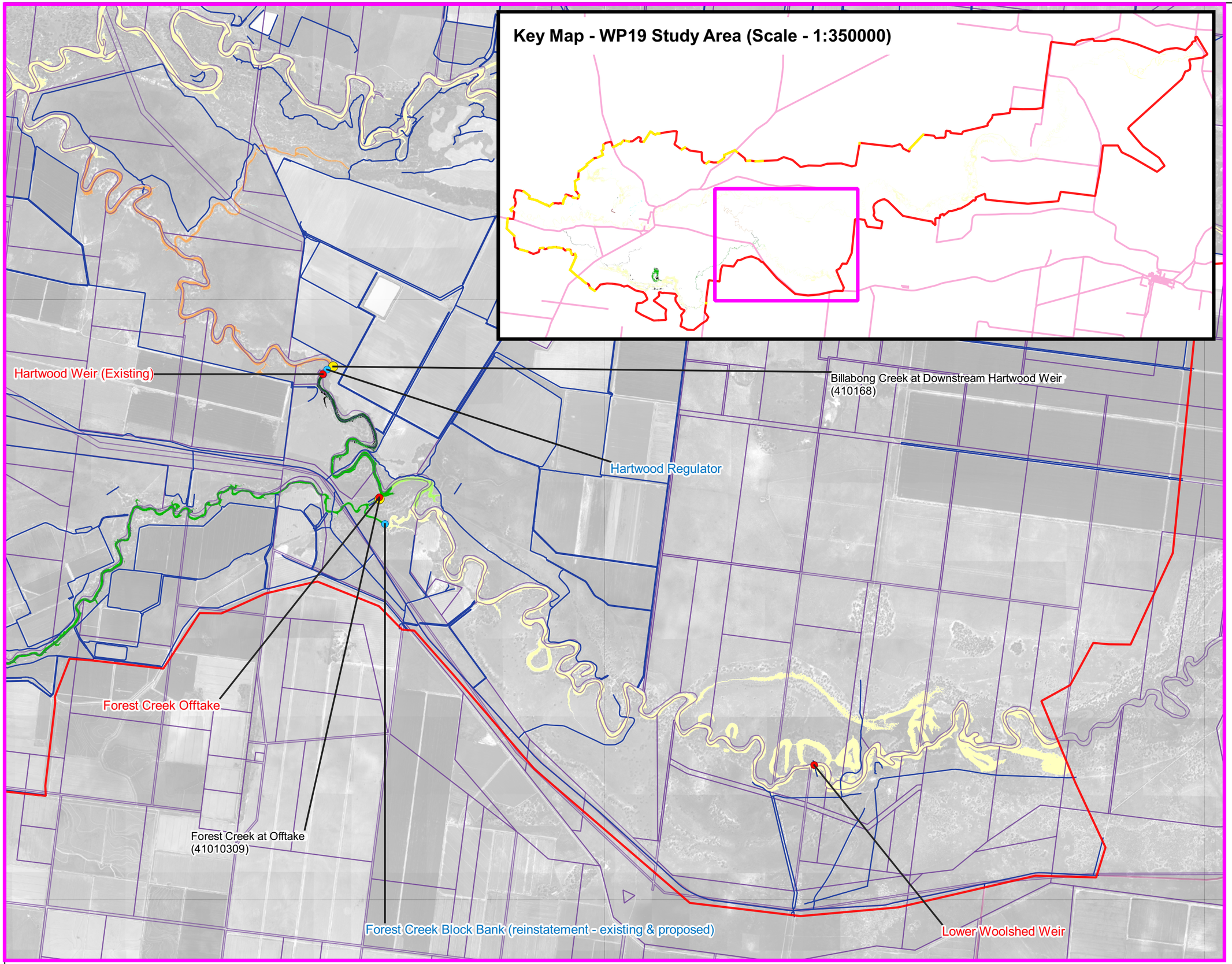
Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE F4.8 - Maximum Operating Flow (500 ML/day) Hazard Category Plot
"Proposed at Full Supply Level"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

Appendix G. Impact Assessment – Flood Flow Scenarios

G1 Flood Impact Plots



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

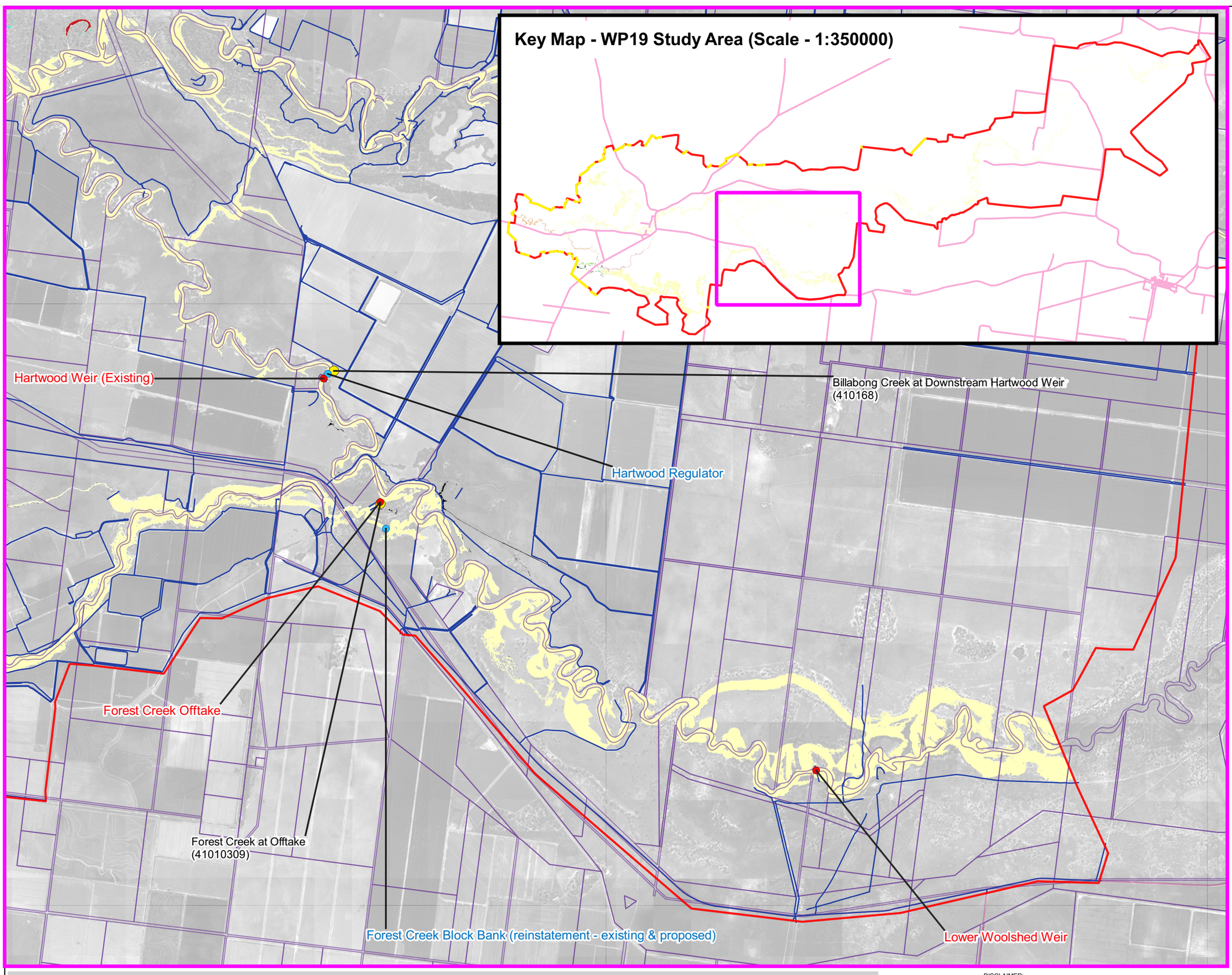
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v02.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G1.1 - 50% AEP Flood Impact Plot
"Proposed" WSL - "Existing" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

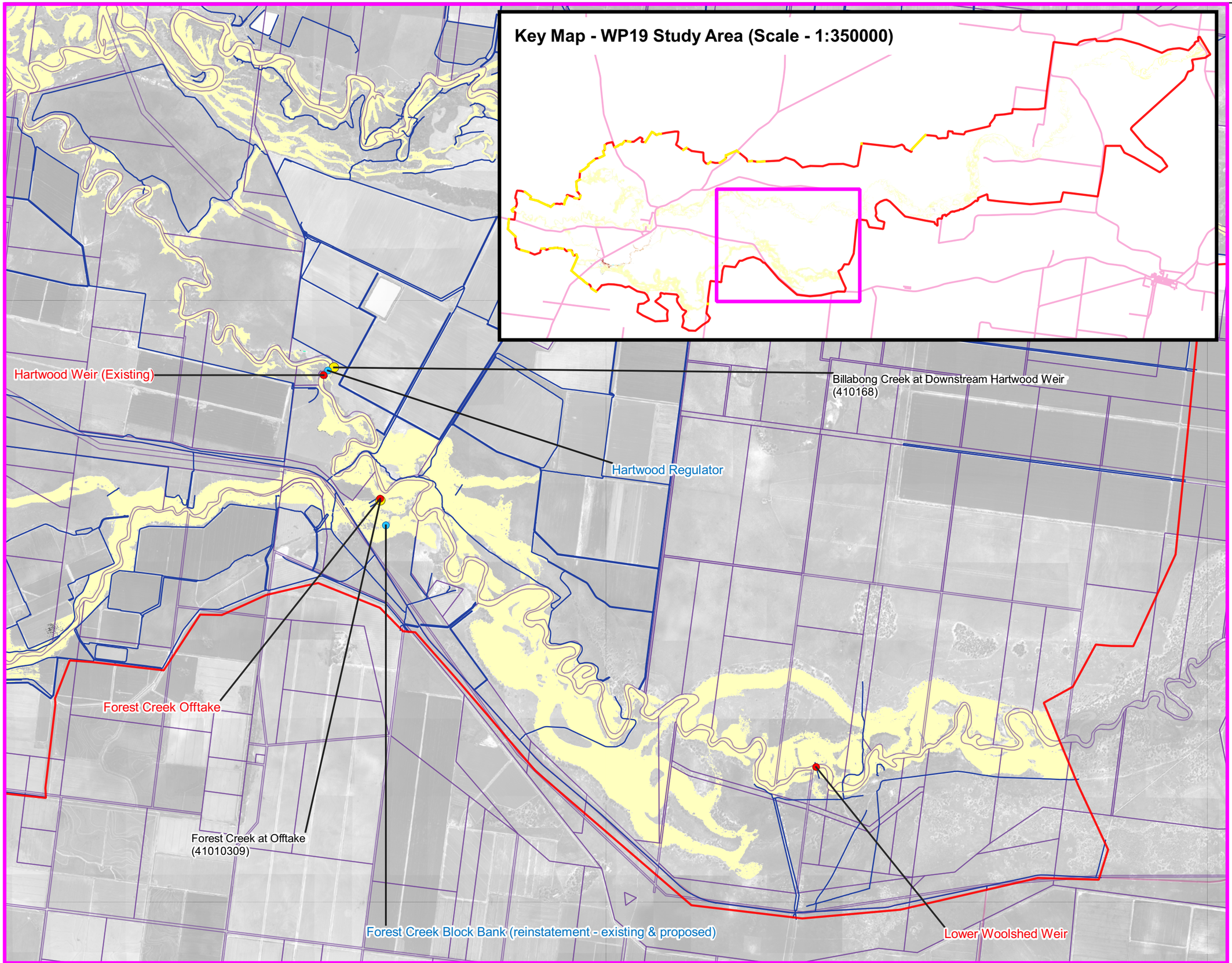
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v02.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G1.2 - 20% AEP Billabong Dominant Flood Impact Plot
"Proposed" WSL - "Existing" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

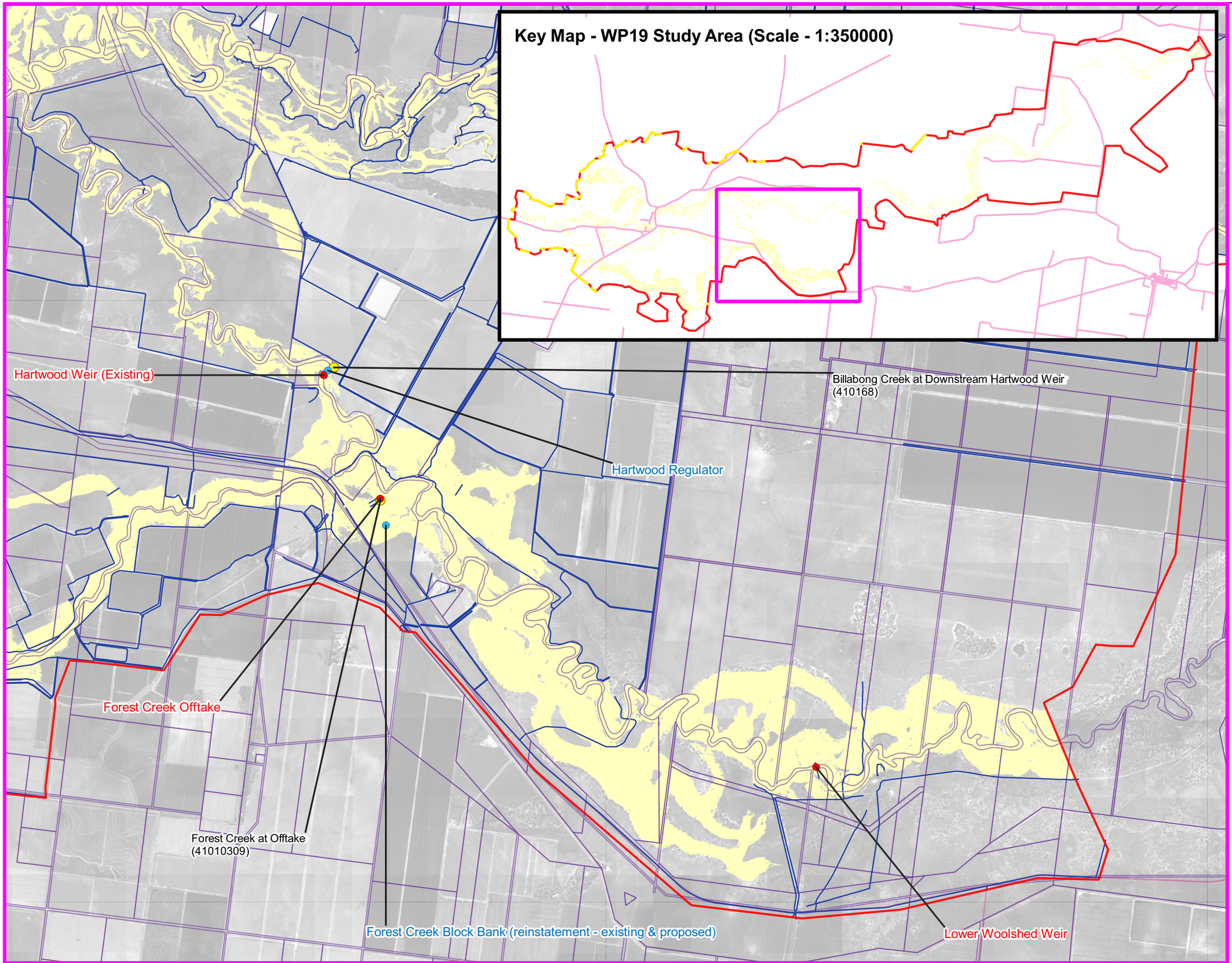
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v02.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G1.3 - 10% AEP Billabong Dominant Flood Impact Plot
"Proposed" WSL - "Existing" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

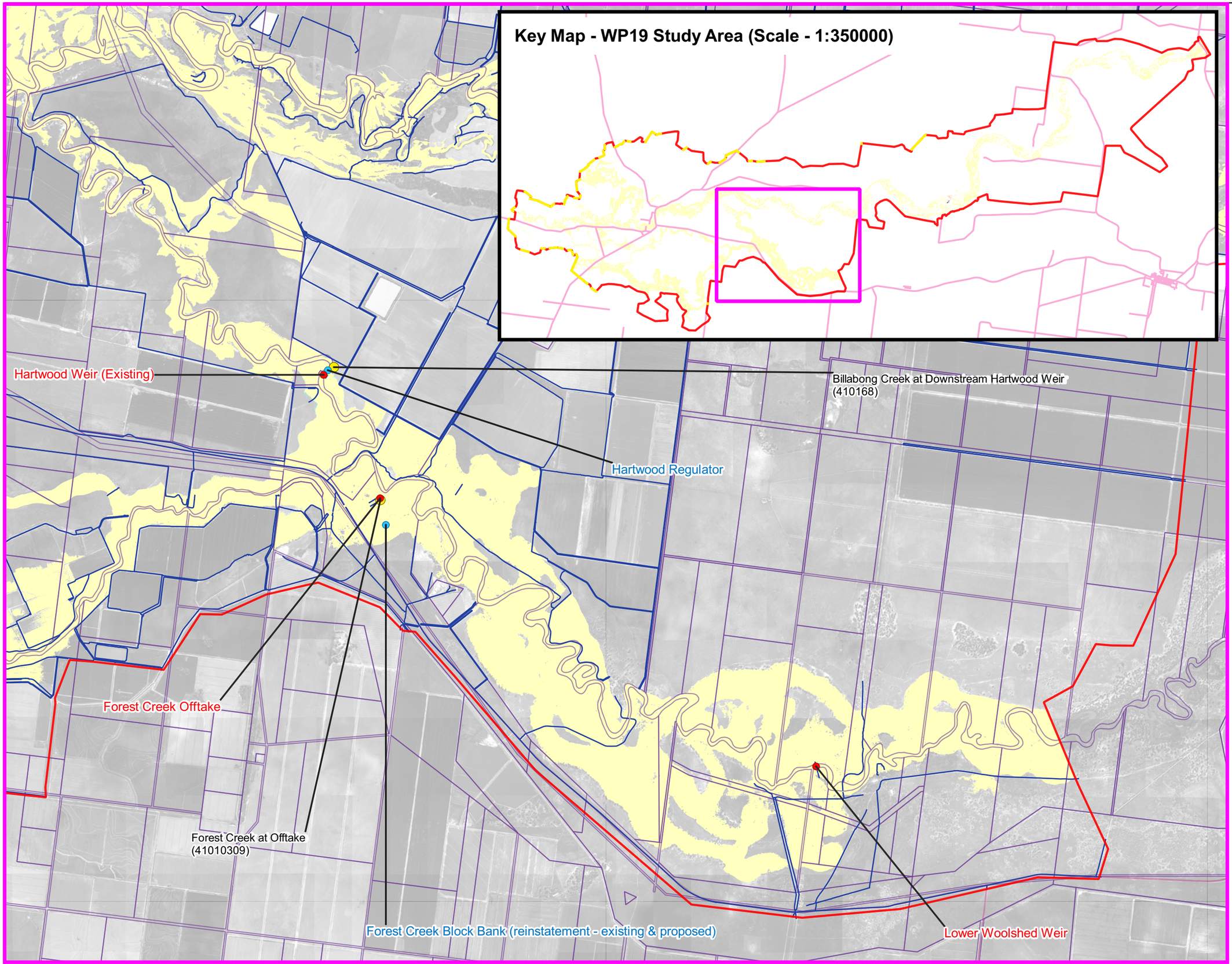
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v02.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G1.4 - 5% AEP Billabong Dominant Flood Impact Plot
"Proposed" WSL - "Existing" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

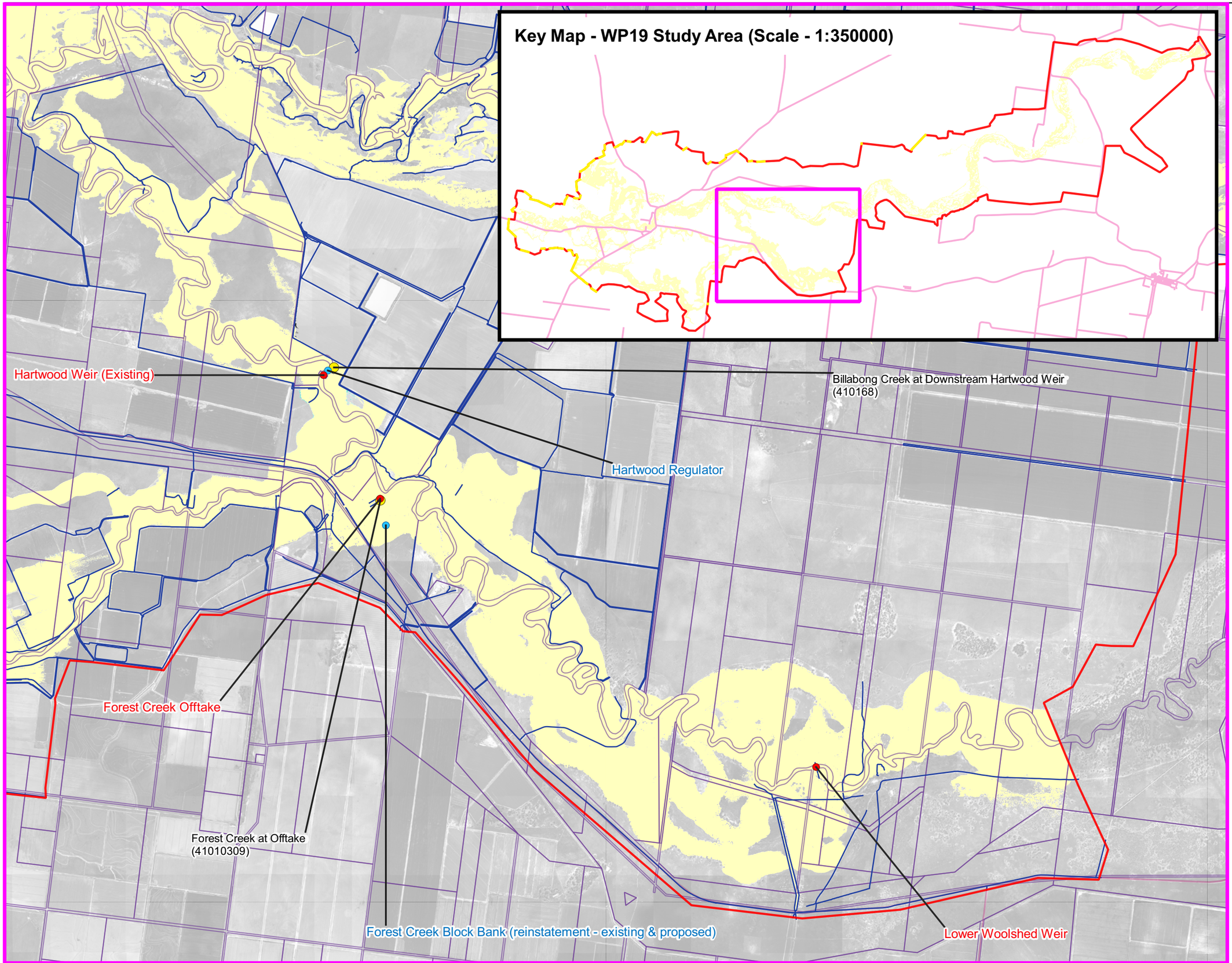
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v02.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G1.5 - 2% AEP Billabong Dominant Flood Impact Plot
"Proposed" WSL - "Existing" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

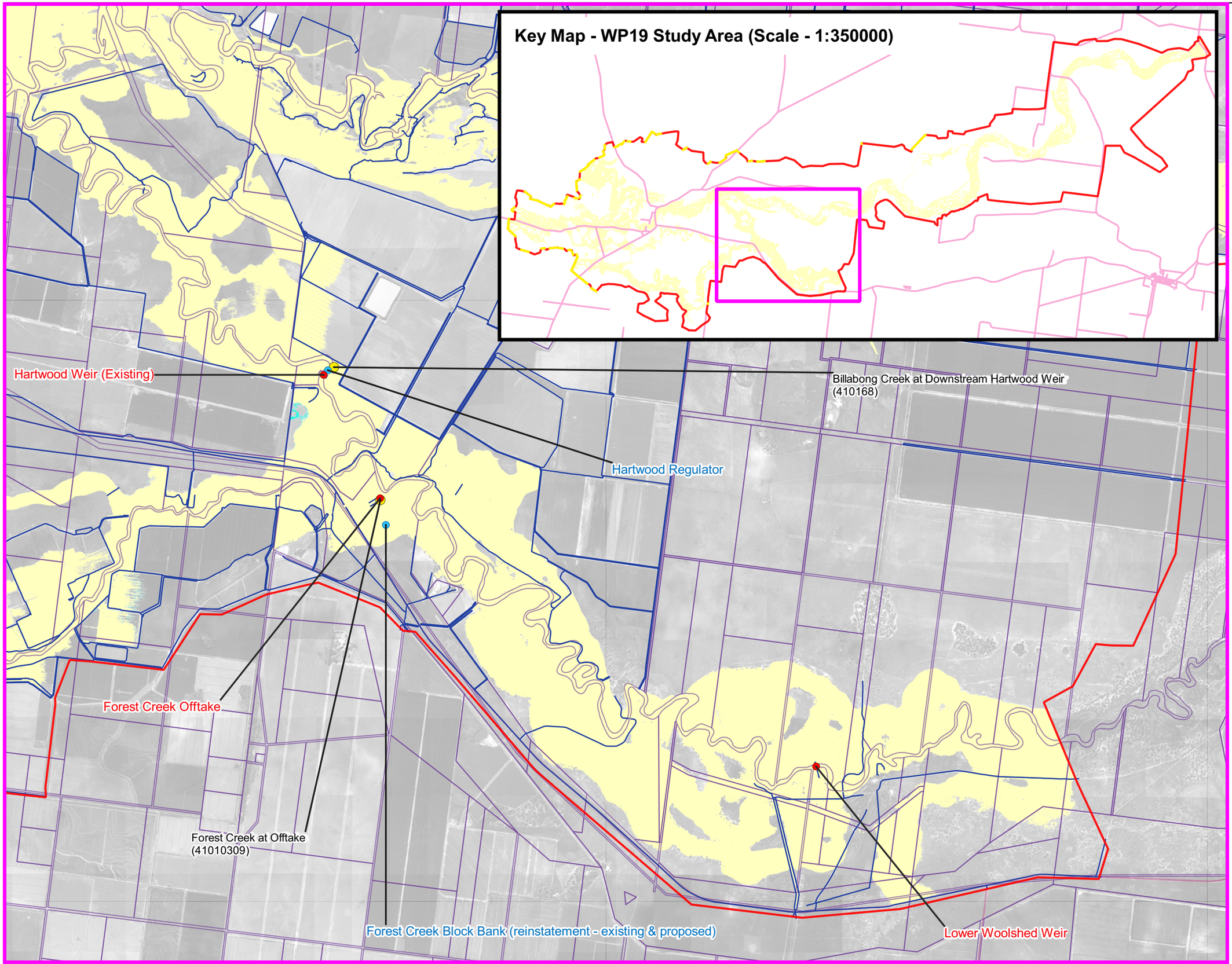
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v02.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G1.6 - 1% AEP Billabong Dominant Flood Impact Plot
"Proposed" WSL - "Existing" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

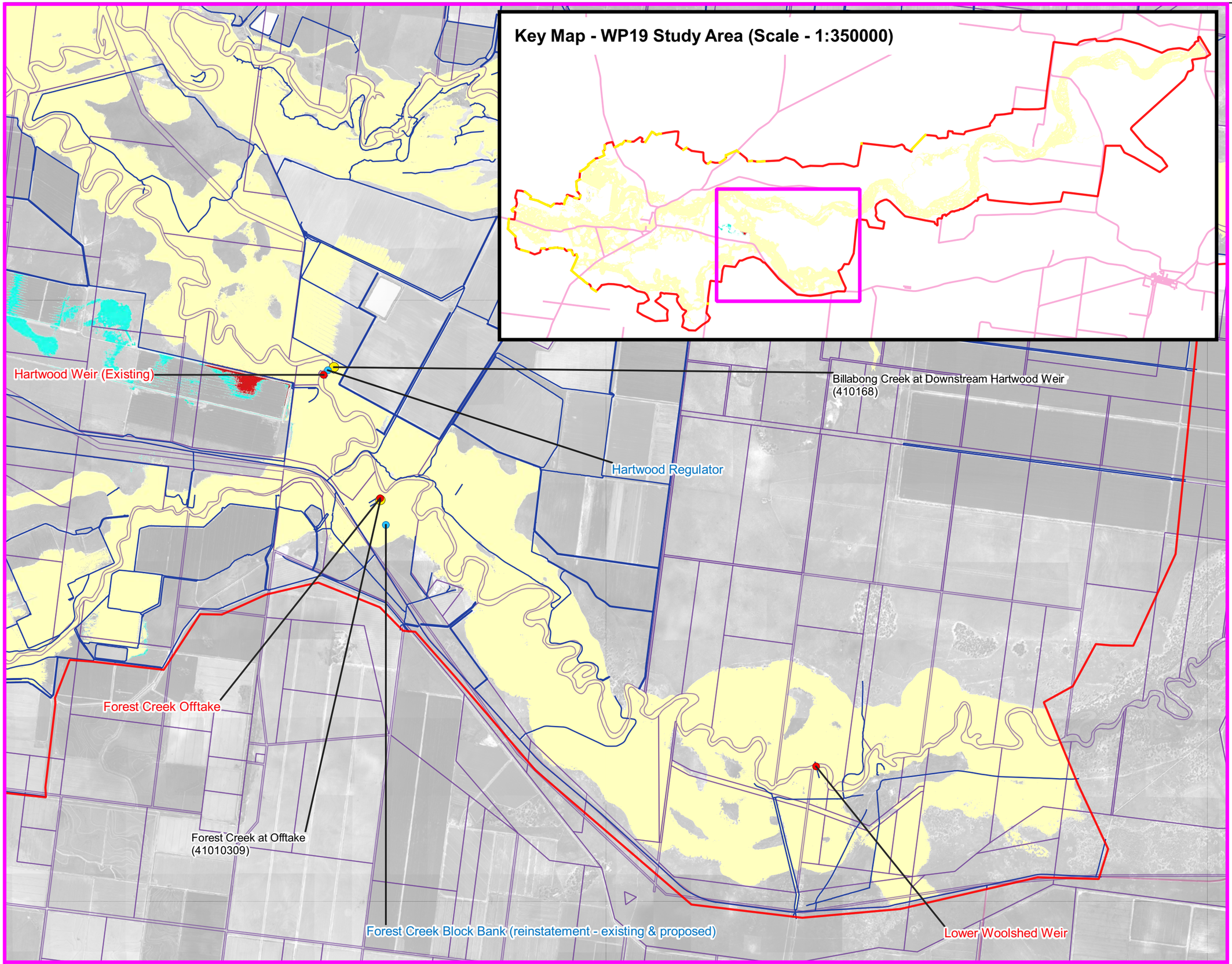
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v02.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G1.7 - 0.5% AEP Billabong Dominant Flood Impact Plot
"Proposed" WSL - "Existing" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

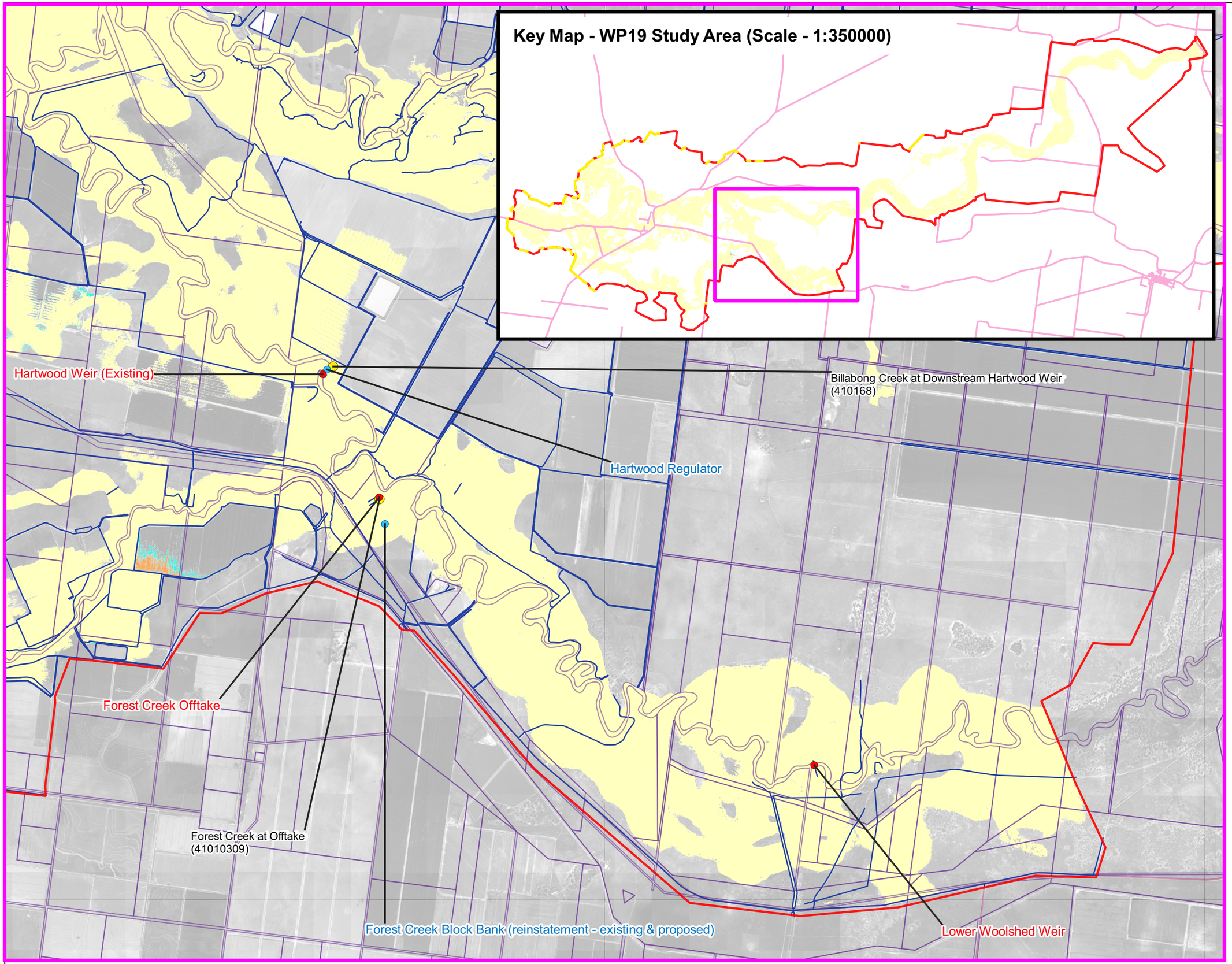
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v02.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G1.8 - 0.3% AEP Billabong Dominant Flood Impact Plot
"Proposed" WSL - "Existing" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

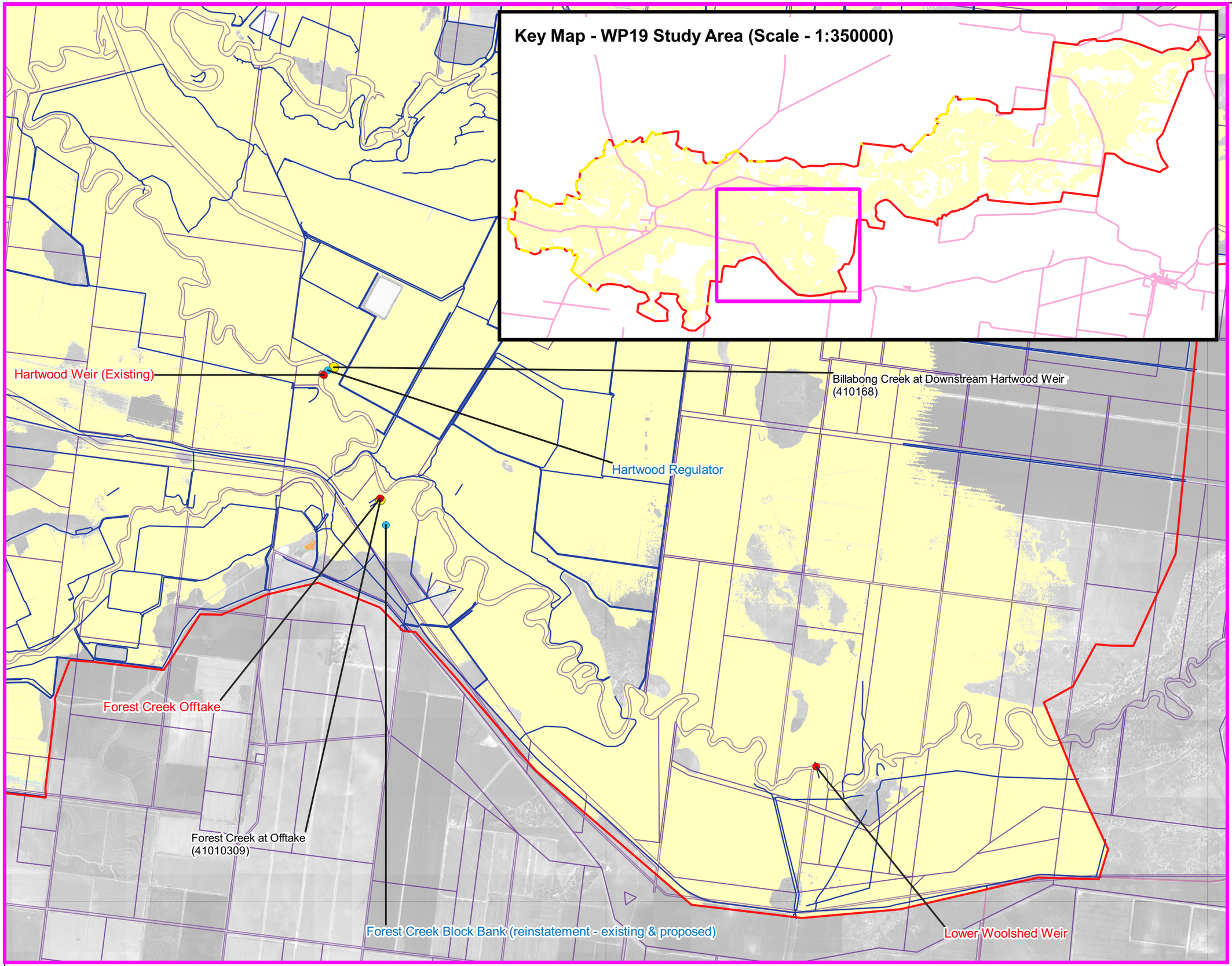
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Afflux
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v02.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G1.9 - 0.2% AEP Billabong Dominant Flood Impact Plot
"Proposed" WSL - "Existing" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Impact (m)

- <= -0.25
- -0.25 to -0.10
- -0.05 to -0.10
- -0.05 to 0.05
- 0.05 to 0.10
- 0.10 to 0.25
- > 0.25
- was wet now dry
- was dry now wet

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

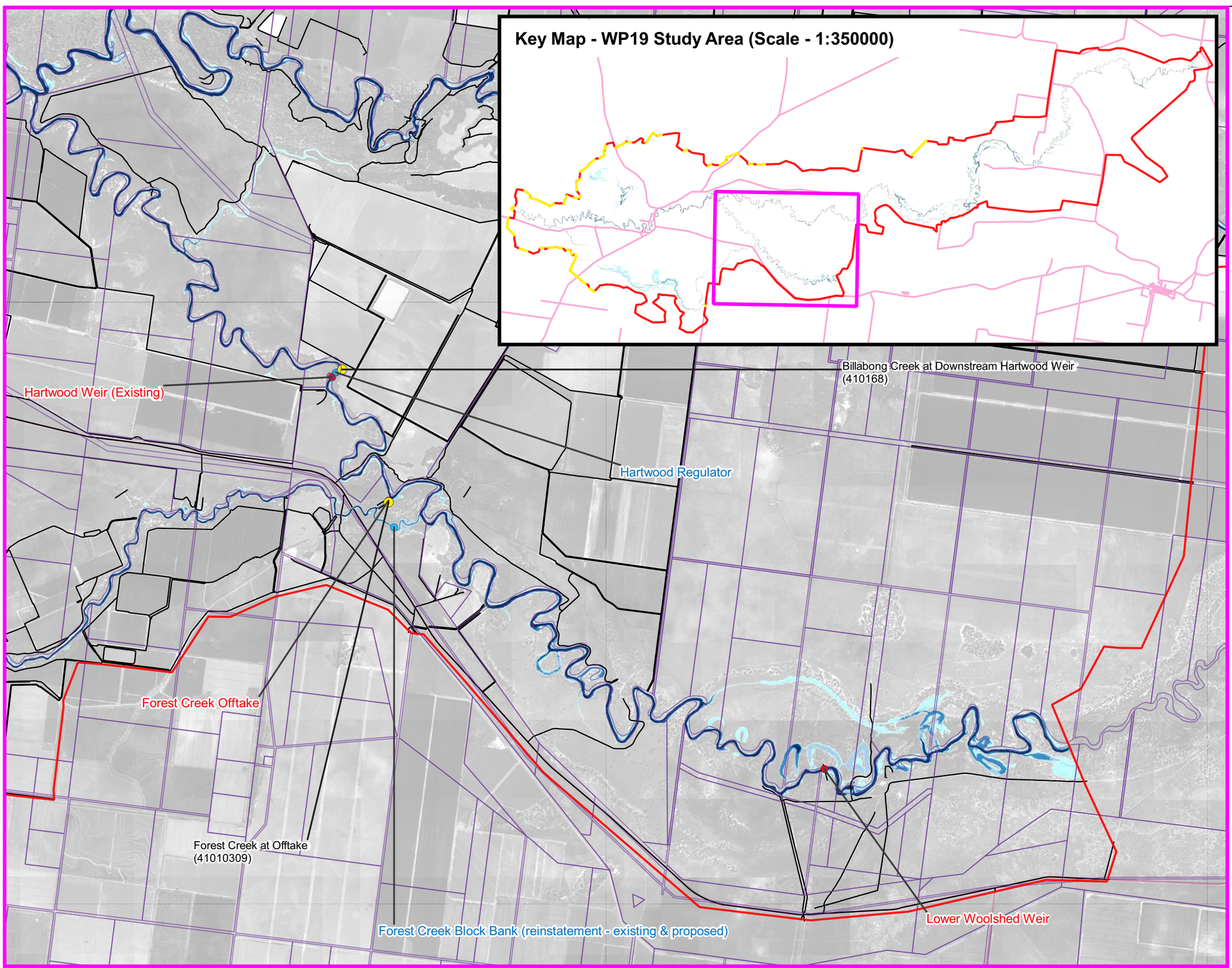
WORKSPACE:
Flood Flow Afflux
G:\21\125376541\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Afflux_Plots_v02.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G1.10 - PMF Flood Impact Plot
"Proposed" WSL - "Existing" WSL

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

G2 Depth Plots



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

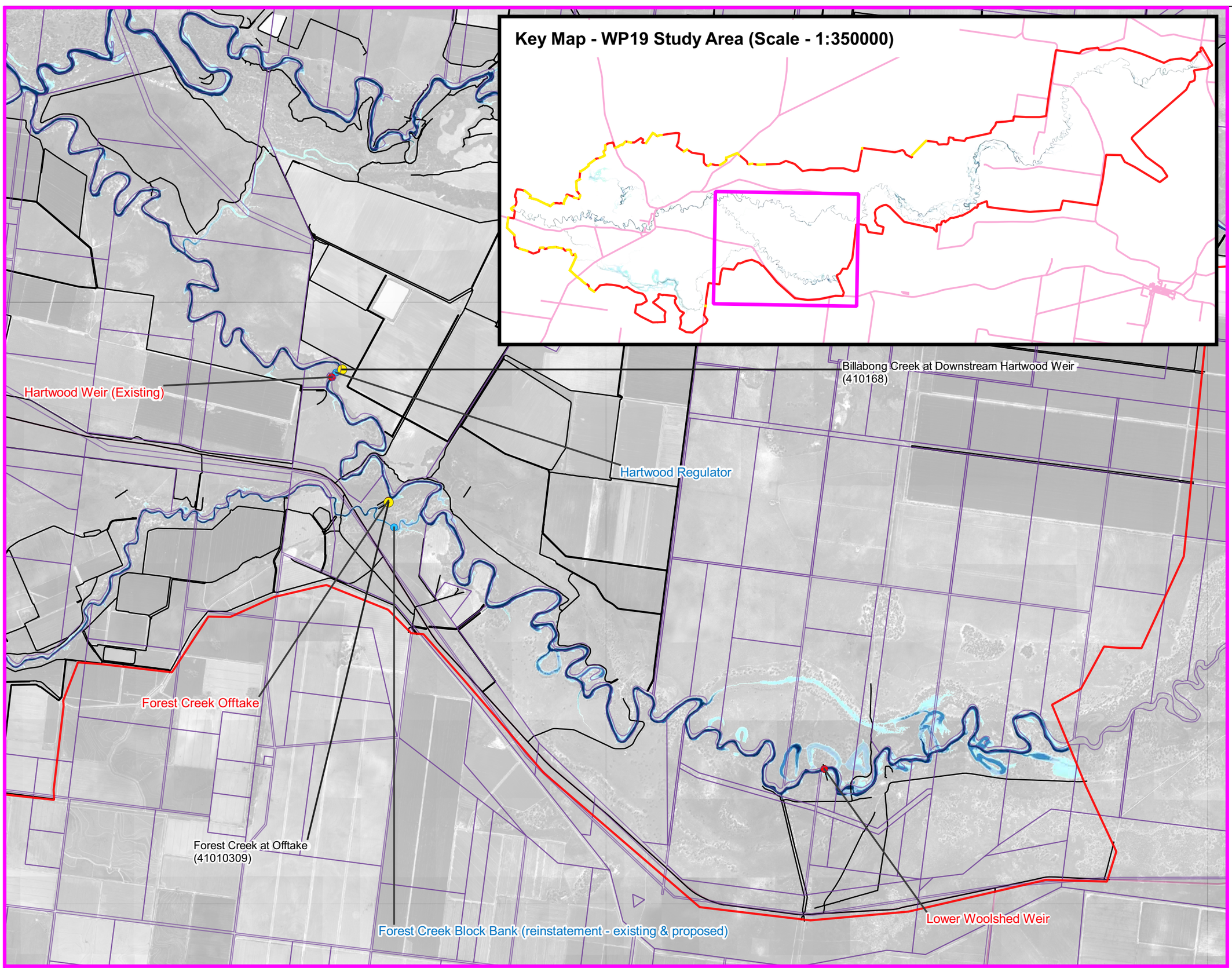
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.1 - 50% AEP Depth Plot]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

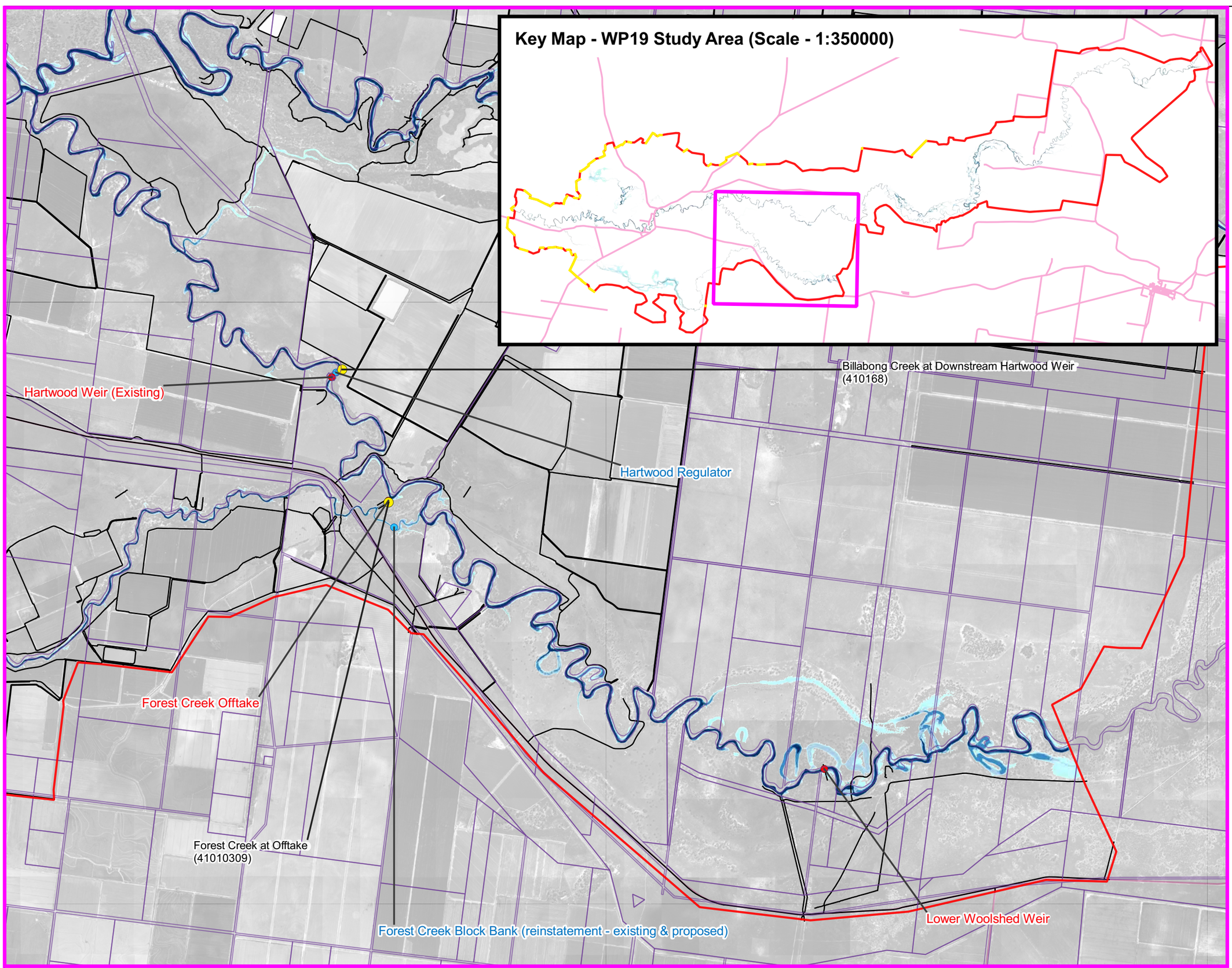
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.1 - 50% AEP Depth Plot]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

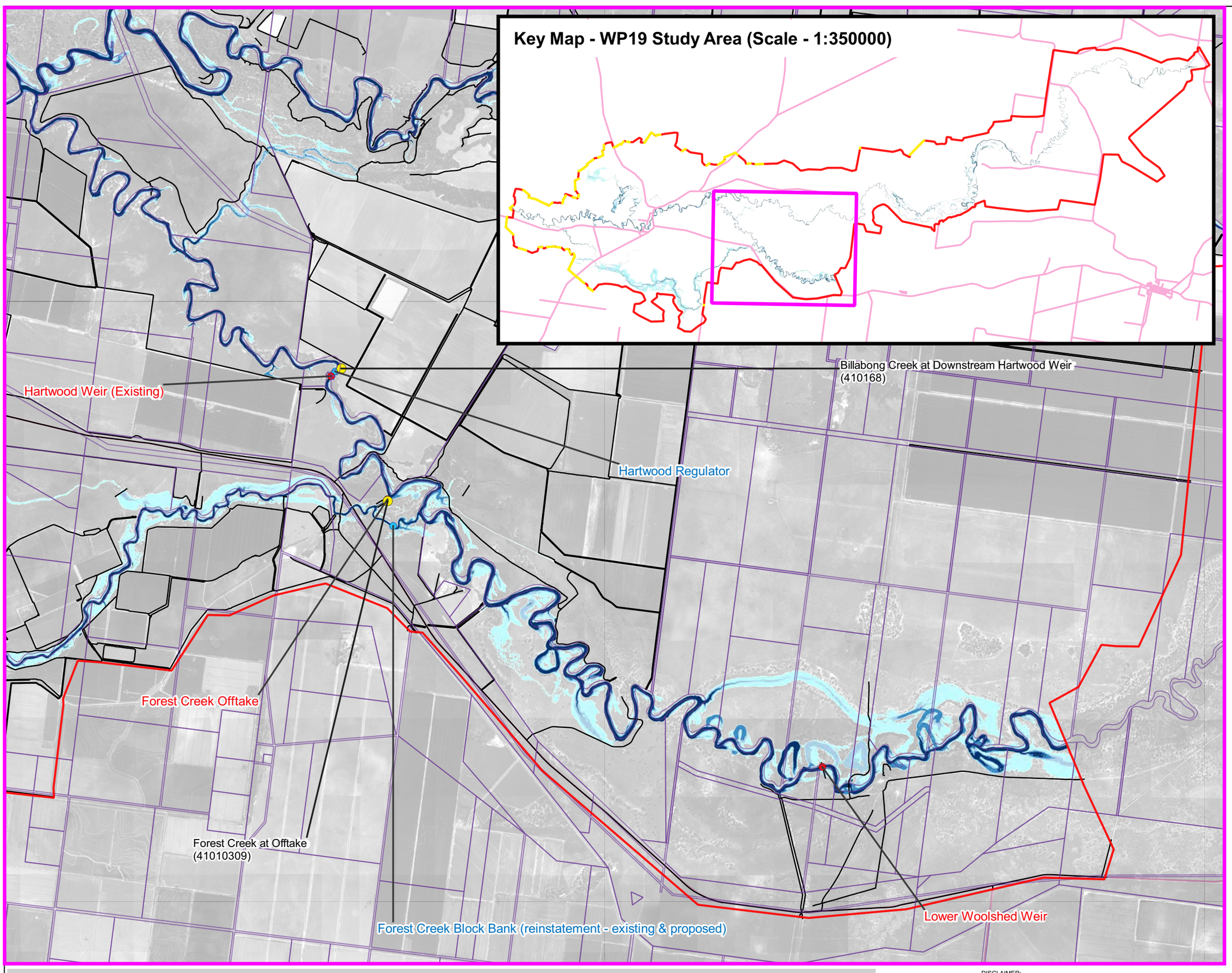
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.2 - 50% AEP Depth Plot]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

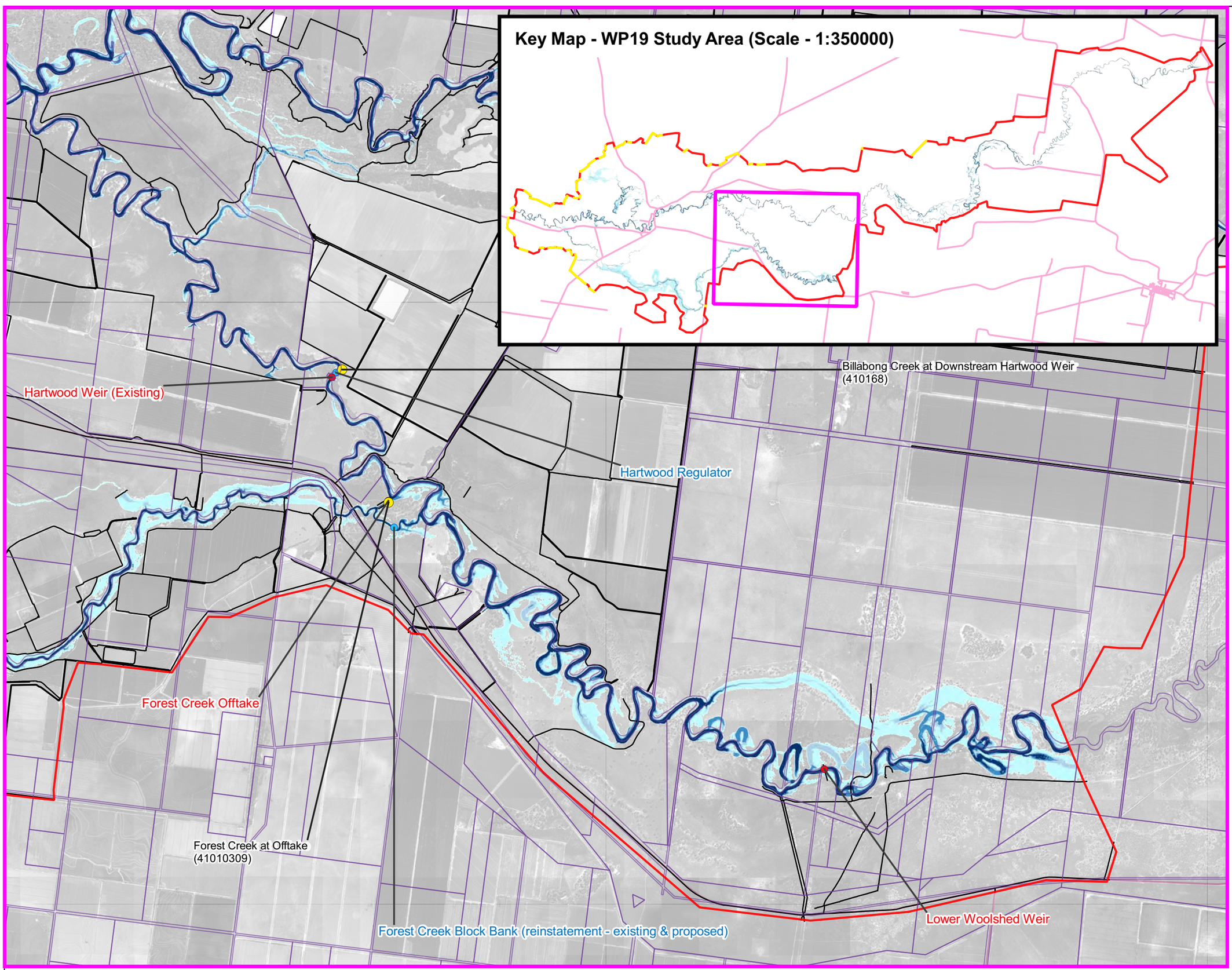
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.3 - 20% AEP Billabong Dominant Depth Plot]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

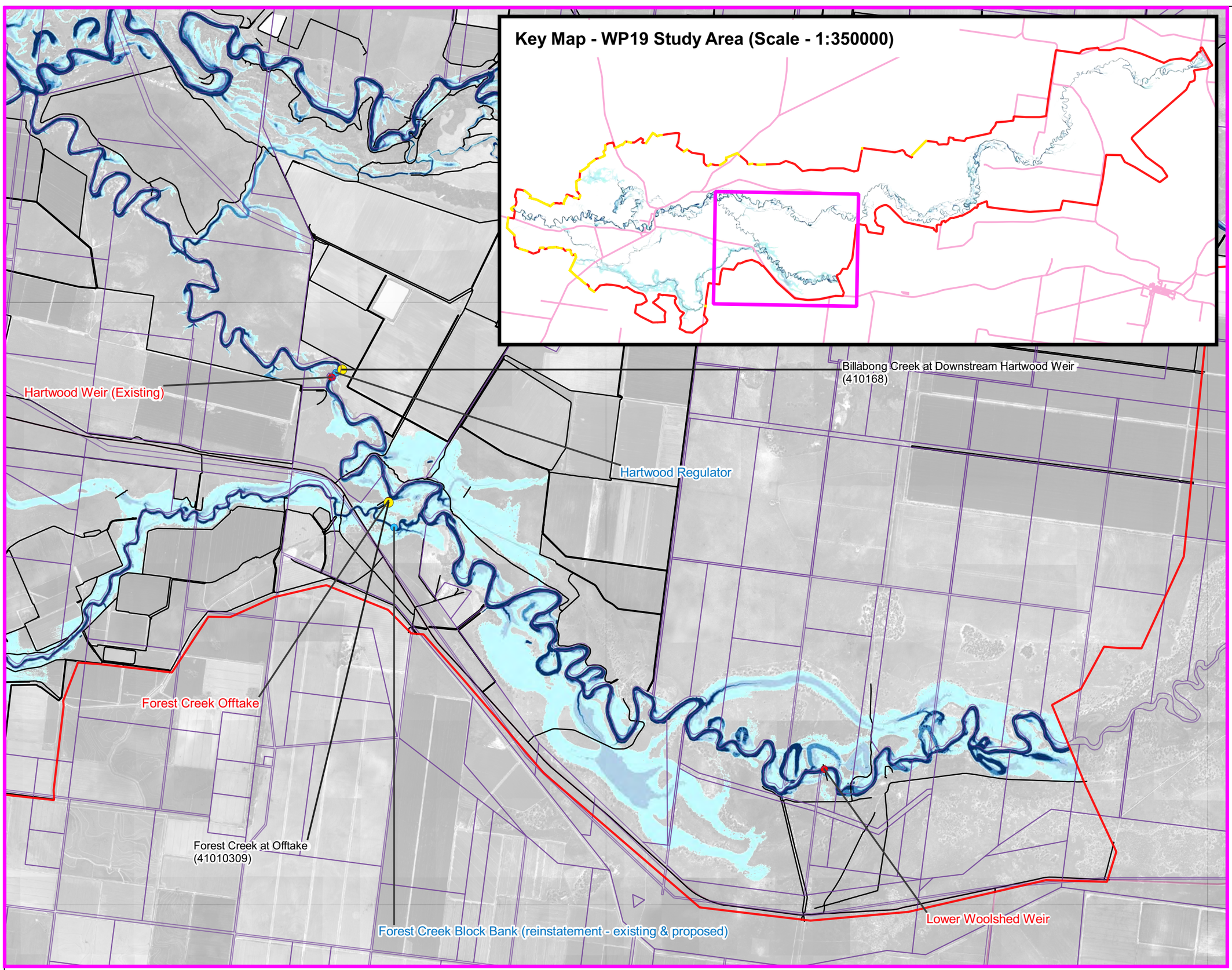
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.4 - 20% AEP Billabong Dominant Depth Plot]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

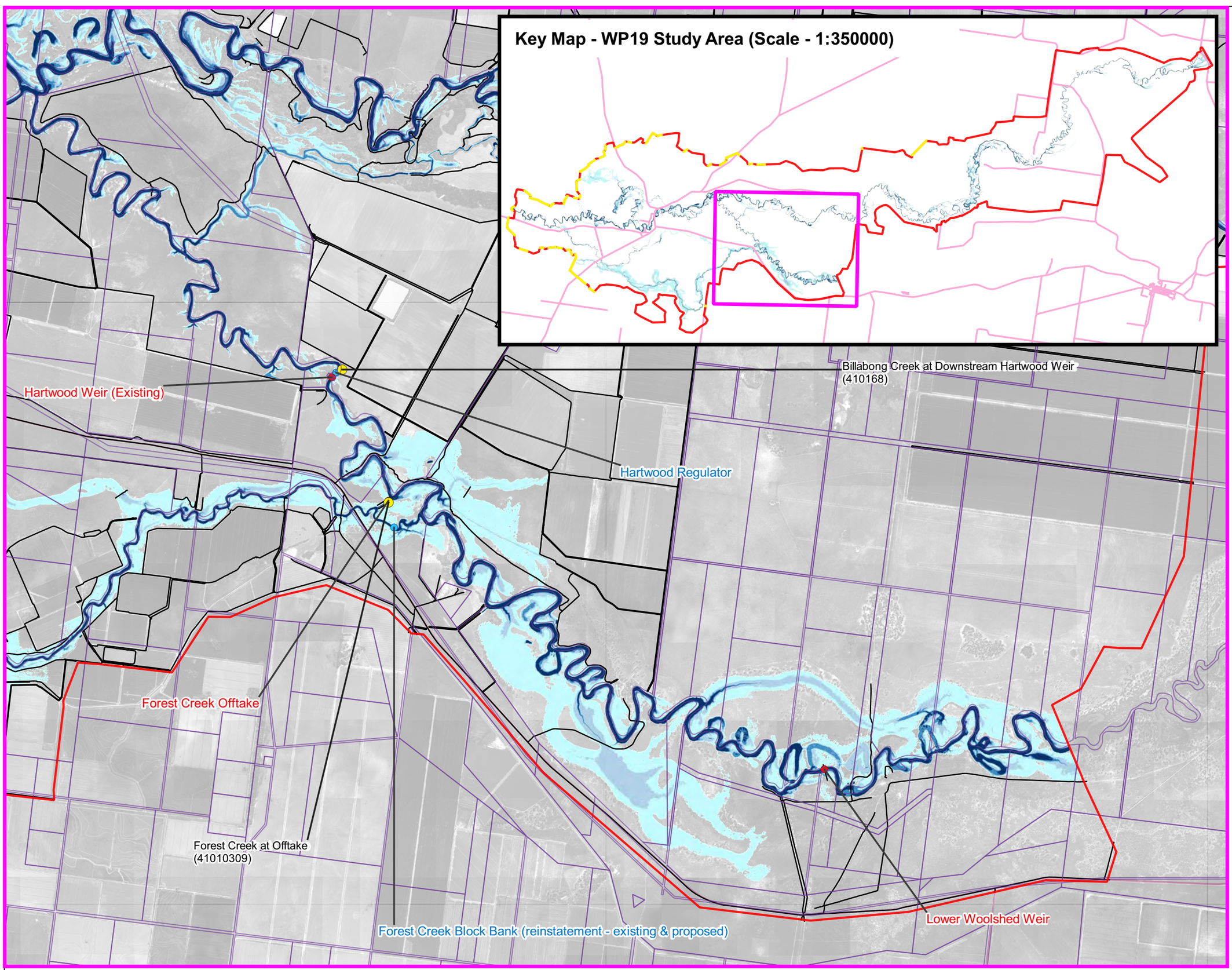
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.5 - 10% AEP Billabong Dominant Depth Plot]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

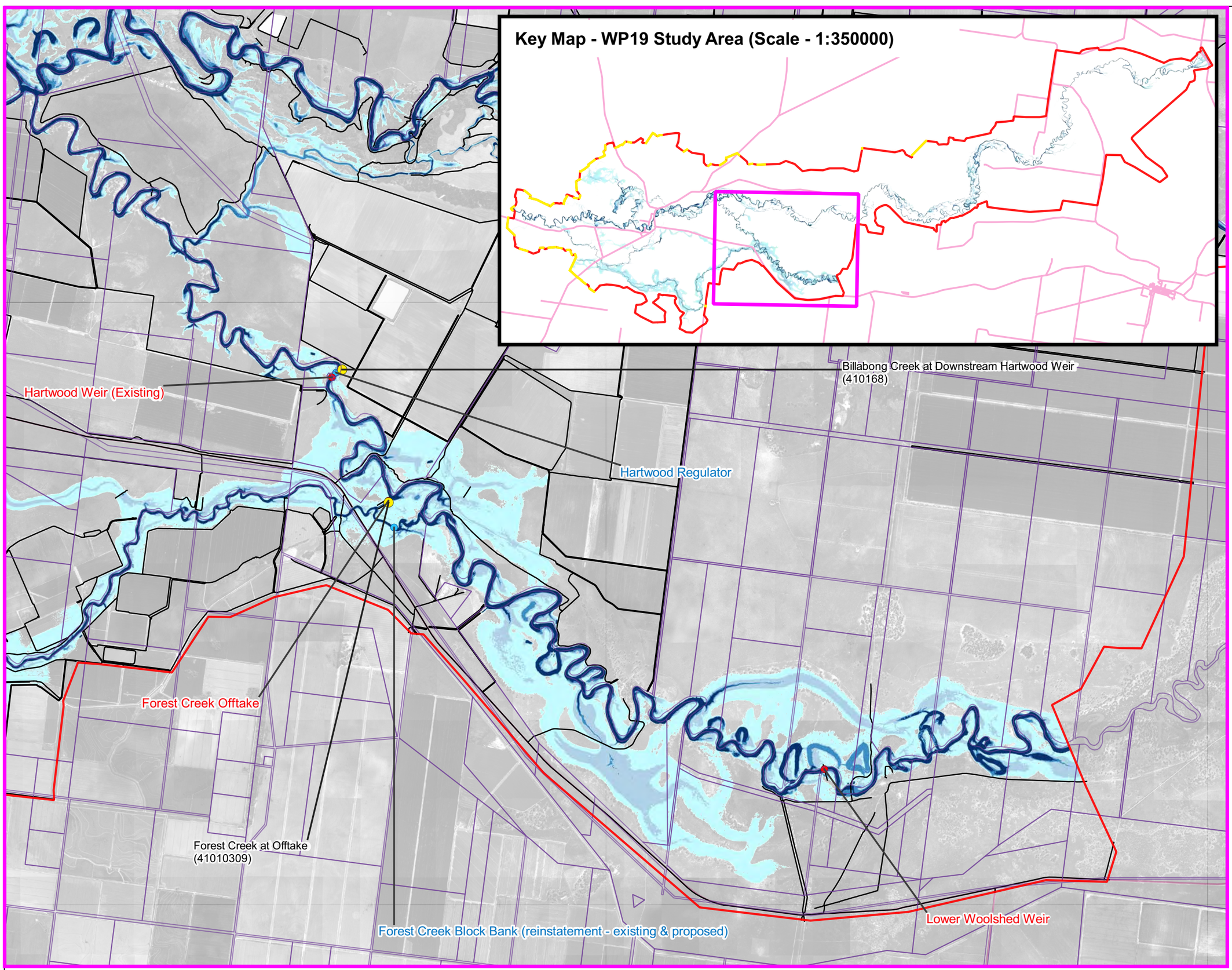
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.6 - 10% AEP Billabong Dominant Depth Plot]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

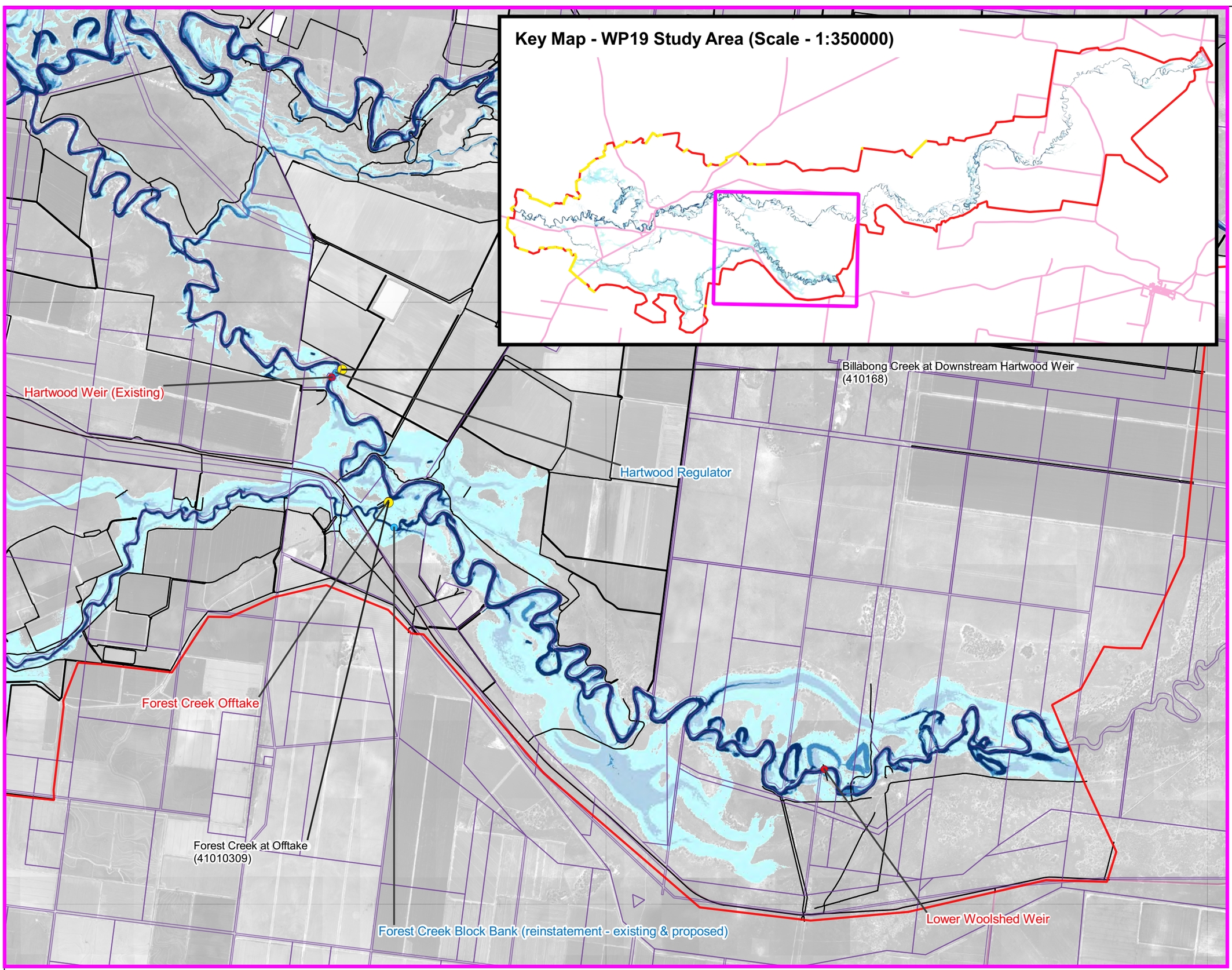
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.7 - 5% AEP Billabong Dominant Depth Plot]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

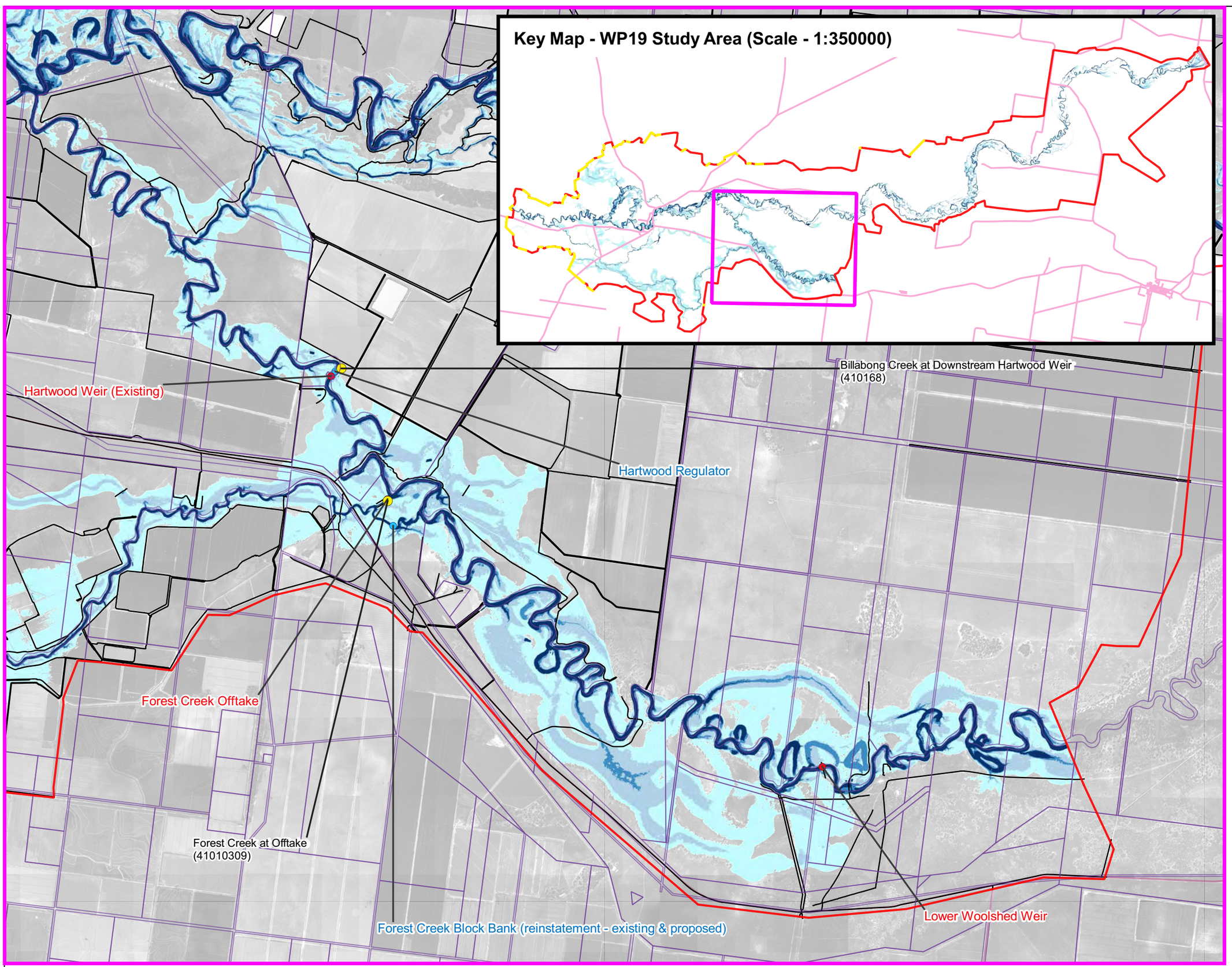
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.8 - 5% AEP Billabong Dominant Depth Plot]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

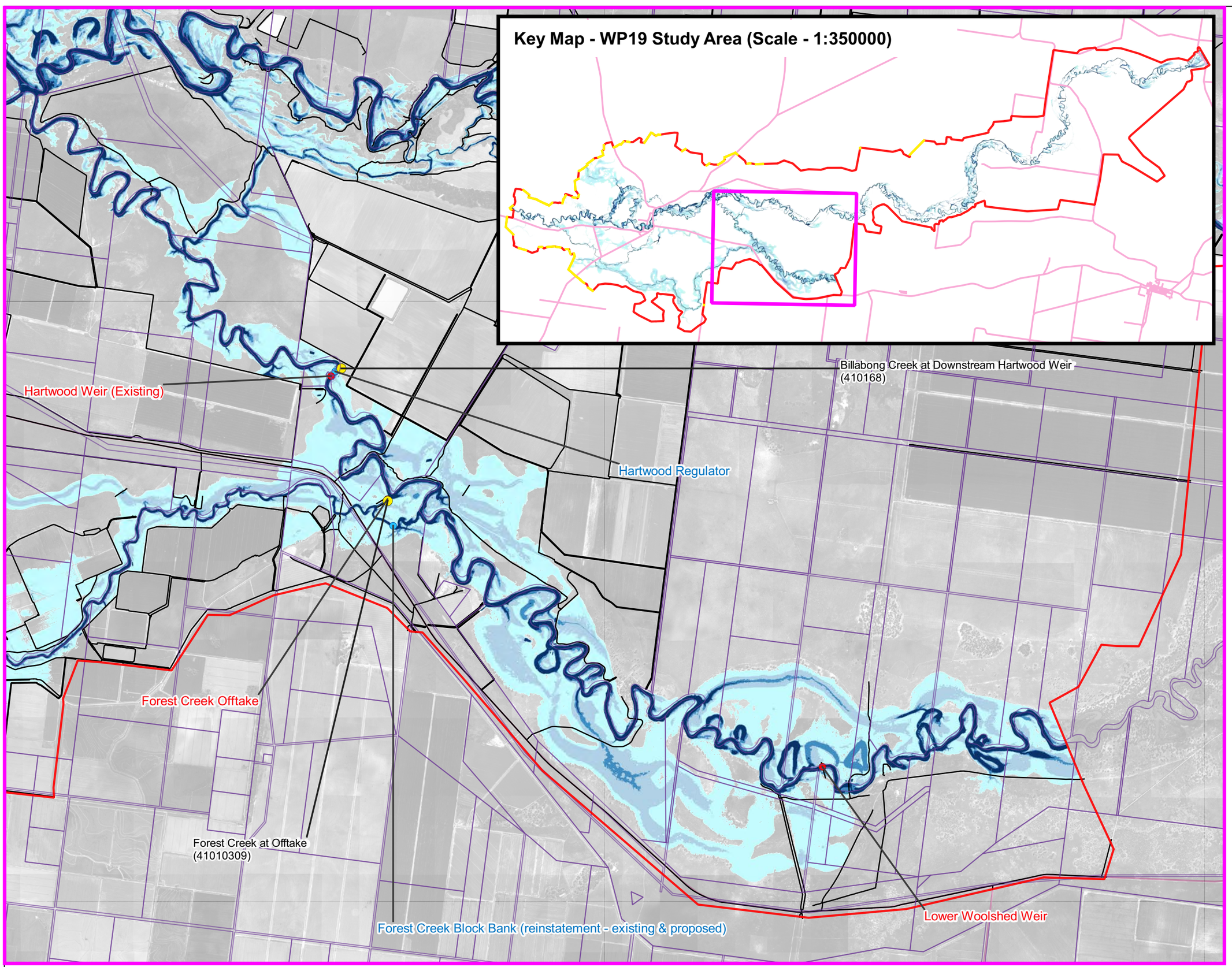
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.9 - 2% AEP Billabong Dominant Depth Plot]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

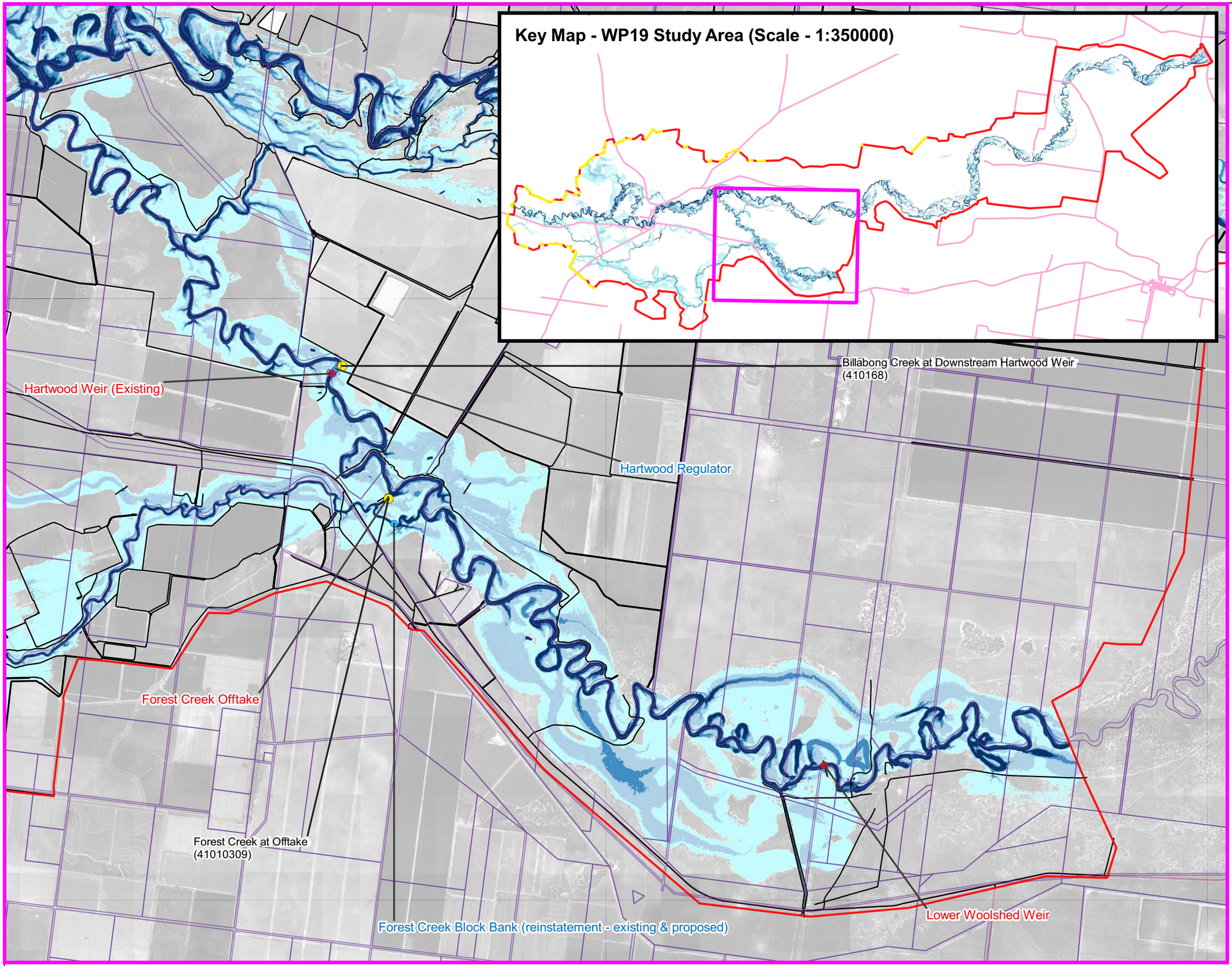
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.10 - 2% AEP Billabong Dominant Depth Plot]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

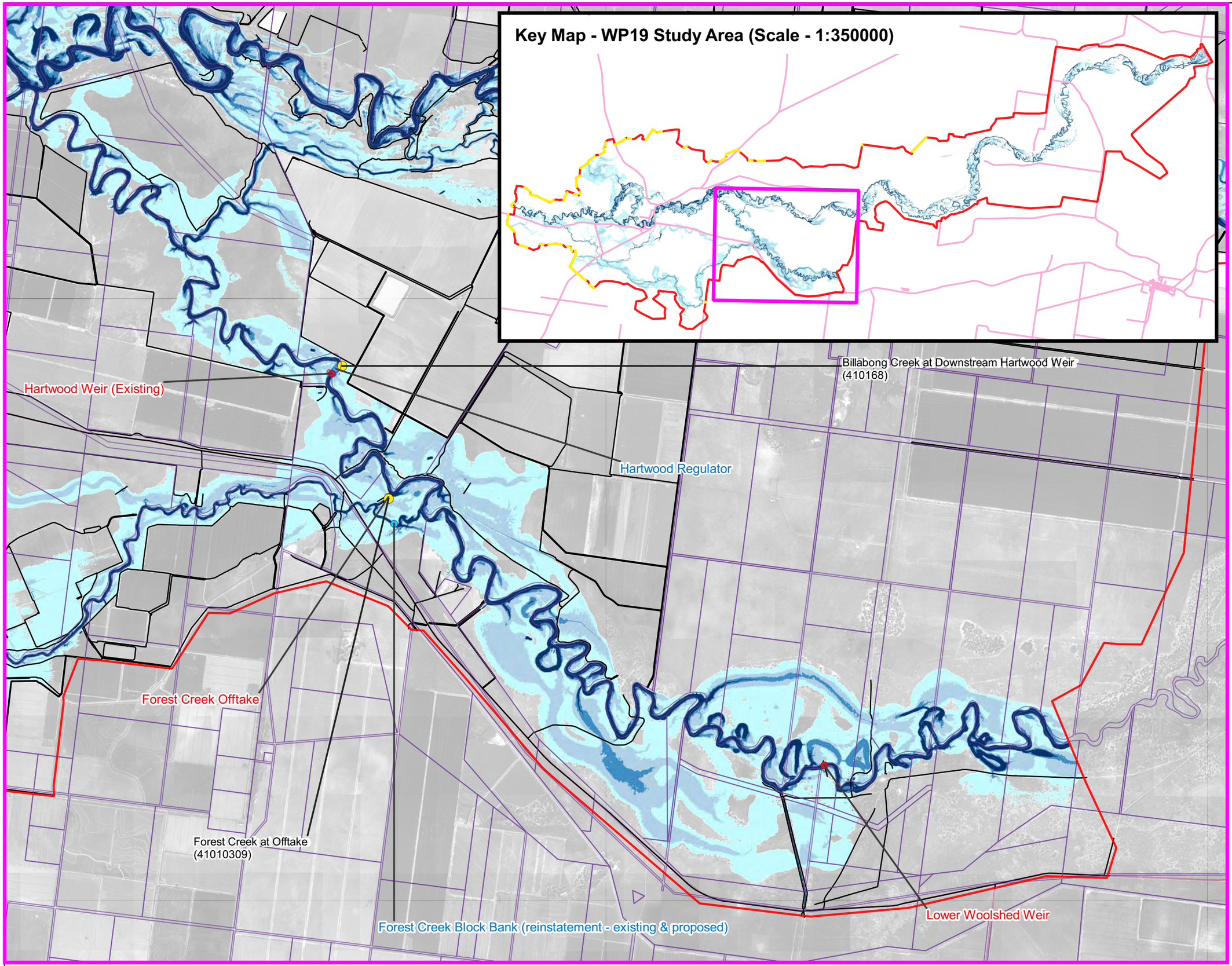
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.11 - 1% AEP Billabong Dominant Depth Plot]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

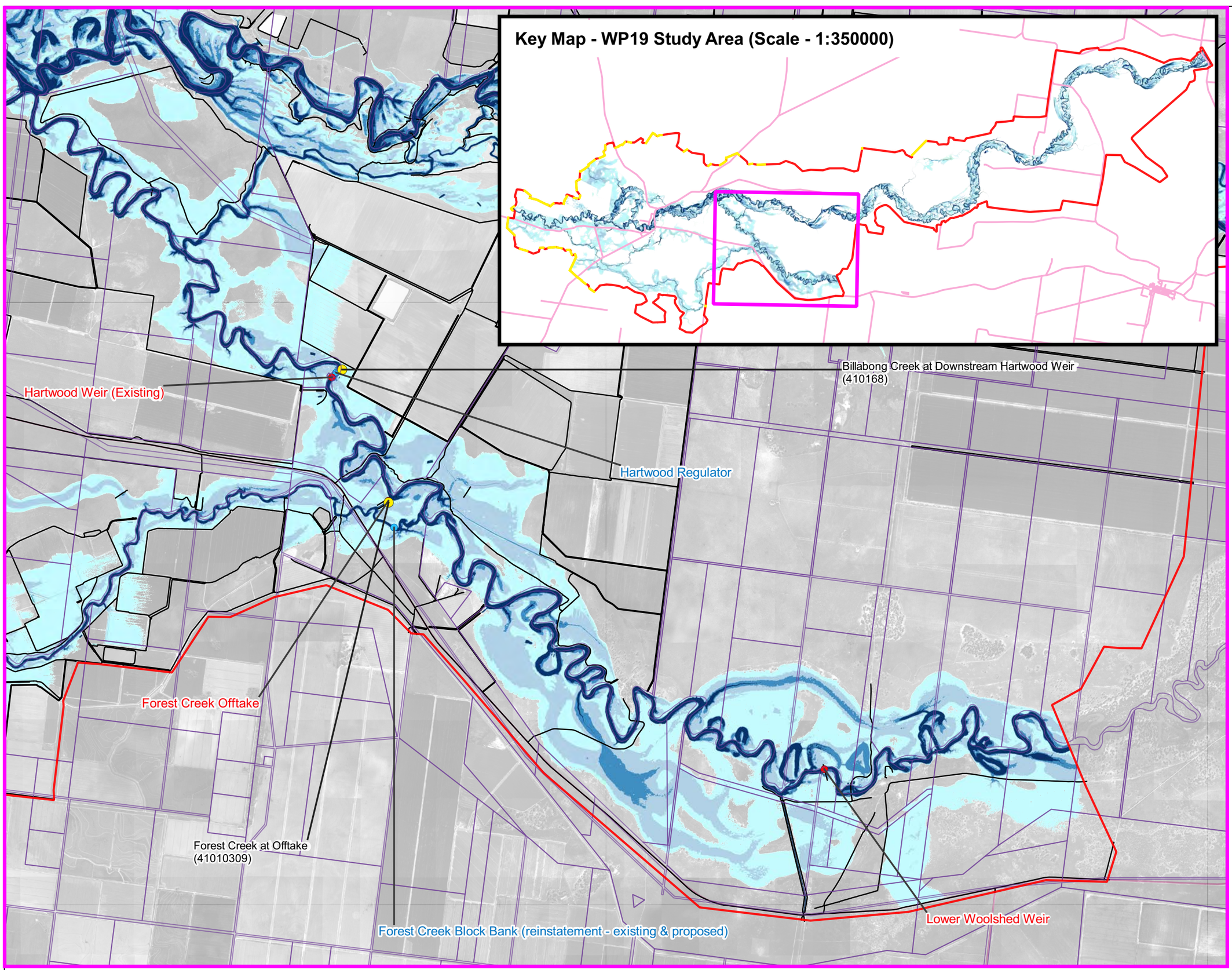
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.12 - 1% AEP Billabong Dominant Depth Plot]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

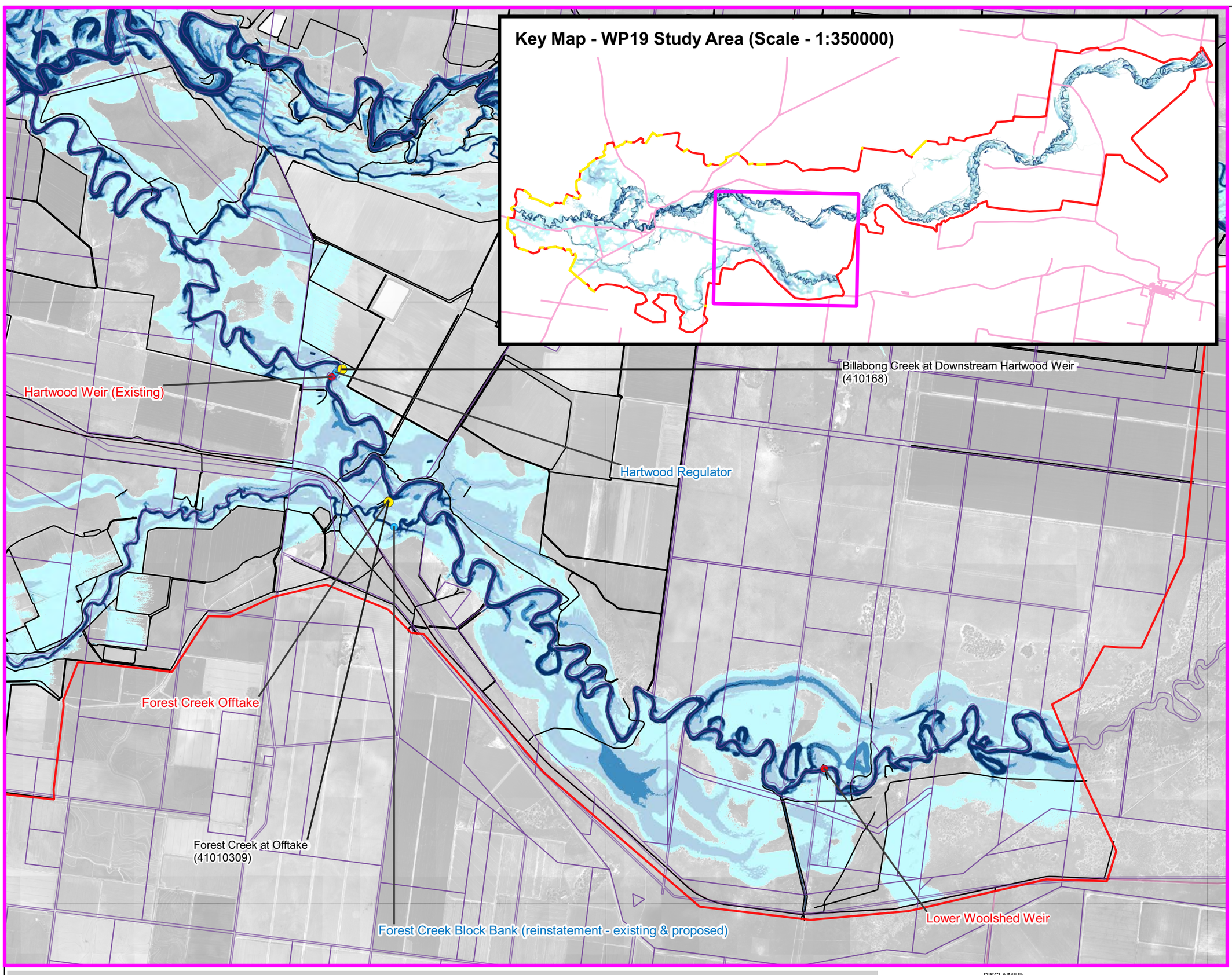
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.13 - 0.5% AEP Billabong Dominant Depth Plot]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

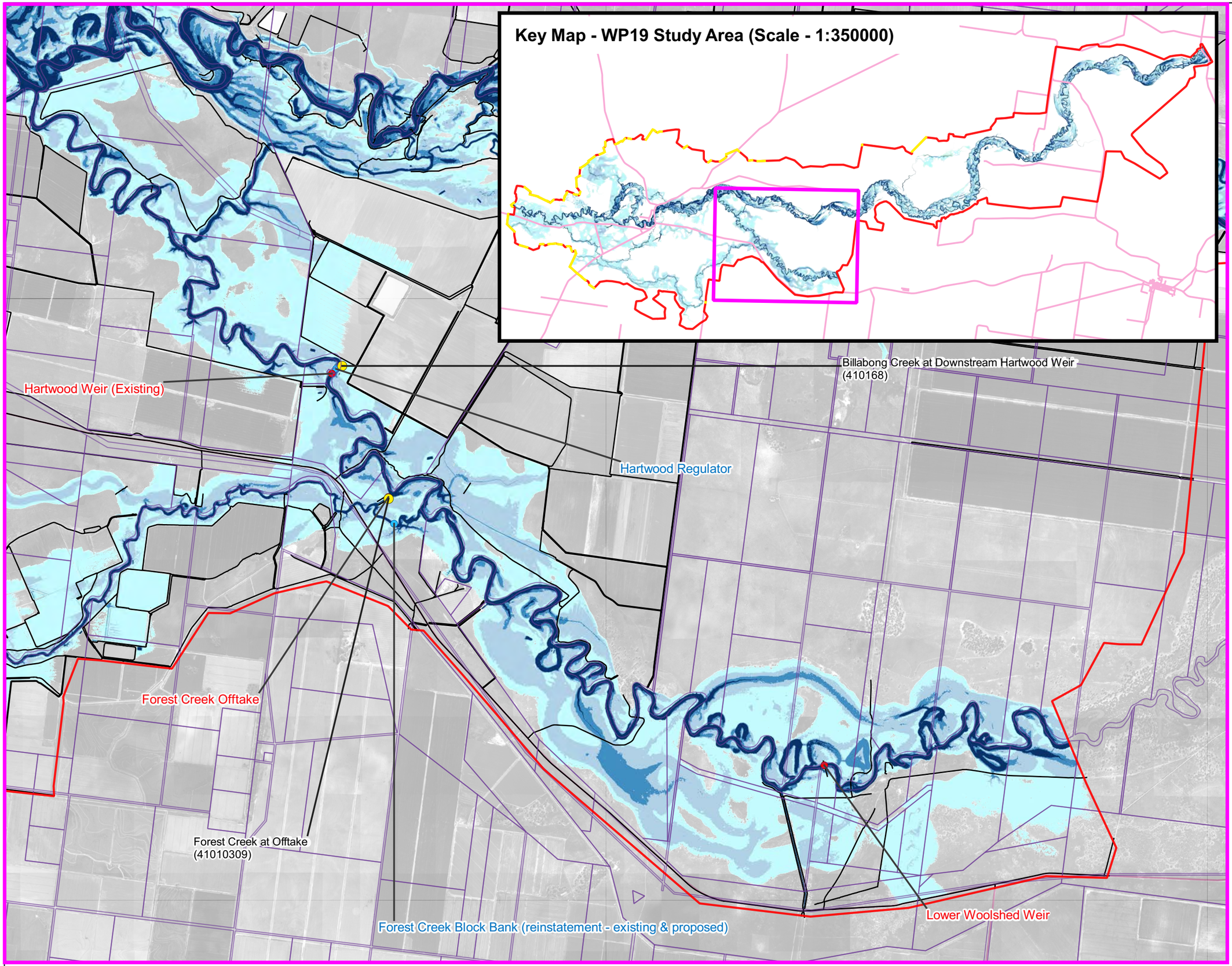
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.14 - 0.5% AEP Billabong Dominant Depth Plot]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

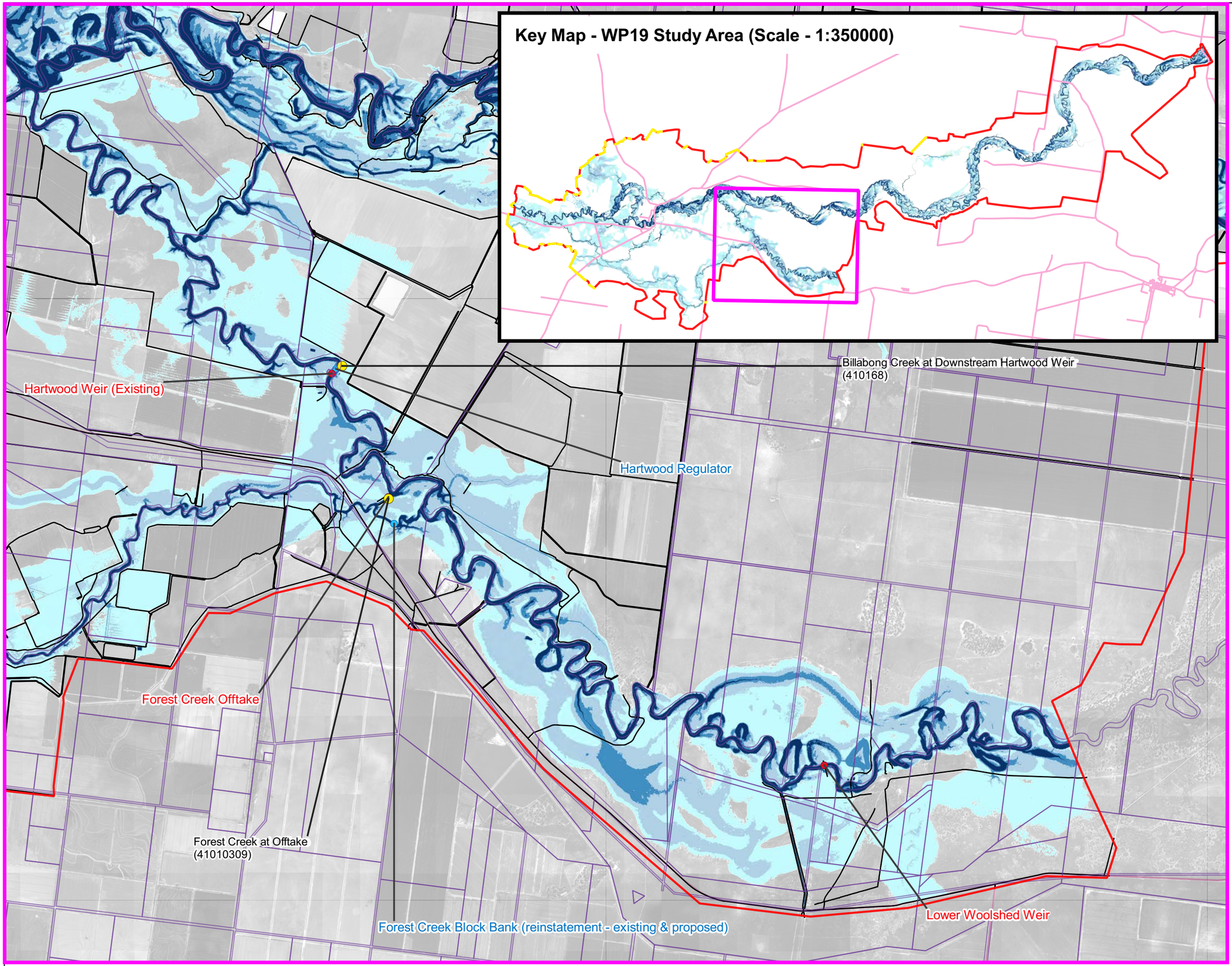
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.15 - 0.3% AEP Billabong Dominant Depth Plot]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

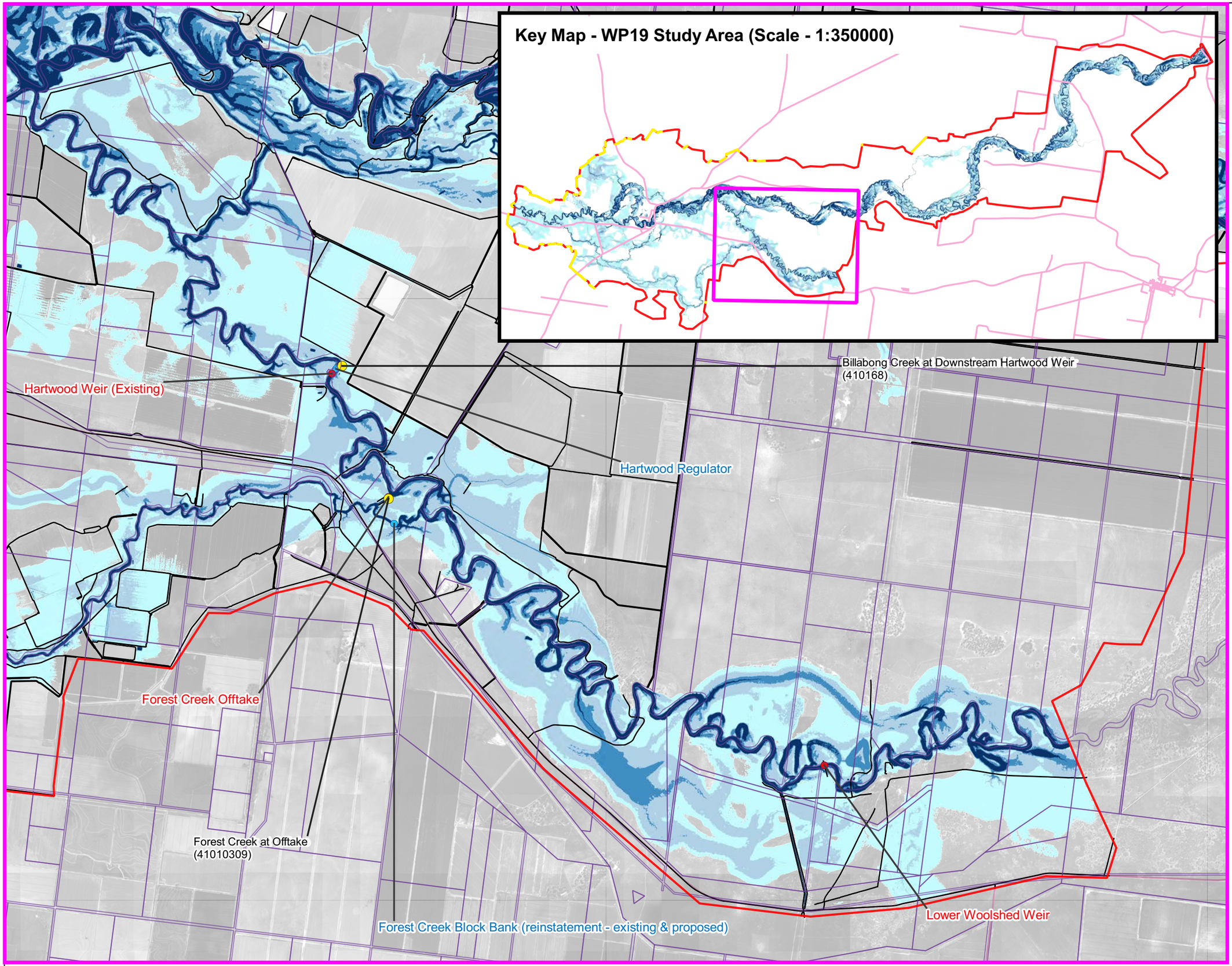
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.16 - 0.3% AEP Billabong Dominant Depth Plot]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

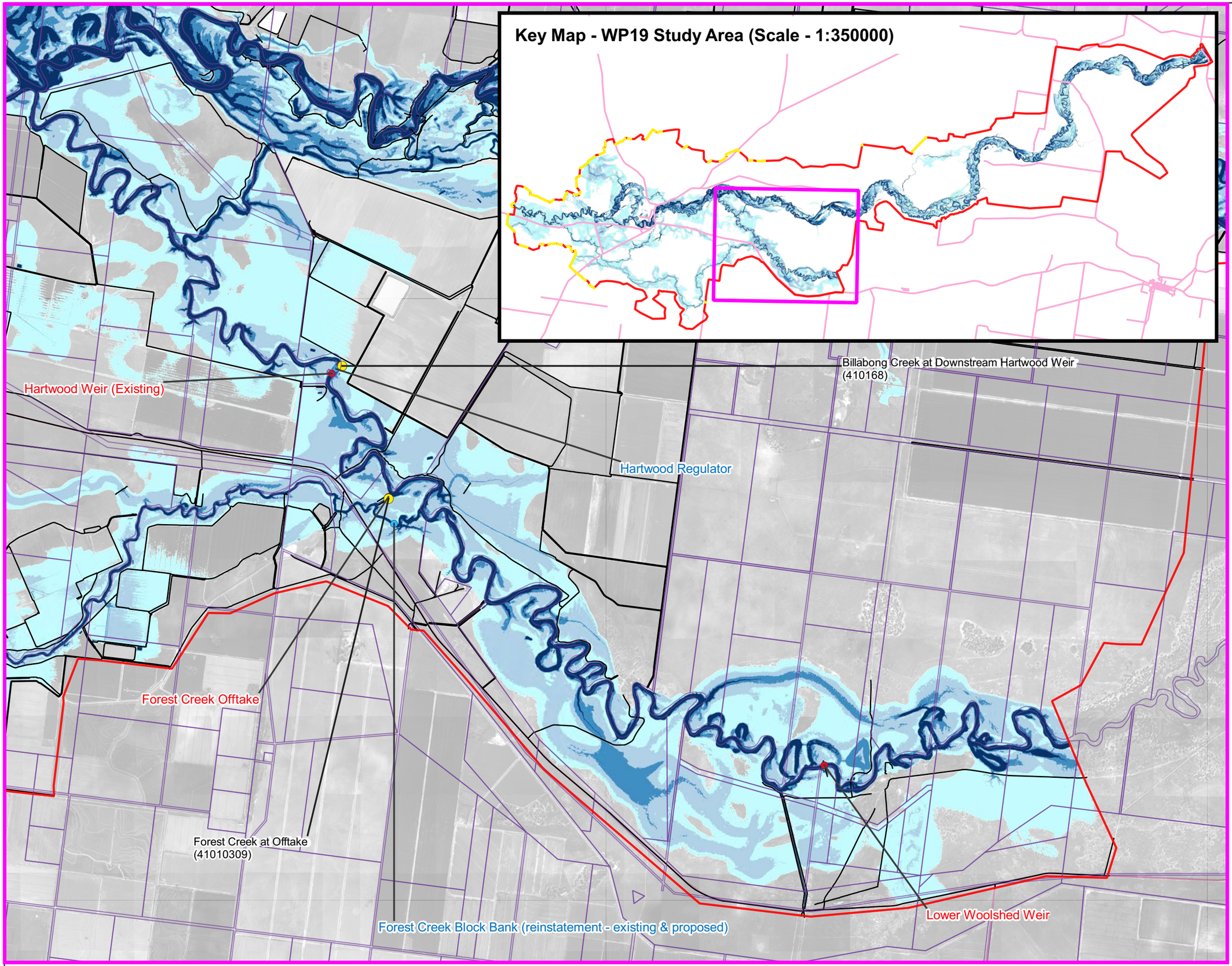
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.17 - 0.2% AEP Billabong Dominant Depth Plot]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

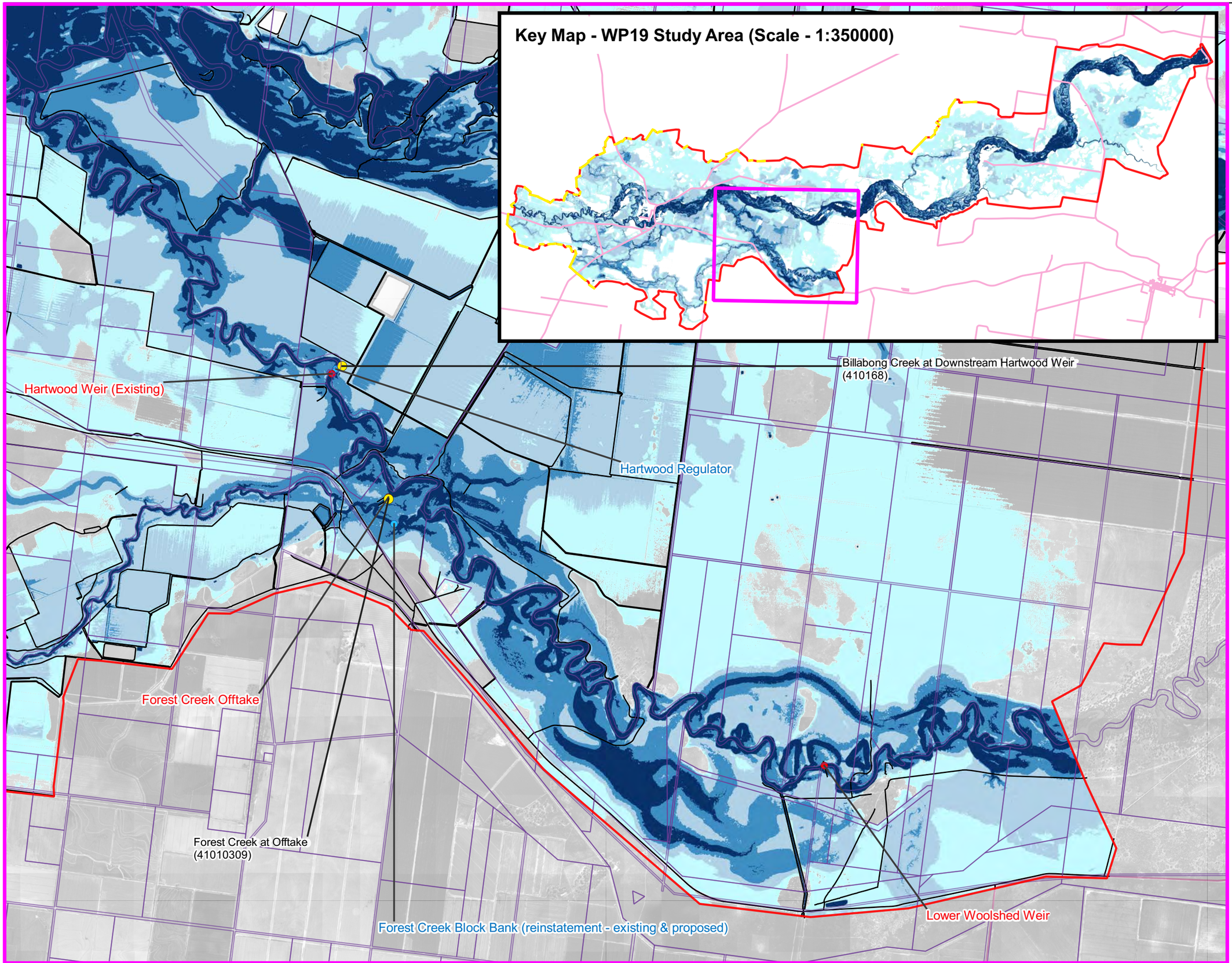
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.18 - 0.2% AEP Billabong Dominant Depth Plot]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

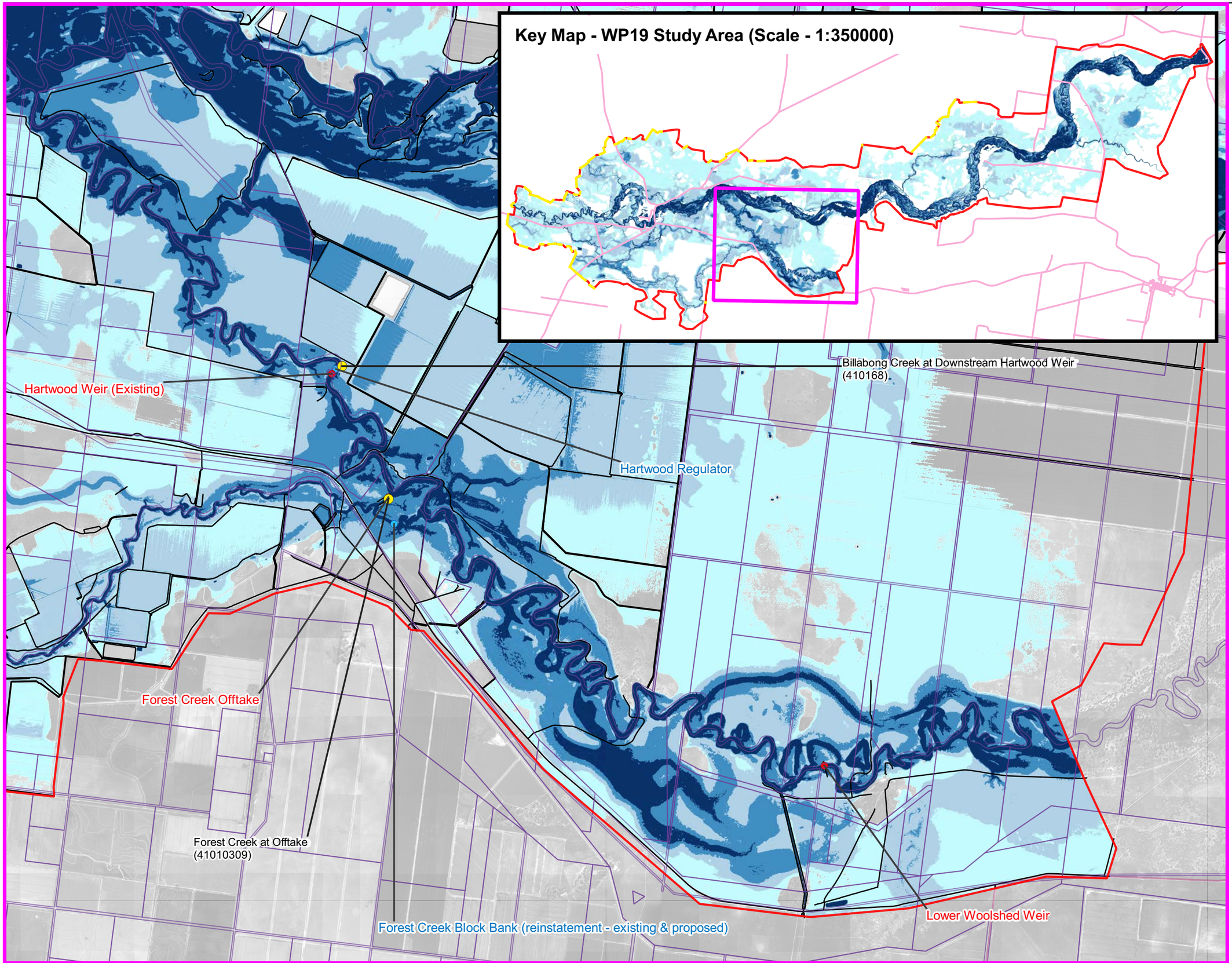
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.19 - PMF Depth Plot]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Roads
- Hydraulic Model Boundary

Depth (m)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

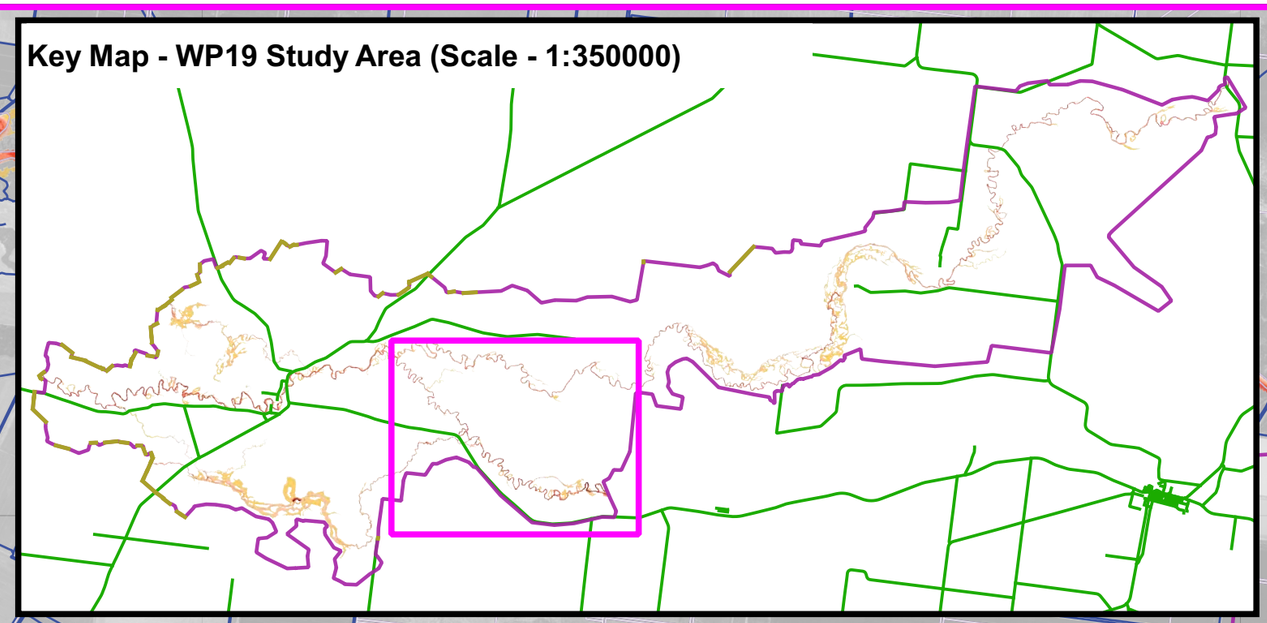
WORKSPACE:
Flood Flow Scenarios
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Depth_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G2.20 - PMF Depth Plot]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

G3 Velocity Plots



Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

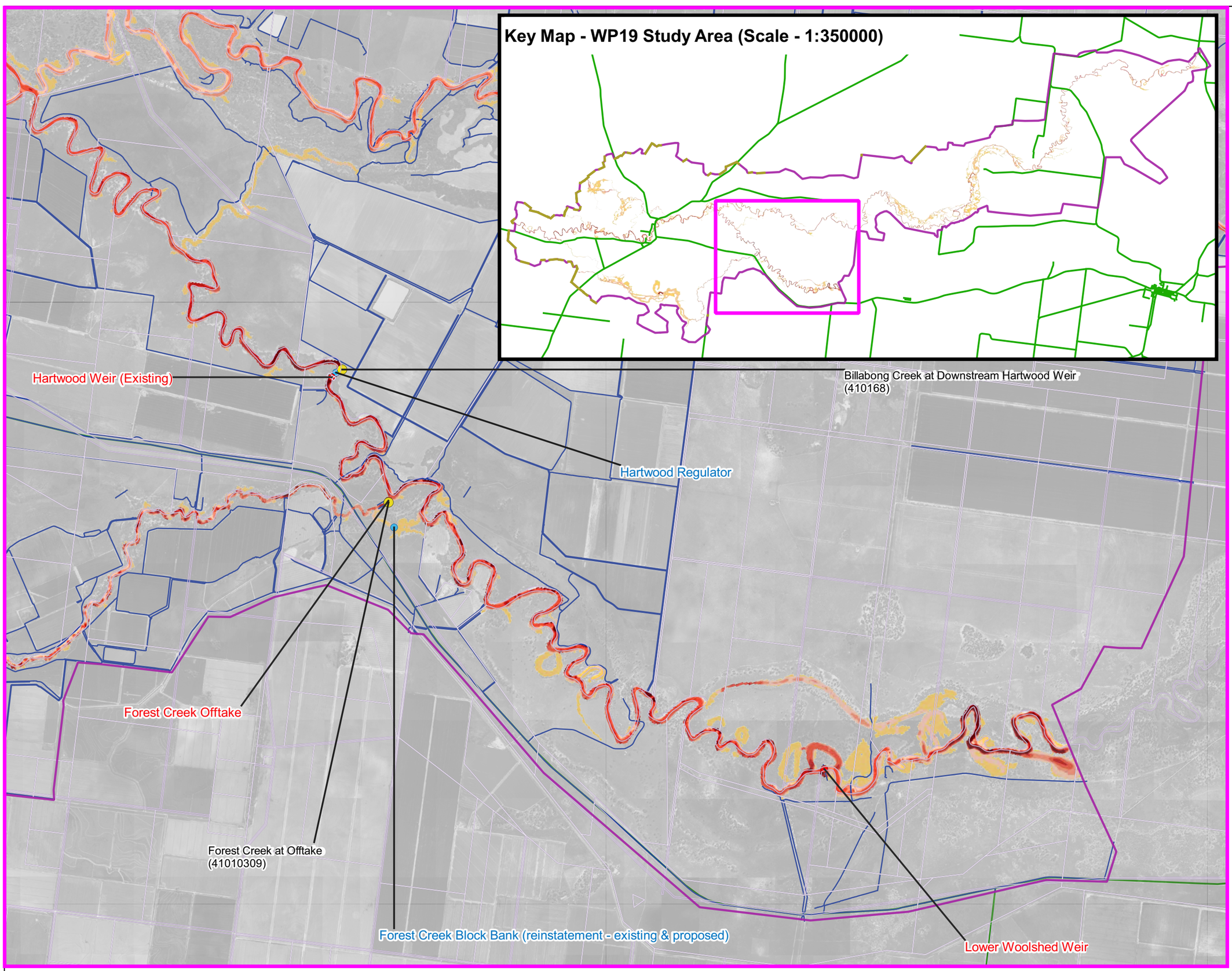
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.1 - 50% AEP Velocity Plot
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

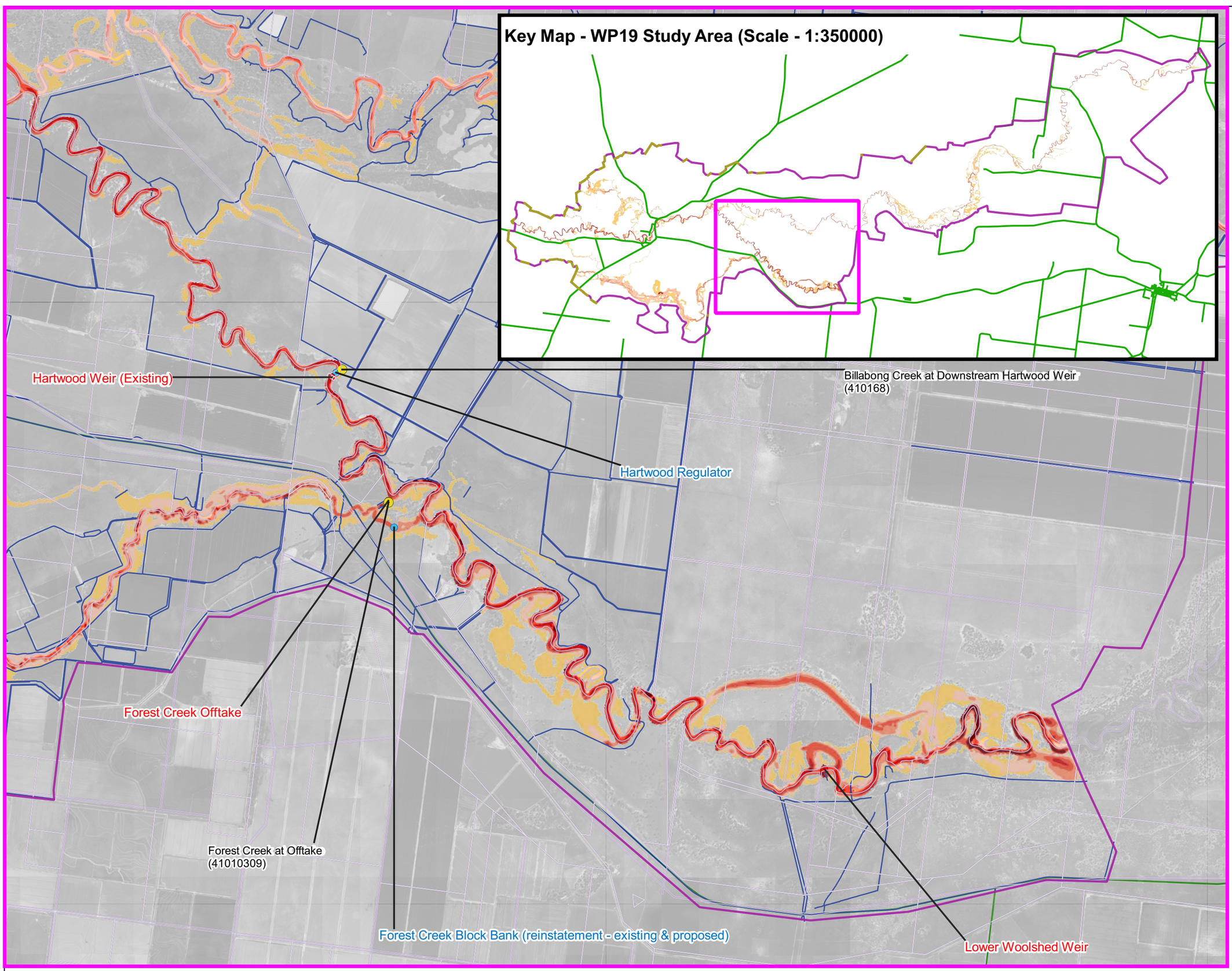
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.2 - 50% AEP Velocity Plot
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

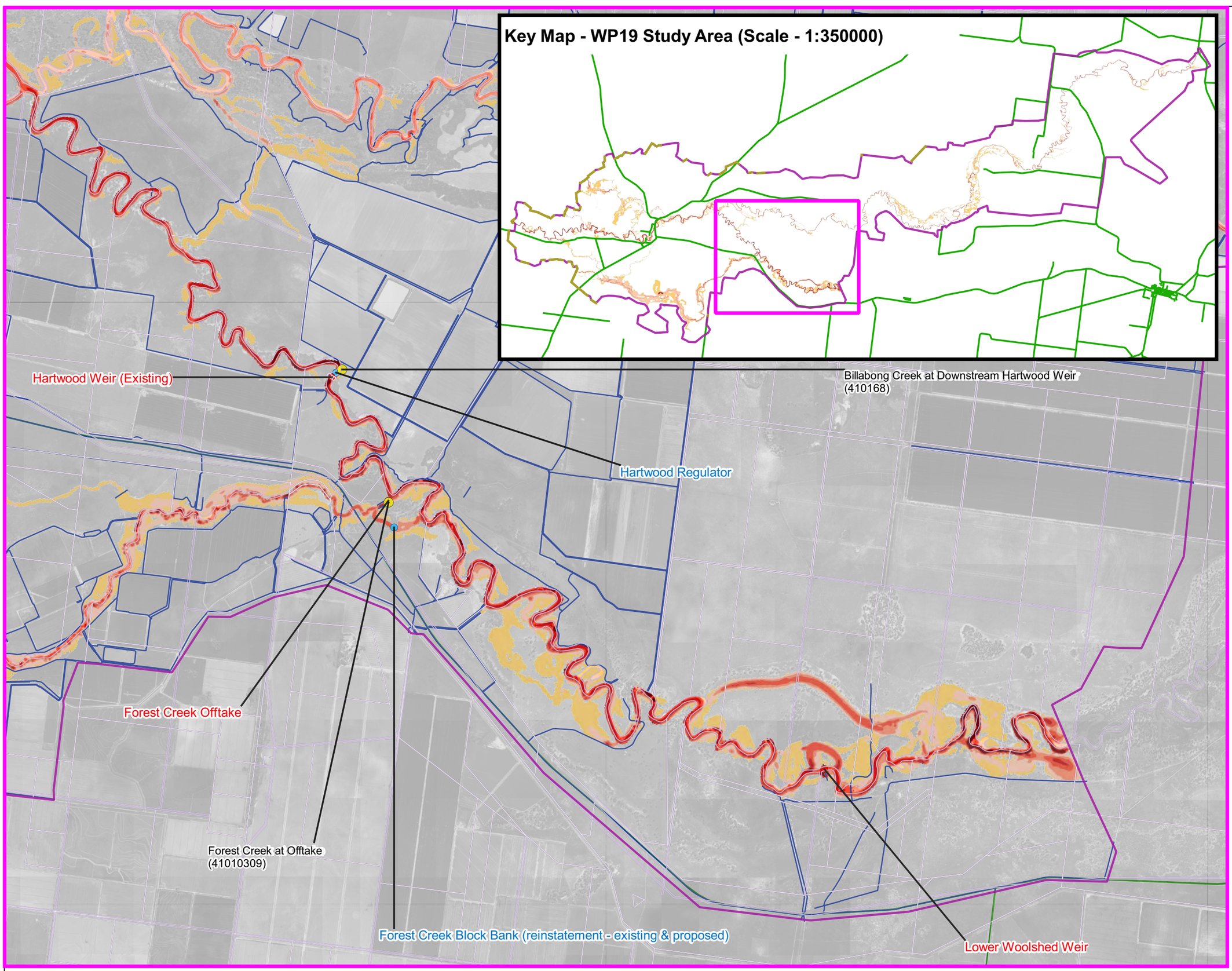
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.3 - 20% AEP Billabong Dominant Velocity Plot "Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

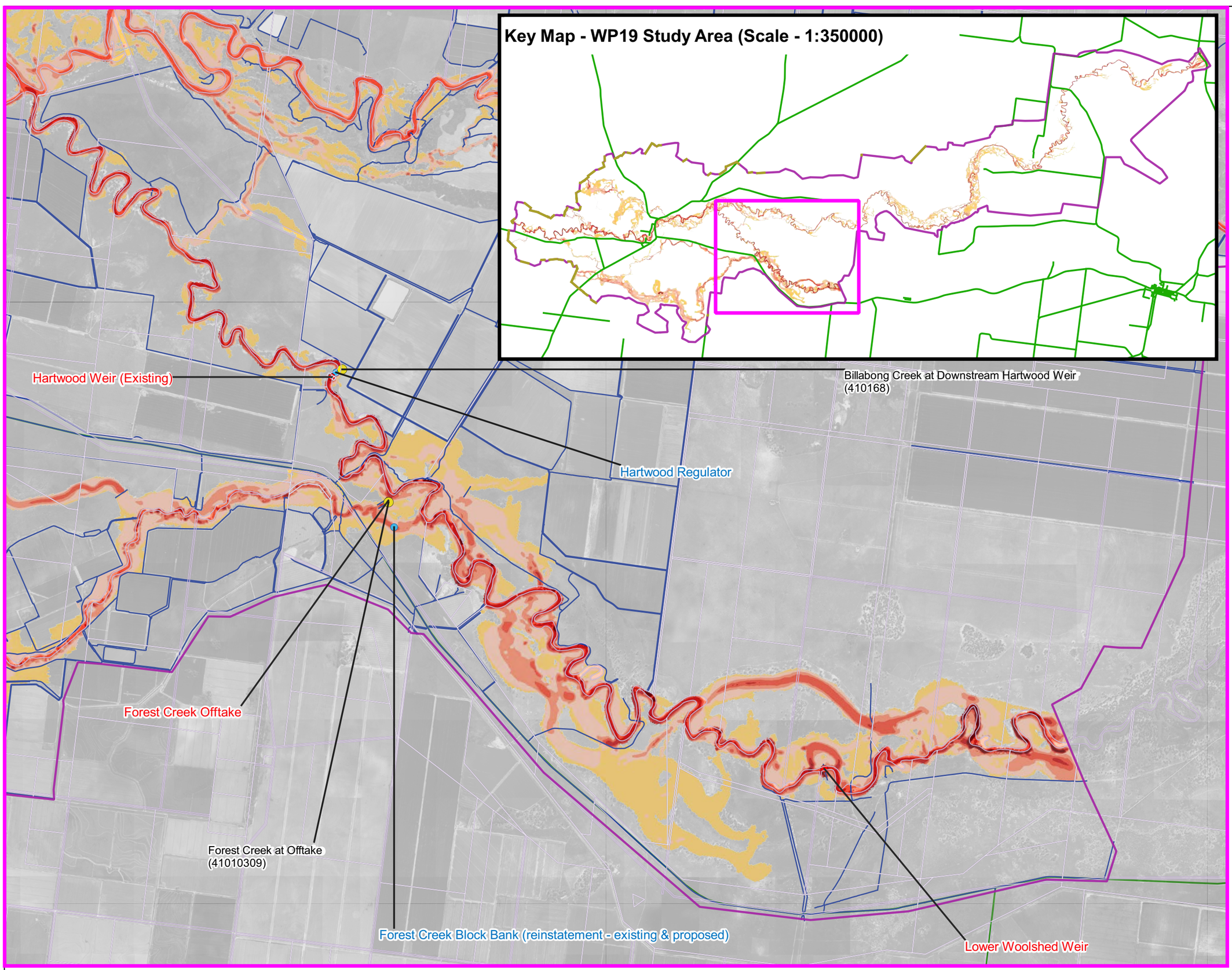
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.4 - 20% AEP Billabong Dominant Velocity Plot "Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

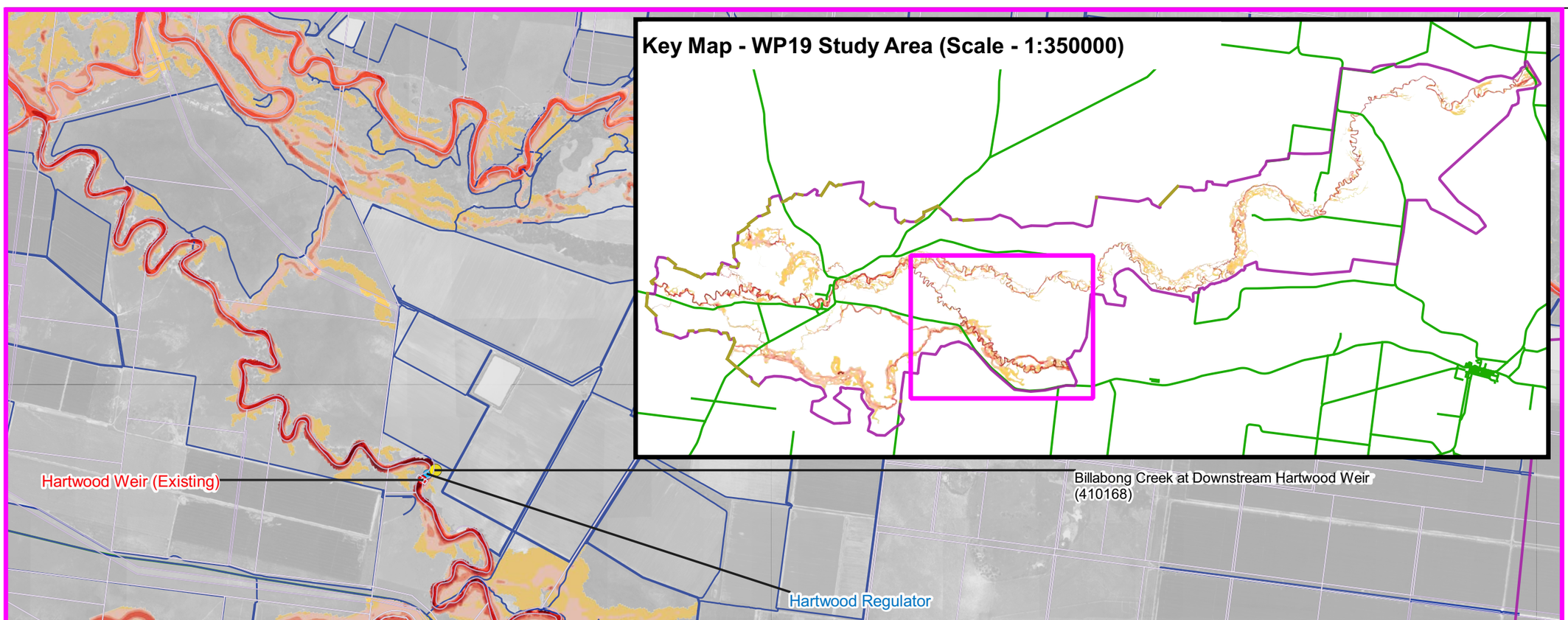
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.5 - 10% AEP Billabong Dominant Velocity Plot "Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

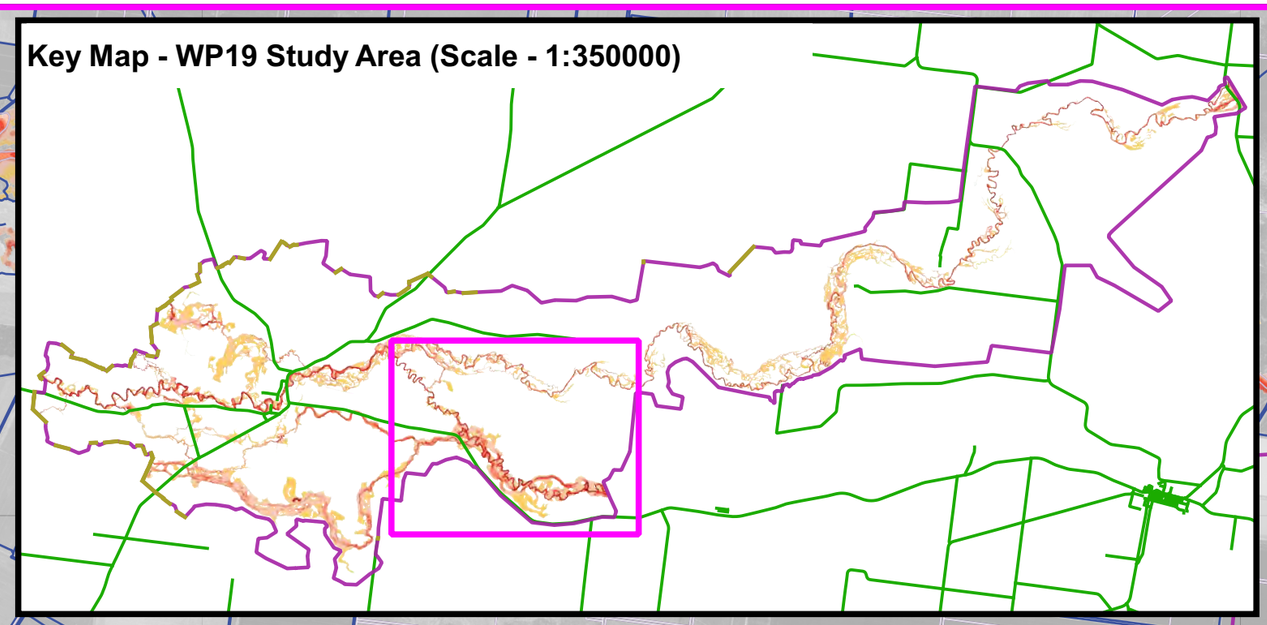
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.6 - 10% AEP Billabong Dominant Velocity Plot "Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

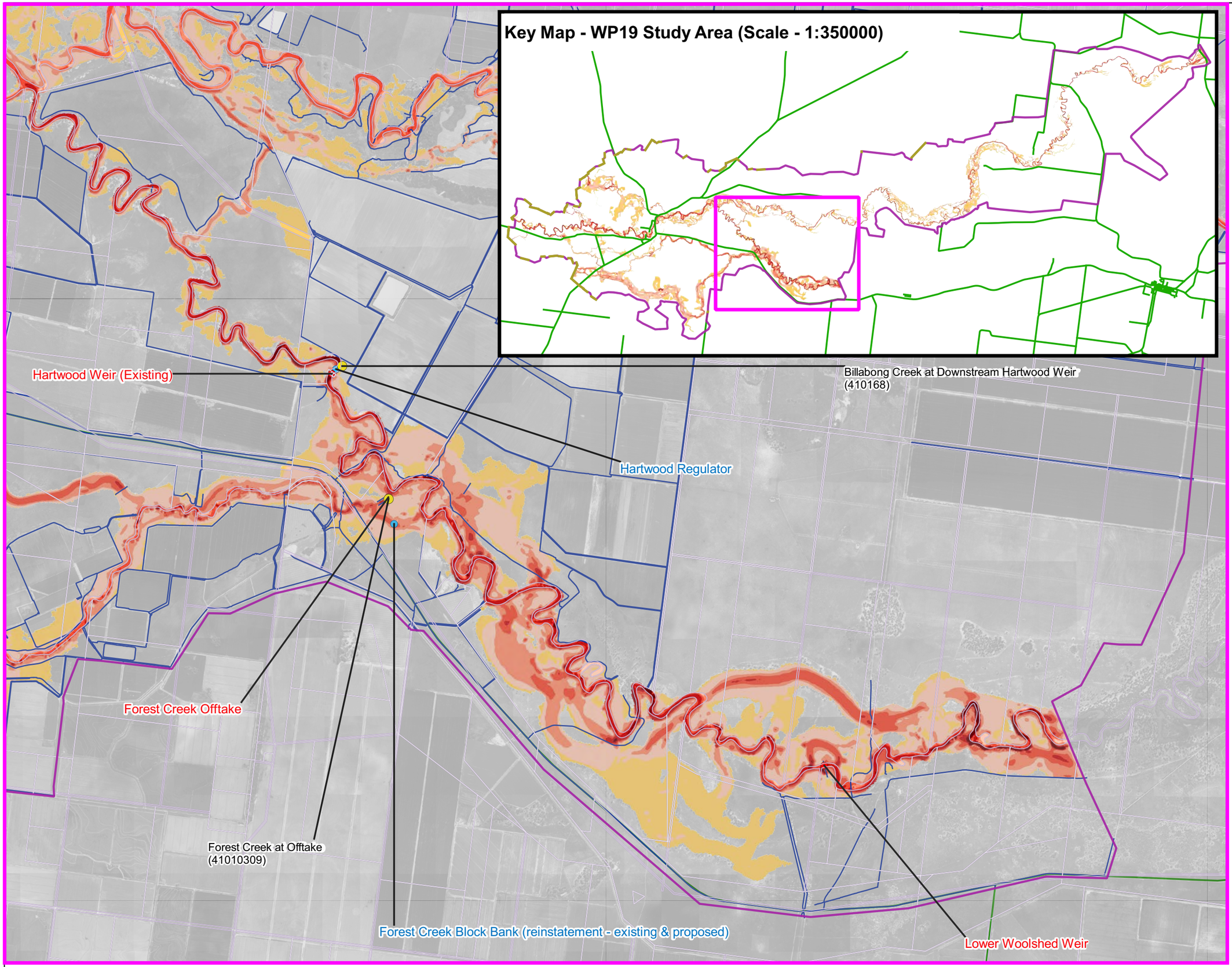
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.7 - 5% AEP Billabong Dominant Velocity Plot "Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

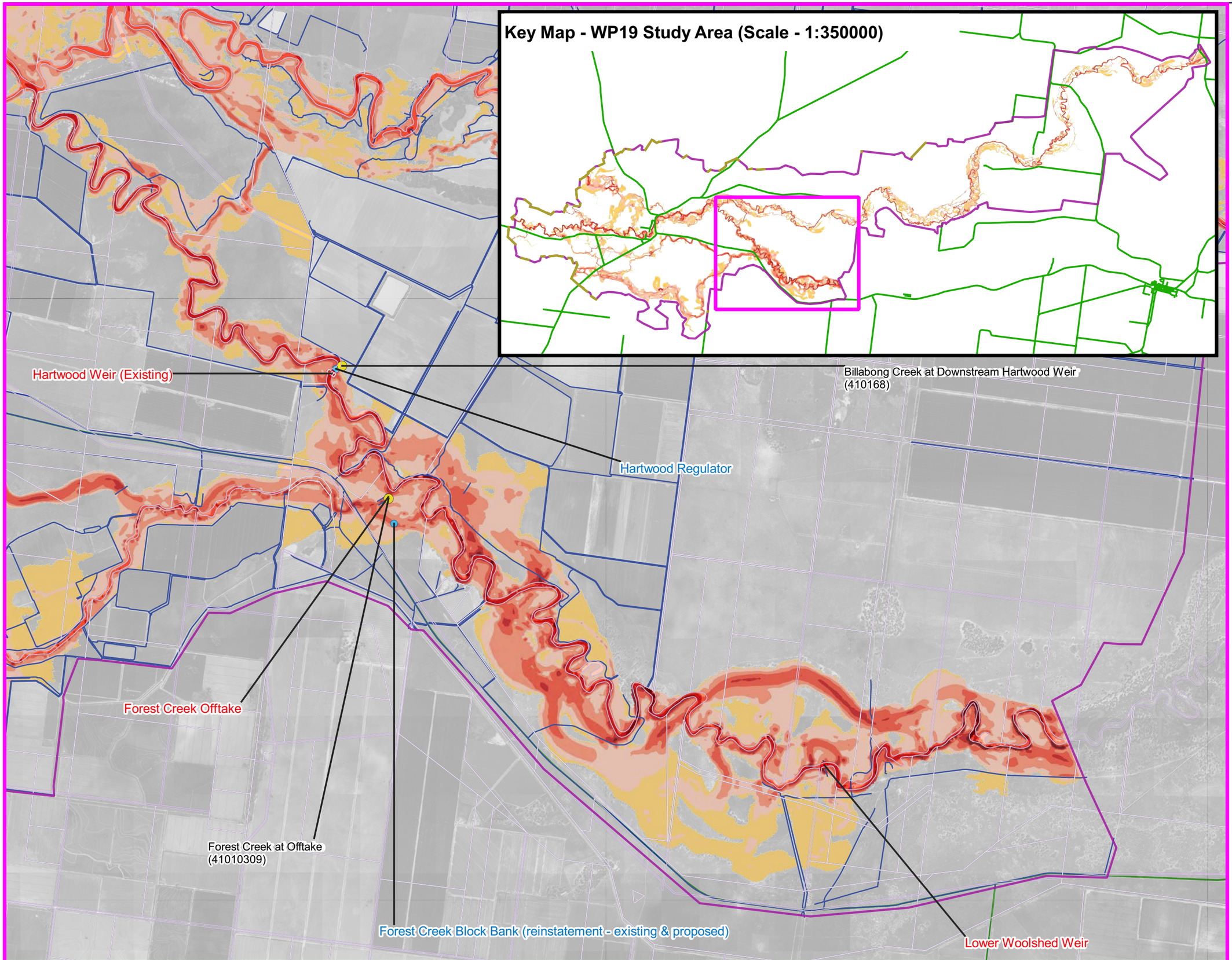
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.8 - 5% AEP Billabong Dominant Velocity Plot "Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

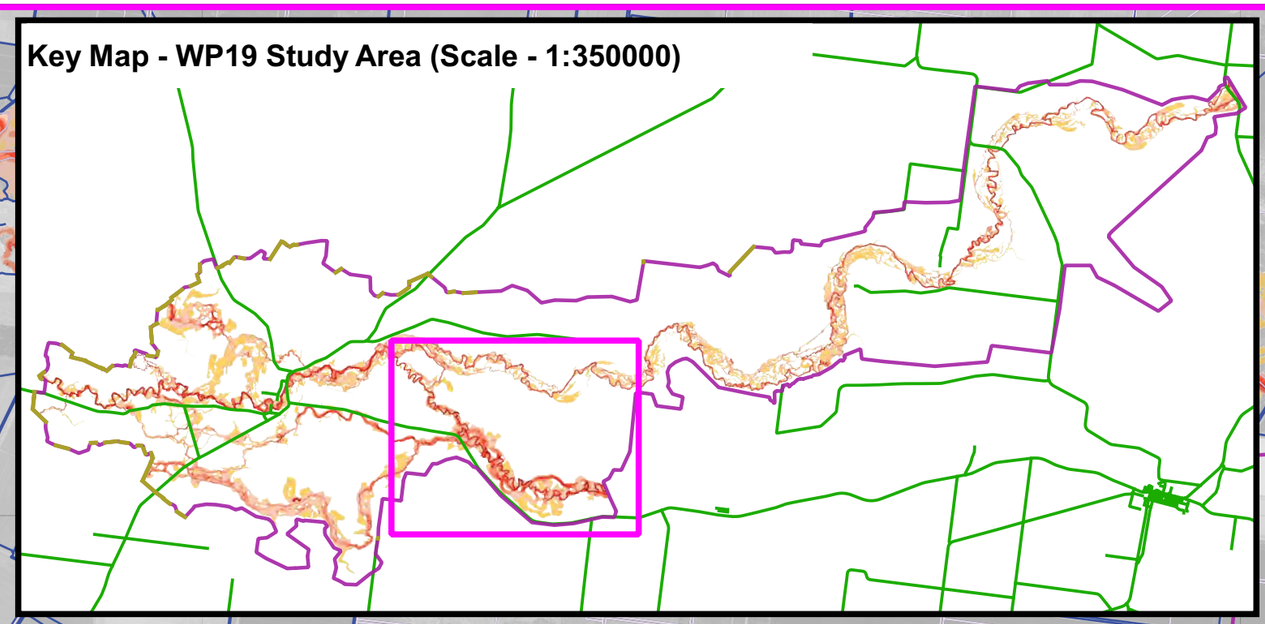
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.9 - 2% AEP Billabong Dominant Velocity Plot
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

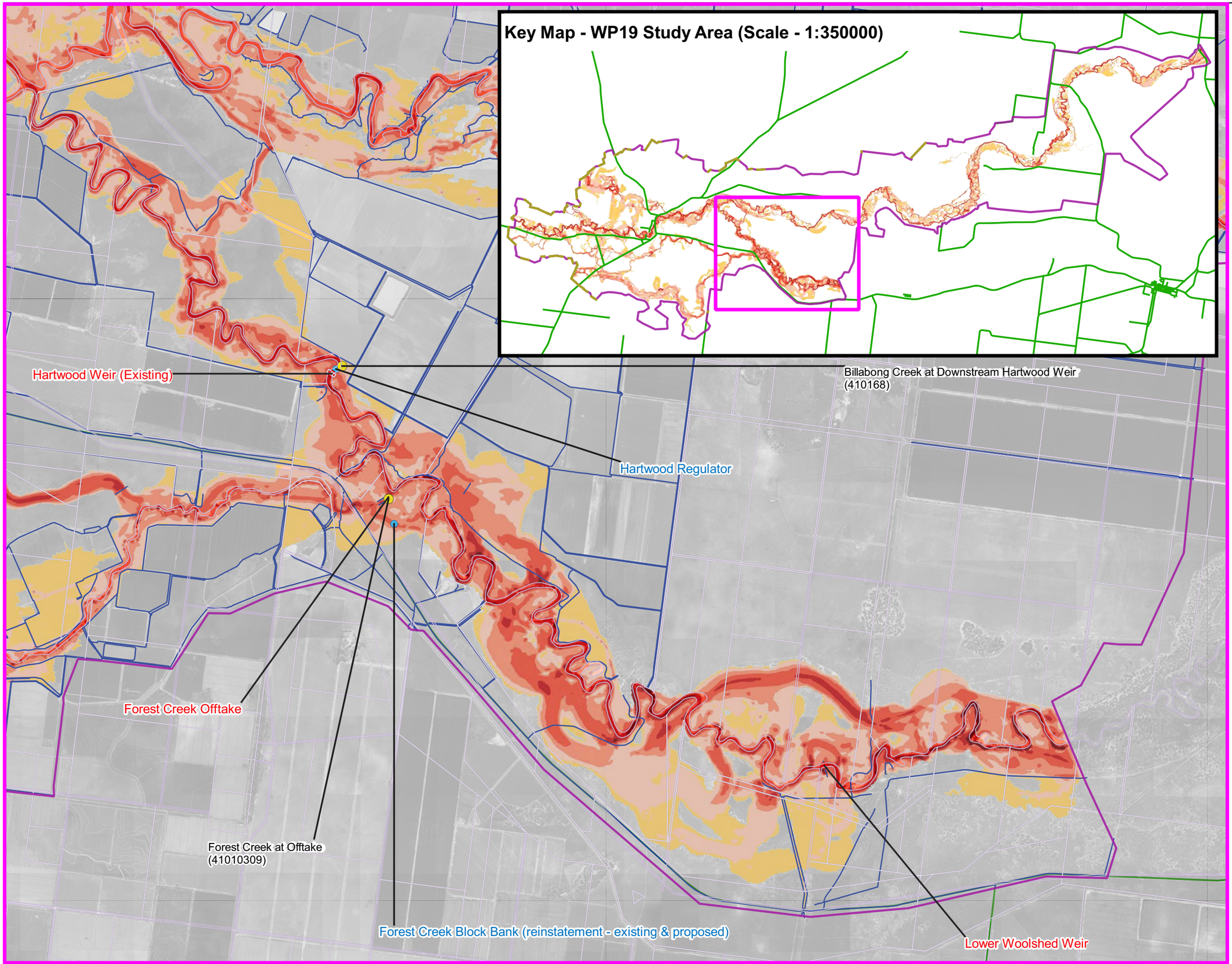
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.10 - 2% AEP Billabong Dominant Velocity Plot "Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

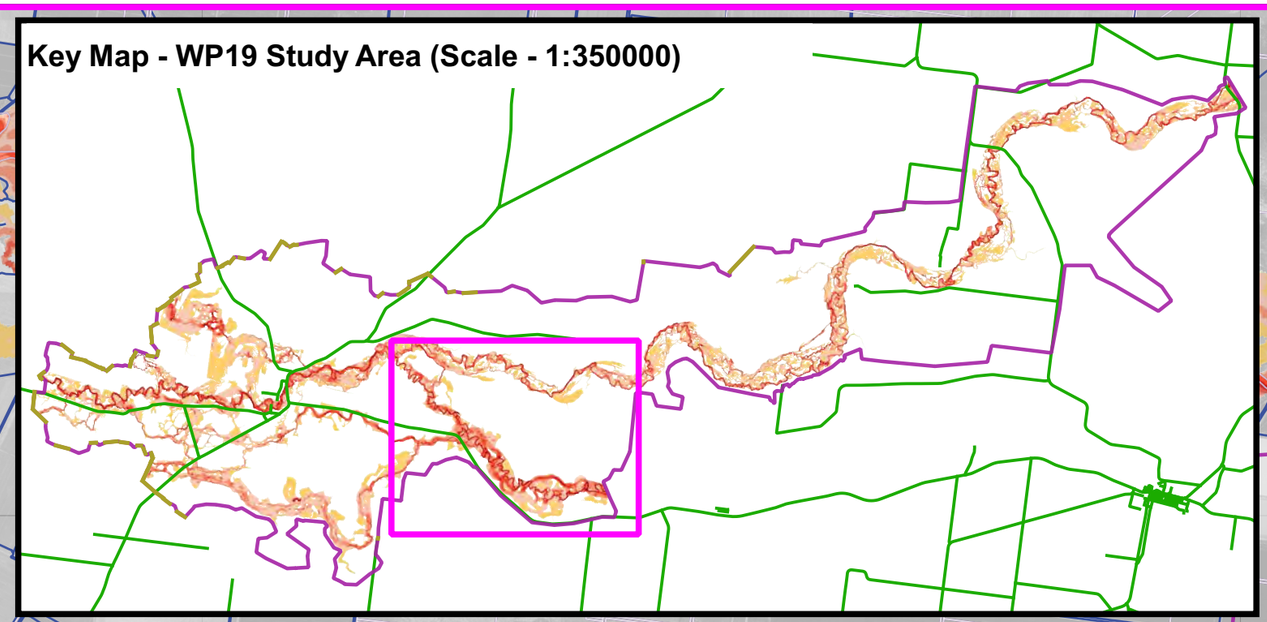
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.11 - 1% AEP Billabong Dominant Velocity Plot "Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

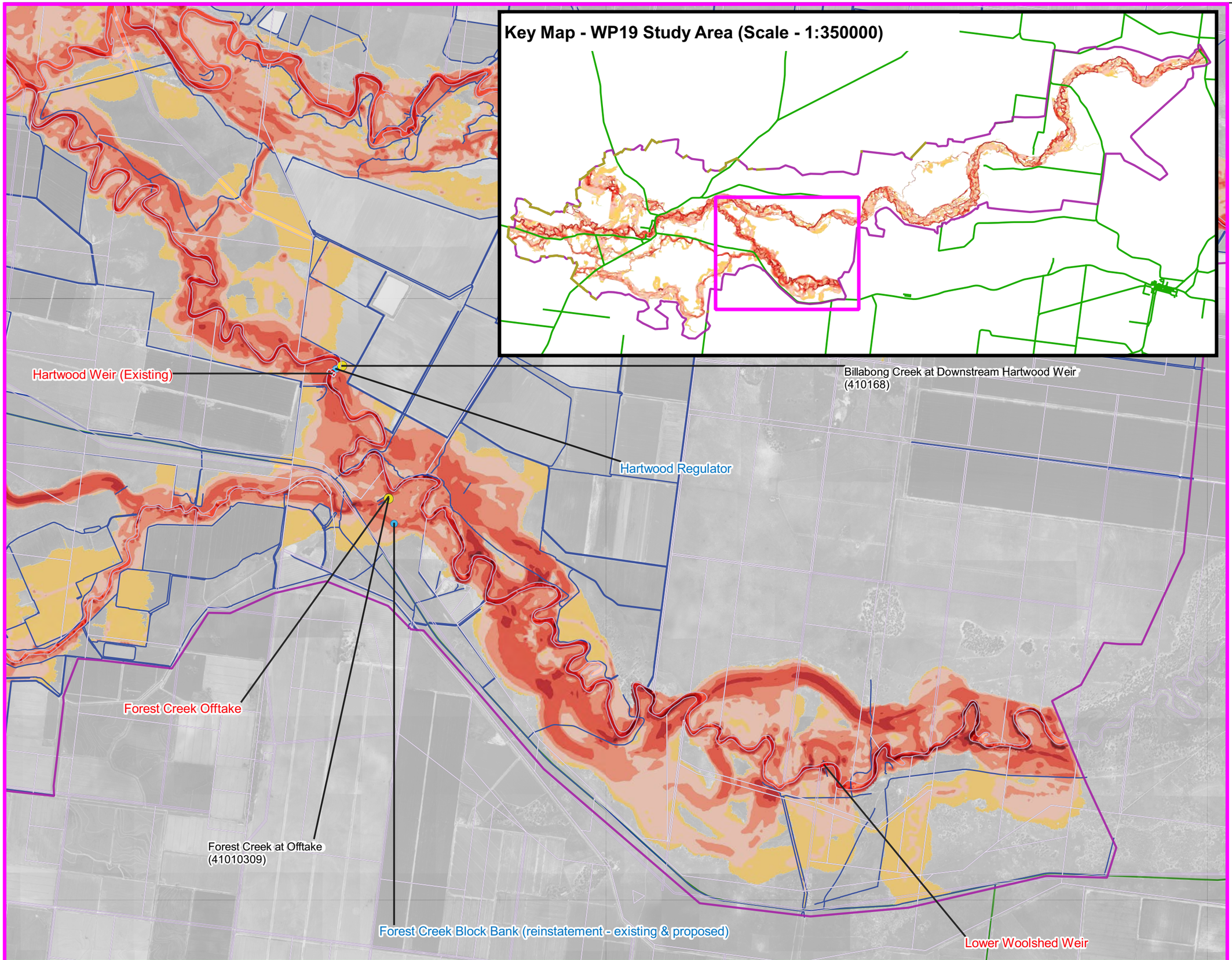
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.12 - 1% AEP Billabong Dominant Velocity Plot
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

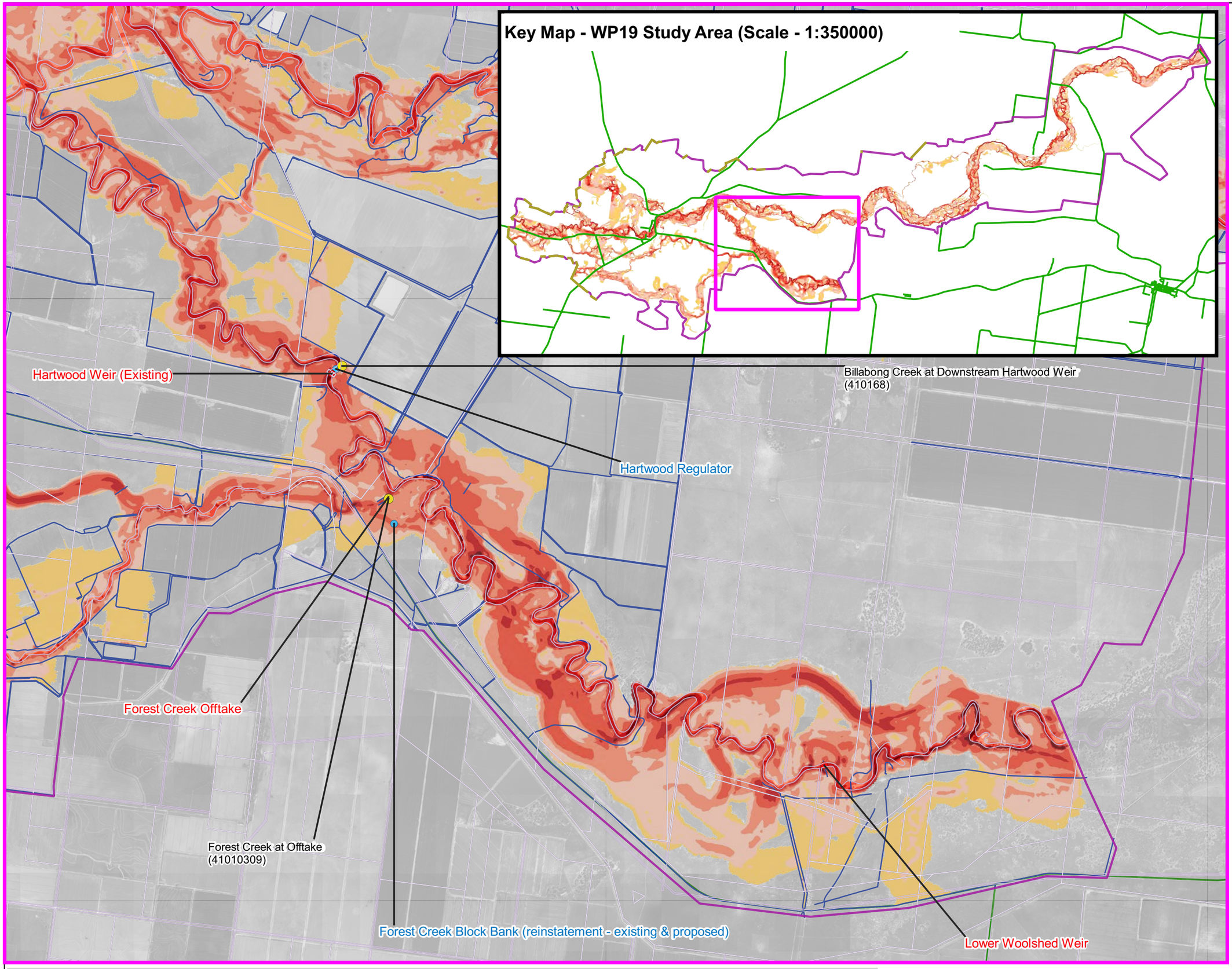
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.13 - 0.5% AEP Billabong Dominant Velocity Plot "Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

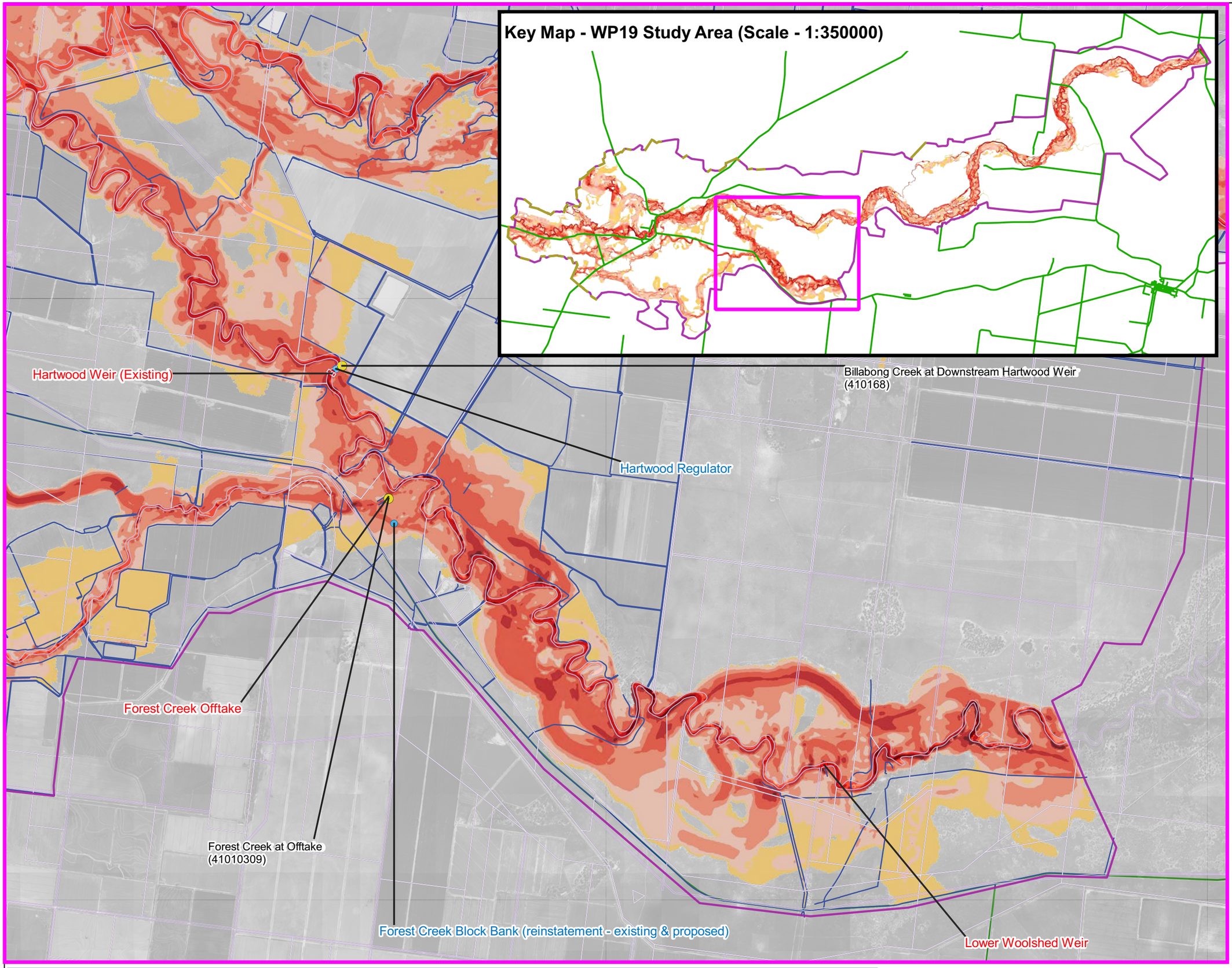
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.14 - 0.5% AEP Billabong Dominant Velocity Plot "Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

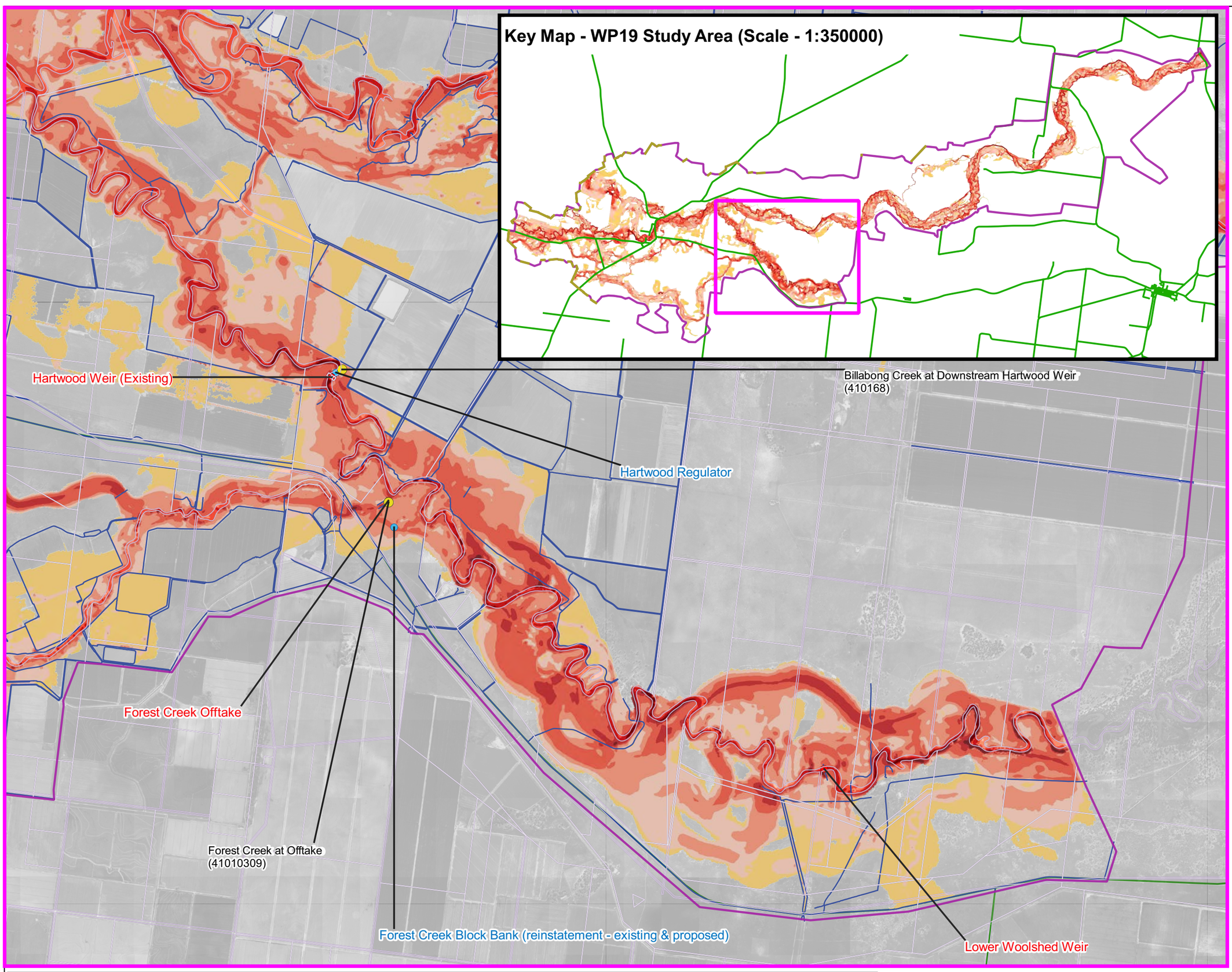
0 1 2 km

DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.15 - 0.3% AEP Billabong Dominant Velocity Plot "Existing"

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

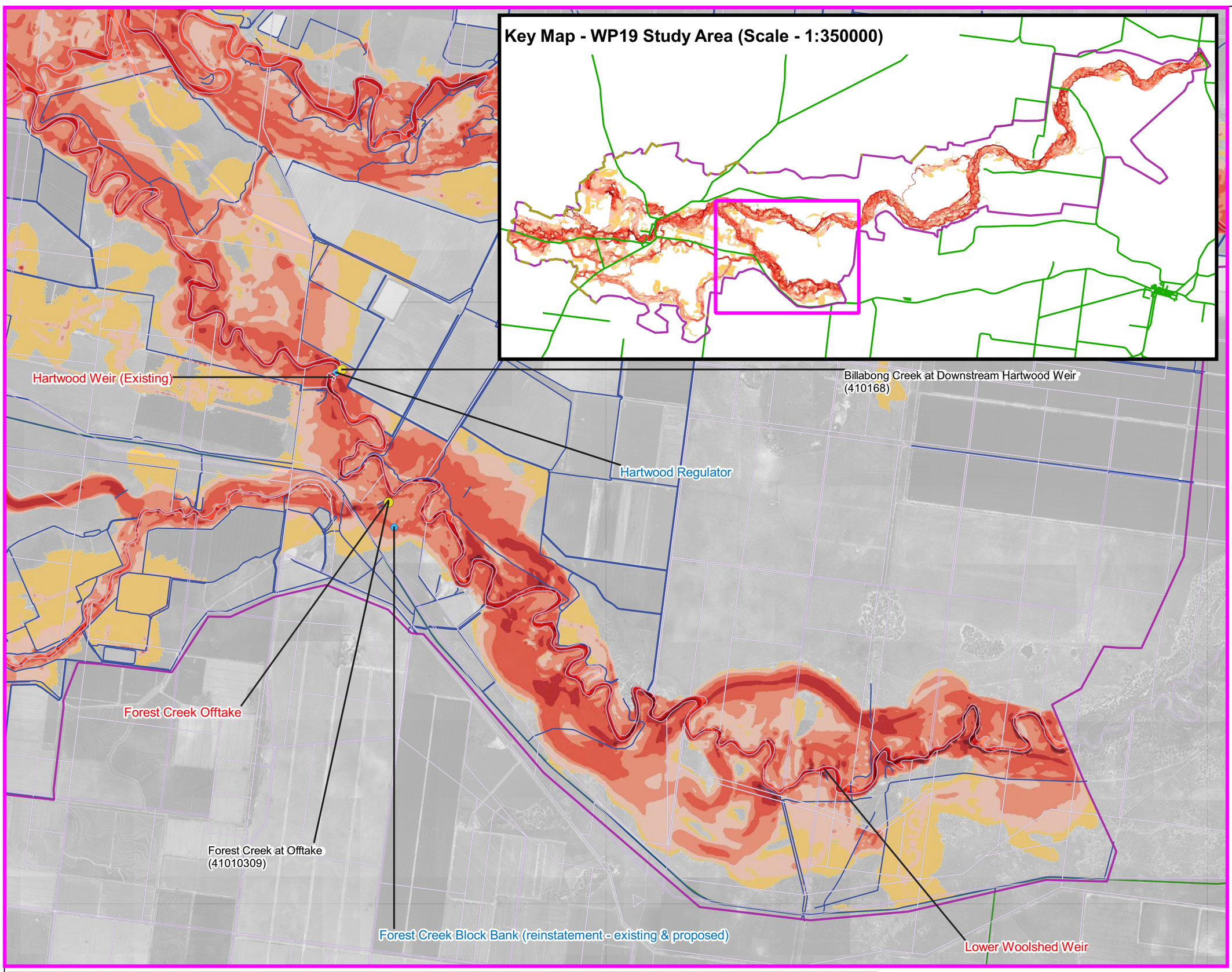
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.16 - 0.3% AEP Billabong Dominant Velocity Plot
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

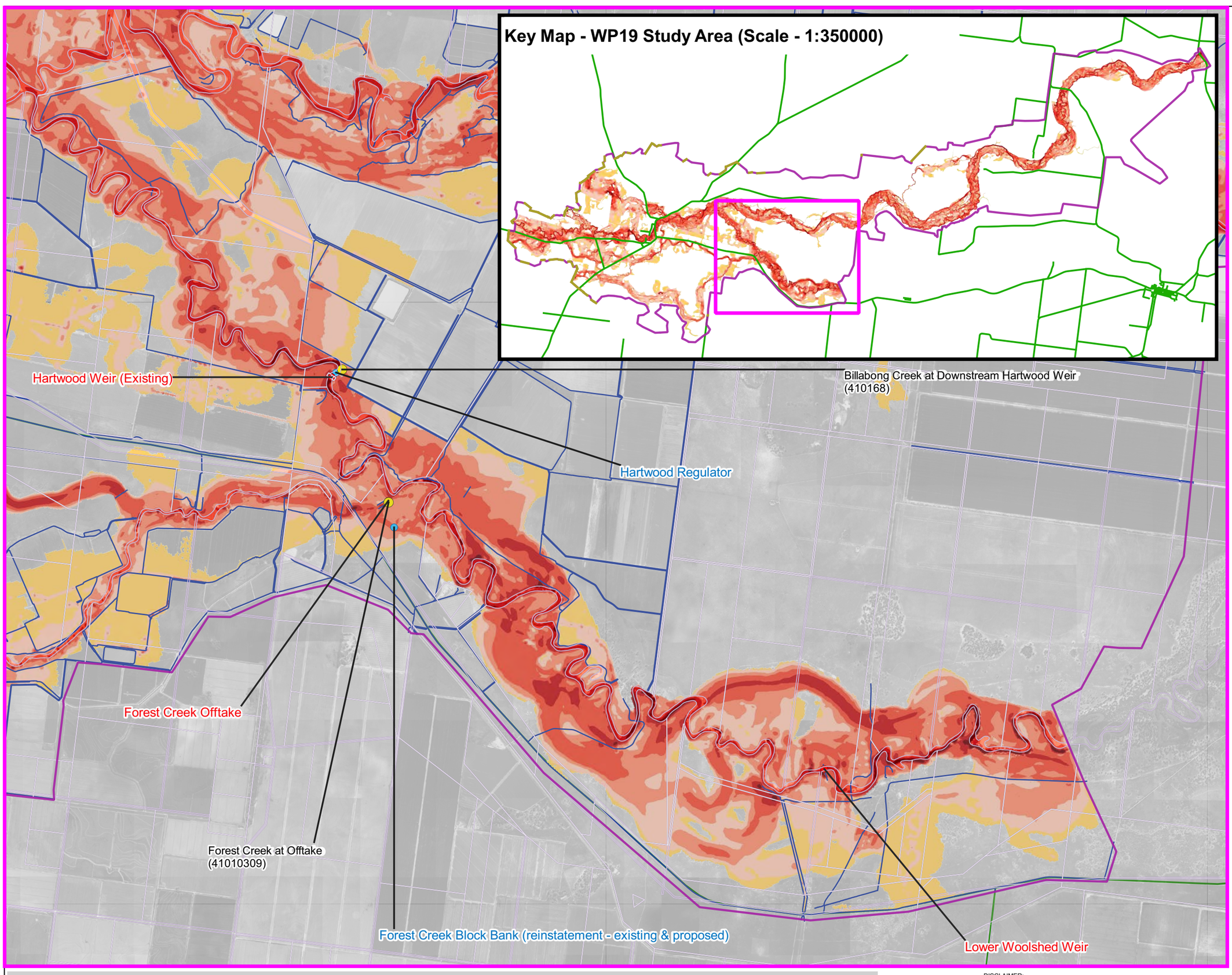
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.17 - 0.2% AEP Billabong Dominant Velocity Plot "Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

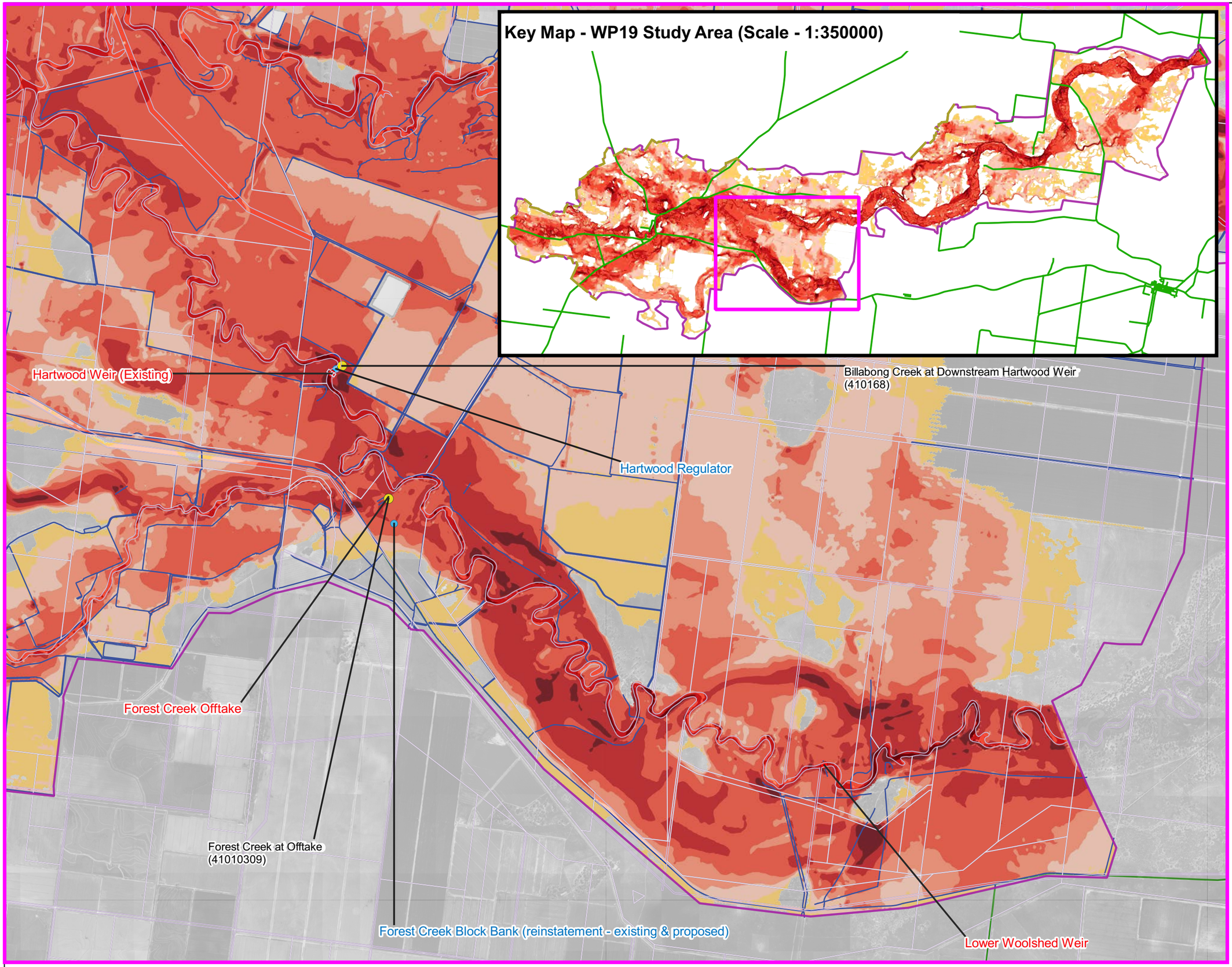
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.18 - 0.2% AEP Billabong Dominant Velocity Plot "Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

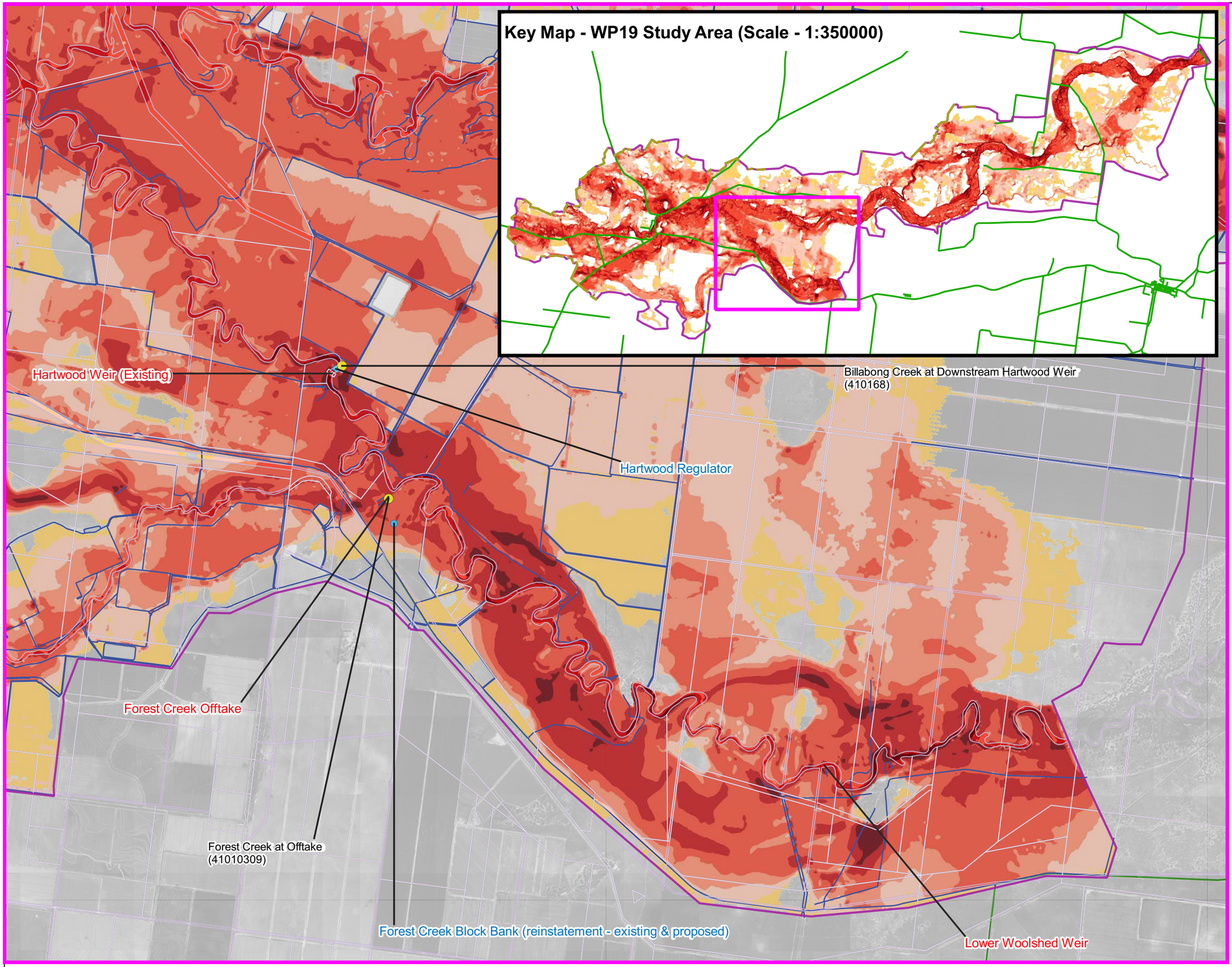
DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.19 - PMF Velocity Plot
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Ridge Lines
- Downstream Boundary Conditions
- Property Boundaries
- Hydraulic Model Boundary

Velocity (m/s)

- <= 0.03
- 0.03 - 0.10
- 0.10 - 0.17
- 0.17 - 0.30
- 0.30 - 0.50
- > 0.50

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties and Roads, Nsw Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DPE, 2021.

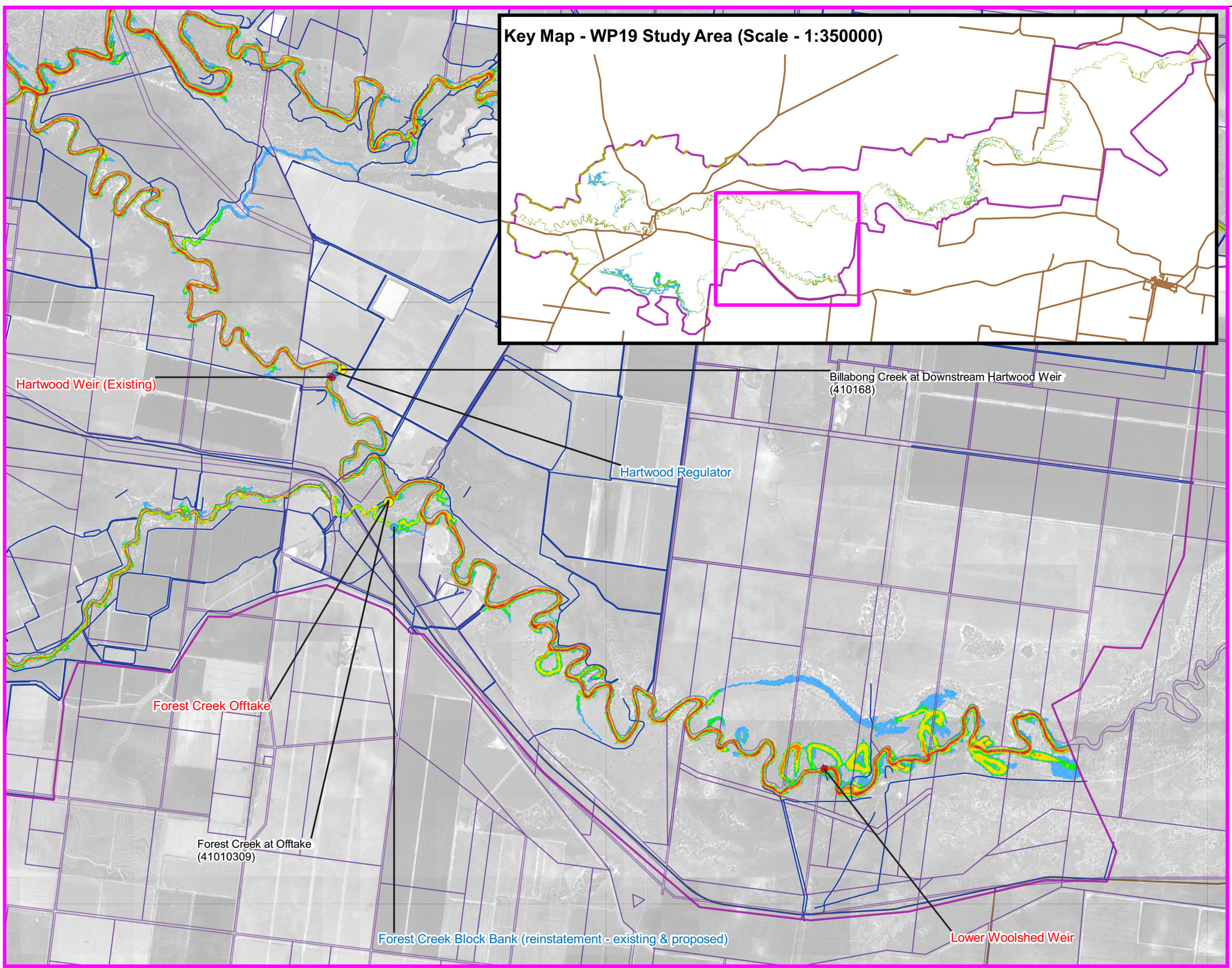
WORKSPACE:
Velocity Atlas Map Generator Flood flows
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Background_Layers\EIS_mapping_SDLAM_LT_Hazard.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G3.20 - PMF Velocity Plot
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.

G4 Hazard Category Plots



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

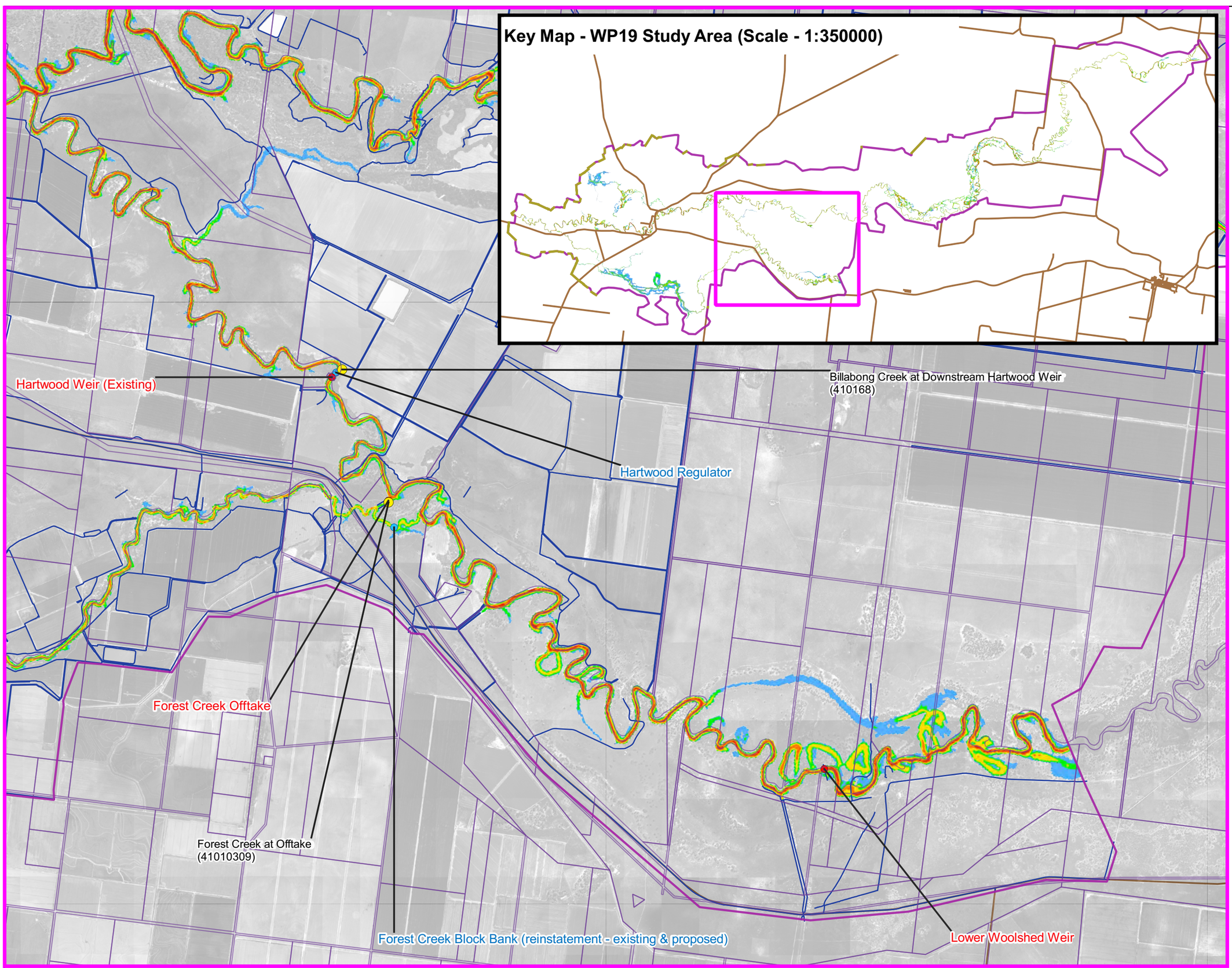
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.1 - Hazard Category Plot: 50% AEP]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

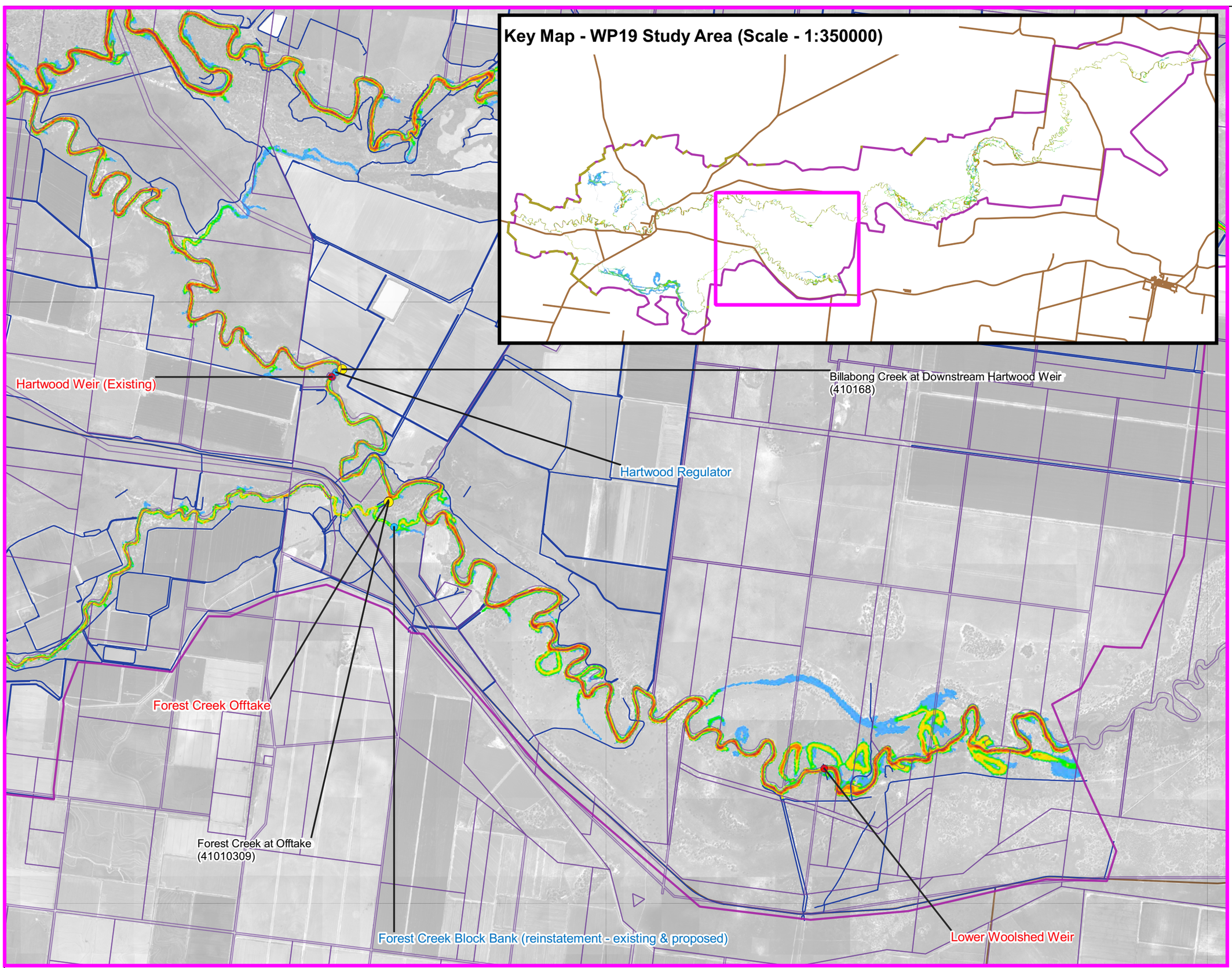
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.1 - Hazard Category Plot: 50% AEP]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

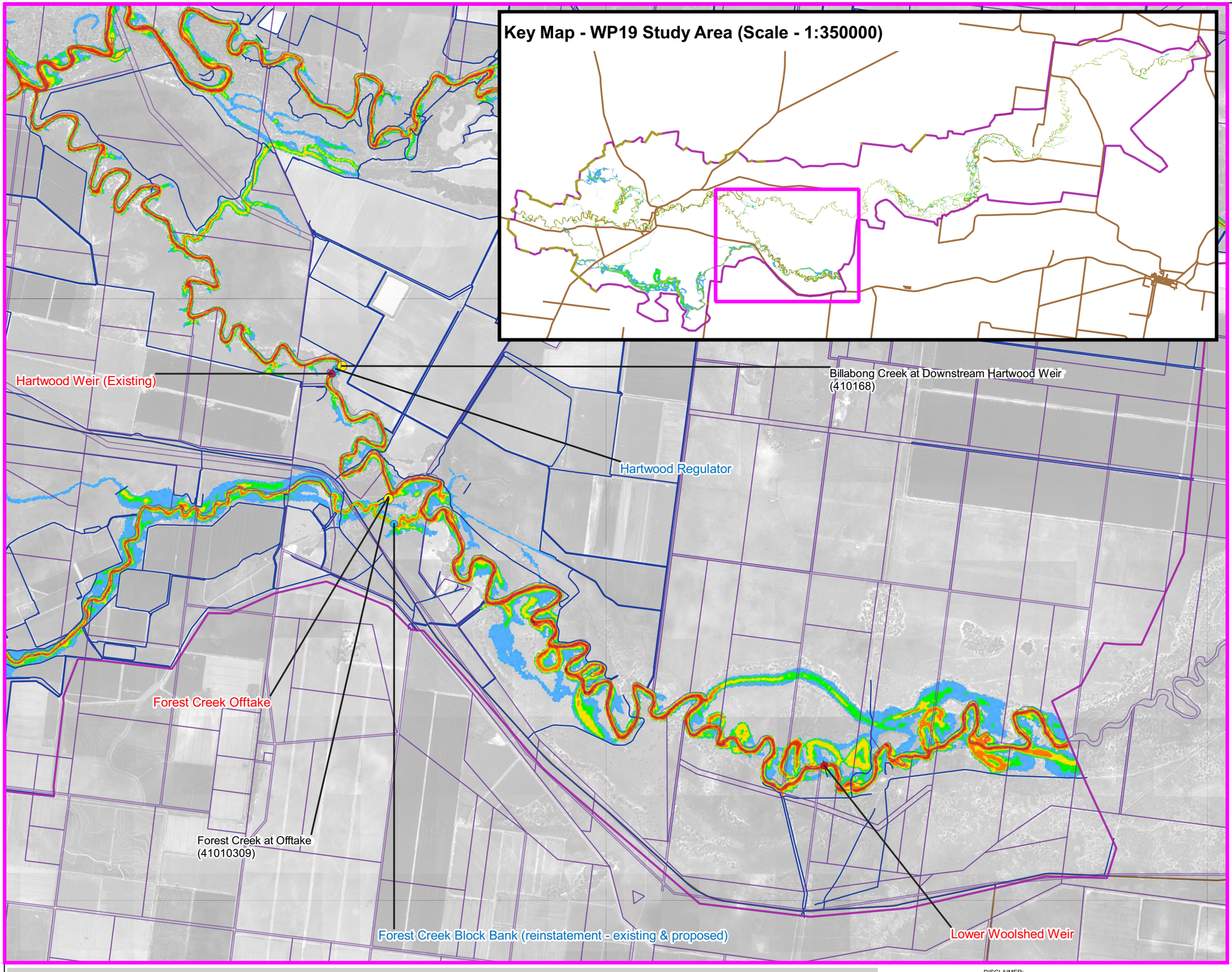
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.2 - Hazard Category Plot: 50% AEP]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

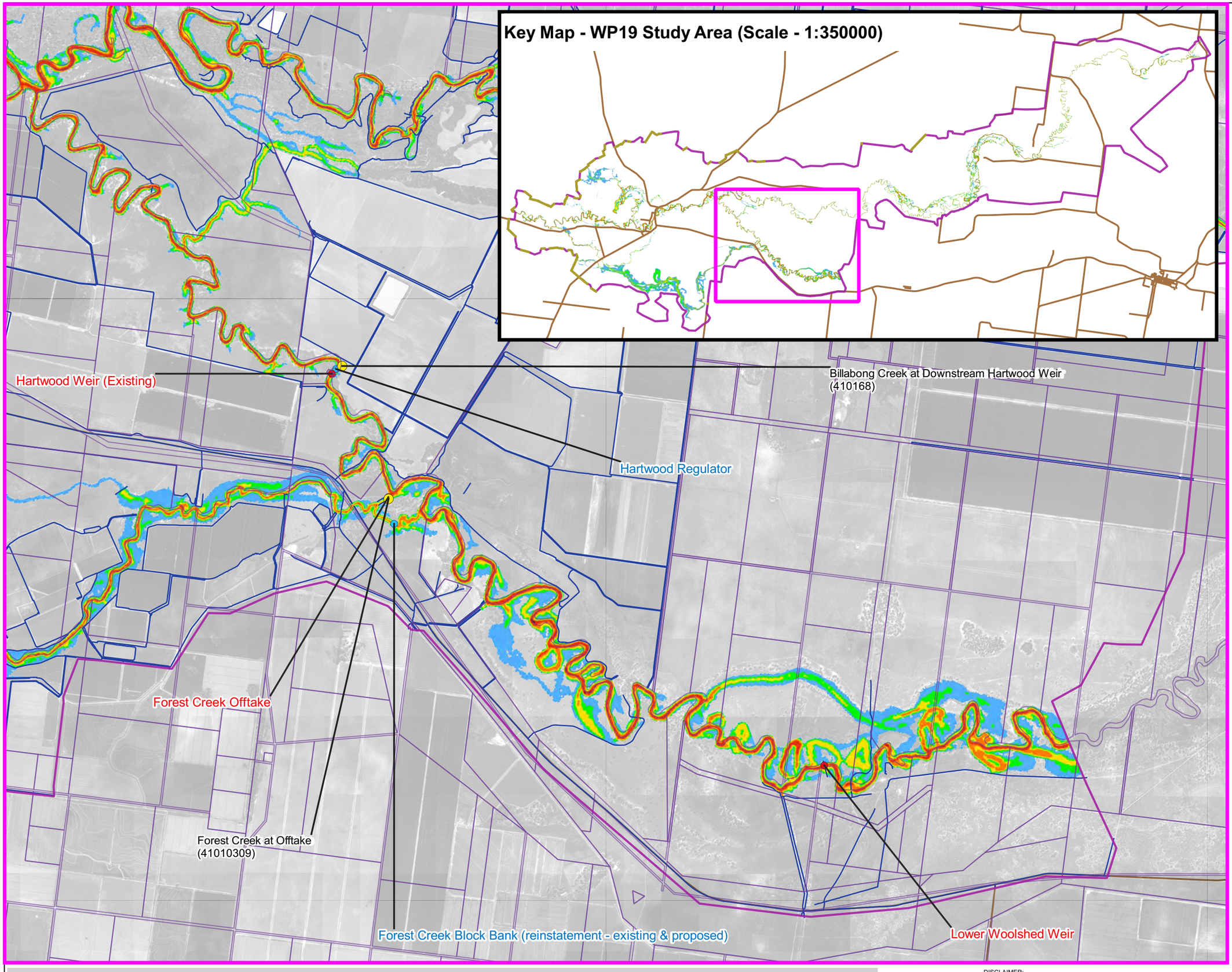
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.3 - Hazard Category Plot: 20% AEP Billabong Dominant]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

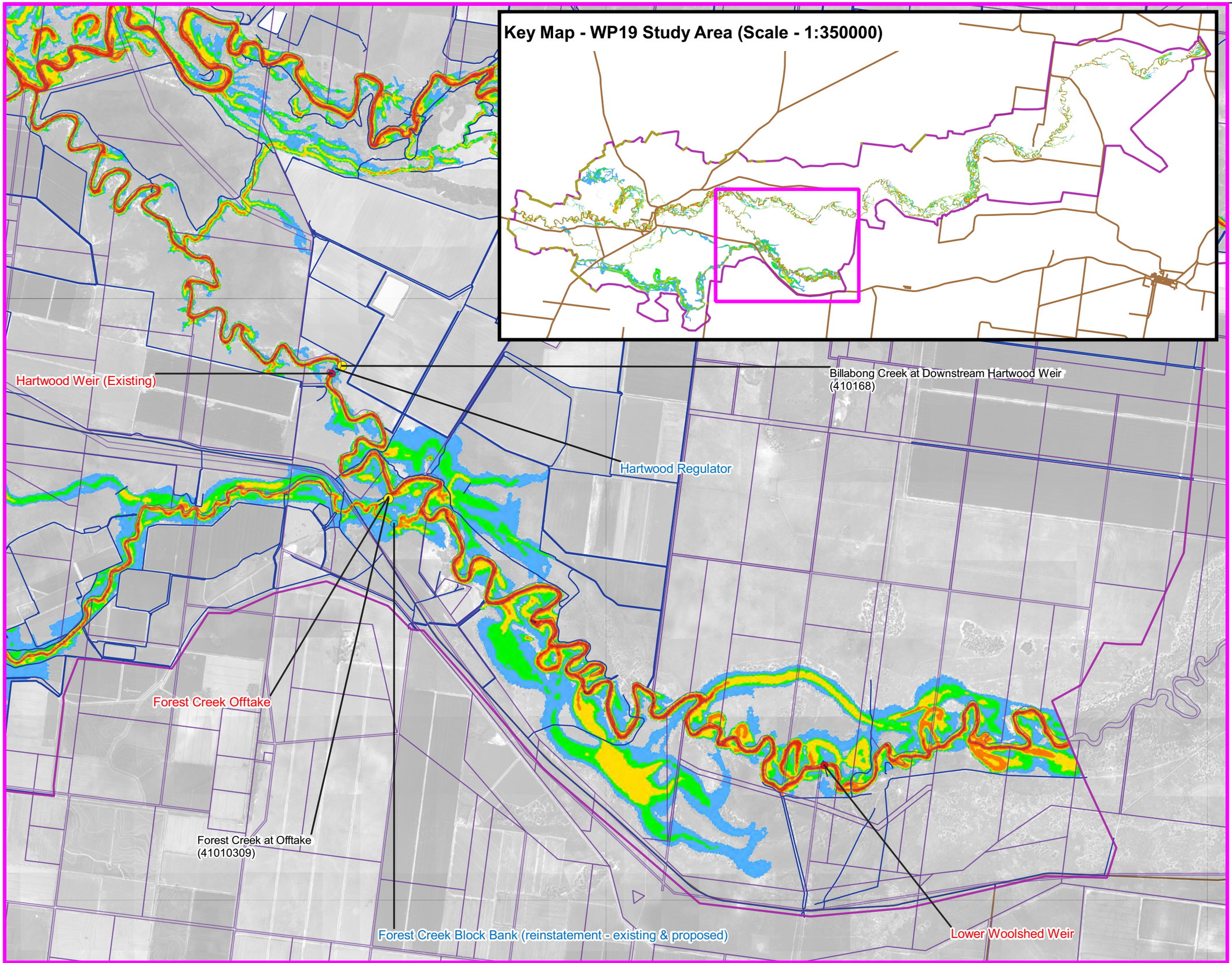
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.4 - Hazard Category Plot: 20% AEP Billabong Dominant]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

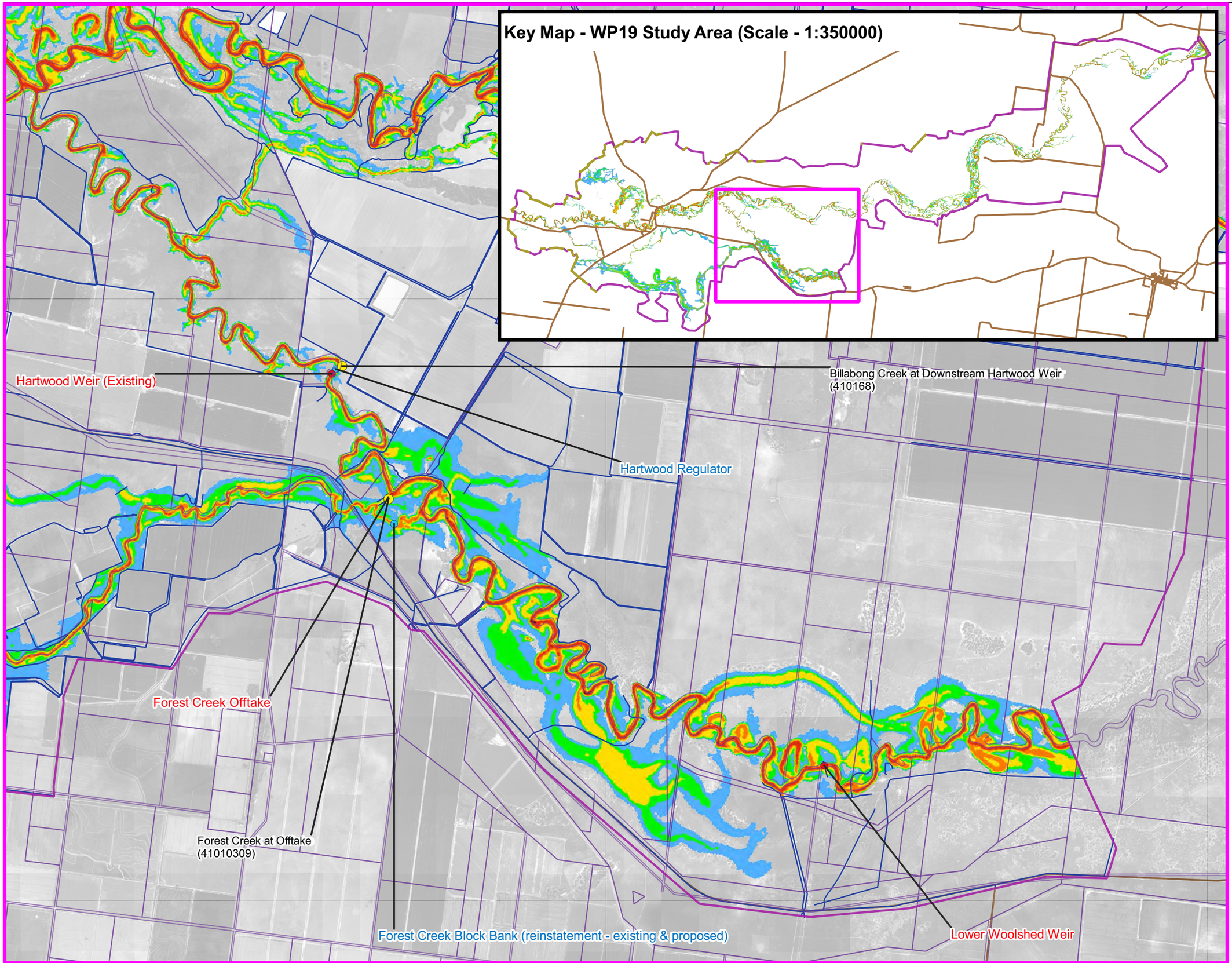
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.5 - Hazard Category Plot: 10% AEP Billabong Dominant]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

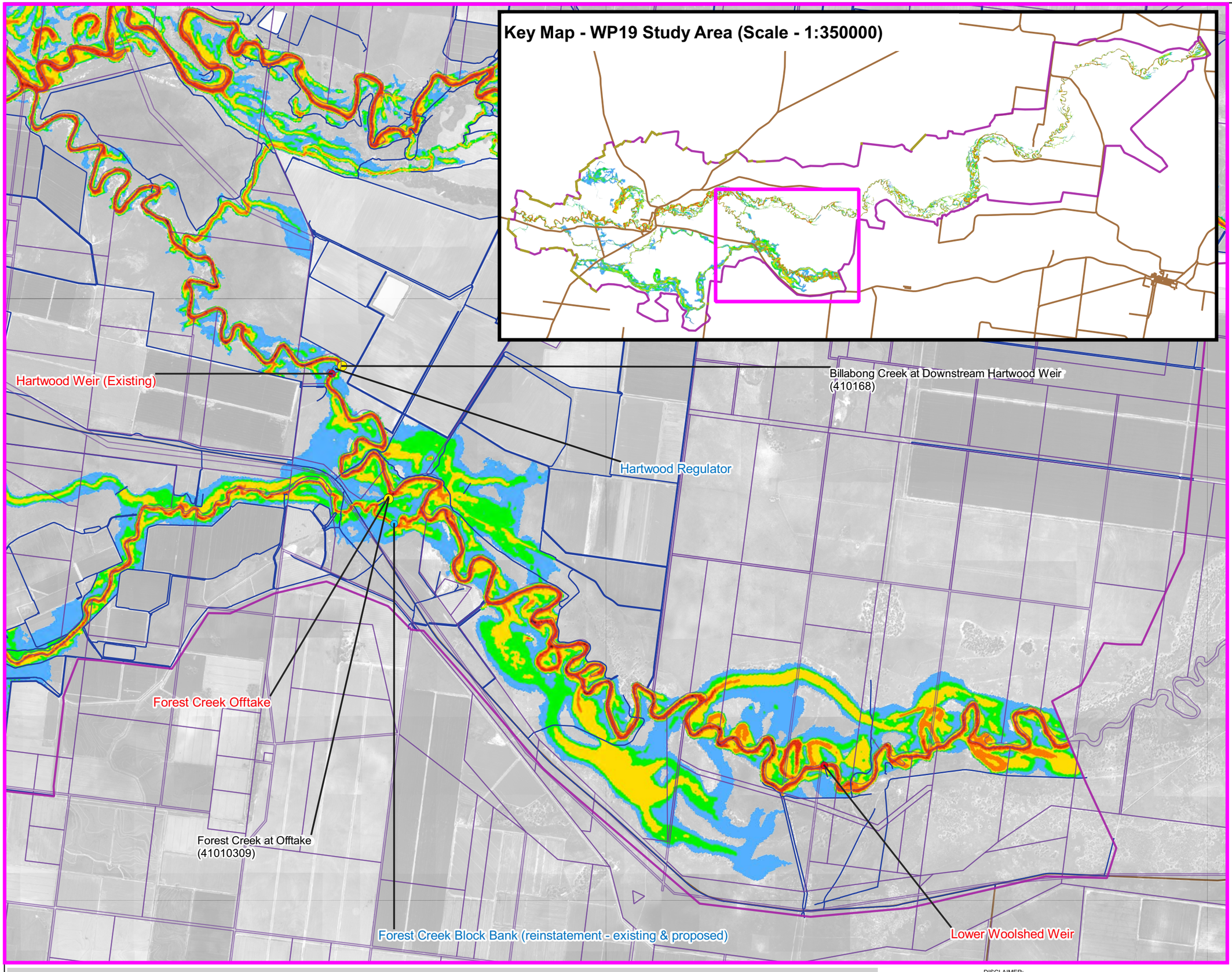
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.6 - Hazard Category Plot: 10% AEP Billabong Dominant]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

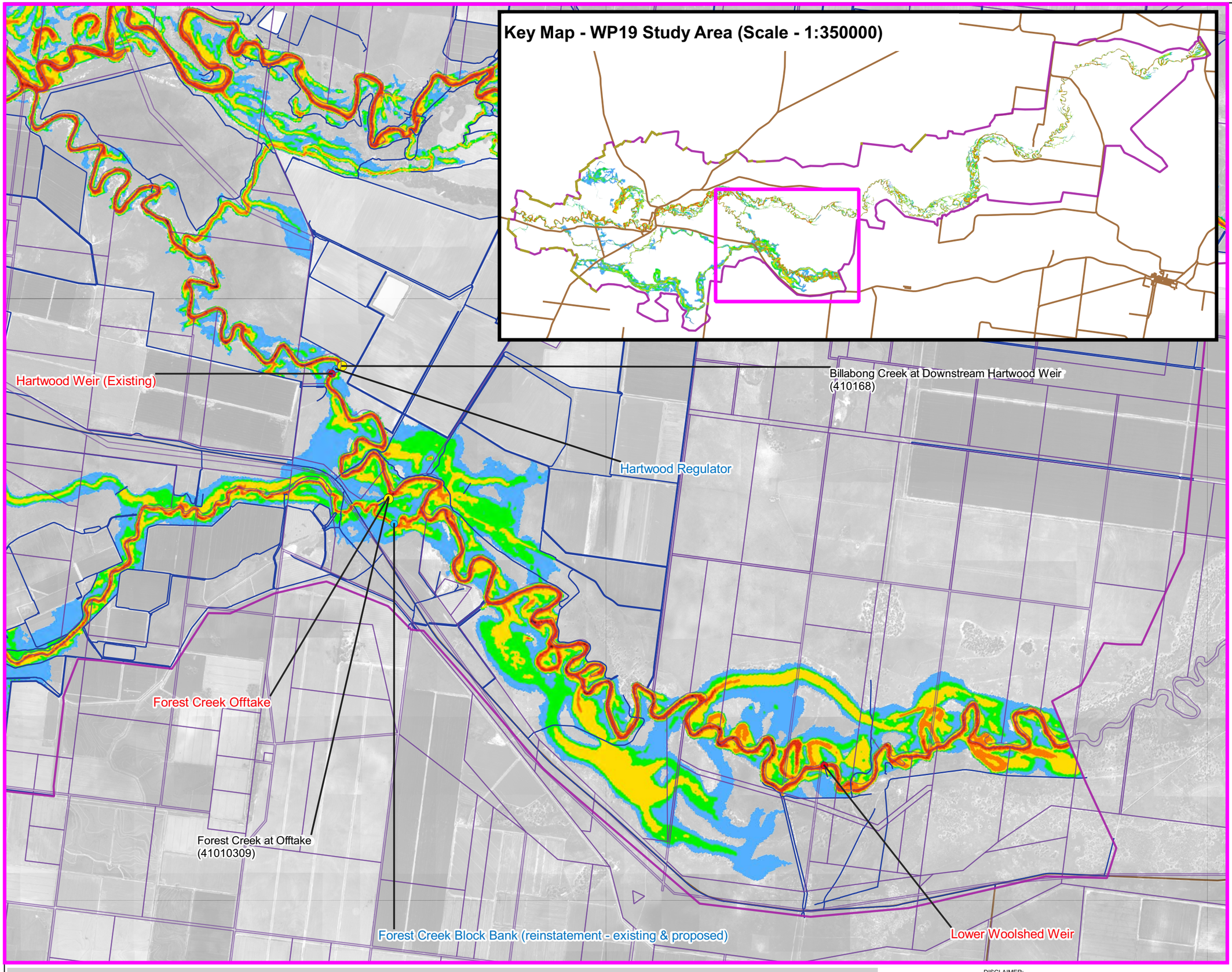
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.7 - Hazard Category Plot: 5% AEP Billabong Dominant]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

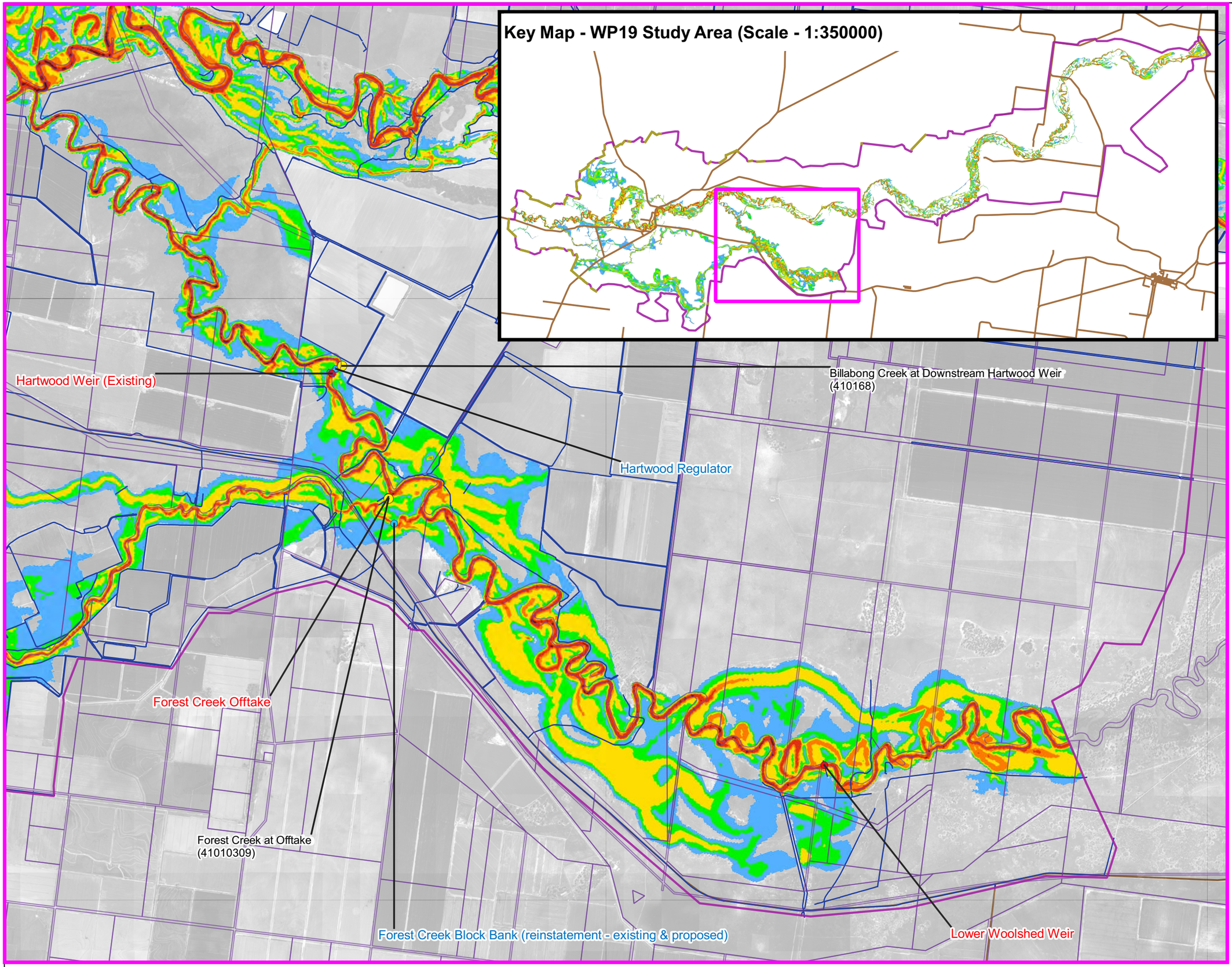
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.8 - Hazard Category Plot: 5% AEP Billabong Dominant]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

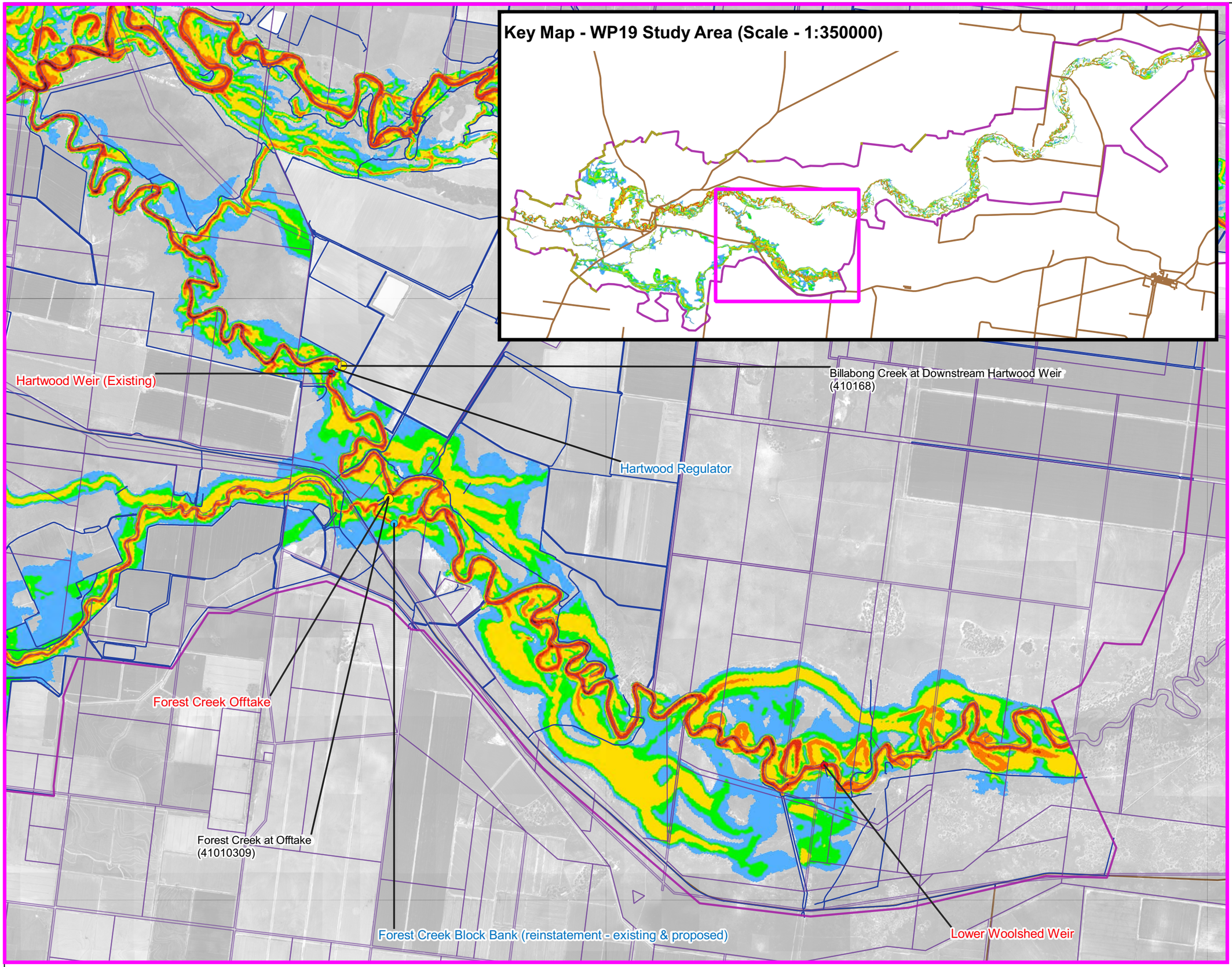
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.9 - Hazard Category Plot: 2% AEP Billabong Dominant]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

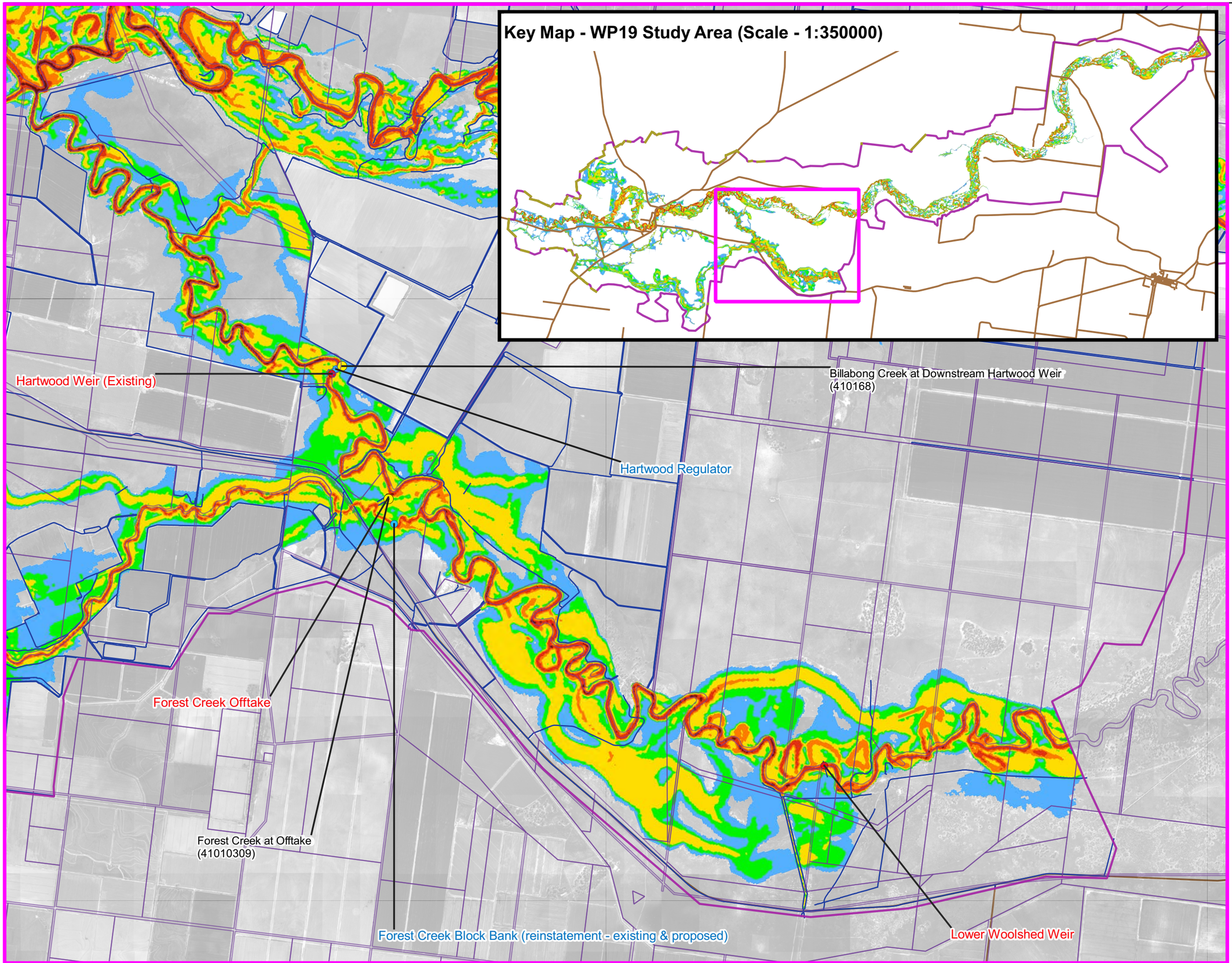
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.10 - Hazard Category Plot: 2% AEP Billabong Dominant]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

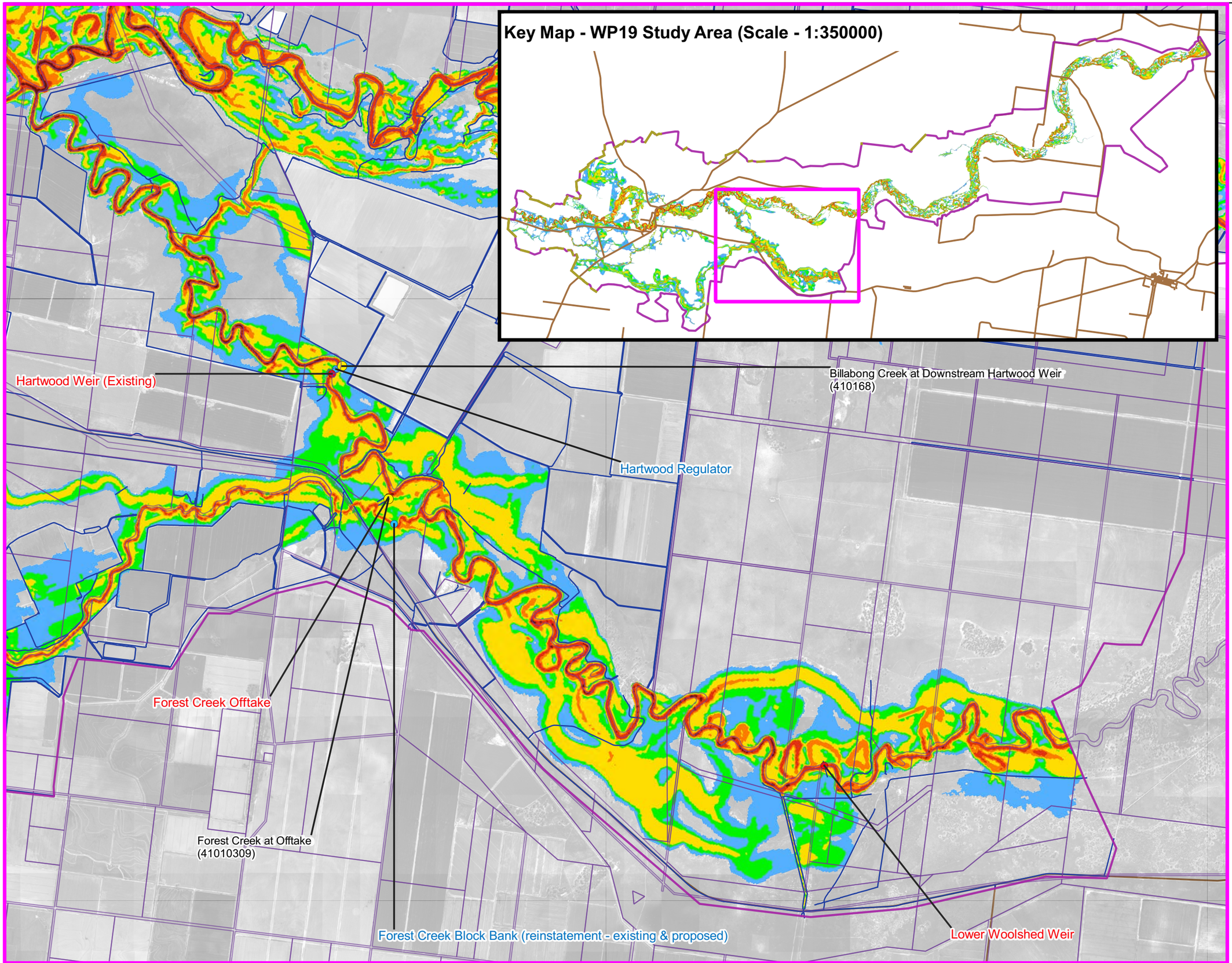
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.11 - Hazard Category Plot: 1% AEP Billabong Dominant]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

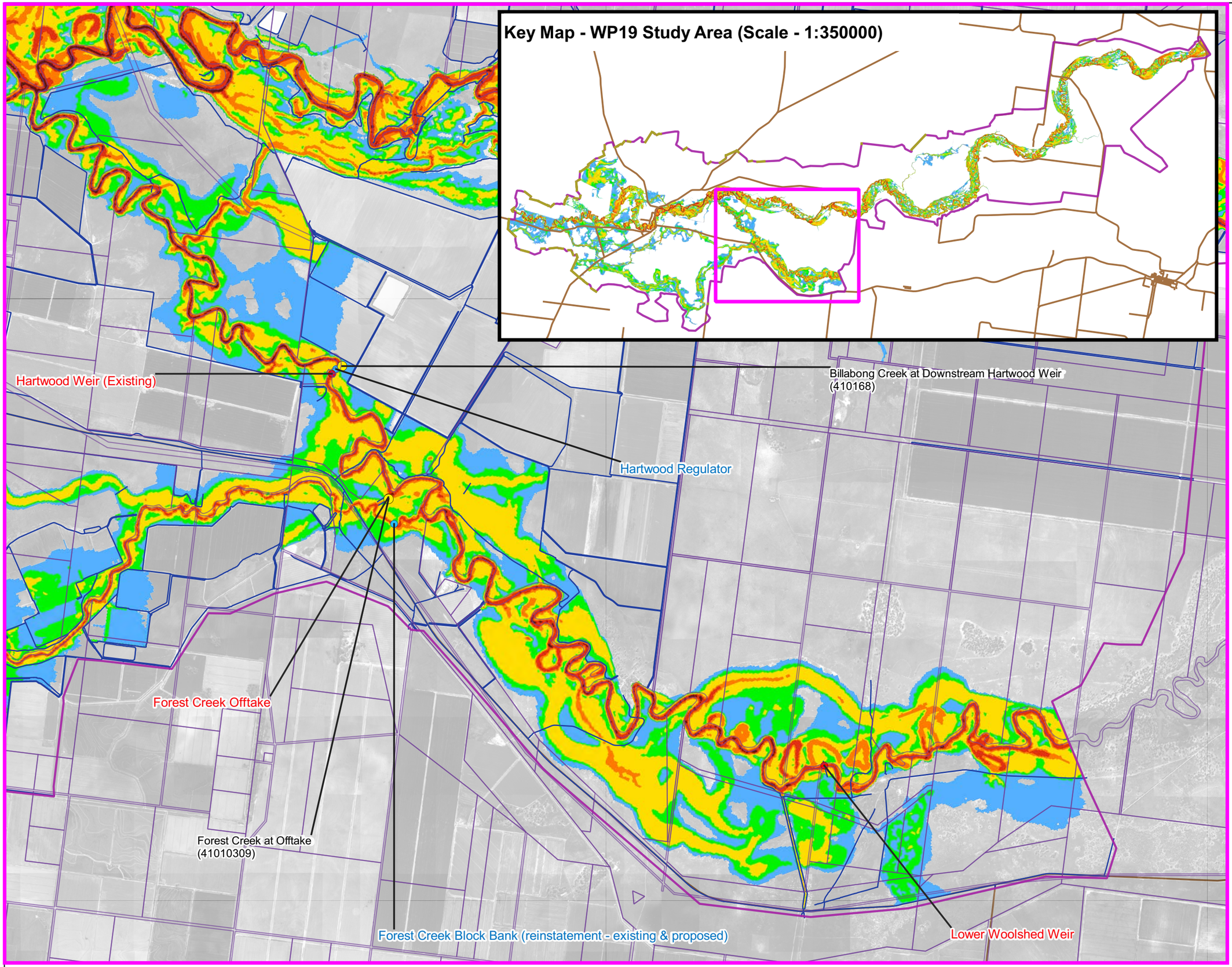
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.12 - Hazard Category Plot: 1% AEP Billabong Dominant]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

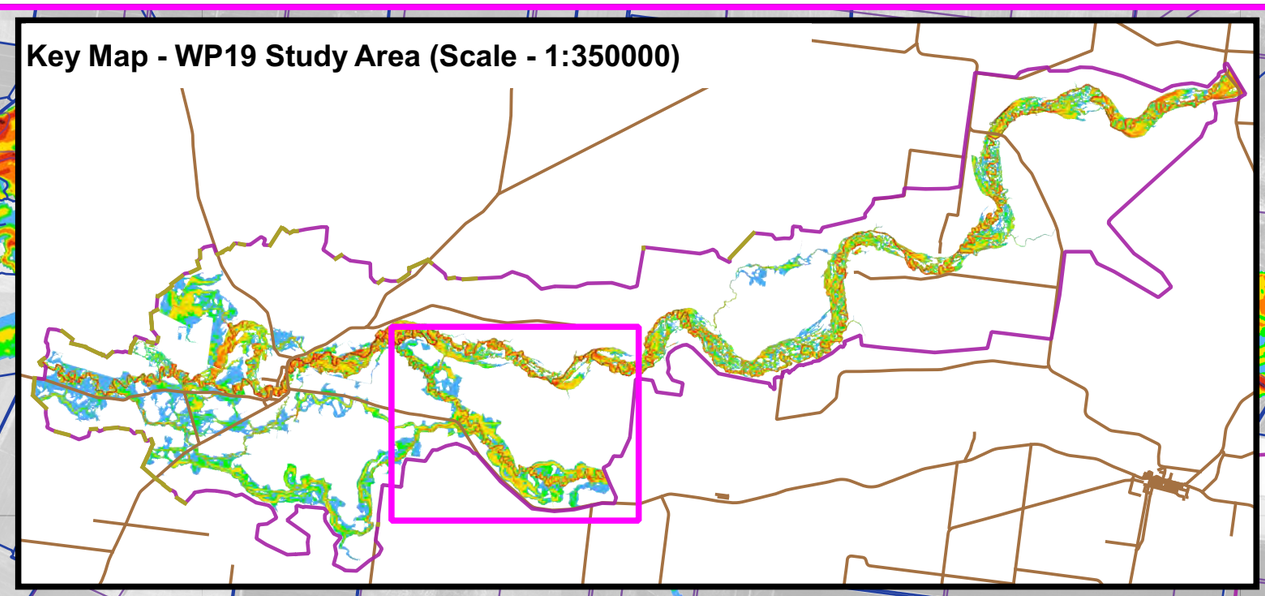
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.13 - Hazard Category Plot: 0.5% AEP Billabong Dominant]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Hartwood Weir (Existing)

Billabong Creek at Downstream Hartwood Weir (410168)

Hartwood Regulator

Forest Creek Offtake

Forest Creek at Offtake (41010309)

Forest Creek Block Bank (reinstatement - existing & proposed)

Lower Woolshed Weir

Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

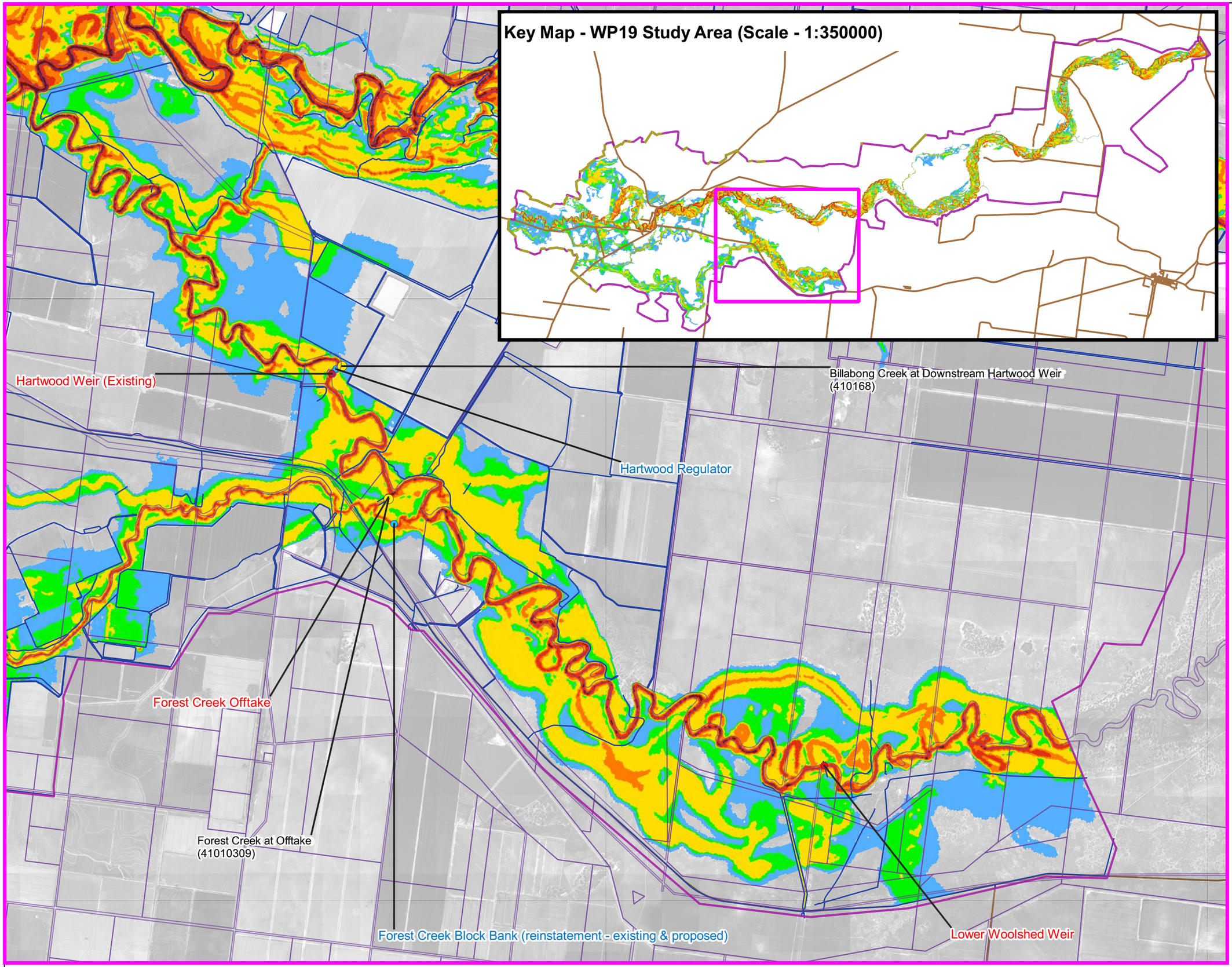
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.14 - Hazard Category Plot: 0.5% AEP Billabong Dominant]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

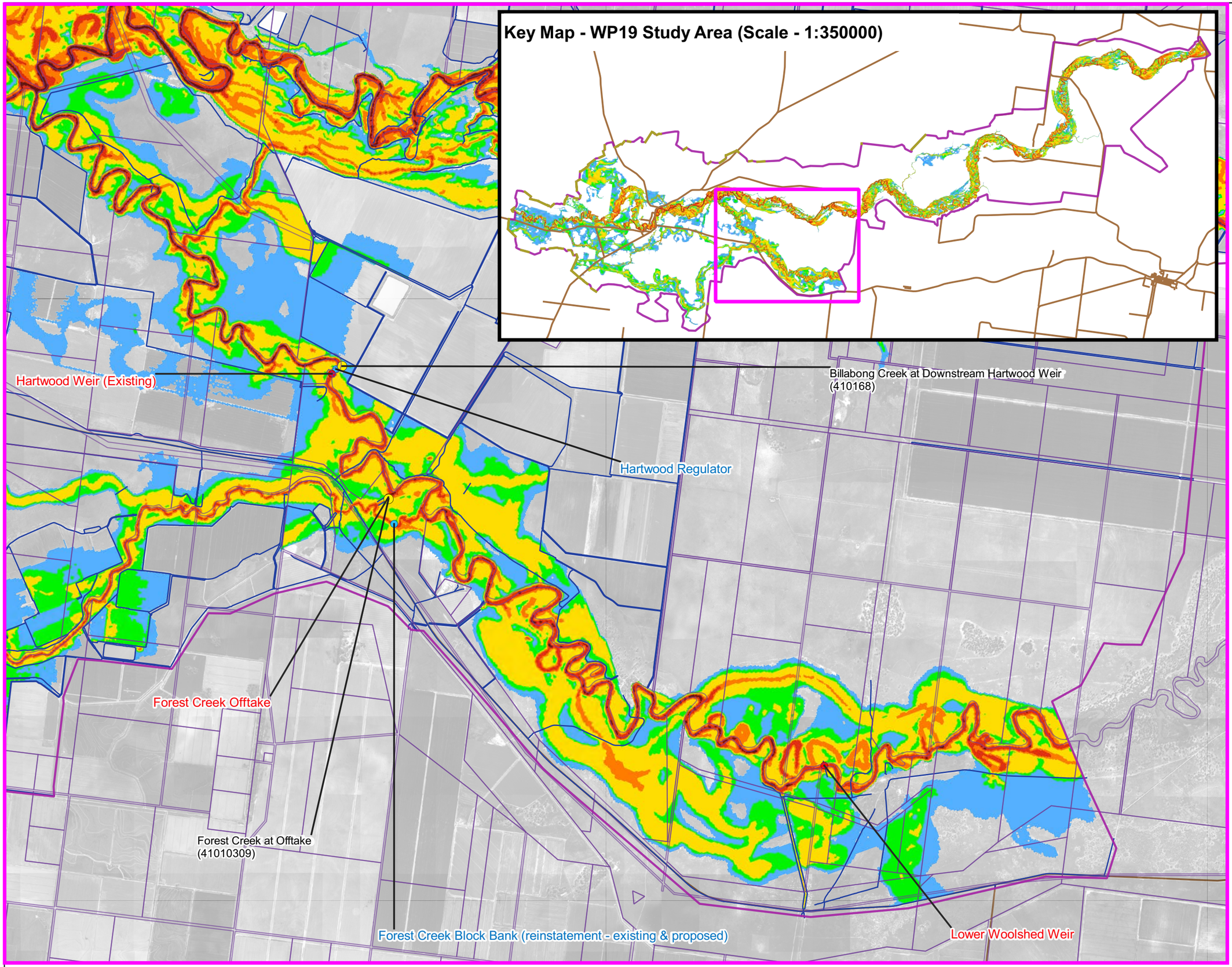
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.15 - Hazard Category Plot: 0.3% AEP Billabong Dominant]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

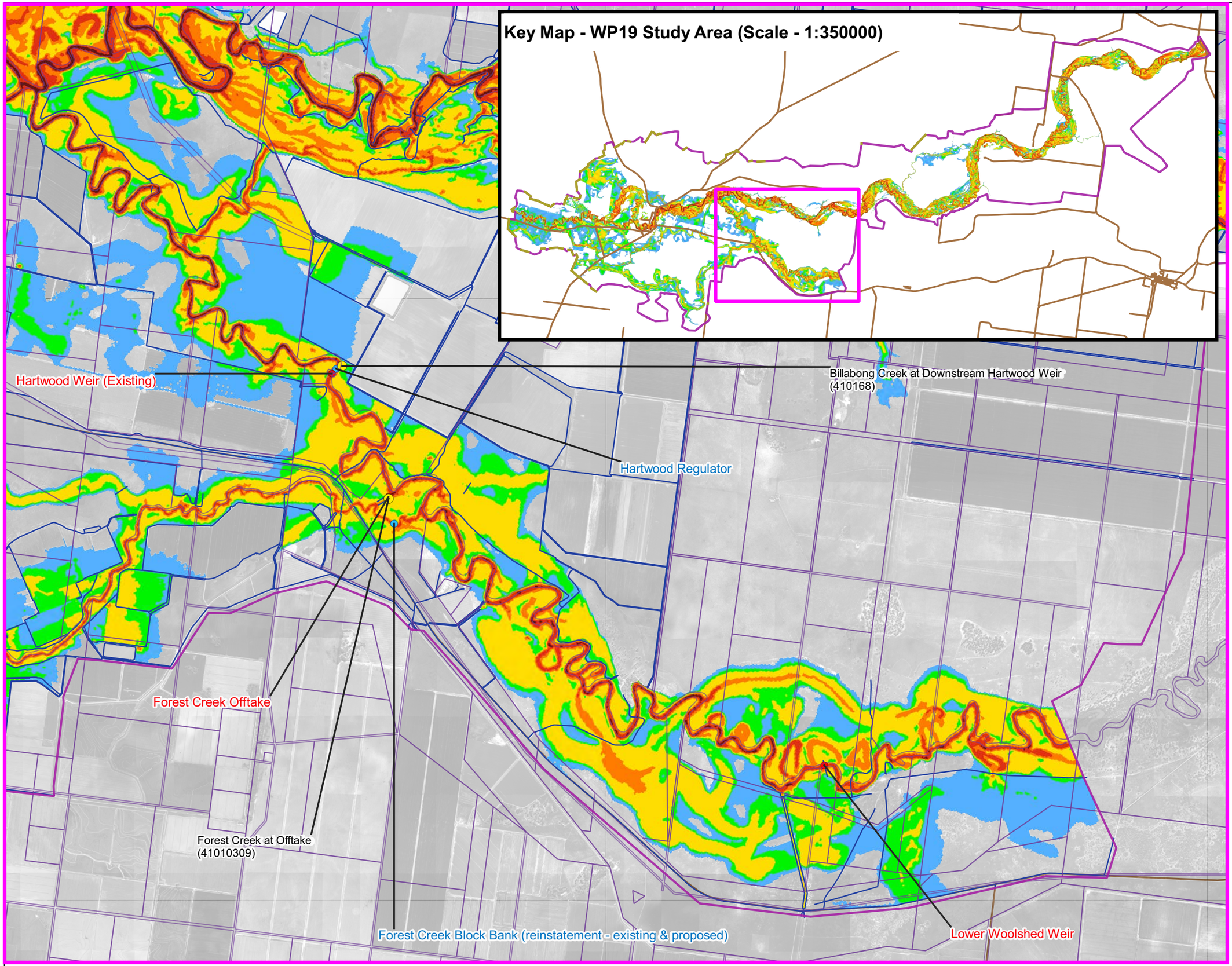
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.16 - Hazard Category Plot: 0.3% AEP Billabong Dominant]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

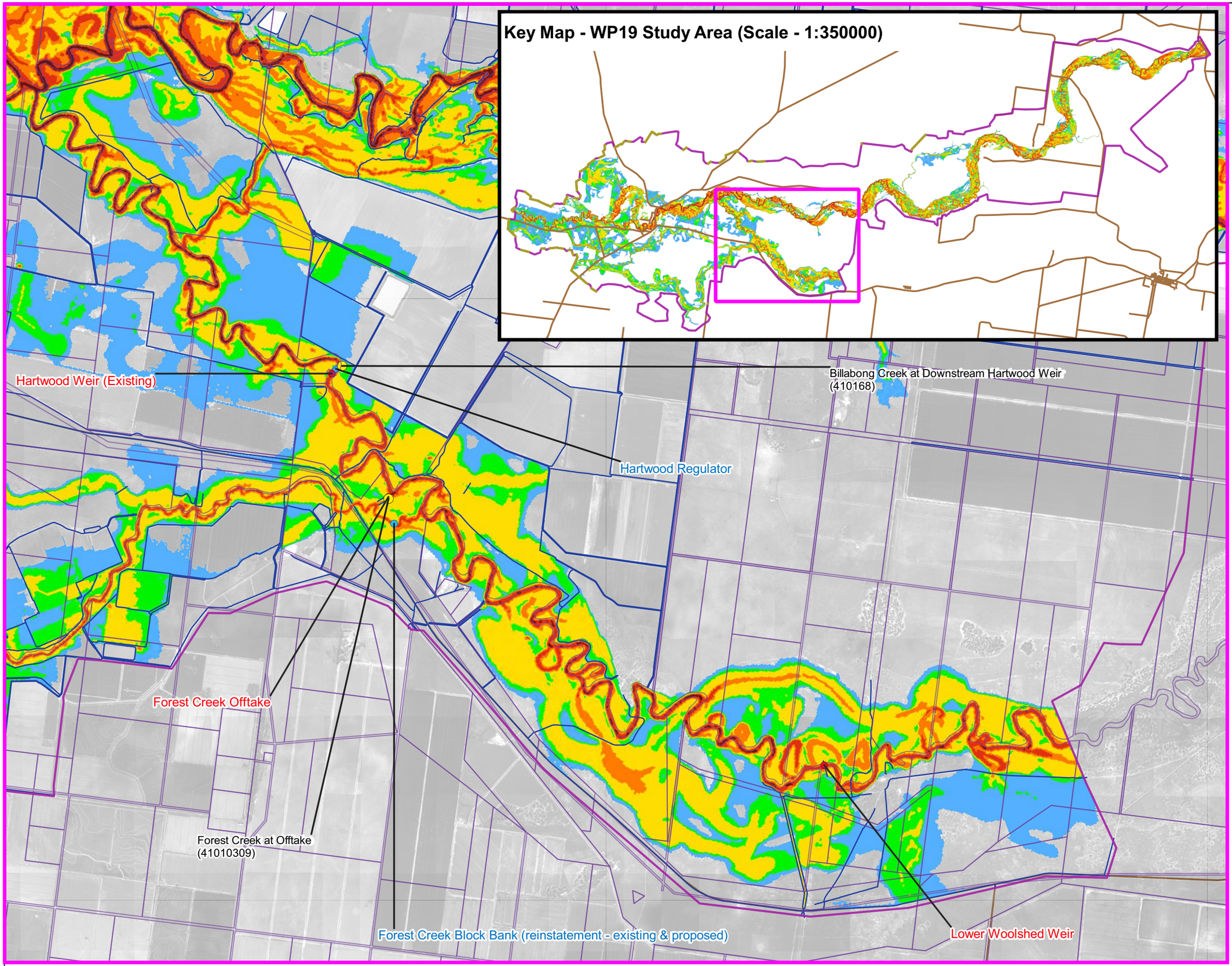
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.17 - Hazard Category Plot: 0.2% AEP Billabong Dominant]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Downstream Boundary Conditions
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

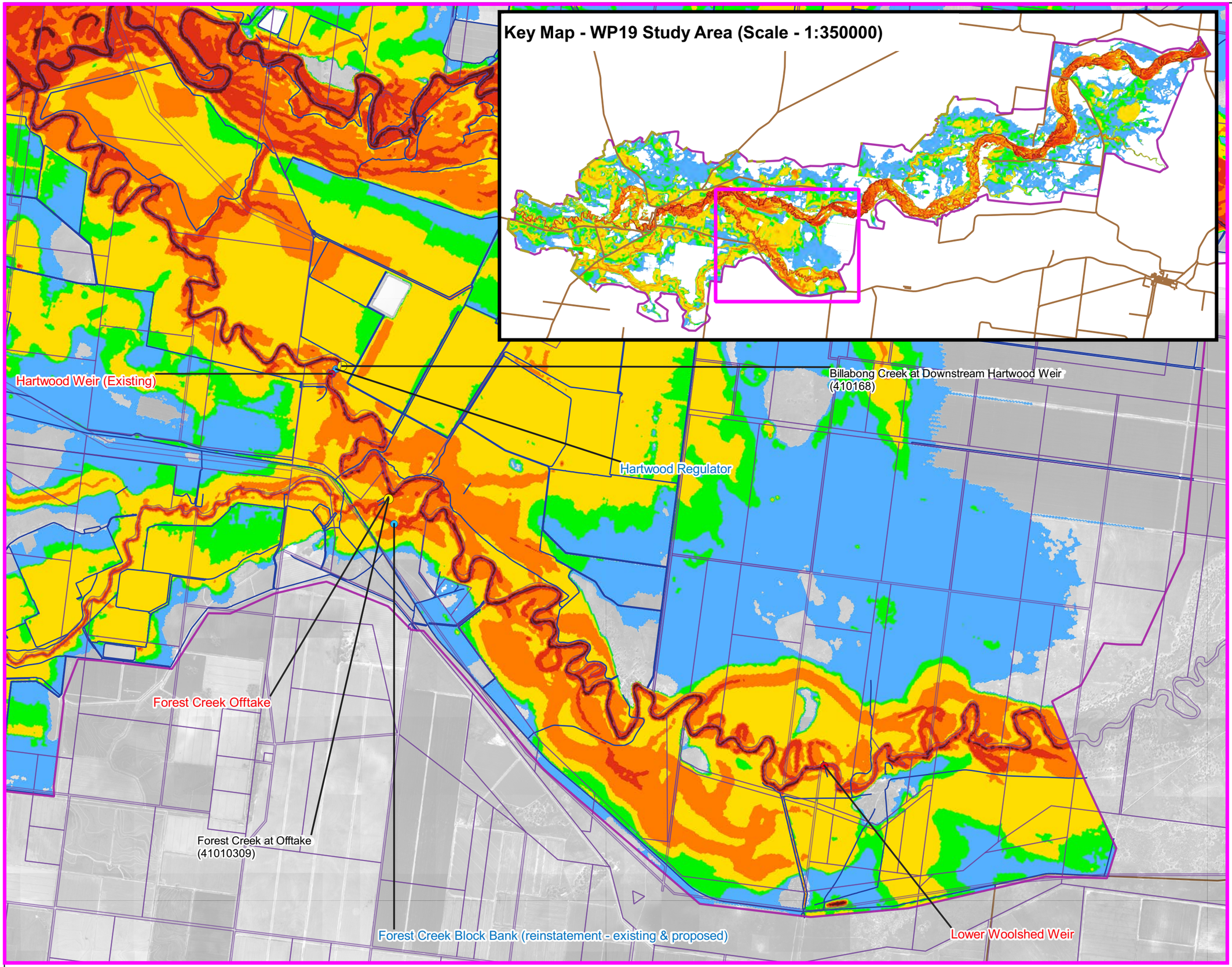
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.18 - Hazard Category Plot: 0.2% AEP Billabong Dominant]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Property Boundaries
- Roads

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

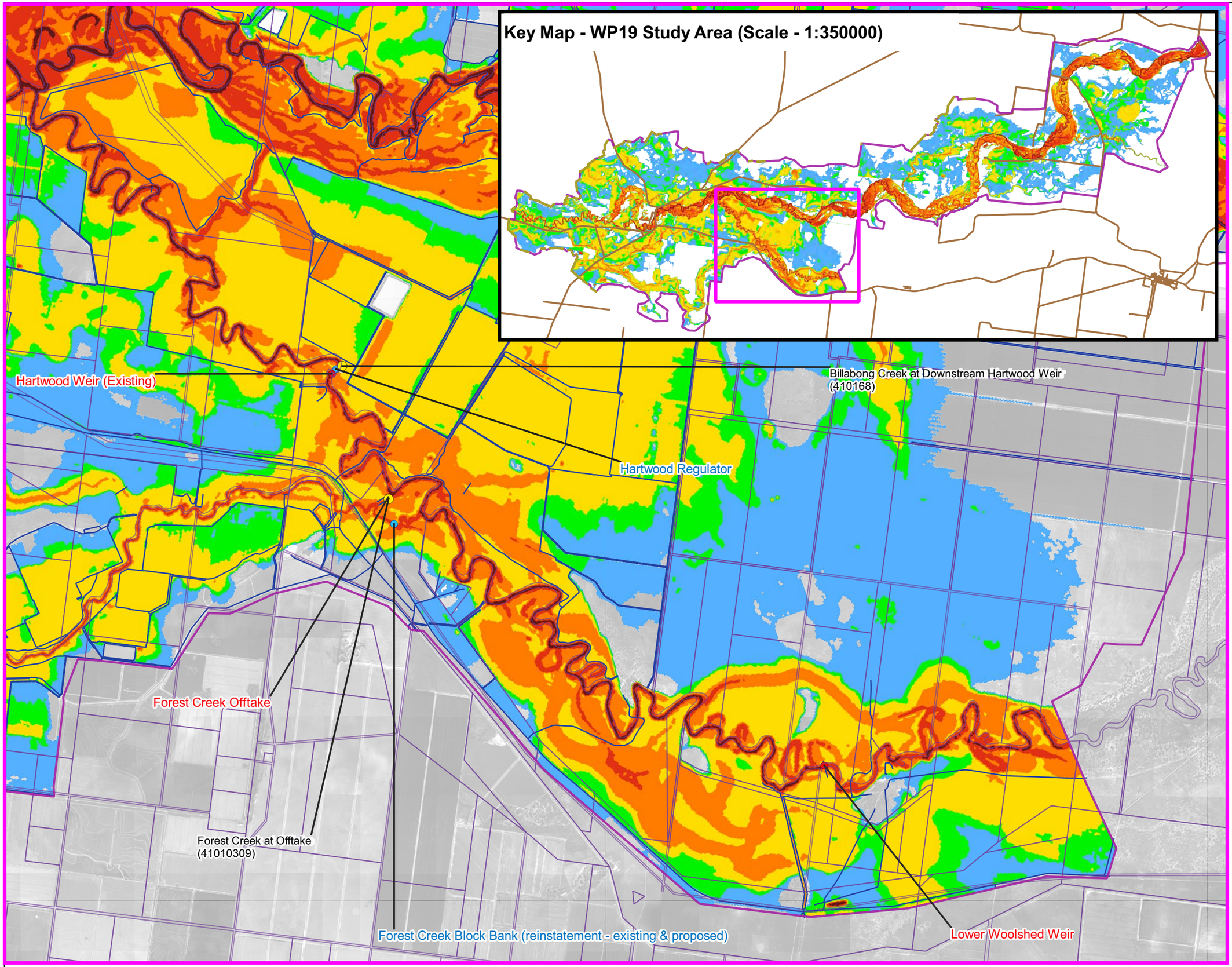
DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.19 - Hazard Category Plot: PMF]
"Existing"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.



Legend

- Key Modelled Structures
- Proposed Structures
- Yanco Gauge Locations
- Property Boundaries

Hazard Classification

- H1 - Generally safe for people, vehi
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children a
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles
- H6 - Unsafe for people and vehicles

N

GDA 2020 Zone 55

1:41000

0 1 2 km

DATA SOURCE:
Properties and Roads, NSW Map Data, 2021; Model layers and results, 3Rivers, 2023; Aerial, NSW DCCEEW, 2021.

WORKSPACE:
Flood
G:\21\12537654\GIS\Maps\Working\EIS_Mapping_Results\Appendix_EIS_Hazard_Plots_v01.qgz

Yanco Creek Modernisation Program - Part 2 Hartwood Regulator
FIGURE G4.20 - Hazard Category Plot: PMF]
"Proposed"

3Rivers

DISCLAIMER:
Produced by 3RP for the Yanco Creek Modernisation Program - Part 2 Hartwood Regulator within the Reconnecting River Country Work Package 19 (RRC WP19) area, which are both SDLAM projects.
3Rivers does not warrant that this document is definitive nor free of errors and does not accept liability for any loss caused or arising from reliance upon information provided herein.
This data should be read in conjunction with the latest revision of the Report entitled "Yanco Creek Modernisation: Hydraulic Modelling Technical Report - Hartwood Weir to Piccaninny Weir Study Area (Document No.: DE19-823-YCM2A-DE-HY-RPT-0001)" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to 3Rivers.