



Date: 09/05/2025

South Gippsland Shire Council

Subject: Flood Modelling Kongwak Cheese Factory (2023)

The Authority advises that it has reviewed the *Flood Modelling Kongwak Cheese Factory (2023)* and is satisfied that it provides an accurate estimation of the 1% AEP flood and is the best data available for this location.

Yours sincerely,

Ben Proctor
Senior Planning Officer – Statutory Planning

The information contained in this correspondence is subject to the following definition.

Definition

1. **AEP** as Annual Exceedance Probability is the likelihood of occurrence of a flood of given size or larger occurring in any one year. AEP is expressed as a percentage (%) risk and may be expressed as the reciprocal of ARI (Average Recurrence Interval).

Please note that the 1% probability flood is not the probable maximum flood (PMF). There is always a possibility that a flood larger in height and extent than the 1% probability flood may occur in the future.

1486-1488 & 1492 Korumburra Wonthaggi Rd, Kongwak – Preliminary flood analysis

To: Kongwak Butter & Cheese

From: Chris Beardshaw

Date: Tuesday 1 August 2023

Introduction

Background

Afflux Consulting has been engaged by Kongwak butter and cheese to undertake a flood analysis and integrated water management plan to support the development of parcels at 1486-1488 & 1489 Korumburra-Wonthaggi Rd, Kongwak. The land use is intended to change from an existing disused cheese and butter factory into a destination hospitality venue.

The site does not have any official record of flooding, though clearly interacts with the Foster Creek. As such the West Gippsland Catchment Management Authority have requested an investigation to see if the property is likely to be subject to flooding from Foster Creek during a 1% AEP flood event.

This technical memo outlines the key findings in the preliminary flood analysis, to support the design of the project during the permit submission process. A detailed and refined flood analysis will then be undertaken to support the detailed design process and development proposal, including the proposed installation of a new bridge across Foster Creek.

Existing conditions

This memo specifically concerns itself with catchment flows in Foster Creek and the land directly surrounding Foster Creek. Foster Creek is currently an existing creek riparian corridor and the land parcels on 1486-1488 & 1492 are designated as land use for private residence and tourist accommodation. The northern border of all land parcels are bordering Foster Creek.

Existing infrastructure

A number of existing infrastructure includes:

- Korumburra-Wonthaggi Rd functions as a bridge over Foster Creek.
- The old cheese factory is left abandoned.
- The old butter factory is well kept and is located directly west of Foster Creek.
- The property on 1492 Korumburra-Wonthaggi Rd is currently a private residence.

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1.1. Flood modelling

Hydrology

For a high level assessment a number of regional hydrological estimate methods have been used for this catchment. CatchmentSIM was utilized to determine the relevant catchments (Figure 1) and a RORB model was constructed. The RORB model was reconciled to a number of regional estimates and the critical event at this location determined.

Hydrographs were extracted for the critical event at key reporting locations for inclusion in the TUFLOW (flood) model to gain an understanding of overland flow and interactions with various infrastructure components and design interventions within the study area.

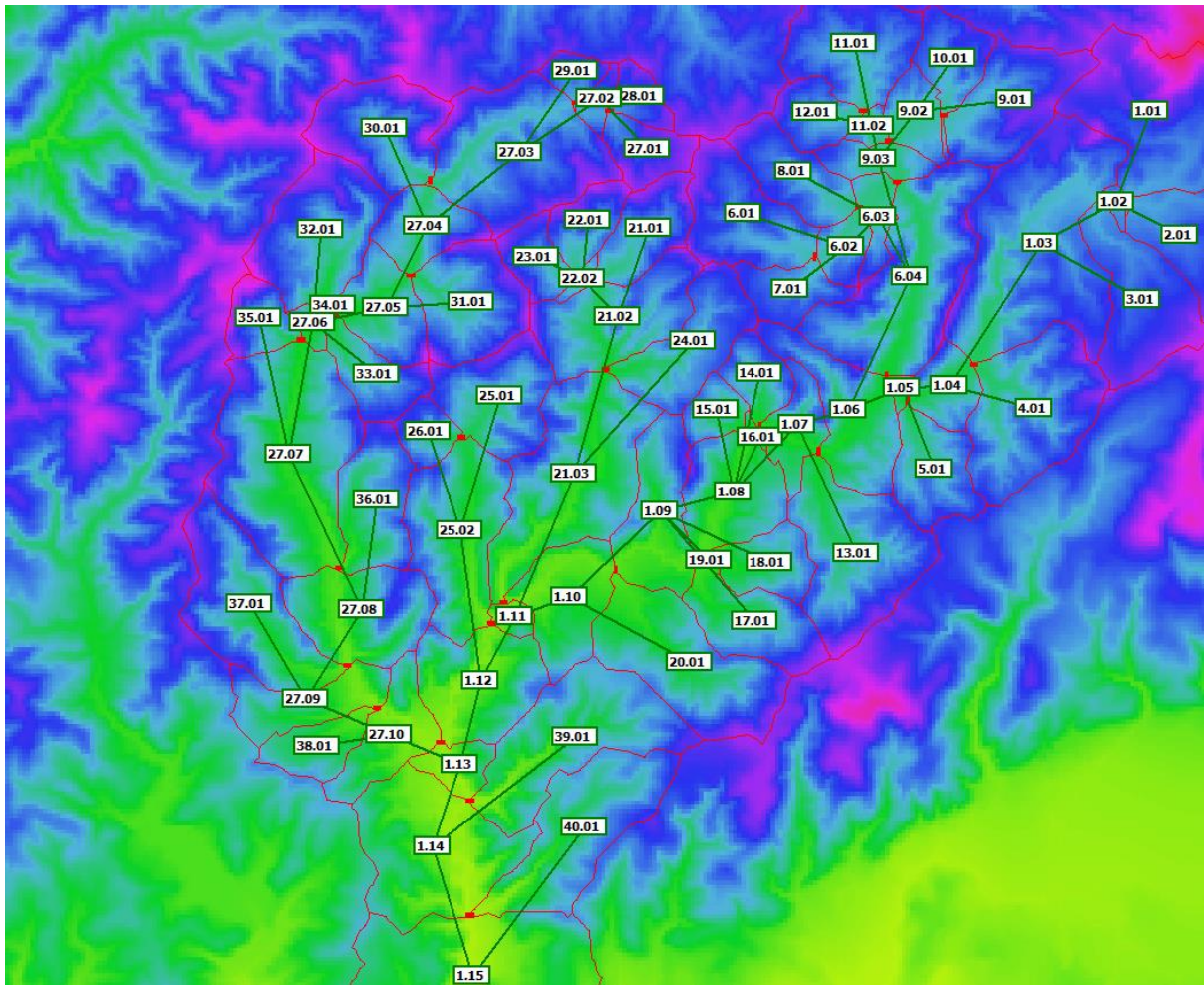


Figure 1. Catchment Model

Table 1: Design Hydrology Summary

Design Event	Flow (m ³ /s)	Comment
9hr	126m ³ /s	Fairly consistent in estimates

The full details of the hydrology modelling are provided in Appendix A.

Hydraulics

A hydraulic model has been developed for the area and is used to inform the remainder of analysis. Full details of the flood model are provided in Attachment 2 with key aspects summarised as follows:

- High resolution model through the study area (resolution is 3 m)
- Inclusion of bridge on Korumburra-Wonthaggi Rd based on DEM surfaces and information from VIC roads Open Data Hub. Major bridge assumptions shown below.
- Model run time at 30 hours to allow critical hydrograph to pass through the site.



Figure 2. Existing Bridge Structure

Table 2: Bridge Assumptions

Bridge Assumptions	Level / Factor	Comments
Deck Level	53.0 mAHD	Surveyed Level
Deck Depth	0.75m	Estimated
Guard Rail Depth	1m	Based on Visual inspection
Guardrail Blockage	30%	Estimate of blockage based on visual inspection
Pier Factor	2%	Blockage Factor on Xsect estimate
Deck width	10.9m	Road width

At this stage a single scenario has been modelled as indicated below

Scenario	Description
Existing conditions	Base model with surveyed data and a representation of 1% AEP flows with the following structures in place: Existing buildings with freeboard Existing road bridge on Korumburra-Wonthaggi Rd.

Table 3: Modelled scenario

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Results

Existing conditions

Results for depth and water surface elevation are presented as Figure 1 and 2 for existing conditions and show the following:

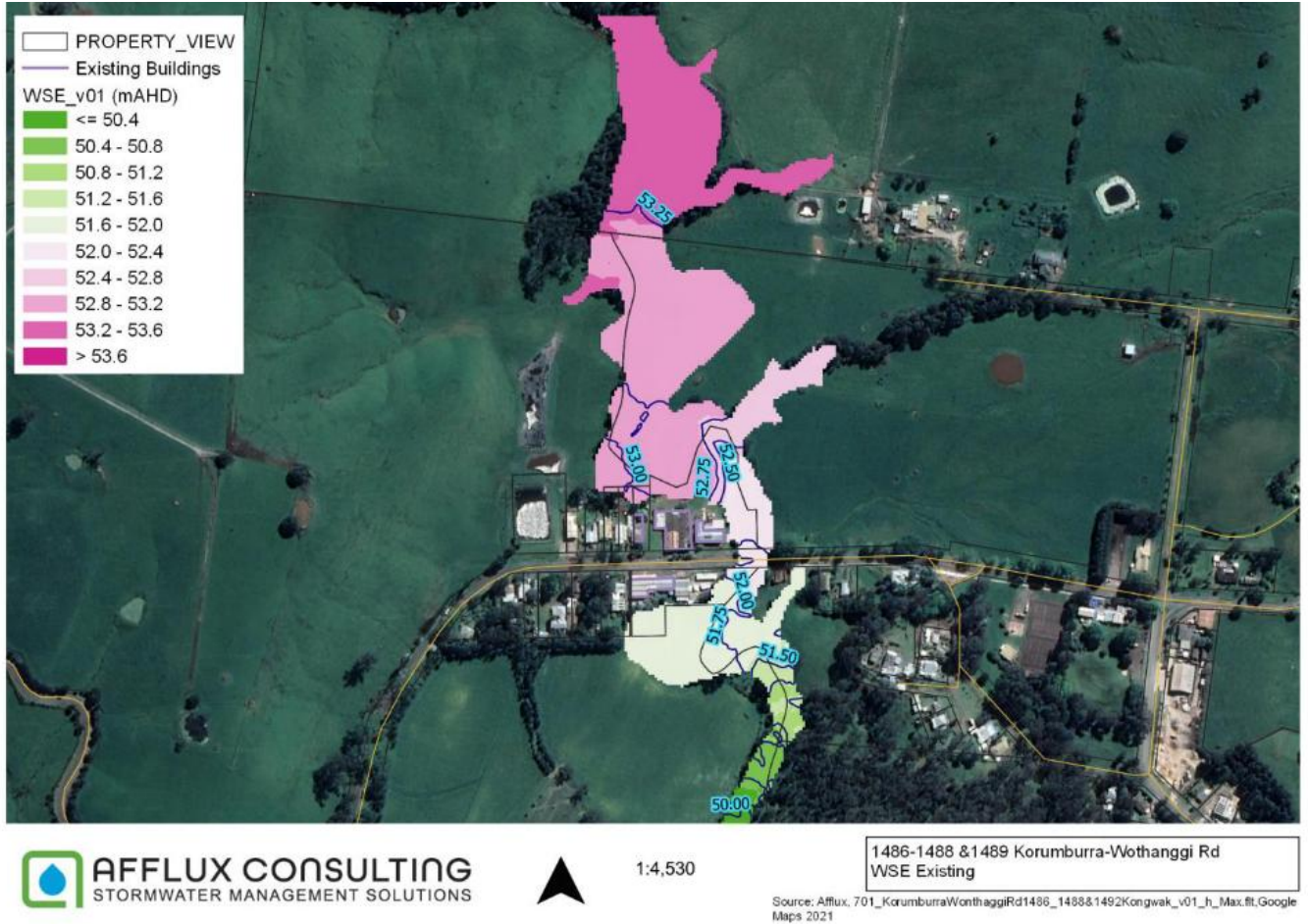


Figure 3. Water Surface Elevation- Existing conditions

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Figure 4. Water Depth- Existing conditions



Figure 5. Water Depth – Existing conditions – zoomed in

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Discussion

Flood mechanism

The flooding mechanisms for the area has been evaluated by reviewing time series plots of flood extent and velocities. Generally it shows the following:

- Water flowing down Foster Creek, stays well in the lower channel for several hours of the design event
- Around 3 hours into the event the water breaks into the macro channel and fills the upstream larger basin areas to the north of the site.
- There is a breakout of flows, south of Kongwak Market around 4 hours into the modelled event that spills west into a farm dam and slowly discharges back into Foster Creek.
- Around 6 hours into the modelled event that spills west towards the old cheese and butter factory. Where water will continue to build up in the terrace surrounding the butter factory until 8 hours into the modelled event.

Separate strategies will be required to deal with each of these separate advancements and should be delivered as a complete package to address flooding in its entirety.

The influence or relevance of each of these flood components in assessing the impact of the current site is addressed in the concept design approach below.



Figure 6. Proposed Building works and FFL's

Recommendations

Based on the analysis undertaken in this study we are able to make the following recommendations with relation to the development and future approvals pathways:

- The peak water level in this preliminary analysis is 52.3m AHD at the Korumburra-Wonthaggi Road.
- The design lower level of the Butter Factory main entrance is proposed at 52.77m AHD. It is understood that a heritage tiled floor is set at this level.
- Given the existing heritage entrance area would require significant approvals to modify and meet a 600mm freeboard, it is not recommended to modify this section and that a management approach for flood risk management be considered for this area. This may include the following considerations:
 - Use of the lower floor area be limited to non-habitable purposes
 - Consideration of flood warning/management plans for the accommodation facilities
 - Consideration of building materials and finishes on the lower administration area
- The upper accommodation facilities are set at 54.46m AHD and have significant freeboard
- The proposed Events courtyard (Ref 12) could be set at 52.9m AHD to meet freeboard requirements. It is understood that this area is more of a temporary facility and may be able to accept a lower level of freeboard
- Any bridge structure (Ref 17) should consider these levels in its design
- Landscape considerations for the open grassed area (Ref 8). This can be in consultation with flood velocities in the area

A number of ancillary technical items have been recommended for consideration in a more detailed analysis of the area:

- Any gauging information for Foster Creek should be considered in a more detailed analysis. The regional equation approach is consistent with a pre-liminary analysis of the site, but ideally this would be matched to a gauge and Flood Frequency Analysis
- Considerations for a Flood Management Plan for the site
- More detailed analysis of the existing bridge and proposed bridge structures
- Greater hydraulic sensitivity analysis. At this stage only a peak flow has been run through the model.

Conclusions

This preliminary flood analysis has provided flows and flood levels with enough detail to provide the CMA and Council with confidence that the development is not overly effected by flooding in its current form. There are a number of recommendations for future work that can be included as permit conditions of the development approval.

Appendix A - Hydrology

To assess the peak flow for the flood analysis, a comprehensive evaluation of various hydrological methods was conducted, the results are summarised in Figure 8. The different methods were generally consistent, indicating a well calibrated precision in predicting peak flows, thus enabling a more robust flood analysis. The predicted peak flow of 126 m³/s is primarily reconciled with the RFFE ARR calculator and the results are shown in Figure 7.

To further refine the hydrological analysis, a RORB model was constructed and a number of other regional equations tested. As can be seen in Figure 8 all methods generally centred around a ~130m³/s flow, and as such the RFFE estimate was adopted. All temporal patterns were run from 10min storm to 168hr storm from to derive a set of hydrographs for each event AEP and critical duration. Only the mean for the critical duration storm results was selected for design as recommended. These results are shown in Figure 9 and Figure 10.

Results | Regional Flood Frequency Estimation Model

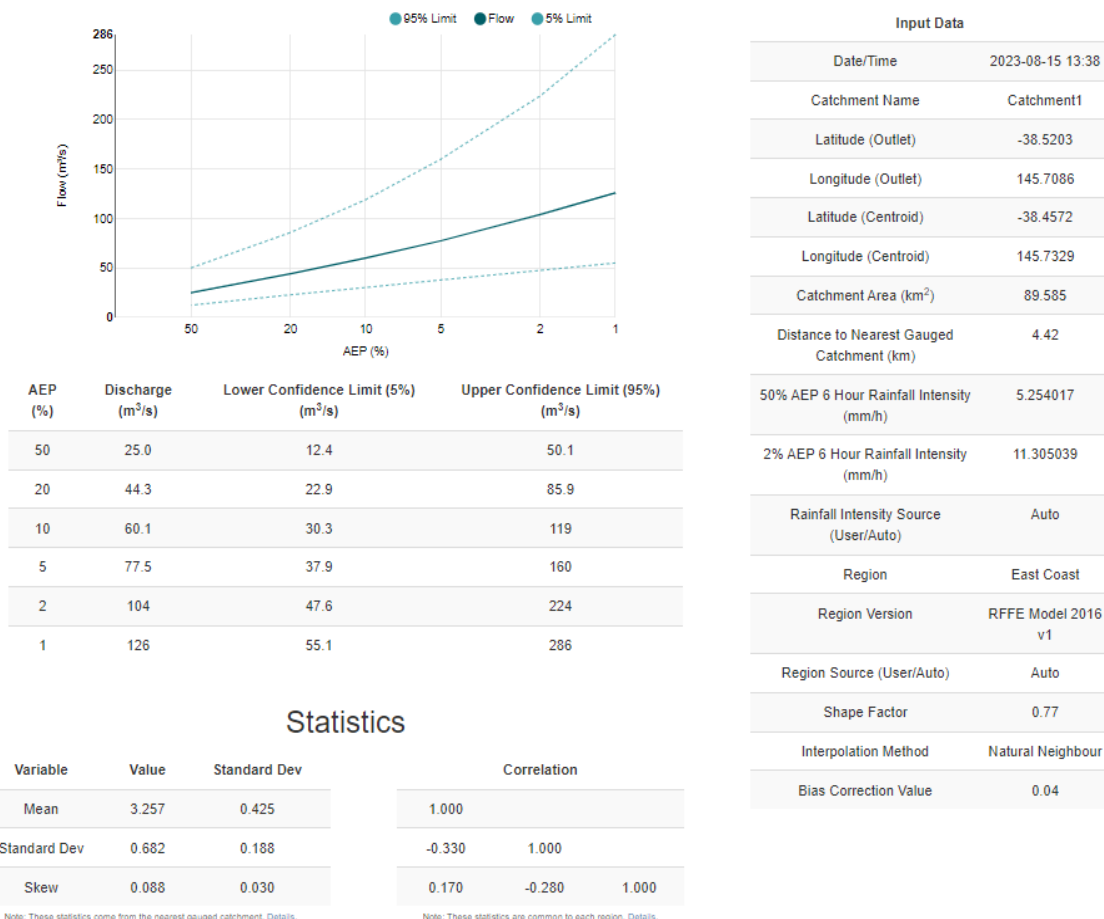


Figure 7. RFFE ARR summary, source: <http://rffe.arr-software.org/>.

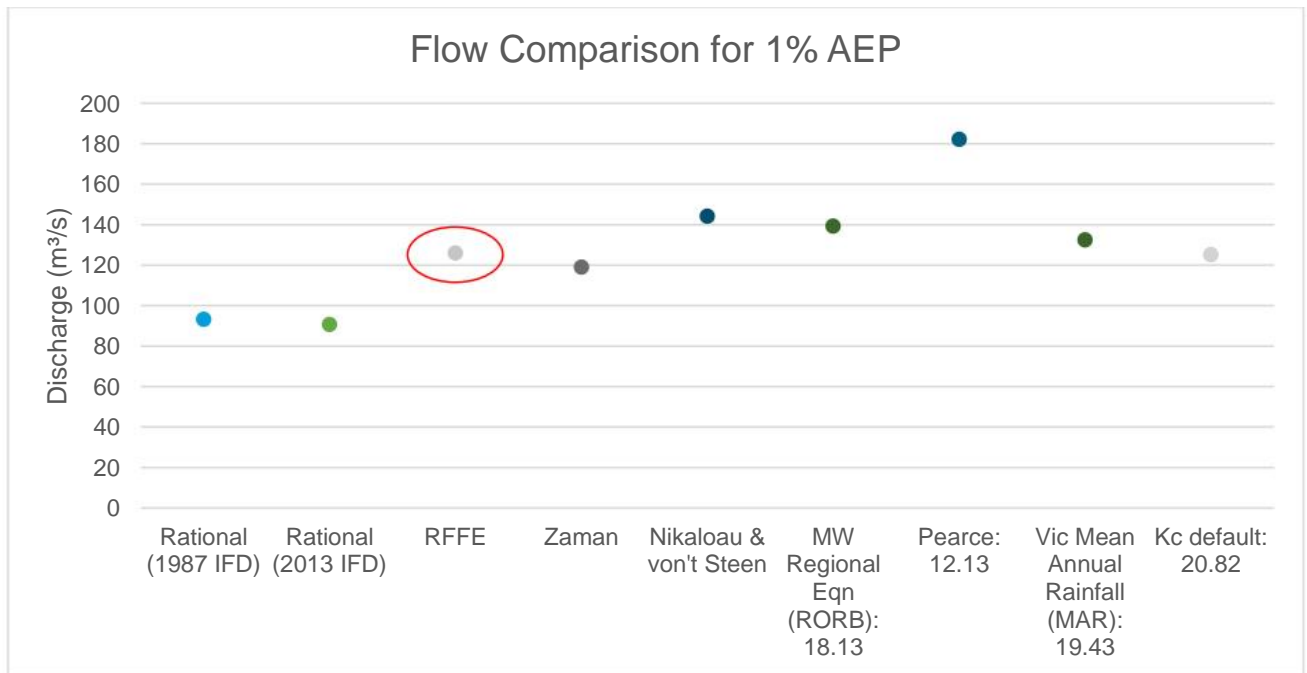


Figure 8. Flow method comparison for 1% AEP.

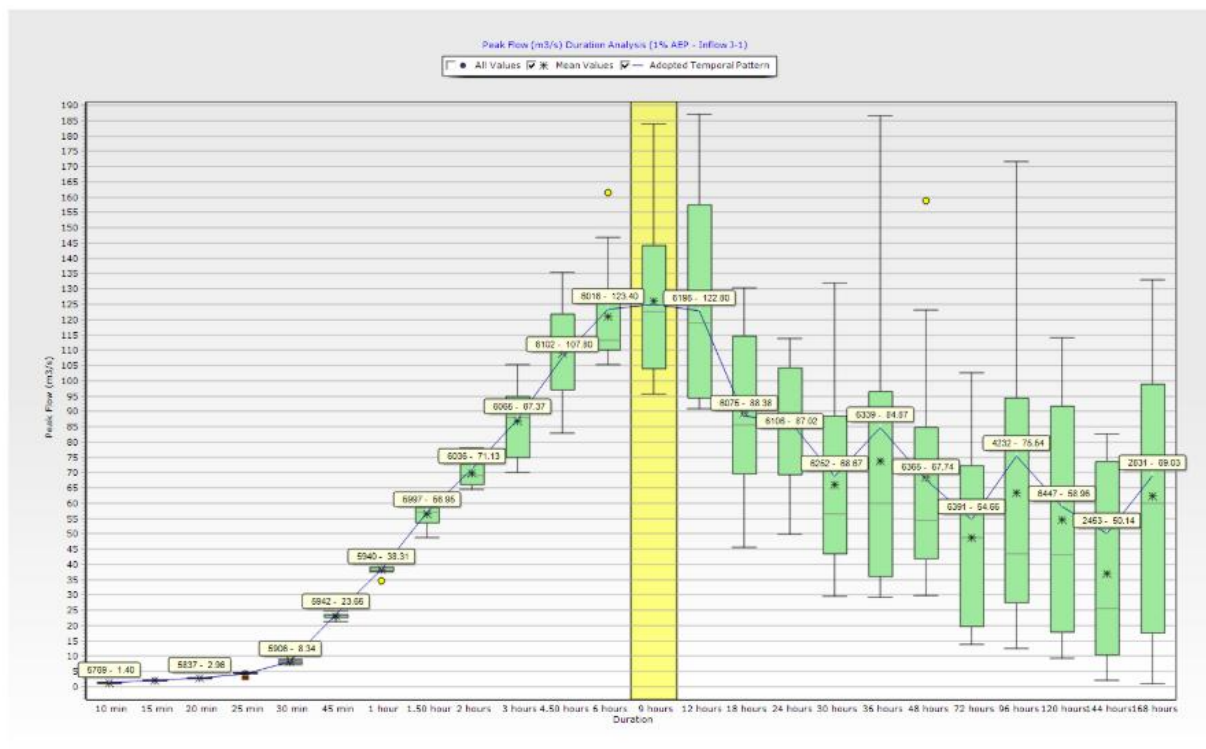


Figure 9. Catchment flows at 1% AEP.

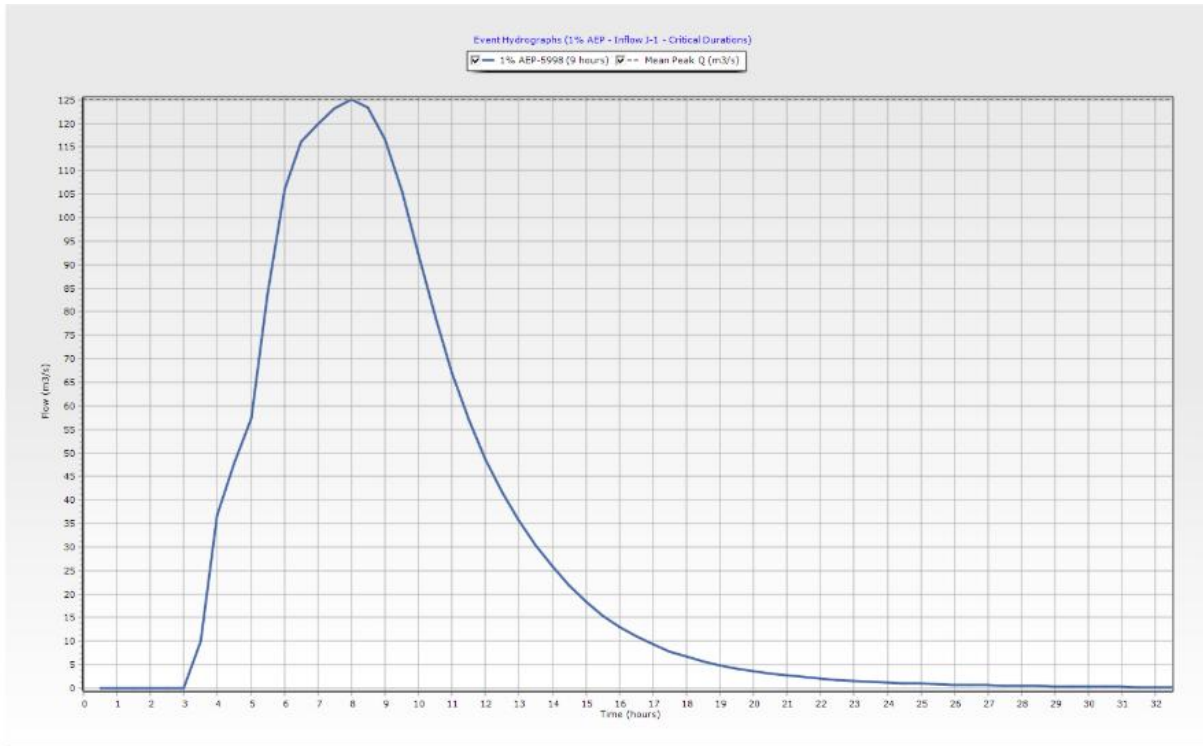


Figure 10. Hydrograph for critical duration (9hr) at 1% AEP.

Appendix B - TUFLOW model setup and Quality Assurance

The following section summarises key aspects of the TUFLOW schematisation and Quality Assurance parameters and is included to provide confidence in the model's capability to replicate real world outcomes to assist in decision making, and includes:

Model setup showing flow into and out of the model, the model extent, existing buildings that may have been impacted by flood, existing bridge on Korumburra-Wonthaggi Rd (Figure 11). The hydrograph determined in Appendix A was input into the "Flow In" 2d_SA as shown in Figure 11.

Material roughness used in scenario modelling is shown in Figure 12, the remaining areas are set at Mannings roughness of 0.060 to represent Waterways/Channel with moderate vegetation.

Key input consideration in model schematisation, including model type, and location of key inputs is set out in Table 4:

Reported Quality Assurance parameters to assess model health. The QA table highlights where issues may occur and any explanations for corrective action or influence on the analysis and interpretation of results for the areas of interest (Table 5:).

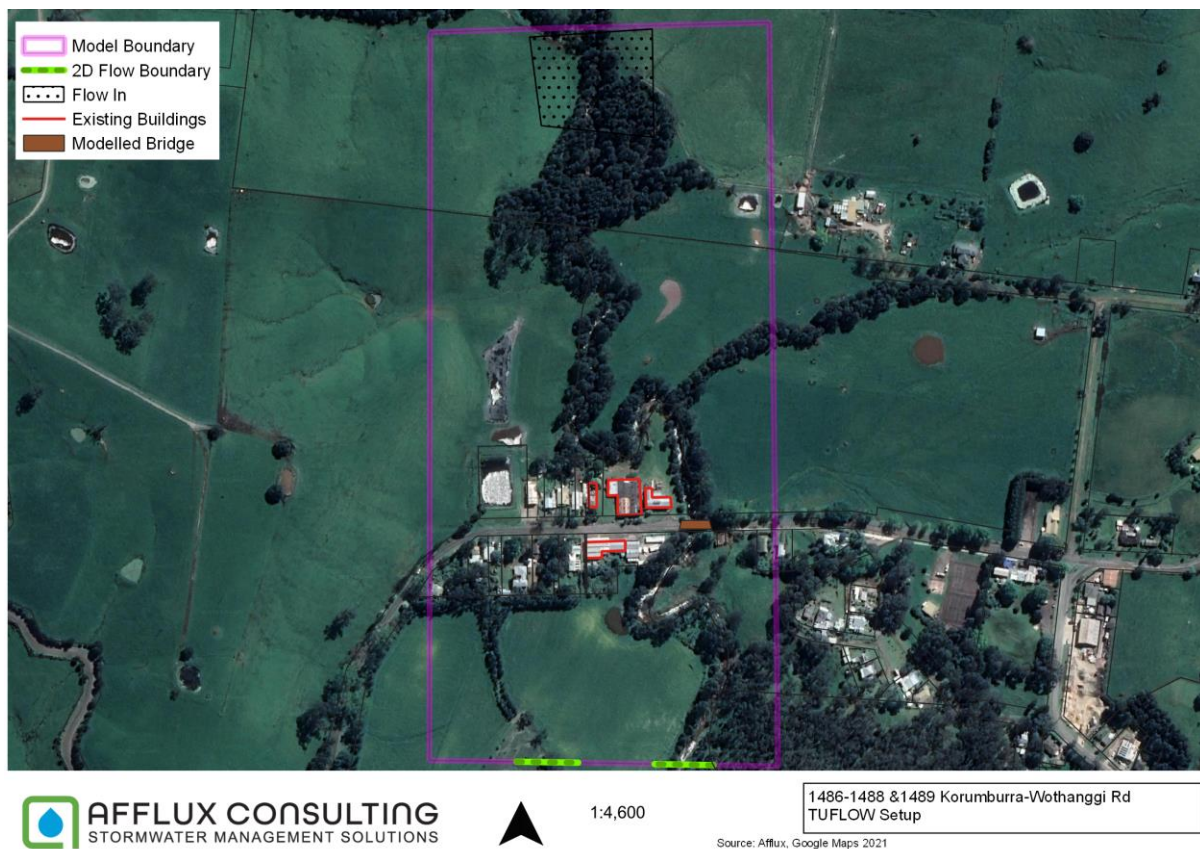


Figure 11. TUFLOW setup – schematisation.

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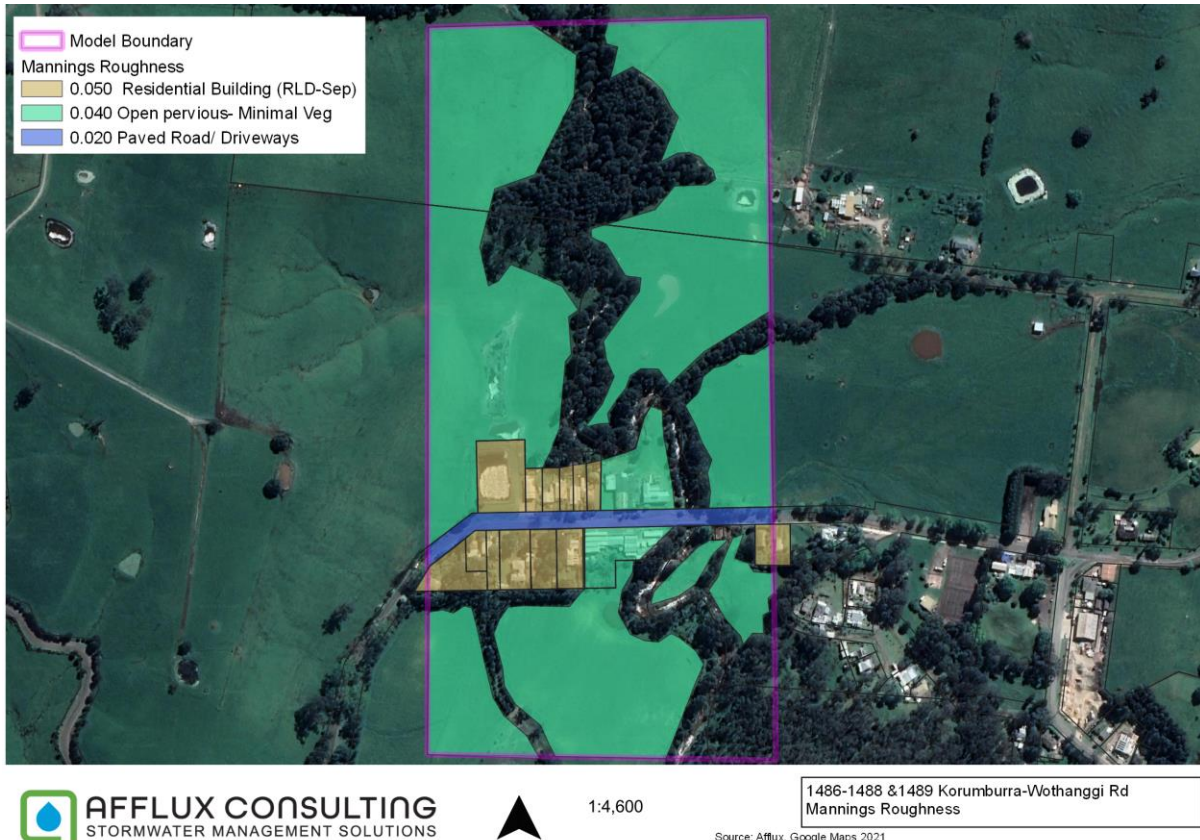


Figure 12. TUFLOW Setup - Mannings Roughness

Table 4: Model Input Parameters

Parameter	Scenarios	Description
Terrain	V01	Sourced from surveyed terrain provided by the client, Pete Wilson Landscape Architecture.
Buildings	V01	Buildings that would have been impacted by the floods was modelled with fill pads at 300mm.
Initial Water levels	V01	No IWL applied
Inflows	V01	2d_SA applied over the top of the catchment, applying design hydrograph.
Outfalls	V01	Two discharge points at the southern boundary to reflect Foster Creek and a farm channel. A standard slope of 0.005 was applied for a typical channel.

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Table 5: Model QA Parameters

Scenario Name	Model Solver	Solution Inclusions	Simulation Time (hrs)	Model Timestep (secs)	Cell Size (m)	Volumetric Error (%)	Cumulative Mass Error (%)	WARNINGS Prior to simulation	WARNINGS During simulations	HCN Repeat Timesteps	NAN Warnings	NAN Repeat Timesteps
v01	2023-03-AA-iDP-w64	HPC Modeller	30.0 (1)	1 (2b)	3.0 (1)	-0.00 (1)	-0.00 (1)	17 (2)	2 (2)	6 (2)	8 (2)	0 (1)

*Additional QA undertaken in form of water level comparison. Differences in area of interest < 1cm (abs).

NOTES: TUFLOW modelling has been undertaken using the Afflux Quality Assurance framework. Model runs have been verified in Classic TUFLOW version and Mass Errors confirmed to be within acceptable limits relative to the interpretation of results. Additional runs have been completed in HPC versions where indicated with relevant parameters reported. For 'production runs' HPC is our preferred modelling engine to lower run times and improved model stability.

For model runs where all QA parameters report values of less than (2) there can be confidence in interpreting results. In other instances results should be interpreted with caution, however an adverse QA parameter does not necessarily mean that the results are in error if the modelling issues are isolated, minor in nature or located away from areas of interest with sufficient hydraulic separation. If this is the case further explanation may be provided.

Key model run and QA Parameters are presented within the Table for reported scenarios.

QA Parameters are described below

Solution Inclusions- Describes particular TUFLOW modelling inclusions used (e.g. CLASSIC versus HPC, Quadtree processing and/or Sub Grid Sampling)

Simulation Time

(1) Model run allow sufficient time for the peak to pass through all areas of interest through to the model outfall.

(2) Model run duration allows sufficient time for the peak to pass through all areas of interest.

(3) Peak hasn't passed through areas of interest. Results should be interpreted with caution.

Model Timestep- Model timestep should be half selected cell size (for Classic simulation) or is adjusted within program for HPC versions

Model Timestep (Classic Runs)

(1) Timestep is appropriate for cell size (i.e. in Classic simulation this should be around 0.2 to 0.5 of the cell size) and Mass Error is below 1%.

(2) Timestep is appropriate for cell size and Mass Error is between 1% and 5%.

(3) Timestep is not ideal relative to cell size, however model runs to conclusion and influence of timestep unlikely to influence at areas of interest. Results should be interpreted with caution.

Model Timestep (HPC)

(1) Model timestep in HPC is within 0.02- 0.5 of the selected cell size.

(2a) Model timestep in HPC is outside 0.02- 0.5 of the selected cell size, however no significant Control Number violations have been reported. Separate checks of dt have been undertaken and confirm regions of small timestep are unlikely to influence interpretation of results.

(2b) In addition to (2a) an additional check has been performed by cross checking with Classic run.

Cell Size- Cell size should be selected based on a combination of model run time and ability to represent terrain likely to influence water flow in areas of interest.

(1) Selected cell size is able to pick up terrain influencers (such as channels and swale) in areas of interest.

(2) Cell size has been used with advanced solution methods (e.g. Quadtree or SGS) to ensure balance between model run time and selecting detail.

(3) Larger cell size relative to terrain. Usually selected to shorten run times, however results should be interpreted with caution.

Cumulative Mass Error, Volumetric Error- Volumetric and Mass errors indicate model stability and that calculations during run time sufficiently account for water into and out of the model. TUFLOW modelling guidelines recommend this should be less than 3%. These errors are reported from the scenario tf.

(1) Mass Error is below 1% and is acceptable.

(2) Mass Error is between 1% and 3%. Error sources have been checked and are remote from areas of interest and unlikely to affect results interpretation or conclusions.

(3) Mass Error above 3%. Results should be interpreted with caution.

HCN Repeat Timesteps, NAN Warnings, NAN Repeat Timesteps- Repeat timesteps and NaN warnings are generated using HPC versions based on model stability during simulation

(1) No Warnings or repeated timesteps.

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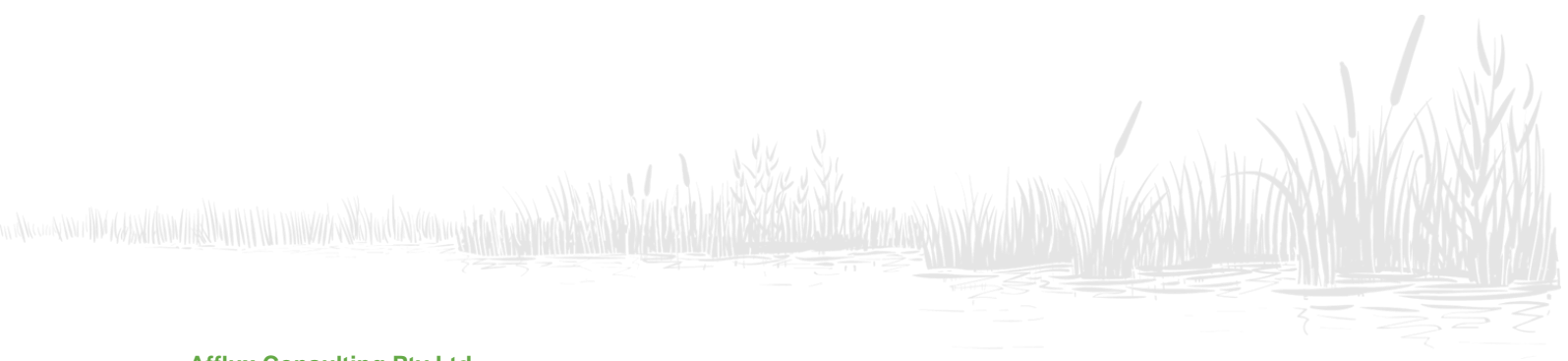
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- (2) Less than 1% of calculated steps. Run time adjustments have been made to maintain model stability and are acceptable.
- (3) Greater than 1% of calculated steps, but locations away from areas of interest. Results can be interpreted with care.
- (4) Greater than 1% of calculated steps and locations near areas of interest. Results should be interpreted with caution.



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