

MEMORANDUM

To [REDACTED] | City of Ballarat
From [REDACTED] | Water Technology
Date 18 June 2026
Subject Ballarat 11 Waterways Amendment C217ball – General Themes
Our ref 26010601_M01_V01_General_Responses.docx

1 SCOPE OF MEMORANDUM

Water Technology were engaged by the City of Ballarat to prepare responses to reoccurring technical themes across the submissions that require modeller input, including:

- Flood Modelling Methodology and suitability for planning purposes.
- Climate change assumptions and planning benchmarks.
- Representation of drainage infrastructure.
- Terrain data and LiDAR resolution.
- Translation of flooding modelling into planning layers.
- Current versus future infrastructure.

2 TECHNICAL RESPONSE

Responses to the themes submitted relating to Amendment C217ball is as follows.

2.1 Flood Modelling Methodology and suitability for planning purposes

The methodology adopted for the Ballarat 11 Waterways has undergone four third-party reviews over the life of the works, spanning from 2017 to 2024. Details on the peer reviews are noted in Section 3.3 of the Summary Report.

There are known limitations to the outputs produced from the Ballarat 11 Waterways flood studies, with the most common being accuracy at a site-specific level. The intent of the flood studies and delineation of the planning control layers is not to produce high-resolution flood mapping for the entire municipality, as this an unachievable task to complete with the resources available for any Council or CMA. This study does however produce outputs of appropriate resolution to identify high-risk inundation extents and problematic areas that required careful consideration before undertaking any works.

2.2 Climate change assumptions and planning benchmarks

The recommendation to proceed with RCP8.5 for the design horizon 2100 (as recommended in ARR4.1) was considered carefully in conjunction with the City of Ballarat and the Corangamite Catchment Management Authority. Adoption of this climate change scenario for the proposed planning controls reassures the study's relevance until revised hydrological modelling can be completed.



Under the climate change scenario adopted, the 1% AEP storm event was increased by a factor of 1.184 (18.4%) for the 2100 RCP8.5 scenario. Climate change modelling under the current standard, ARR4.2, requires scaling of rainfall data to reflect current climate levels by accounting for the increase in global warming level since the baseline IFD representation period (1961-1990). Rainfall depths are then subject to further scaling to represent future climate conditions.

As an example, should the ARR4.2 considerations be applied to the Canadian Creek & Tributaries hydrologic model, the current day representation of rainfall IFD's would be comparable to the RCP8.5 2100 event that has been modelled.

Should planning controls be delineated using ARR4.2 recommendations it would be for the year 2100 and would entail a 34% to 86% in rainfall intensity.

An overview of IFD factors for ARR4.2 climate scenarios and the adopted climate scenario IFD scaling for the 1% AEP event are provided in Table 1.

Table 1 Climate change IFD scaling

Duration	SSP3		SSP5		RCP8.5
	2030 (current day)	2100 (future climate)	2030 (current day)	2100 (future climate)	Adopted Scaling
<1hr	1.18	1.66	1.20	1.86	1.184
1.5hr	1.17	1.59	1.18	1.77	
2hr	1.16	1.55	1.17	1.71	
3hr	1.14	1.5	1.16	1.64	
4.5hr	1.13	1.45	1.14	1.58	
6hr	1.12	1.42	1.13	1.54	
9hr	1.12	1.39	1.13	1.5	
12hr	1.11	1.37	1.12	1.47	
18hr	1.10	1.34	1.11	1.43	
>24hrs	1.10	1.32	1.11	1.41	

2.3 Representation of drainage infrastructure

Stormwater drainage infrastructure in each of the models is comprised of infrastructure obtained from various sources. The bulk of the infrastructure is informed by City of Ballarat's spatial dataset. It is known to City of Ballarat and Water Technology that there are gaps in this dataset. To reduce the gaps, stormwater drainage plans from Council's archives and recent developments were reviewed to provide greater detail on the stormwater drainage infrastructure. In conjunction with the spatial datasets and drainage plans, numerous site inspections were undertaken across the life of the project to confirm infrastructure presence and dimensions.

Specifics on drainage infrastructure depths, or invert levels, was a common data gap across each of the models, with invert levels needing to be confirmed by referring to engineering plans. Where plans were not available, methods to establish appropriate design inverts were used so that the drainage infrastructure in the model represented a suitable system. These methods are outlined in each of the reports and are a common approach in the industry. While survey of the stormwater drainage system is the ideal solution, it becomes less feasible for a municipal wide study when compared to a specific site assessment.



2.4 Terrain data and LiDAR resolution

All base terrain data for the Ballarat 11 Waterways used a 1-metre LiDAR dataset that was captured in October 2019, which is the most recent and best quality LiDAR dataset available for each of the model extents. Where urban development and/or drainage infrastructure works were conducted since the capture the LiDAR, Digital Elevation Model's of the works were included in the models, where available.

2.5 Translation of flooding modelling into planning layers

Planning control layers are informed by the flood model depths, velocities, and velocity x depth output maps. These maps are used to identify the high-hazard flood extents which are classified a Floodway Overlay (FO). The remaining flood extents in riverine locations is classified as Land Subject to Inundation (LSIO), which represents extents with a lower hazard level. Although the LSIO is lower in hazard, it does still have the potential to inundate properties or dwellings above floor level and earthworks within these extents can result in adverse impacts to neighbouring properties.

The third planning control layer is the Special Building Overlay (SBO). This overlay is primarily located over urban catchments where no natural riverine inundation occurs and typically features pit and pipe systems. These areas are typically outside of the CMA's jurisdiction has the stormwater infrastructure in these areas are Council assets. The SBO can be comprised of high and low hazard flood extents.

2.6 Current versus future infrastructure

The inclusion of planned drainage infrastructure was not included in hydrologic or hydraulic models. Pre-emptively including this infrastructure would have implications if it the construction of the infrastructure was delayed or designs were to change. This could result in inaccurate overlays and misrepresentation of high/low risk flooded areas; therefore, it was determined only constructed infrastructure would in included in the modelling and mapping.



3 CAPABILITY STATEMENT

3.1 Report Authors

██████████
Senior Engineer
Water Technology Pty Ltd
1/5 Bridge Street
Newtown, VIC 3220

Qualifications:

- Bachelor of Engineer (Civil) (Hons), Deakin University, 2017

Affiliations:

- Member, Institution of Engineers Australia

Area of Expertise:

- Assessment of flood and stormwater management;
- Expert in hydrological and hydraulic modelling;
- Advanced knowledge in application of GIS.

██████████
Senior Principal Engineer
Water Technology Pty Ltd
15 Business Park Drive
Notting Hill, VIC 3168

Qualifications:

- Bachelor of Engineering (Environmental) (hons), RMIT University, 2007
- Graduate Certificate, River Health Management, University of Melbourne, 2009

Affiliations:

- Member, Institution of Engineers Australia, Chartered Professional Engineer
- Member, Water Industry Operators Association of Australia
- Member, National Engineers Register

Area of Expertise:

- Assessment of flood and stormwater management;
- Expert in hydrological and hydraulic modelling;
- Expert witness for drainage and flood related issues at environmental effects panels, planning panels, and civil hearings.