Summary Report

Woodend Flood Study

AWE200155 / 304600136

Prepared for
Macedon Ranges Shire Council

8 November 2023

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1 Introduction

1.1 Report context

This is a '*Summary Report*' providing high-level detail of the Woodend Flood Study. Refer to the Woodend Flood Study Report (Stantec, 2023) for the final report which provides more details of the work undertaken and the findings form the Woodend Flood Study.

1.2 Overview

Macedon Ranges Shire Council (Council) with support from the Natural Disaster Resilience Grants Scheme managed by Emergency Management Victoria engaged Cardno (now *Stantec*) to undertake a detailed hydrological and hydraulic modelling assessment of the Woodend Township.

The intention of the project was to have updated and sufficient flood information capable of being used by a variety of stakeholders including authorities and the community for land use planning, flood management planning, emergency response and flooding education. The North Central Regional Floodplain Management Strategy 2018-2028 also requires the land-use planning controls for Woodend to be updated.

This project consisted of a number of stages including:

- Data Review – assessing the data available and determining the most appropriate information to utilise;
- Hydrological Modelling – deriving flows which represent flood events so that these can be introduced to the hydraulic model;
- Hydraulic Modelling – determining flood risk in the catchment as a result of these flows (for example flood depth, velocity and hazard); and
- Flood Mapping – preparing GIS and mapped outputs to illustrate the hydraulic model findings.

1.3 Flood History;

Woodend has been subject to a number of heavy rainfall events, which have led to widespread flooding, including in September 1993, November 2010, January 2011 and more recently in 2022. The January 2011 event was the largest flood event in living memory for Woodend. However, the 1993 event still remains an event against which flooding is compared. After the 1993 event, a series of flood levees were constructed along Five Mile Creek in order to increase the level of protection to properties which were inundated during the 1993 event.

1.4 Study Area

The study area is shown in Figure 1-1, which indicates:

- The hydrologic model catchment – this has been developed based on topography;
- The Hydraulic model extent which is centred on the Woodend Township as the area of interest for this study; and
- The Victorian Government defined waterways including Five Mile Creek (NB: Waterways are designated in accordance with section 188 of the Water Act 1989).

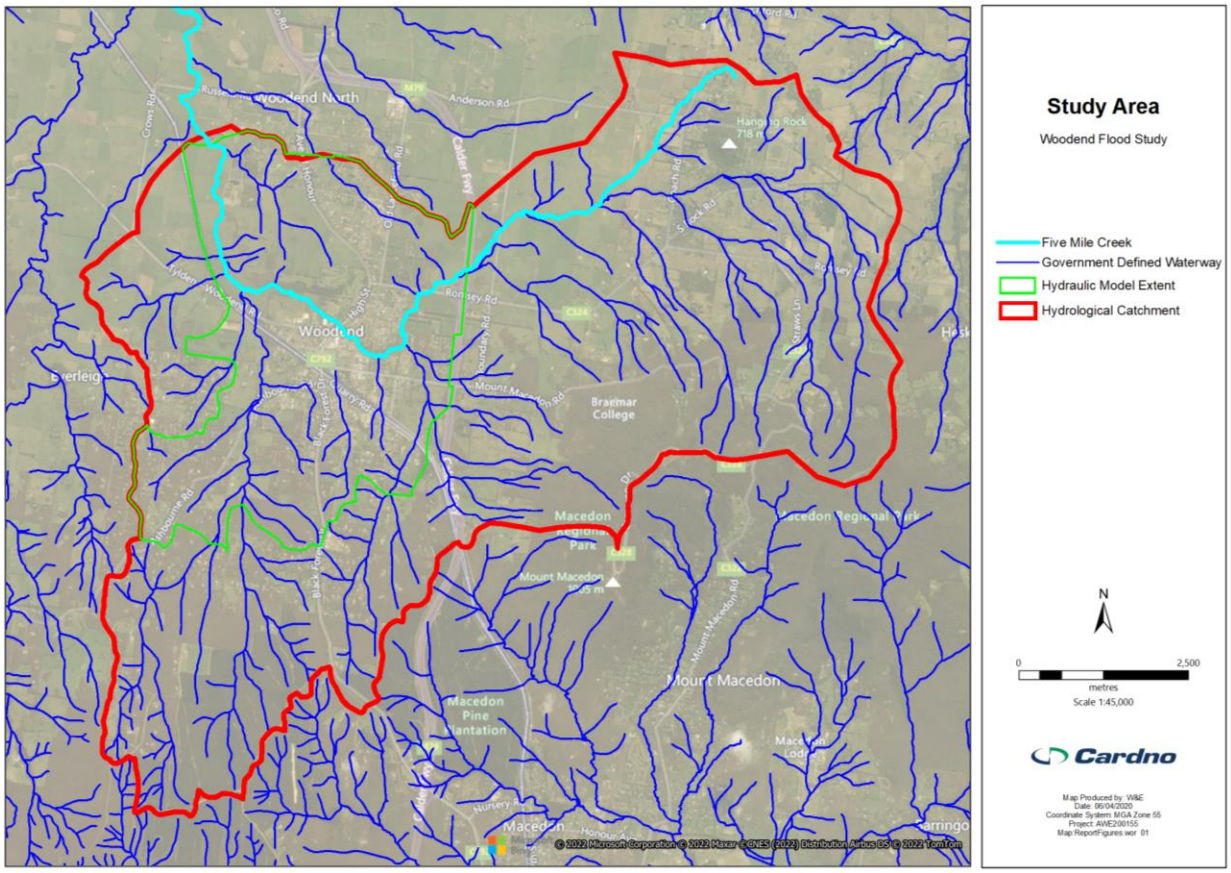

Figure 1-1 Study Area

2 Community consultation and feedback

2.1 Community consultation

A key objective for this study was to engage with the community to ensure their input was considered and incorporated into the study. Despite the limitations of face-to-face consultation due to COVID-19, it is expected that two rounds of community feedback will have occurred by the completion of the project. The 1st round involved getting community feedback as to where flooding within the community occurs, with the second round in 2023 to inform the community of the study's outcomes and to present the final report alongside any additional feedback received to a future Council Meeting for adoption.

3 Hydraulic and hydrological modelling

As part of this study, a calibrated hydrological RORB model was developed for the 1993, 2010 and 2011 events with a calibrated hydraulic developed for both the 1993 and 2011 events.

3.1 Hydrological analysis

The *Australian Rainfall and Runoff 2019* Guidelines provided the basis for the hydrological analysis undertaken, including the model parameters used and the future climate scenarios adopted.

3.2 Hydrologic model calibration and validation

Three distinct large historical flood events have been selected in order to attempt to calibrate the hydrological model to the Calder Highway Bridge, these events are:

- September 1993;
- November 2010; and
- January 2011.

To determine if the peak design flow rates were appropriate, four separate methods were used to help validate the hydrological model, to the Calder Highway Bridge. This included but was not limited to incorporation of data from the stream gauge just upstream of the Calder Highway bridge to undertake a Flood Frequency Analysis, a Regional Flood Frequency Estimate and consideration analysis of previous hydrological models including the calibrated RORB model for the 1993 flood event developed by Crapper (1995).

3.3 Hydraulic analysis

The *Australian Rainfall and Runoff 2019* Guidelines provided the basis for the hydrological analysis undertaken and the TUFLOW hydraulic model developed for the study.

3.4 Hydraulic structures

Within the floodplain near the Woodend Township, there are several different hydraulic control structures that significantly impact the flood behaviour. These include the Calder Highway Bridge, various flood levees and retarding basins and the railway.

3.5 Hydraulic model calibration and validation

To test the accuracy of the RORB calibration, two historic flood events were selected to calibrate the TUFLOW model including the 1993 event and the 2011 event. Due to lack of gauge data for the 1993 event and limitations with the high flow gauge data, surveyed flood levels for both the 1993 and 2011 events were used for the hydraulic model calibration.

Results from the hydraulic model were validated against all supplied (71) Council hotspots including all locations mentioned in the Coomes 1997 study. There was a reasonable match between the modelled flood extents and the associated defined flow paths with known Council hotspots.

Three separate sensitivity scenarios were assessed in order to determine how sensitive the hydraulic model was to a change in parameters. The assessed scenarios include blockage, hydraulic manning's roughness and a change in the downstream boundary levels and was undertaken for the 5% AEP, 1% AEP and 0.1% AEP flood events.

3.6 Hydraulic model results

The results from the hydraulic model were processed in-line with the methodology outlined by Swan et al 2018, where the results from each run of the hydraulic model (runs vary by duration and temporal pattern) are combined based on AEP. Where the peak value (depth, levels, velocities etc.) from all the combined runs forming the final output.

Peak flow rates as determined within the hydraulic model are outlined in outlined in Table 3-1.

Table 3-1 Hydraulic Model Design Flow Rates

AEP	Hydraulic Model Peak Flow Rate (m^3/s)
0.2EY	36 m^3/s
10% AEP	40 m^3/s
5% AEP	55 m^3/s
2% AEP	77 m^3/s
1% AEP	95 m^3/s
0.1% AEP	159 m^3/s

4 Outputs from the study

4.1 Assessed events and flood mapping

All assessed events outlined in Table 4-1 below.

Table 4-1 Assessed events

Scenario	AEP					
	0.2EY	10%	5%	2%	1%	0.1%
2B - Base Case (Existing Conditions)	√	√	√	√	√	√
3 - Fully Developed for Permissible Land Uses			√		√	√
4D -Sensitivities to Climate Change (Increased Rainfall Intensities)			√		√	√
5 - Design Events for Levee Assessment (Scenarios to also Include the Design Flood and Events above the Design Flood)	√	√	√	√	√	√

Refer to Figure 4-1, Figure 4-2 and Figure 4-3 for the 0.2 EY, 1% AEP flood extent map and 1% Climate Change AEP flood extent map.

For details of all flood mapping undertaken refer to the final report.

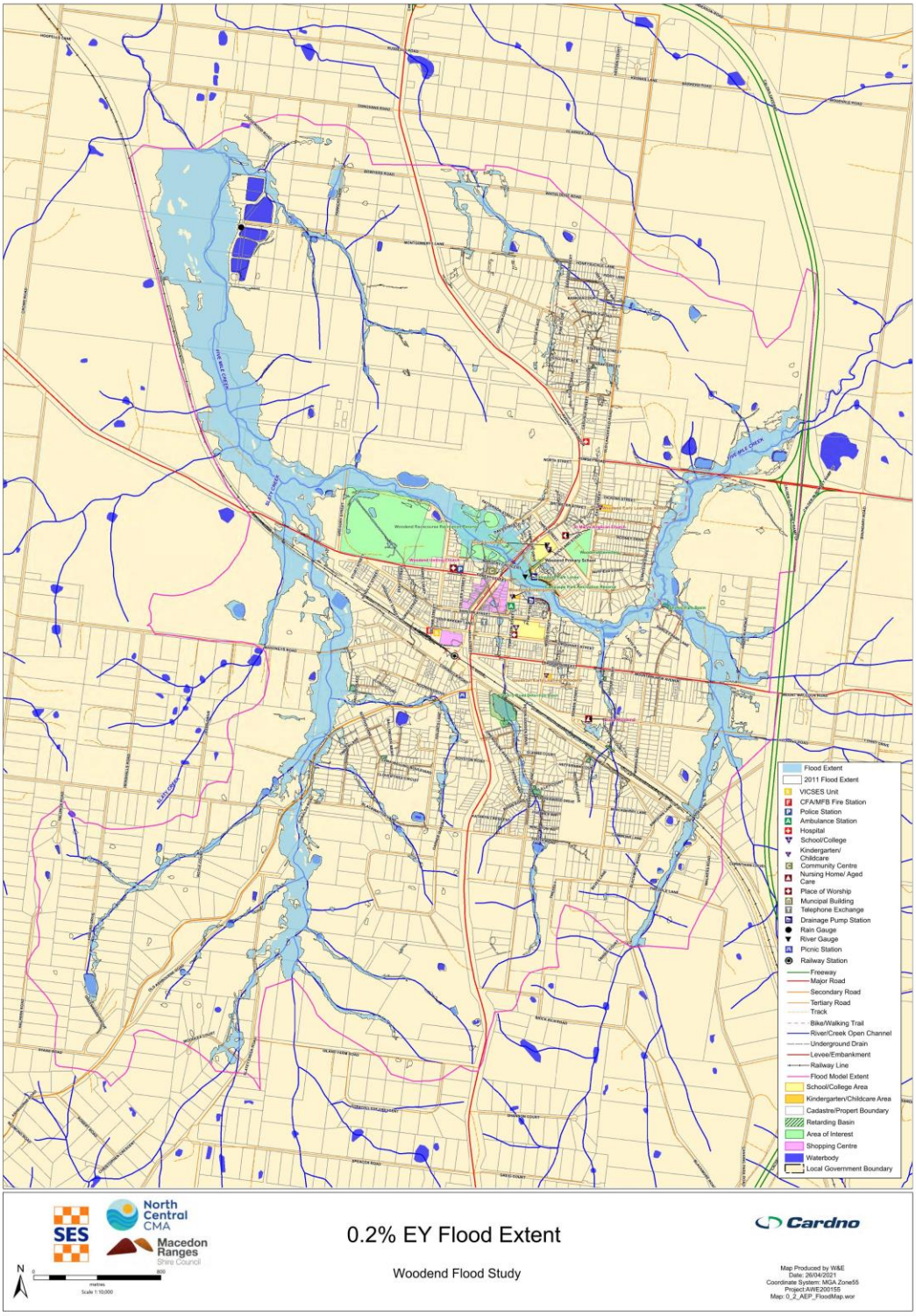

Figure 4-1 0.2% EY Flood Extent Map

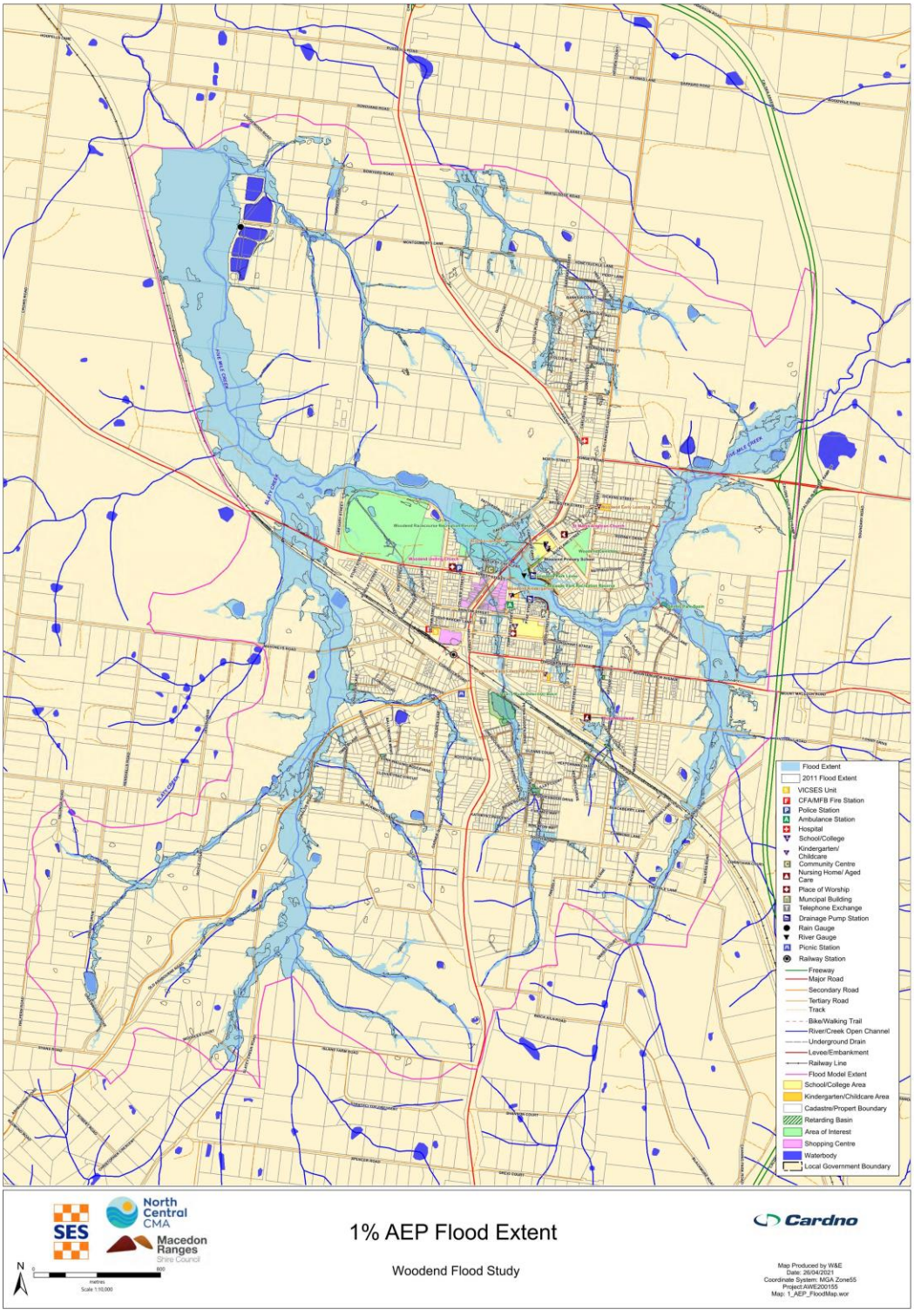

Figure 4-2 1% AEP Flood Extent Map

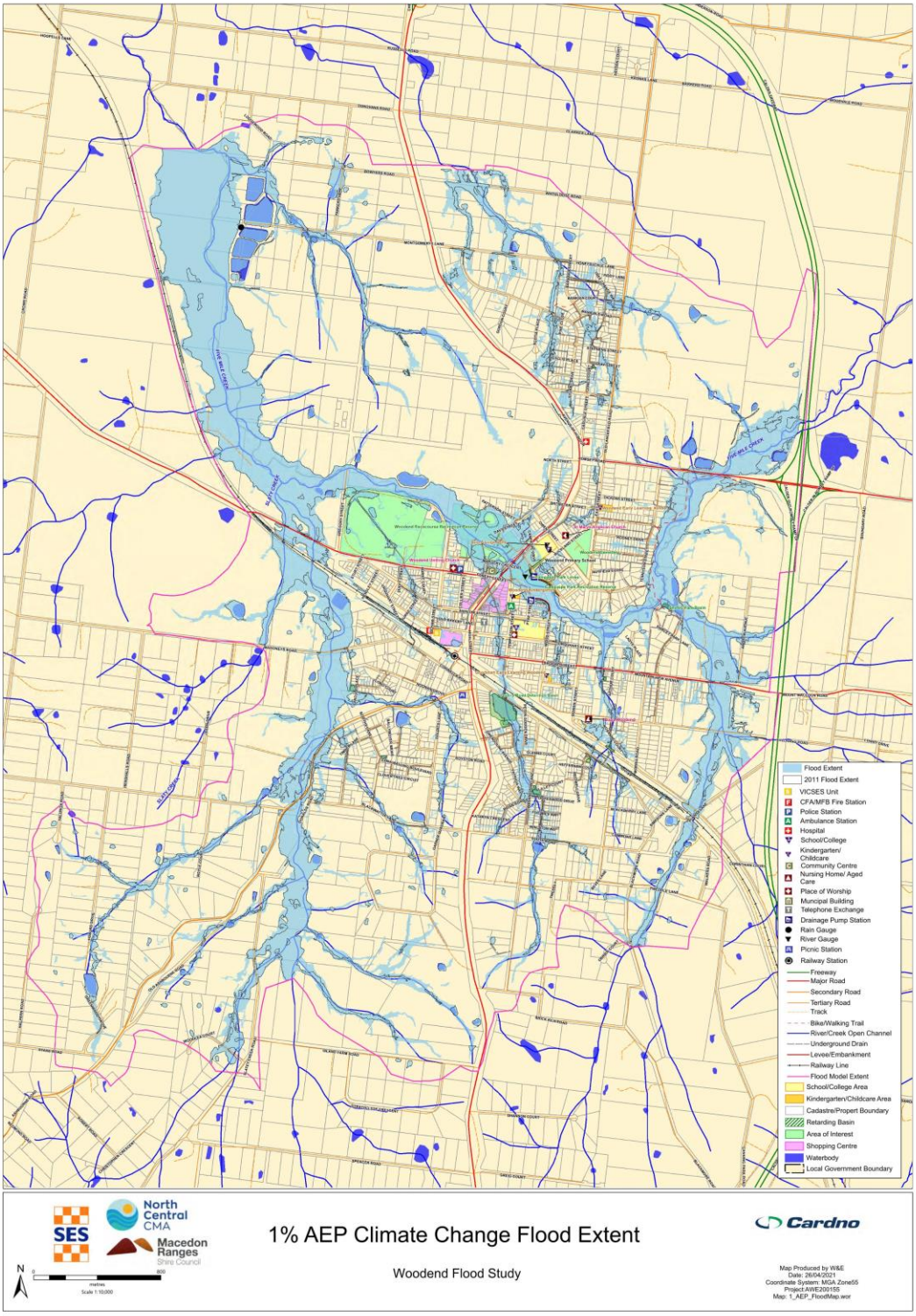

Figure 4-3 1% AEP Climate Change Flood Extent Map

4.2 Flood emergency planning

Outputs to inform an update to the Macedon Ranges Shire Flood Emergency Plan was provided as part of the study which includes but is not limited to providing updated flood intelligence in the form of flood consequence data and flood mapping. Refer to the final report for details.

5 Conclusion and recommendations

The Woodend Flood Study provides an improved understanding of flood behaviour within and around Woodend. The hydrological model was successfully calibrated to the September 1993, November 2010 and January 2011 flood events with the hydraulic model successfully calibrated/validated to both the 1993 and 2011 flood events. A series of design flood events have been modelled providing updated flood intelligence with regard to the impact of flooding within Woodend ranging from the 0.2EY event up to the 0.1% AEP event.

This study positions Council and its partner stakeholders to explore mitigation options in the future to managing existing and future risks associated with flooding.

The Study undertaken has recommended that:

- Council and the NCCMA make available the results of the flood study through an appropriate digital platform to residents of Woodend.
- Land use and/or development controls be implemented via Planning Scheme Overlays to reflect the findings of the study.
- Updates be made to the Municipal Emergency Management Plan reflecting the findings of this study.
- A flood mitigation study be undertaken to investigate options to address the most significant flooding identified in this study.

This is a '*Summary Report*' providing high-level detail of the Woodend Flood Study. For full details of the study refer to the Woodend Flood Study Report (Stantec, 2023).

6 Acknowledgements

Stantec would like to acknowledge the following organisations and people who have provided invaluable assistance throughout this project:

- Leslie Woo from the Macedon Ranges Council who has been instrumental directing the project in order to provide council with the results required to inform future decisions within Woodend
- Nathan Treloar from the North Central Catchment Management Authority for providing guidance on historical flood records, past flood studies and past flood mitigation projects within Woodend
- Dr. Tony Ladson from Moroka Pty Ltd for providing expert guidance throughout the project
- The residents of Woodend who have been diligent in capturing and recording information regarding flood events (particularly the 1993 event) within the community and making this information available to both The Shire of Macedon Ranges and to the North Central Catchment Management Authority for use in this study.

7 References

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