



# Winton Scoping Flood Study – Final Report

Prepared for Benalla Rural City Council

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Cover Image: Stantec, (*Winton Creek Crossing at Winton-Glenrowan Road, 9 February 2022*)

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# 1 Introduction

## 1.1 Overview

Stantec was engaged by Benalla Rural City Council (BRCC) to undertake the Winton Scoping Flood Study. The Goulburn Broken Regional Floodplain Management Strategy (GBRFMS) 2018-2028 identified this Scoping Study as a medium priority. The Strategy identified a lack of flood information available for Winton however did recognise the risk of flooding to the township from Winton Creek and Seven Mile Creek.

Winton is located within BRCC with a population of 108 (2016 Census).

The anticipated outcomes from the study were identified within the project brief and were:

- Rudimentary flood mapping for Winton;
- provide relevant information to allow updates to the Municipal Flood Emergency Plan; and
- increased awareness and understanding of flood risk in Winton.

Additionally, the investigation has assessed at a high level the potential for structural and non-structural mitigation options including consideration of development and planning controls, flood warning system options and identified further work to be undertaken.

The outputs from this study should help inform the following:

- a future update of the Benalla Rural City Council Flood Emergency Plan;
- the development of a Local Flood Guide for the township of Winton; and
- the identification of further work to be undertaken to implement flood mitigation options.

## 1.2 Study Area

Winton is a small Victorian rural location within the local government area of BRCC. Winton is located near Benalla and upstream of the Winton Wetlands as shown in Figure 1 and has a recorded population of 108 according to 2016 census.

Seven Mile Creek and Winton Creek are the two waterways running from south to north of interest for this study. Seven Mile Creek traverses the township at Fox Street with Winton Creek running 800m west to the township. These two waterways join 2 km north of the Hume Freeway discharging to the Winton Wetlands.

## 1.3 History of flooding

Although records provided limited information, Winton has a history of flooding including during the period of the 1920s and 1930s. More recently flood events of interest to the Winton community include flood events in October 1993, October 2010, October 2021 and January 2022.

## 1.4 Limitation of the Study

- This study is limited to being a **Scoping Study**. Detailed hydrological or hydraulic modelling has not been undertaken as part of this study.
- **High-level options identification and assessment** only. A detailed mitigation options assessment has not been undertaken as part of this study.

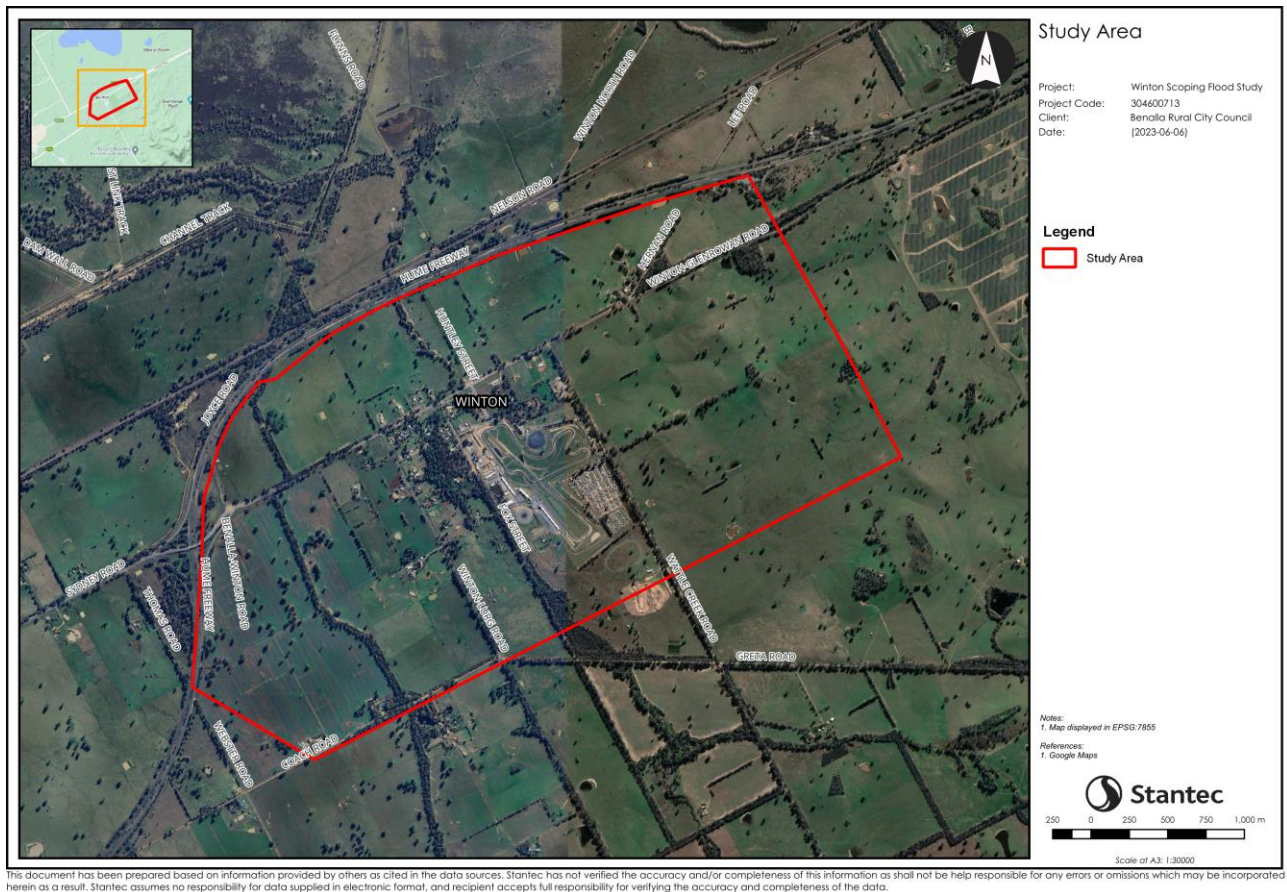


Figure 1 Study Area



## 2 Abbreviations and definitions

Table 1 Abbreviations and definitions

Abbreviation	Name Definition
<b>AAD</b>	Average Annual Damages
<b>AEP</b>	Annual Exceedance Probability The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.
<b>AHD</b>	Australian Height Datum
<b>AIDR</b>	Australian Institute of Disaster Resilience
<b>BoM</b>	Bureau of Meteorology
<b>BRCC</b>	Benalla Rural City Council
<b>CFA</b>	Country Fire Authority
<b>DELWP</b>	Department of Environment, Lands, Water and Planning (now changed to the Department of Environment, Energy and Climate Action)
<b>DEM</b>	Digital Elevation Model
<b>ELVIS</b>	Elevation Information System ( <i>Elevation and Depth – Foundation Spatial Data</i> )
<b>GBCMA</b>	Goulburn Broken Catchment Management Authority
<b>GIS</b>	Geographical Information Systems
<b>IFD</b>	Intensity, Frequency, Duration
<b>LiDAR</b>	Light detection and ranging (LiDAR) data. <i>LiDAR is a remote sensing technology that uses laser light to sample the surface of the earth's surface to produce point cloud datasets that are able to be visualized, shared and used as an input to flood modelling.</i>
<b>FFA</b>	Flood Frequency Analysis
<b>FLARE</b>	Flash Flood Advisory Resource
<b>HRCC</b>	Horsham Rural City Council
<b>RFFE</b>	Regional Flood Frequency Estimates <i>RFFE is a data-driven approach, which attempts to transfer flood characteristics from a group of gauged catchments to ungauged locations of interest (where design floods need to be estimated).</i>
<b>TFWS</b>	Total Flood Warning System
<b>TUFLOW</b>	<i>TUFLOW is a hydraulic modelling software for flood, urban drainage, estuarine and coastal assessments</i>



### 3 Site Visit

A site visit at Winton was undertaken after the inception meeting on 27<sup>th</sup> July 2022. Table 2 outlines several photos taken during the site visit with details of the location within the catchment.

Table 2 Site Visit Photos

Location description	Photo
<b>Winton CFA Station:</b> <b>135 Winton-Glenrowan Road, Winton (Corner of Huntley Street and Winton-Glenrowan Road, Winton)</b>	
<b>Private Residence</b> <b>(134 Winton-Glenrowan Road, Winton)</b>	










Location description	Photo
<p><b>Winton-Glenrowan Road, Winton</b> <b>(Looking south-west from the Winton CFA Station)</b></p>	
<p><b>Winton-Lurg Road, Winton</b> <b>(South-west of the Greta Road/Winton-Lurg Road intersection)</b></p> <p>On the day of site inspection (27<sup>th</sup> July 2022) the area was observed to have water within the low points across the paddock.</p>	
<p><b>Seven Mile Creek crossing at Greta Road</b> <b>(upstream of Winton Township)</b></p> <p>Evidence of scouring and erosion observed including rock rectification works</p>	





Location description	Photo
<b>Winton Creek crossing at Coach Road (upstream of Winton Township)</b>	
<b>Winton Primary School (30 Fox Street, Winton)</b>	
<b>Fox Street, Winton (Local drainage road crossing conveying drainage from the eastern to western side of Fox Street and discharging into Seven Mile Creek)</b>	



Location description	Photo
<b>Seven Mile Creek Crossing</b> (Corner of Winton-Glenrowan Road and Fox Street)	
<b>Winton Creek Crossing</b> (Winton-Glenrowan Road – east of the Hume Highway)	





## 4 Data Review

### 4.1 Data Register

Table 3 outlines data received, its source, description and how the data will be used in the project.

**Table 3 Data Register**

ID	Data Type	Data Source	Name	Description	Date Received	Application of Data
1	GIS	DEECA	wangaratta_mosaic-boundary_epsg7855.shp	A polygon that shows the area of coverage for 2019 LiDAR	05/08/2022	Confirms the LiDAR coverage area enabling an assessment of whether the area of LiDAR obtained is sufficient
2	GIS	DEECA	wangaratta_index1km_epsg7855.shp	Polygons that show the area of coverage for each 2019 LiDAR datasets	05/08/2022	Indicates the coverage and location for each LiDAR dataset
3	GIS	DEECA	wangaratta_2022feb03_dem1m_v10cm_epsg7855.tif	1 m Digital Elevation Model covering the Winton township	05/08/2022	Used for catchment analysis and hydraulic model build
4	GIS	DEECA	wangaratta_2022feb03_dsm1m_v10cm_epsg7855.tif	1 m Digital Surface Model covering Winton Township	05/08/2022	Not relevant to the project
5	GIS	DEECA	wangaratta_2022feb03_mpts-c2_v10cm_ahd_epsg7855.laz	Standard format for storing LiDAR data as points with Orthometric (AHD) datum	05/08/2022	Not relevant as LiDAR will be used in raster format
6	GIS	DEECA	wangaratta_2022feb03_mpts-c2_v10cm_ell_epsg7855	Standard format for storing LiDAR data as points with Ellipsoidal (ELL) datum	05/08/2022	Not relevant as LiDAR will be used in raster format
7	GIS	DEECA	2022feb03_aerial_vis_10cm_epsg7855.tif	Aerial photos that cover the Winton township area	05/08/2022	Used to inform top estimate roughness of land material for hydraulic modelling and mapping
8	Excel	DEECA	Lurg_IFD_Analysis.xlsx	IFD analysis was undertaken by GBCMA using rainfall recorded at the Lurg Fire Tower	11/08/2022	Used to inform the magnitude of the January 2022 event and the community consultation stage
9	Photo	GBCMA	Site Inspection Photos on 9th February 2022 (hard copy)	As per Name	11/08/2022	Used to confirm the locations of interest including from historic flood events
10	Map	GBCMA	Site Inspection Notes_9th February 2022 (hard copy)	Location of each photo been taken	11/08/2022	Used to confirm the locations of interest including from historic flood events





ID	Data Type	Data Source	Name	Description	Date Received	Application of Data
11	Gauge	BoM/DEWLP	Rainfall gauges near the Winton catchment	Assessed gauges include: >Benalla Airport (BoM), >Lurg Fire Tower (DEECA) >Molyullah (Killanoola) (BoM) >Greta West (BoM)	24/08/2022	Inform the daily and sub-daily rainfall for historical events
12	Website	BoM	Flash Flood Advisory Resource (FLARE)	Authoritative resource created to assist agencies with flash flood warning responsibilities, such as councils and emergency services, to design, implement and manage fit-for-purpose flash flood warning systems.	25/08/2022	Useful as a reference point with regards to the implementation and management of flash flood warning systems.
13	PDF	HRCC	'Information on flooding in Natimuk' - Horsham Rural City Council website	The guide was prepared by Horsham Rural City Council (HRCC) to help Natimuk residents be better informed and prepared for future flooding and its potential impacts.	26/08/2022	Used to review a recent pilot project undertaken for a flash flood warning system in collaboration with Council and BoM.

## 4.2 Topographic Information

The 2019 1m LiDAR obtained for an area covering the Winton township and locations immediately downstream and upstream was supplied by GBCMA. Additionally, 10m LiDAR was obtained from the VicMap Elevation DEM (ELVIS, Geoscience Australia) for areas within the catchment boundary where 1m LiDAR was not available. This informed the catchment analysis and delineation undertaken in Section 5. Refer to Figure 2 for details of the LiDAR obtained.

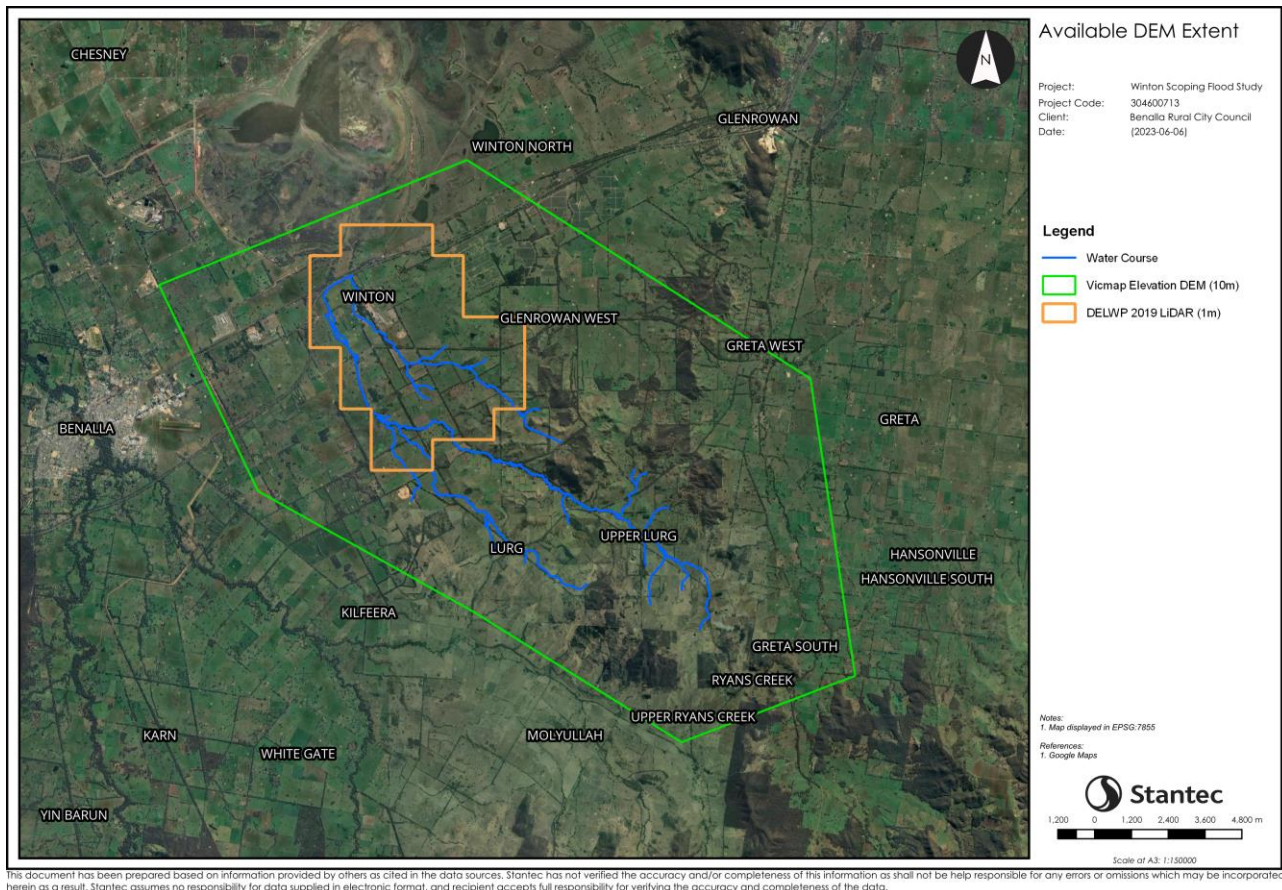
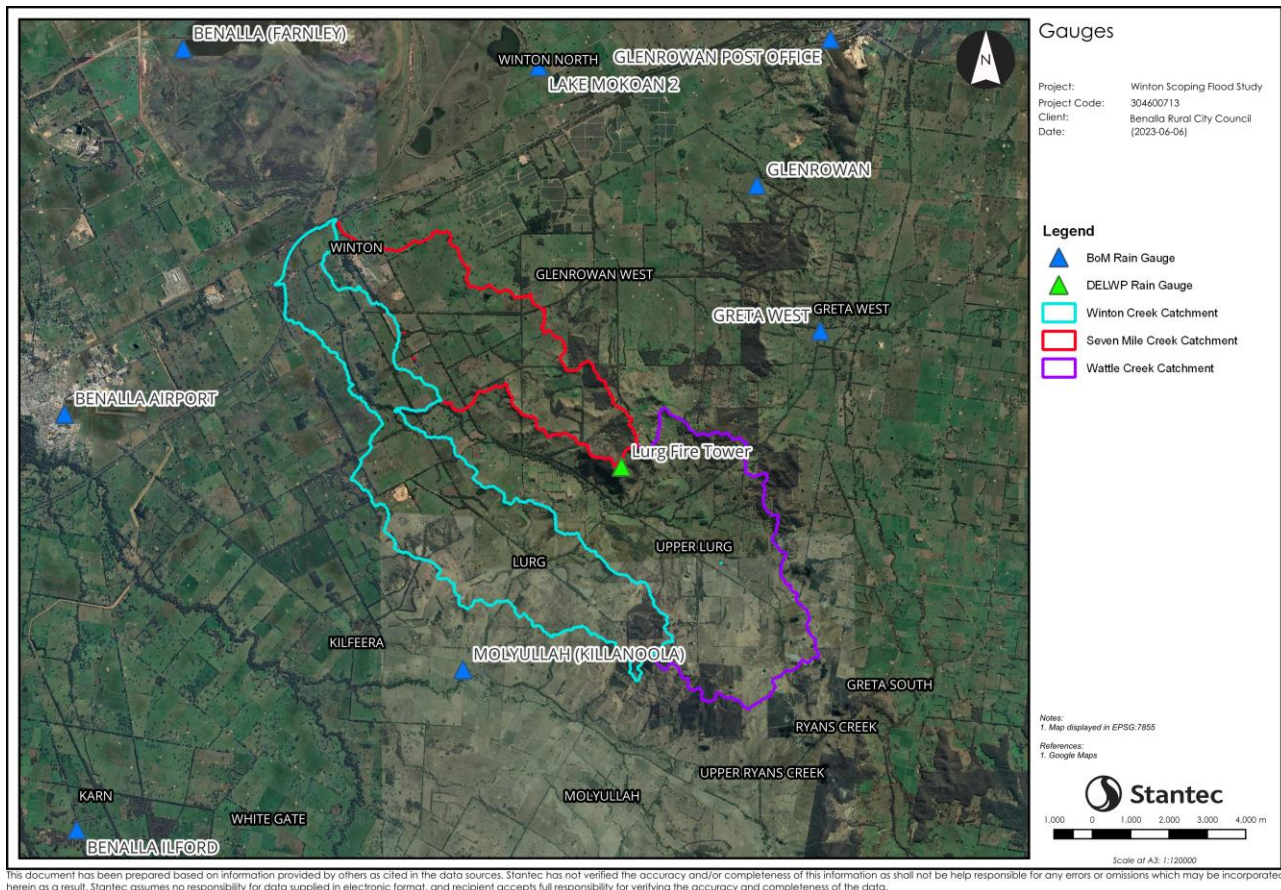


Figure 2 LiDAR Coverage

## 4.3 Gauge

There is no streamflow gauge on either Seven Mile Creek or Winton Creek upstream of the Winton township. Several rainfall gauges owned by BoM and DEECA are identified in the vicinity of the catchment. These are shown in Figure 3 and described below:

- Benalla Airport (BoM), 8 km West;
- Lurg Fire Tower (DEECA), 8.5 km Southeast;
- Molyullah (Killanoola) (BoM), 11 km South; and
- Greta West (BoM), 12 km East



**Figure 3 Rainfall Gauges**

The DEECA Lurg Fire Tower rainfall gauge recorded an 81.5mm burst of rainfall within 2 hours on 29<sup>th</sup> January 2022. This is equivalent to a 0.2% AEP event based on the IFD analysis undertaken by GBCMA which is presented in Section 5.3. The daily rainfall at other BoM gauges is outlined in Table 4, suggesting that rainfall across the catchment was significantly impacted by spatial variation based on topographic characteristics.

**Table 4 Daily Rainfall at BoM Gauges for Jan 2022 Event**

Gauge	Daily Rainfall (29/01/22)	Daily Rainfall (30/01/22)
Benalla Airport	35.2 mm	20.1 mm
Molyullah (Killanoola)	31.6 mm	34 mm
Greta West	22.4 mm	45.4 mm
Lurg	82.8mm	81.5mm

## 4.4 Road Closure Information

At the site visit it was discussed anecdotally that the Benalla-Winton Road was closed for a period of time during the January 2022 flood event. Approaches by Stantec and Council were made to find out more information about the road closures. Following consultation with local community representatives it was confirmed that the Winton-Glenrowan Road in the Winton township between Wattle Creek Rd and the roundabout adjacent to the Hume Highway was closed with the assistance of the local community and CFA Captain during the evening of the 29th January and reopened again around mid-morning on the following day.





## 4.5 Historical Flood Events

It is known that Winton experienced flooding in the 1920s and 1930s with flooding significant enough to wash away the railway resulting in the derailment of a train, as well as flooding of a certain dwelling (Trove, 2023). Information obtained from the community consultation undertaken, confirmed that other flood events of interest for the Winton township community occurred in October 1993, October 2010, October 2021 and January 2022.

It is acknowledged that there is very limited data available from the above historic events. Community engagement including the dissemination of a survey was mailed out to the Winton township community during the study. From this, some information in the form of photographs and other historic information from flood events were provided during the community consultation undertaken.

The outcomes of the survey were presented in section 6.





## 5 Catchment Analysis

### 5.1 Limitations of this analysis

- The catchment analysis undertaken is limited to being a high-level analysis only – this included the catchment analysis relying on 10m VicMap Elevation DEM data. Additionally, the estimation of 1% AEP flows in the hydraulic model uses the Regional Flood Frequency Estimates (RFFE) approach which is a limiting factor in the results presented;
- The primary purpose of the catchment analysis undertaken was to inform the community consultation approach for this study. The flood mapping results presented are relied on for preliminary flood planning purposes only; and
- It is advised that the use of flood maps provided in Appendix B including the flood depth, flood extent, flood hazard, flood level and flood velocity maps are only to be utilised by specialists with technical expertise in interpreting the results and understanding the limitations of the flood model results. Stantec will not be responsible or accountable for any misinterpretation of the flood maps provided within this report.

### 5.2 Catchment Delineation

The major waterways in the catchment are Winton Creek (including Wattle Creek tributary) and Seven Mile Creek traversing across the Winton township. **Error! Reference source not found.** presents the catchment delineation for each identified waterway based on the VicMap Elevation DEM (10 m).

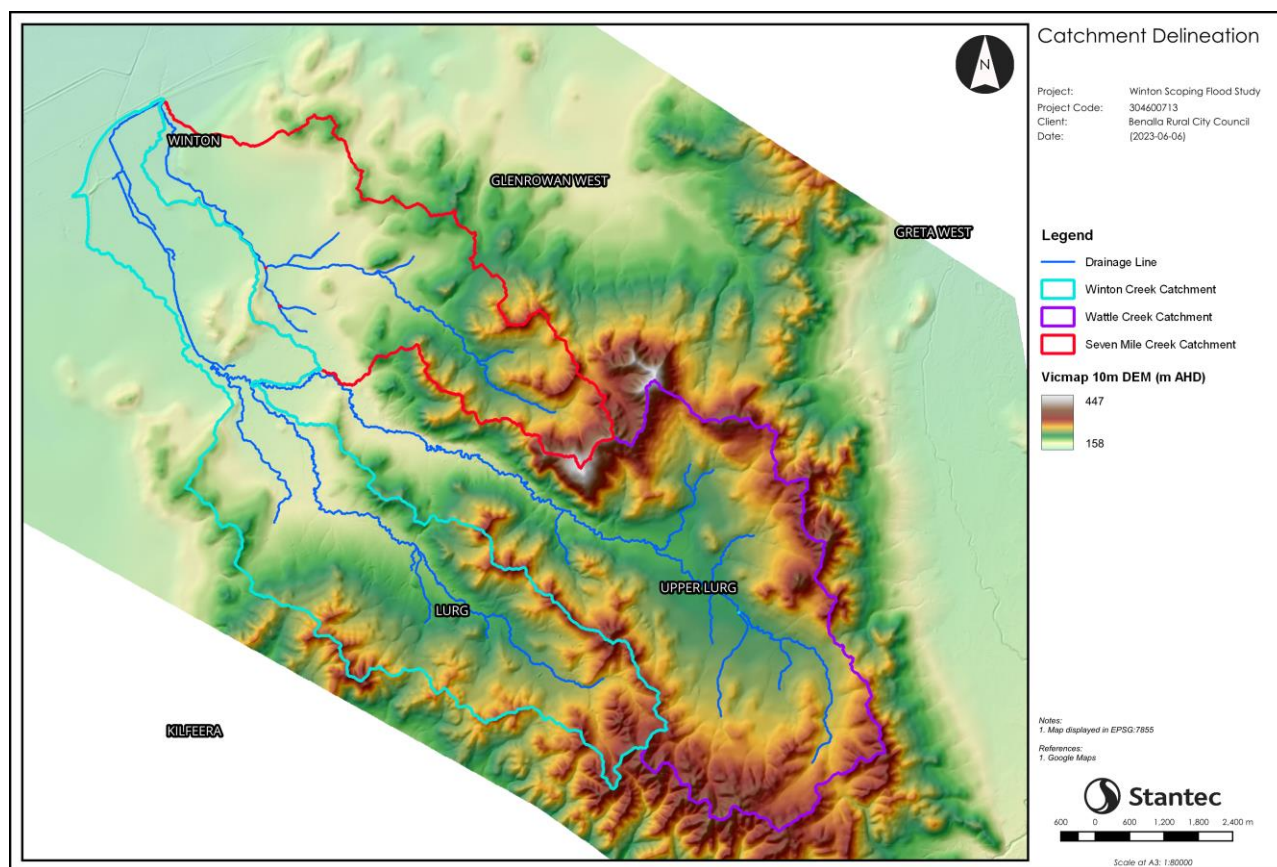


Figure 4 Catchment Delineation



Table 5 outlines the catchment sizes for the major waterways. This was used to inform the estimation of the 1% AEP design flows in the hydraulic model using the RFFE<sup>1</sup> approach.

**Table 5 Catchment Sizes**

Catchment Name	Catchment Size (km <sup>2</sup> )	RFFE (m <sup>3</sup> /s)
Seven Mile Creek	19.8	74.5
Winton Creek (Including Wattle Creek tributary)	65.7	150

### 5.3 Hydraulic Model

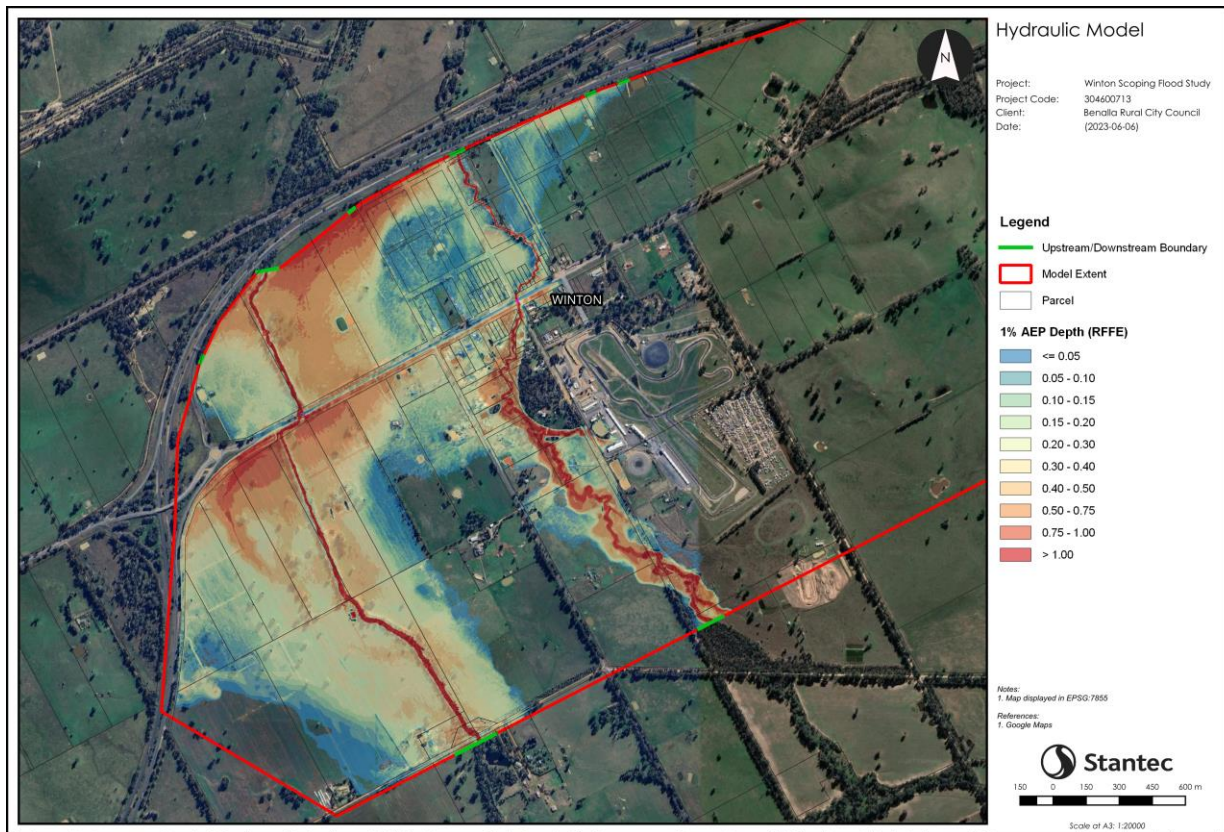
A 2D hydraulic model using TUFLOW was developed at a high level to estimate the flooding extent by incorporating the RFFE 1% AEP flows listed in Table 5 as upstream inflow boundaries. The 2019 1m LiDAR was used as the Digital Elevation Model (DEM) to form the basis of the 2D model that enables water routing on the surface based on topographic characteristics. Several outflow boundaries were modelled at major crossings along the Hume Freeway allowing water to escape from the model. Steady state flows have determined the hydrograph shape with the adopted parameters are based on Chow 1973. No structures have been included within the model, however the bridges under Winton-Glenrowan Road have been burnt into the topography. The DS boundaries have been modelled as slope boundaries.

The modelled flood extent and depth are shown in Figure 5. The results suggest houses to the west of the Seven Mile Creek are significantly inundated for 1% AEP event, whilst the racecourse is not likely to be impacted by the flooding from Seven Mile Creek.

The set of flood maps are provided within Appendix B of this report. This includes the following flood maps:

- 1% AEP flood depth map;
- 1% AEP flood extent map;
- 1% AEP flood hazard map;
- 1% AEP flood level map; and
- 1% AEP flood velocity map.

<sup>1</sup> Regional Flood Frequency Estimation (RFFE) is a data-driven approach, which attempts to transfer flood characteristics from a group of gauged catchments to ungauged locations of interest (where design floods need to be estimated).



**Figure 5 Modelled 1% AEP Flood Depth**

## 5.4 IFD Analysis

An analysis of the IFD data at the Lurg Fire Tower rainfall gauge shown in Figure 6 was undertaken by the GBCMA to assess the significance of the January 2022 event. The recorded rainfall against a range of durations was plotted on the IFD curve to estimate the magnitude of the rainfall event. In a future event, this can be used as a guidance tool that analyses the amount of rainfall against time to help work out the magnitude of the likely extent of flooding based on historical flood events.

Based on this analysis, the January 2022 event was estimated to be a 0.2% AEP magnitude event for the 2-hour critical duration rainfall event (refer to Section 6.3). However, it should be noted the rainfall across the catchment was significantly impacted by spatial variation due to varied topographic characteristics. As such, there are uncertainties to estimate the magnitude of the actual flooding that was experienced by Winton in January 2022, but it is likely the event ranged between a 2% to 0.5% AEP event. This helped inform the approach to undertake the hydraulic analysis approach to incorporate the RFFE 1% AEP flows as detailed in section 5.3. Furthermore, the information gathered from survey respondents assisted to inform a comparison of the estimated 1% AEP extent and the locations and properties impacted in the January 2022 flood event. This is described further in section 6.4.



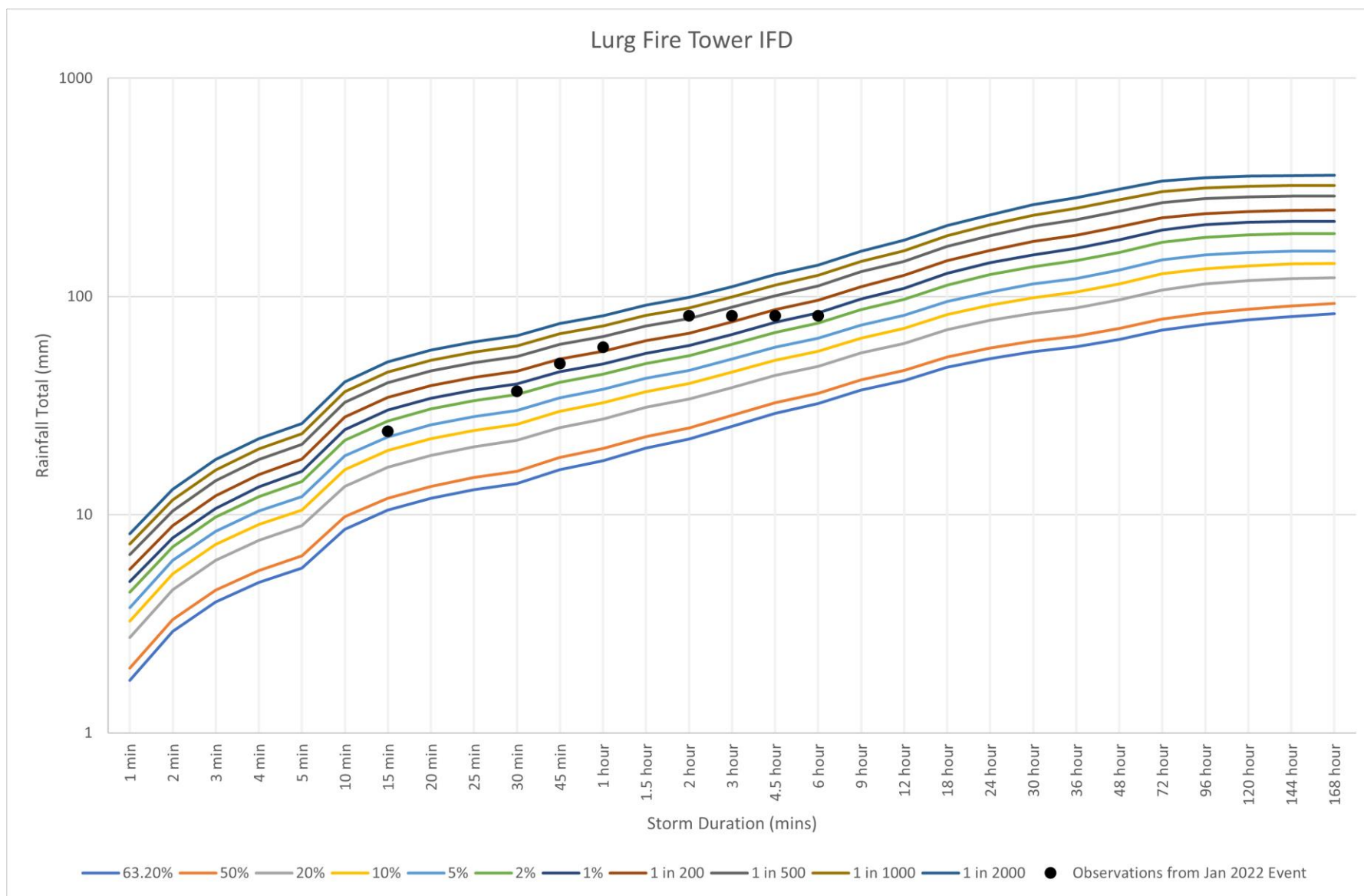


Figure 6 Guidance of Likelihood of Flooding at Winton (GBCMA, 2022)





## 6 Community Engagement

### 6.1 Post flood assessment and data collection

In February 2022, the GBCMA and Council undertook a site visit to Winton and surrounding areas to assess the impact of flooding. This included liaising with the community, rail and road authorities, VICSES and the local CFA.

The information from the post flood assessment and data collection was relied on to inform the key areas of interest for the study and helped to identify key community members to be targeted within the community consultation. The information included photos showing locations where washout and erosion occurred along the waterways, debris flood marks providing an indication of locations flooded and identified other community assets and properties impacted within Winton. The information collected enabled the flood locations impacted (including impacted infrastructure and properties) to be compared to the flood model results.

### 6.2 Overview of the Winton Township Scoping Flood Study Survey

To obtain a better understanding of the recent floods, a flood survey and questionnaire was prepared by Stantec with Council's approval and sent to each household at Winton via AusPost. Over 400 surveys in total were sent out to the owners and residents of Winton.

The survey contained a series of questions which sought and obtained information relating to:

- Background information including contact information and preferences, property occupation history and residence/business status details;
- Historic flooding context and details of flood affects and impacts;
- Availability of historic flood information;
- Features of interest of relevance to flooding impacts;
- Flood management issues at Winton; and
- Actions to be considered to reduce flood impacts at Winton.

### 6.3 Responses to the Winton Township Scoping Flood Study Survey

Fourteen (14) responses were received, with eight (8) respondents confirming impacts from past flood events. With a population of 108 people (2016 Census data), this was considered a strong response rate and was consistent with the response rate of similar surveys undertaken at other locations.

A range of themes emerged from the consultation with the community of Winton. Detailed below in Table 6 are the details of the fourteen (14) responses received. Key themes to emerge from the survey responses included the identification of concerns associated with the condition, capacity and/or functioning of waterways and drainage assets and the management including maintenance of creeks, waterway and drainage assets.



Table 6 Community Flood Scoping Study Response Summary Table

ID	Street Address	Affected by flooding?	General description of flooding	Are there any physical features / works on your property or elsewhere at Winton which you consider exacerbate flooding?	What do you see as the main flood management issues at Winton?	What actions would you like to see considered for reducing the impacts of flooding at Winton?	Do you have any other flood related concerns you wish to bring to the attention of Council
1	541 Greta Rd, Glenrowan West	No	-	-	-	-	No
2	638 Wattle Creek Rd, Lurg VIC 3673	Yes	<ul style="list-style-type: none"> <li>- Minor building (e.g., garage, shed) flooded to above floor level</li> <li>- Grounds flooded in the front or rear yard</li> <li>- Flooded on the road outside my property</li> <li>- Property was isolated</li> </ul>	-	-	-	-
3	49 Winton-Lurg Rd, Winton	Yes	- Minor building (e.g., garage, shed) flooded to above floor level	Creek is windy overflows at banks. Creek full of debris. Rubbish washed down creek. Weeds from previous floods.	My property has been inundated multiple times over the years. Fences ripped out due to Creek water not flowing and going over the banks.	Better management of creek/banks improved deeper to allow better flow. Some way of preventing creek from flowing so slow allowing creek levels to rise over banks up to my house.	Why my property has been flooded & damaged at least 5 times in 11 years.



ID	Street Address	Affected by flooding?	General description of flooding	Are there any physical features / works on your property or elsewhere at Winton which you consider exacerbate flooding?	What do you see as the main flood management issues at Winton?	What actions would you like to see considered for reducing the impacts of flooding at Winton?	Do you have any other flood related concerns you wish to bring to the attention of Council
4	36 Eleven Mile Creek Rd, Glenrowan	No	Never experienced flooding in my property but have been affected by flooding in surrounding areas	Lack of maintenance in roadside gutters, build-up of debris on road shoulders which restrict flow of water	Drains & creeks can't cope with sudden downpours	Works to aid water to get away. Addition of drains & culverts to aid this	They need to TALK to the residents and take ACTION OUTSIDE the township of Benalla! Letters to the council get no action -they are referred to the relevant department but -(not) Benalla!
5	48 Fox St, Winton	Yes	- Grounds flooded in the front or rear yard - Minor building (e.g., garage, shed) flooded to above floor level - Flooded on the road outside my property	-	Seven Mile Creek Which Runs Behind Out Property Is Blocked with Debris	Clean And Clear Seven Mile Creek	No
6	88 Winton-Glenrowan Road Winton	Yes	Minor building (e.g., garage, shed) flooded to above floor level	The road is highest in front of our house - the creek is blocked upstream of our property - the bridge at fox street is too small - water flows over the road above the bridge	As I see it, there is no flood management - Goulburn Murray Water don't want to help remove the blockages in the creek.	Putting decent culverts in across the road so the roadside drains on the other side of the road actually flows water. Remove the trees upstream. Put an extra culvert at the bridge near Fox Street.	-



ID	Street Address	Affected by flooding?	General description of flooding	Are there any physical features / works on your property or elsewhere at Winton which you consider exacerbate flooding?	What do you see as the main flood management issues at Winton?	What actions would you like to see considered for reducing the impacts of flooding at Winton?	Do you have any other flood related concerns you wish to bring to the attention of Council
7	28 Wattle Creek Road, Winton	No	-	-	-	-	-
8	53 Coach Rd, Winton 3673	No	- Flooded on the road outside my property - Never experienced flooding in my property but have been affected by flooding in surrounding areas	-	YOU CAN'T CONTROL NATURE!!	-	Winton Township Needs A WATER SUPPLY
9	82 Winton-Lurg Rd Winton 3673	No	- Flooded on the road outside my property - Never experienced flooding in my property but have been affected by flooding in surrounding areas	-	Flooding (major) occurred at the intersection of Winton/Lurg Rd and the Glenrowan Rd	Better Roadside Drainage + Renewal of tree and grass Debris alongside Winton/Lurg Rd	Roadside Drains not maintained.
10	77 Winton-Glenrowan Rd, Winton	Yes	- Grounds flooded in the front or rear yard - Flooded on the road outside my property	Wire fence across the creek opposite Fox St catches debris & restricts water flow. Channels under Lurg Rd block & followed by the open drain down to	The only issue is that the rush of water down the creeks cannot get away fast enough.	Maybe do something with the wire fence, clear the open drain from Lurg Rd to Winton Creek	-





ID	Street Address	Affected by flooding?	General description of flooding	Are there any physical features / works on your property or elsewhere at Winton which you consider exacerbate flooding?	What do you see as the main flood management issues at Winton?	What actions would you like to see considered for reducing the impacts of flooding at Winton?	Do you have any other flood related concerns you wish to bring to the attention of Council
				Winton creek does not clear.			
11	9 Winton-Lurg Rd, Winton 3673	Yes	<ul style="list-style-type: none"> <li>- Grounds flooded in the front or rear yard</li> <li>- Minor building (e.g., garage, shed) flooded to above floor level</li> <li>Flooded on the road outside my property</li> </ul>	Insufficient drainage, water unable to escape down both sides of Winton-Lurg Road & Winton-Glenrowan Road. The water backs up at the inside corner of both of these roads	Lack of sufficient drainage from the creek running behind Winton as well as lack of sufficient drainage away from the corner of 2 roads mentioned above (Winton-Lurg Road and Winton-Glenrowan Road)	The excess water is unable to escape due to the height of Winton-Glenrowan Rd + the height of Winton-Lurg Road + there is insufficient drainage on the South side to North side of Winton-Glenrowan Rd.	There has been no attempt to clear drains or remove debris from previous floods from drains of waterways
12	14 Fox St Winton	Yes	<ul style="list-style-type: none"> <li>- Grounds flooded in the front or rear yard</li> <li>- Minor building (e.g., garage, shed) flooded to above floor level</li> <li>- Flooded on the road outside my property</li> <li>- Property was isolated</li> </ul>	The creek is full of young gum trees for approx. 30 metres from the Glenrowan Rd bridge going upstream. A large amount of debris gets caught in the trees	Better drainage and culverts on streets, keeping natural waterways clear.	-	The runoff of water from Fox St that goes through our property



ID	Street Address	Affected by flooding?	General description of flooding	Are there any physical features / works on your property or elsewhere at Winton which you consider exacerbate flooding?	What do you see as the main flood management issues at Winton?	What actions would you like to see considered for reducing the impacts of flooding at Winton?	Do you have any other flood related concerns you wish to bring to the attention of Council
13	128 Coach Road	No	- Never experienced flooding in my property but have been affected by flooding in surrounding areas	-	-	More culverts between Winton Creeks + Winton township over Winton Glenrowan Rd + Hume Fwy needs more culverts	-
14	19 Winton-Lurg Rd	Yes	<ul style="list-style-type: none"> <li>- Minor building (e.g., garage, shed) flooded to above the floor level. Noting that the main building doesn't flood because stumps were built up 200 ml in the building stages.</li> <li>- Grounds flooded in the front and rear yard.</li> <li>- Flooded on the road</li> </ul>	The road out of the front of our property is higher than our ground level. Currently flood waters level out when they go over the road. Flood waters still can't escape quick enough to the corner of the property and under the culvert despite the improvements.	The creek narrows and curves at the back of our property and it continues to catch debris (logistics) after heavy rain. Blockages of the creek are major cause of flooding in the past.	Upkeep and clearing of the waterways, under road drainage (larger culverts) and roadside water management. Continued clearing of the current culvert to Winter Creek.	Maintenance and improvements to culverts that run along Winton-Lurg Rd and Winton-Benalla Rd (Old Sydney Road).



ID	Street Address	Affected by flooding?	General description of flooding	Are there any physical features / works on your property or elsewhere at Winton which you consider exacerbate flooding?	What do you see as the main flood management issues at Winton?	What actions would you like to see considered for reducing the impacts of flooding at Winton?	Do you have any other flood related concerns you wish to bring to the attention of Council
			outside my property. Property was isolated				

## 6.4 Analysis of the responses to the Winton Township Scoping Flood Study Survey

The community responses were spatially analysed by comparing them against the estimated 1% AEP flood extent as shown in Figure 7. This comparison was undertaken as it was estimated that the January 2022 event was between 2% and 0.5% AEP as discussed in Section 5.4. As such, the flood event for January 2022 event should share some similarities and correlation with the estimated 1% AEP flood extent. It is noted that seven (7) of the responses are located within the modelled extent for Winton township. The key findings from this comparison are detailed below:

- Survey number 9 indicated their property was not affected by flooding but the road outside the property was flooded. This matches well with modelled results as the estimated 1% AEP flood extent reaches Winton-Lurg Road at this location.
- Survey number 13 indicated their property was also not affected by flooding but have been affected by flooding in surrounding areas. This is consistent with modelled results showing the property is outside but close to the estimated 1% AEP flood extent.
- Survey number 3, 6, 10, 11 and 12 indicated their properties experienced inundation of building with some of these being limited to a shed, outbuilding or garage. This is consistent with the modelled results suggesting that the residential area near Winton-Glenrowan and Winton-Lurg Road are at risk of flooding from Seven Mile Creek.
- Survey number 5 indicated their shed or garage was inundated as well as the road outside the property. It is noted that this location is outside the estimated 1% AEP flood extent due to the high topography. It is possible that the inundation of this property was caused by localised overland flooding.

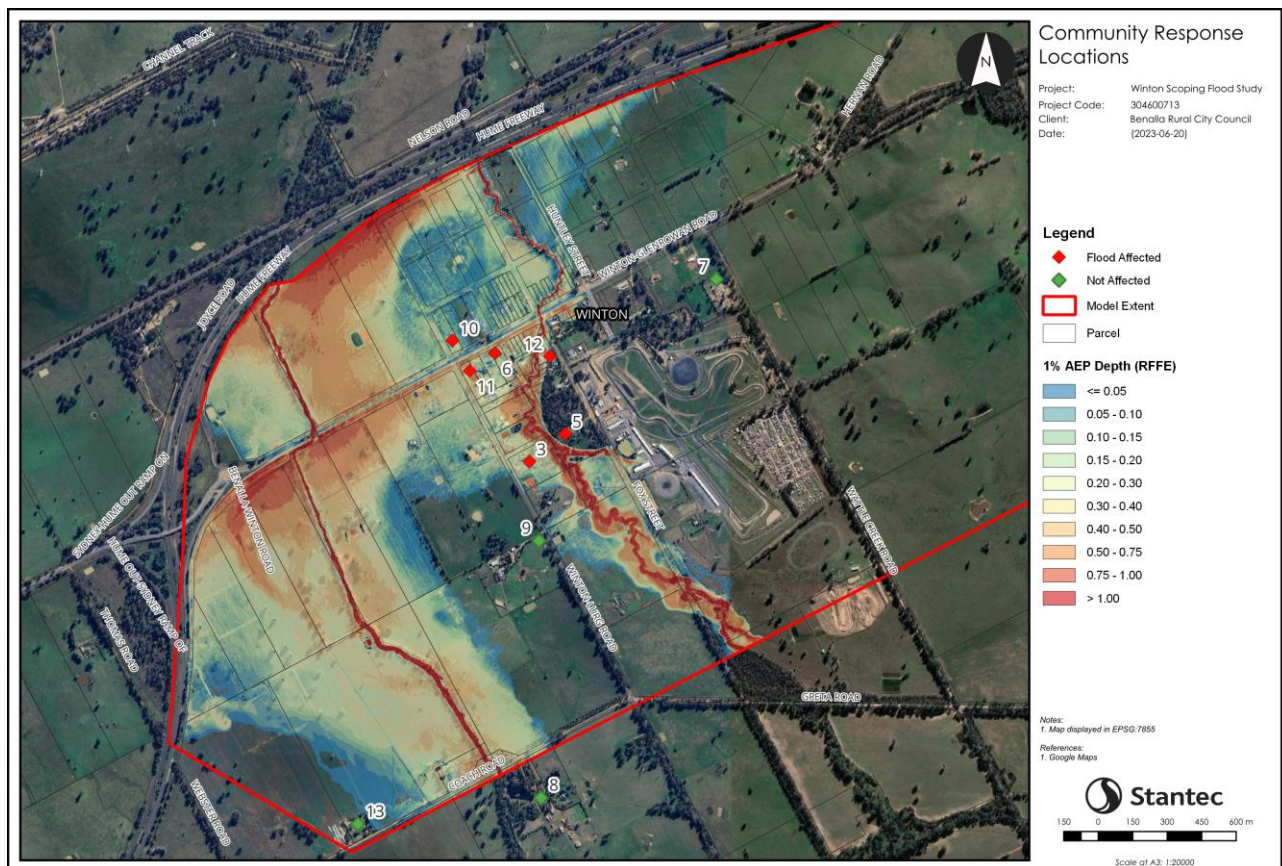


Figure 7 Community Response Locations



## 6.5 Other engagement with the community

Additional engagement occurred with the community and included:

- discussions with some survey respondents including via email communications and telephone calls;
- direct engagement with key stakeholders within the Winton community including the local CFA Captain; and
- site meetings with residents of Winton including one that occurred on 21<sup>st</sup> June.

From the further engagement directly with some of the survey respondents some additional contextual information was provided, additional information from historic flood events was obtained to inform the study including photographs from historic flood events and additional items of interest emerged from this follow up consultation. This included information from historic flood events including primarily the January 2022 flood event and some anecdotal information from other historic flood events such as the October 1993 flood event. These follow up consultations also provided insights into broader matters of concern to the Winton community that fall outside of the scope of this study, for example, items of concern associated with runoff from the Winton raceway.

Depicted below are some photos of the January 2022 flood event which were provided by the community to inform the study. These photos were taken the day after the peak of the flood event, noting that the peak of the flood event occurred overnight.



Figure 8 January 2022 flood (Winton-Glenrowan Rd/Winton-Lurg Rd intersection)



**Figure 9 January 2022 flood (South of Winton-Glenrowan Rd between Fox St and Winton-Lurg Rd intersections)**

The site meeting on 21<sup>st</sup> June 2023 undertaken with Council and two (2) long term residents of Winton assisted to validate and expand on some of the key items and themes which emerged from the survey responses. The key comments from the community members in attendance at this site meeting are summarised in Table 7 below:

**Table 7 Summary of Community feedback from 21<sup>st</sup> June 2023 site visit**

Location	Summary of Community Feedback
Intersection at Winton-Glenrowan Road and Fox Street	<ul style="list-style-type: none"> <li>The works to widen the road at this intersection to accommodate Raceday traffic to the Winton raceway have resulted in: <ul style="list-style-type: none"> <li>Changes to surface levels including raising of Fox Street (~250mm) level to Winton-Glenrowan Road, creating an embankment on Fox Street which acts as an impoundment for waters south of Winton-Glenrowan road;</li> <li>Reductions in hydraulic capacity with formerly 4 large culverts under Winton-Glenrowan Road at Fox Street replaced at the time with 3 smaller culverts; and</li> <li>Increased impacts from minor floods including the closing of Winton-Glenrowan Road.</li> </ul> </li> </ul> <p>*Periodic works to reseal the Winton-Glenrowan Road have raised the road and contributing to the impounding affect</p> <ul style="list-style-type: none"> <li>Issues with the functioning of other stormwater assets were raised including: <ul style="list-style-type: none"> <li>Silting and loss of hydraulic capacity at the small underground pipe under Fox Street at the Winton-Glenrowan and Fox Street intersection and for a small culvert under Winton-Glenrowan Road approximately 30m east of Fox Street</li> </ul> </li> </ul>
<b>Downstream of Winton Township</b>	<ul style="list-style-type: none"> <li>Concerns raised with the hydraulic capacity and 'choke points' in locations downstream of the Winton township were raised.</li> </ul>



## 7 Issues and Opportunities

### 7.1 Flood mechanisms and typical travel times

In Australia, flash floods are defined as those floods that occur within six (6) hours of the causative rainfall event (BoM, 2023). Due to the nature and size of the upstream catchments, the travel time associated with flooding affecting the Winton township is estimated to be less than 6 hours. Hence the Winton township is affected by flash flooding.

Whilst Winton is affected by flash flooding it is important to note that the Winton township can be caused by different flood mechanism including localised overland flows.

Described below are the two (2) key flood mechanisms of interest for the Winton township:

- **Flash Flooding:**

Water exceeding the channel capacity of Seven Mile Creek and Winton Creek and inundating the floodplain environments.

- **Overland Flooding:**

Extensive rainfall occurring on the surface that exceeds the capacity of the local drainage system.

It is common that both types of flood mechanisms can occur during a single event, however, they're likely to occur at different timing. Typically for the Winton township, the response time for flash flooding is approximately 2-3 hours but may be less than 0.5 hours for overland flooding.

Figure 7 shows the likely approximate extent for flash flooding for the 1% AEP event from Seven Mile Creek and Winton Creek. The results do not account for inundation caused by the local rainfall. However, of the two (2) flood mechanisms, flash flooding will produce the worst-case flood event as flooding associated with the flash flooding has a much larger catchment area. Additionally, compared to localised overland flooding, the locations at risk are more able to be defined for flash flooding affecting the Winton township.

### 7.2 Flood warning system

Winton has no flood warning system in place currently. Due to the localised nature and rapid onset, the observation of flash flooding events using the existing rainfall and river gauges is challenging as only one rainfall gauge (Lurg Fire Tower) is located within the Winton Creek catchment. As such, intense bursts of rainfall typically caused by severe storms and convective weather systems can often miss the rain gauge network, meaning that the most intense rainfall goes unrecorded.

Given the significantly limited gauge network and the limited typical travel times associated with flood events impacting the Winton township, it is considered not feasible to establish a formal BoM level of service and associated BoM flood warning system.

Further discussion of the issues and opportunities associated with the Total Flood Warning System (TFWS) concept are detailed below with details of what opportunities there are to overcome the issues associated with the constraints associated with the existing gauge network and limited typical travel times.

#### 7.2.1 Total Flood Warning System

Flood warning systems serve to coordinate the community to prepare for, and respond to, potential flood events. The TFWS concept has been developed to describe the full range of components that must be collaboratively developed by all responsible agencies, if flood warning services are to be provided effectively. There six components of the TFWS defined by the roles and responsibilities:

1. **Monitoring and Prediction:** detecting environmental conditions (rainfall) that lead to flooding and predicting river levels during the flood.
- Given the relatively small catchment sizes with 2-3 hours of response time, streamflow or water level gauges will not provide much benefit and the flood warnings for Winton will be more likely to rely on rainfall monitoring. However, there is only one rainfall gauge (Lurg Fire Tower) located within the catchment upstream of Winton. As observed from the January 2022 event that the



catchment was significantly impacted by spatial variation based on topographic characteristics, it is viewed that more rainfall gauges would be required to provide an enhanced rainfall monitoring network capability.

2. **Interpretation:** identifying in advance the impacts of the predicted flood levels on communities at risk.
  - It is possible to establish rainfall triggers to be set at thresholds at one or more gauging sites to then be converted into alert messages for responsible agencies and members of the community as a warning that flash flooding may be imminent. The best way to determine the most appropriate triggers to use would be through a detailed flood study of the area, and through inspection of historic data records. In the absence of a detailed flood study, initial rainfall thresholds can be set based on rainfall Intensity Frequency Duration (IFD) data. Rainfall thresholds may also be documented within a future update to the Rural City of Benalla Flood Emergency Plan.
  - An analysis of the IFD data at the Lurg Fire Tower rainfall gauge shown in Figure 6 can be used as a guidance tool that analyses the amount of rainfall against time to help work out the likely extent of flooding based on historical flood events. A detailed flood study can help determine more accurate flood extents and levels based on a known significance of rainfall. The catchment analysis undertaken by Stantec further advances the work undertaken by the GBCMA to assist in understanding and interpreting the impacts on the Winton township.
3. **Message Construction:** devising the content of the message which will warn people of impending flooding.
  - A warning is a message that informs the community of an impending or current threat and promotes appropriate response or actions. The following provides a summary of documents providing guidance on warning messaging and warning systems in general:
    - i. Public Information and Warnings Handbook (AIDR, 2018)
    - ii. Guideline 1: Warning Message Construction: Choosing your words (AIDR 2018)
    - iii. Guideline 2: Warnings Republishers (AIDR 2018)
    - iv. Australia's Emergency Warning Arrangements (Attorney-General's Department, 2013)
    - v. Australian Disaster Resilience Manual 21: Flood Warning (Attorney-General's Department, 2009)
    - vi. Australian Disaster Resilience Manual 4: Evacuation Planning (Attorney-General's Department, 2017)
    - vii. Australian Disaster Resilience Handbook 5: Communicating with People with a Disability: National Guidelines for Emergency Managers (Attorney-General's Department, 2013)
  - In fast responding flash flooding environments like Winton, it is necessary that pre-defined warning messages would need to be constructed beforehand because there will be insufficient time to design them once the rain event has begun. Predefined warning messages also need to be well understood and known by the community prior to a flood event that are underpinned by pre-determined thresholds. VICSES will not provide a flash flood warning until flash flooding is observed (it is reactive, not proactive).
4. **Communication:** disseminating warning information in a timely fashion to people and organisations likely to be affected by the flood.
  - A multi-modal approach to issue warnings maximises the likelihood that as many people as possible will receive and comprehend a warning. There are several modes well suited to flash flood warnings including Emergency Alert, Community Sirens, SMS, etc.
5. **Protective Behaviour:** generating appropriate and timely actions and behaviours from the agencies involved and from the threatened community.
  - A Local Flood Guide for Winton residents should be prepared by VICSES to outline the consequences of flooding and describes what residents should do, before, during and after flooding. This should be used as a guidance for flood education to the local community.





- Sandbagging is one of a key protective behaviour responding to flash flooding. The Natimuk Flood Warning System describes the approach for sandbagging for different types of houses below:

*In weatherboard homes it is most effective to place a sandbag in the toilet and over the plug hole in the bath and shower and in other sinks. This will stop the flow of flood water back up these systems. Brick houses can more effectively be sandbagged by also sandbagging doorways and weep holes.*

6. **Review:** examining the various aspects of the system with a view to improving its performance

- TFWS reviews are typically undertaken following a flood event or as part of a dedicated and detailed study. The assessment Stantec has undertaken as part of this study forms part of a high-level review to identify issues and opportunities, however, is undertaken in the context of there being no flood warning system is in place for Winton. Refer above for further details of our assessment and the recommendations of this study relating to the key opportunities.

#### **Natimuk Flash Flood Warning Case Study:**

The pilot flood warning systems being implemented for Natimuk (Natimuk Creek) was identified as a project of interest. Key differences identified as a comparison included the larger catchment size of Natimuk Creek resulting in a longer response time (7 hours) and the availability of a gauge monitoring network which consists of two rainfall gauges.

The “Natimuk Flood Guidance Tool” developed in the 2013 Natimuk Flood Study indicates what properties and dwellings are likely to experience flooding based on the amount of rain that falls over a certain time period. An IFD chart that maps the amount of rainfall against time is included in this document and this will help work out the likely extent of flooding. The tool also summarises the dwellings that are likely to experience over floor flooding with a range of flood event.

In addition, the flood warning for Natimuk highlights the importance of sandbagging for weatherboard and brick houses to reduce the damage caused by flood water.

Notwithstanding the significant limitations associated with the catchment characteristics and gauge monitoring network, a more detailed flood investigation would be required to inform a potential flash flood warning system for Winton.



### 7.3 Flood Planning Controls

Development and planning controls provide a key opportunity to manage flood risk which includes ensuring that the use and development of land considers and adopts approaches to limit future flood risk.

Flood controls typically come in the form of applying these via the introduction of new flood related development planning controls typically in the form of applying zones and overlays to land affected by flooding or via the building regulations.

Resource availability can be a barrier to the implementation of flood planning controls, however Land Use Planning and building controls offer low cost and effective non-structural flood mitigation option. Other factors that can help inform the efficacy of implementing flood planning and/or building controls include the plans for the future development of areas within and around the township of Winton.

To implement land use planning and/or building controls it would be prudent to undertake a further study to better understand and identify the flood risks with consideration for flood impacts and consequences ranging from property impacts to isolation risks, impacts associated with different flood probabilities and to develop an enhanced appreciation and understanding of the vulnerabilities of the area to flooding. However, as detailed in the Conclusions and Recommendations in section 8, it is recommended that interim flood planning controls are established. This is recommended on the basis that further consultation with the local community is undertaken prior to the implementation of interim flood planning controls.

The planning controls should be developed in accordance with the framework set out in the Victorian Planning Provisions (VPP) shown below in Figure 10.



Figure 10 The Legislative Context of Planning Schemes in Victoria (Warrnambool City Council, 2018)

### 7.4 Flood Education

Flood education offers opportunities to build community resilience, enhance awareness and assist to facilitate preparedness actions for future flood events. The National Strategy for Disaster Resilience recognises that "providing information and warnings is important but educating people how to act on their knowledge is equally important".

Webber and Dufty (2008) identified the following as the functions of flood education:

- **Preparedness conversion**  
Learning related to commencing and maintaining preparations for flooding such as knowing the impact from flood levels.
- **Mitigation behaviours**  
Learning and putting into practice the appropriate actions for before, during and after a flood such as sandbagging
- **Adaptive capability**



Learning how to change and maintain adaptive systems (e.g., warning systems) and build community competencies to help minimise the impacts of flooding.

- **Post-flood learnings**

Learning how to improve preparedness levels, mitigation behaviours and adaptive capability after a flood.

There is an opportunity to leverage the recent flood events that have impacted Winton including the January 2022 event to deliver a tailored and meaning flood education program. With the information from this study, there is an opportunity for a Local Flood Guide to be prepared in consultation with and for the Winton community. Ongoing engagement with key stakeholders with the local community is vital to the effectiveness of the flood education initiatives.

## 7.5 Structural Mitigation

Structural mitigation options entail targeted and planned physical works that will be undertaken to reduce the risk of flooding.

Handbook 7 of the Australian Disaster Resilience Handbook Collection (Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia) details management (structural and non-structural) options for existing risk and residual risks at a community at property scale. The structural options are summarised below:

- Permanent levees and associated works;
- Temporary barriers;
- Flood gates;
- Flood mitigation dams;
- Detention and retardation basins; and
- Improved flow conveyance (i.e., channel widening, bypass flow conveyance).

Community input and feedback from the community consultation process undertaken provided an opportunity for the community to raise suggestions regarding potential flood management options. One of these options includes enhancing the hydraulic capacity of the existing waterways and drainage system. This includes but is not limited to the suggestion to install high flow culverts under Winton-Lurg and Winton-Glenrowan Road.

Structural works to investigate options such as levee or temporary barrier systems or retarding basins within the upstream catchment are not in scope for this study.

A further study would be needed to identify and assess the cost-benefit of potential mitigation options.

For any detailed assessment of flood mitigation options, a detailed flood study would first be required to be undertaken. Following the identification of flood mitigation options from this study, these would need to be tested within the model to assess their effectiveness via a cost-benefit analysis using an Average Annual Damages (AAD) assessment to compare the flood damage costs between existing and developed conditions.



## 8 Conclusion and Recommendations

The Winton Scoping Flood Study was undertaken to provide a better understanding of flood risk for the Winton township and identify future issues and opportunities. With a known history of flooding across the Winton township, over 400 flood surveys and questionnaires were sent to each household at Winton to understand the flood related issues and concerns from the local community. The results were collected and analysed to inform the analysis of future opportunities and the final recommendations.

Rudimentary flood mapping across the Winton study area was undertaken with 1% AEP flow estimation using the RFFE method at the Winton and Seven Mile Creeks. The modelled results generally comply with community's description of past flood event. This mapping can be used as a high-level guide and helps inform the recommendations for some short-term actions to be implemented. Should some of the longer-term considerations be taken forward for implementation a more detailed flood study is required.

It was determined during the course of the project not to proceed with undertaking survey to inform the study. To provide a greater level of confidence in the flood mapping results and property flood risk information, targeted floor level survey could be undertaken in the future.

The recommendations based on the information assessed throughout this study are presented in Table 8.

**Table 8 Recommendation List**

No	Recommendation	Comments
<b>Short-medium term actions</b>		
2	Prepare a Local Flood Guide for Winton township	VICSES would be responsible for implementation this option including developing the Local Flood Guide and undertaking community education associated with its roll out.
3	Establish interim flood planning / development controls	To implement this option, resourcing the implementation of this option at Council and GBCMA would be critical. Funding may be required to implement this option.
<b>Longer Term Considerations</b>		
3	Undertake a detailed flood study in accordance with ARR2019 for accurate flood information to update the municipal flood emergency plan, identify flood mitigation options including flood planning controls	<p>To implement this option, its assumed funding would need to be secured to undertake the study and implement any subsequent mitigation options.</p> <p>Its only anticipated that this option would be considered further if the flood risk profile changes significantly within Winton from what it is today,</p>
4	Undertake a study to identify improvements to the rainfall and/or stream gauge monitoring network which may include consideration of 1 -2 additional rainfall gauges within upstream catchments and a more formal adoption of a flood warning system for the Winton township.	<p>To implement this option, its assumed funding would need to be secured to undertake the study, implement any subsequent options. Cost sharing arrangements and ongoing maintenance costs would need to be established for any new gauges.</p> <p>There may not be significant benefit to be achieved with regard to flood warning due to the flashy nature of flooding for the Winton catchment.</p>
5	Undertake a mitigation options study to the cost and benefit analysis of potential structural mitigation options	<p>To implement this option, its assumed funding would need to be secured to undertake the study and implement any subsequent mitigation options.</p> <p>It is assumed that one of the options could be to explore the option of increasing the hydraulic capacity of the creek running through Winton.</p>





## Potential future additional actions

6

Clear and remove debris that block the drains and waterways

It is noted that many of the survey respondents identified actions associated with removing debris from drains and waterways to reduce the impact of flooding at Winton. Whilst this is identified as a short-term action localised removal of in and around structures would be supported (subject to permit requirements)

Further consultation with the community may be necessary.

Likelihood that this would need to be formalised within a scheduled authority maintenance regime.

Based on the risk profile for Winton and our findings from this study it is recommended that Council and its partners should seek and/or obtain funding to implement the recommended short-medium term actions. Of the longer term considerations, it is recommended that Council give consideration for prioritising of the implementation of flood planning controls and the establishment of improvements to the rainfall and/or stream gauge monitoring network.



## 9 References

Australian Bureau of Statistics, *Winton (Vic.)* webpage, <https://www.abs.gov.au/census/find-census-data/quickstats/2016/SSC22800> accessed on 22<sup>nd</sup> June 2023.

Australian Disaster Resilience Handbook Collection, Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia <https://knowledge.aidr.org.au/media/3521/adr-handbook-7.pdf> accessed on 22<sup>nd</sup> June 2023.

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Benalla Rural City Council, *Flood & Storm* webpage <https://www.benalla.vic.gov.au/Your-Community/Fire-Flood-Emergency/Flood-Storm> accessed 22<sup>nd</sup> June 2023.

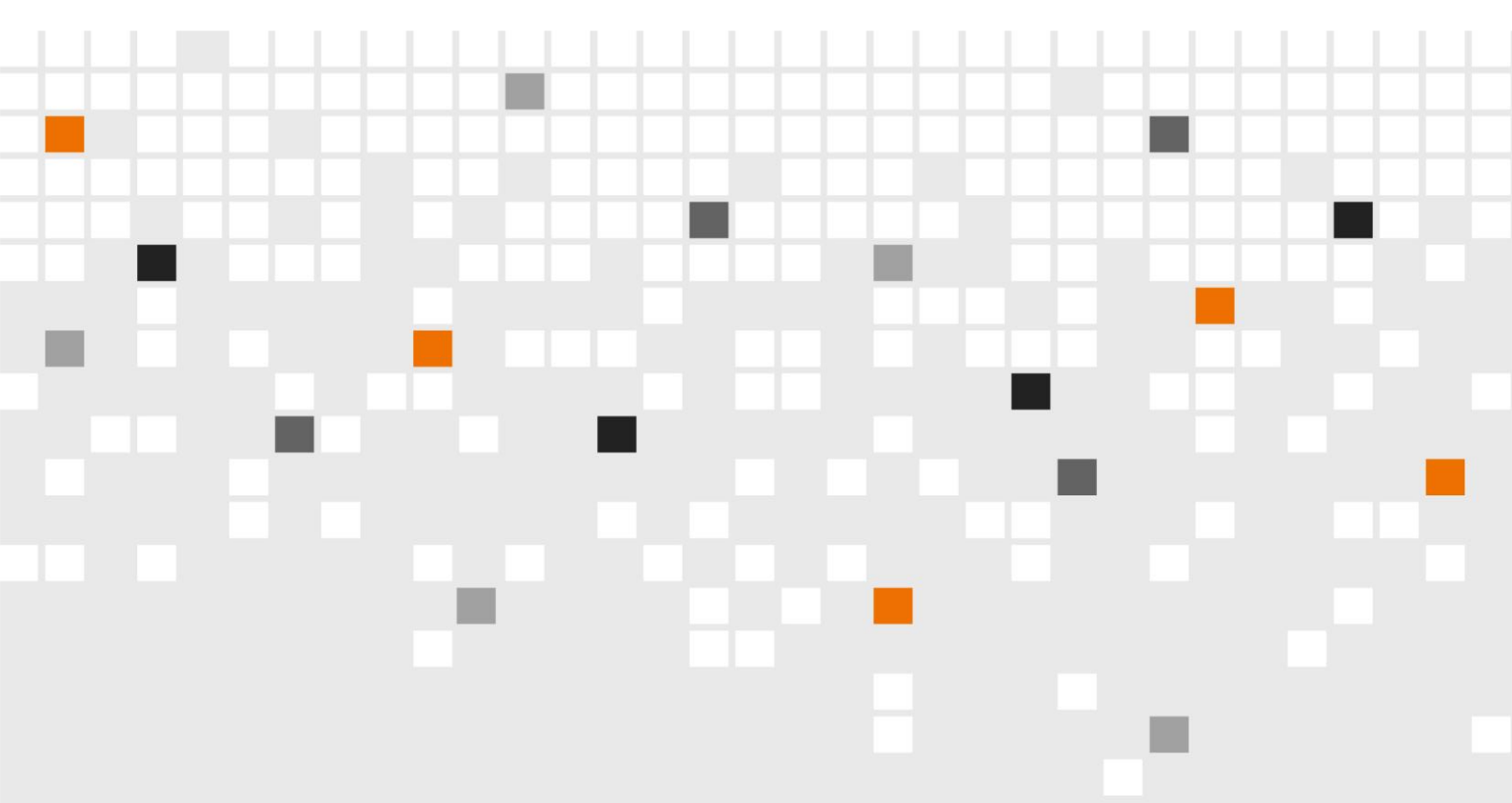
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DEWLP (2019). Guidelines for Development in Flood Affected Area <https://www.water.vic.gov.au/managing-floodplains/floodplain-management/land-use-planning> accessed 22<sup>nd</sup> June 2023.

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Webber D, Dufty N, (2008). A New Approach to Community Flood Education, Molino Stewart Pty Ltd, Parramatta.



# Appendix A: Flood Survey





## HAVE YOUR SAY IN THE Winton Township Scoping Flood Study Survey

The Winton Township Scoping Flood Study was identified as a key priority in the Goulburn Broken Regional Floodplain Management Strategy 2018-2028. The Study is seeking to collate any available information relating to flooding including photos, flood marks or other data from the local community and key organisations. The study will provide Council and GB CMA with a better understanding of flood risks for the

Winton township and help to inform what further work may be necessary to benefit land use planning and flood emergency planning, including flood information and flood warning considerations. Please complete the survey below and return in the supplied Reply Paid envelope to Stantec offices (address below). If you have further relevant information that can't be covered in the survey, please include this information separately.

Your contact details are optional and will only be used to contact you for more information for this study with your consent. **\*Could you please fill in your street address so we know the location of your flood observations.**

### 1. Your Details

Name:	
Street Address:*	
Telephone:	
Email:	

### 2. Can we contact you directly for more information?

<input type="checkbox"/> Yes, via telephone	<input type="checkbox"/> Yes, via email	<input type="checkbox"/> No
---------------------------------------------	-----------------------------------------	-----------------------------

### 3. How many years have you occupied this address?

<input type="checkbox"/> Years	<input type="checkbox"/> Months
--------------------------------	---------------------------------

### 4. Is this property a residence, business or other (e.g. school, church etc)

<input type="checkbox"/> Residence	<input type="checkbox"/> Business	<input type="text"/>	Other – please specify
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### 5. Has your property previously been affected by flooding?

<input type="checkbox"/> Yes	<input type="checkbox"/> No
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### 6. If your property has previously been affected by flooding, please indicate all that apply:

<input type="checkbox"/> Main building (e.g. house) flooded to above floor level	<input type="checkbox"/> Grounds flooded in the front or rear yard
<input type="checkbox"/> Minor building (e.g. garage, shed) flooded to above floor level	<input type="checkbox"/> Flooded on the road outside my property
<input type="checkbox"/> Never experienced flooding in my property but have been affected by flooding in surrounding areas	<input type="checkbox"/> Property was isolated

### 7. If the main building on your property was flooded to above floor level, please describe what details you can recall including the year of the flood, the depth of flooding above floor level (metres or inches) and the approximate duration of flooding (hours or days)

Year of flood	Depth above floor	Duration





## HAVE YOUR SAY IN THE Winton Township Scoping Flood Study Survey

8. Do you have any of the following information which you would be willing to make available for the study:

Reliable recorded or observed peak flow mark  
(e.g. this could be the maximum height that  
the flood reached on a wall, fence post, tree etc)

Photographs or videos of flooding at your  
property or elsewhere at Winton

☐ Yes

☐ No

☐ Yes

☐ No

If you answered yes to question 8, please provide flood information to the project team via Emergency Management Coordinator David Lawrence on (03) 5760 2638 or [david.lawrence@benalla.vic.gov.au](mailto:david.lawrence@benalla.vic.gov.au)

9. Are there any physical features / works on your property or elsewhere at Winton which you consider exacerbate flooding (e.g. raised roads, channel banks etc)?

☐ Yes

☐ No

Please provide a description of the features / reason for your response:

10. What do you see as the main flood management issues at Winton?

11. What actions would you like to see considered for reducing the impacts of flooding at Winton?

12. Do you have any other flood related concerns you wish to bring to the attention of Council (e.g. specific issues which you feel need investigating)?



# Appendix B: GIS Figures



