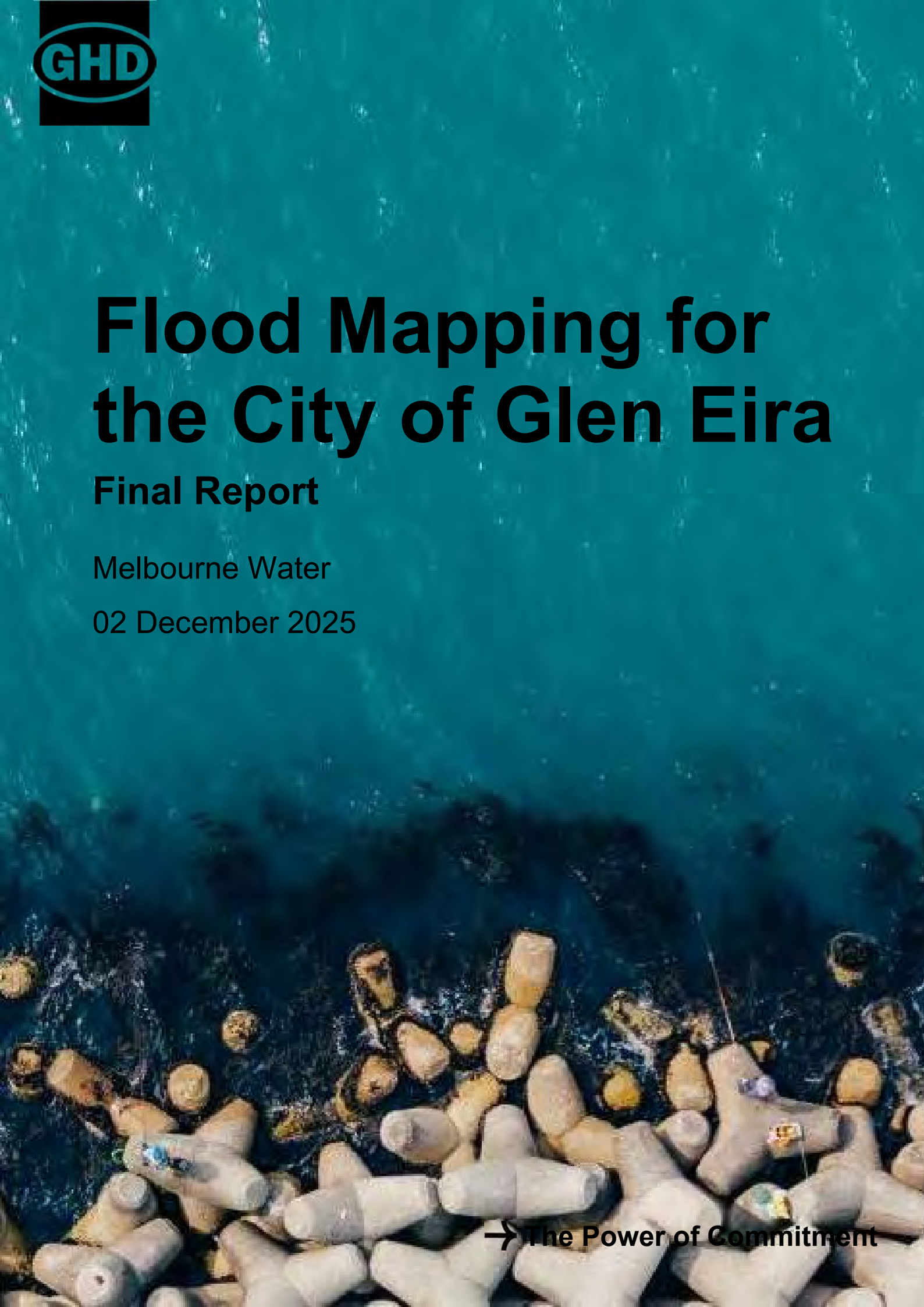
Flood Mapping for the City of Glen Eira

Final Report

Melbourne Water

02 December 2025



The Power of Commitment

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1. Introduction

1.1 Background and scope

GHD was appointed by Melbourne Water (MW) to update flood information for the Glen Eira City Council. This project provides an improved understanding of flood risk and technical information to support future decisions about planning, infrastructure, and emergency management.

In 2021, Melbourne Water, in conjunction with the Glen Eira City Council, prepared flood extents for incorporation into the Glen Eira Planning Scheme as Special Building Overlay (SBO), based on 1% AEP output from the following previous flood mapping projects:

– Murrumbeena Drain Post-Mitigation (GHD, 2020).
– Mordialloc Settlement Drain (GHD, 2013).
– Shakespeare Grove Main Drain (BMT WBM, 2012).
– Elwood Canal (GHD, 2011).

With a growing recognition of the need to consider climate change, current and future planning scheme flood information is to be based on Climate Change 1% AEP flood extents. For Glen Eira this meant increasing rainfall intensities by 18.5% and the consideration of sea level rise near the coast. Given that GHD had undertaken the previous flood modelling for Melbourne Water for the majority of the Glen Eira municipality, and in recognising that the most recent versions of these previous models used a mix of LiDAR (2008 and 2018), increased rainfall percentages (18.5% and 32%) and ARR methodologies (1987 and 2019), Melbourne Water engaged GHD to update and re-run these models to produce more consistent Climate Change 1% AEP flood extents.

While the initial scope was to take the most recent versions of the RORB and TUFLOW models for the above four catchments and upgrade them to adopt the most recent LiDAR (2018), increased rainfall intensities (18.5%) and ARR 2019 (ARR v4.1)[1] methodologies, the scope was subsequently expanded to incorporate Council drainage in the modelling and prepare 'Council' flood extents. As a result of including Council drainage, it was agreed with Melbourne Water to combine the previous Elwood Canal and Shakespeare Grove Main Drain TUFLOW models into a single model to avoid having to replicate Council drainage in the original separate models. Figure 1.1 shows the catchments modelled as part of this project.

The updated RORB and TUFLOW models underwent an independent peer review process by external consultants, in line with relevant Melbourne Water guidelines.

Following the immediate focus of preparing flood extents for the Climate Change 1% AEP event, the scope was expanded further to model and prepare the standard flood mapping output for the other flood events required by Melbourne Water.

The scenarios and events listed in Table 1.1 were modelled as part of this project.

Table 1.1 Scenarios and events modelled and mapped

Scenario	Impervious Fractions	Rainfall Intensities	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
A (Base Case)	Existing	ARR 2019	✓	✓	✓	✓	✓
C or D (Climate Change, with or without Sea Level Rise) *	Existing	ARR 2019 increased by 18.5%	✓	✓	×	×	✓

* only the combined Elwood Canal/Shakespeare Grove TUFLOW model allowed for Sea Level Rise as a result of climate change.

[1] In this document all references to ARR2019 refer to Australian Rainfall and Runoff 2019 as published in 2021. In 2024, this version (ARR 2019) is now retrospectively referred to as ARR version 4.1 to distinguish it from version 4.2 (which was released in August 2024 and incorporates significant changes to the climate change recommendations).

1.2 Purpose of this report

The purpose of this report is to document the methodology, underlying assumptions used, and results of the modelling of the existing Melbourne Water and Council drainage systems within the City of Glen Eira. Reference should also be made to the previous four modelling reports (listed below) for further information regarding some underlying assumptions:

– Murrumbeena Drain Post-Mitigation Flood Mapping Final Report (GHD, 2020).
– Mordialloc Settlement Drain Flood Mapping Final Report (GHD, 2013).
– Flood Mapping for Shakespeare Grove Main Drain & Byron Street Main Drain Final Report (BMT WBM, 2012).
– Elwood Canal ARR2016 Flood Mapping Update Final Report (GHD, 2019).

1.3 Limitations

This report has been prepared by GHD for Melbourne Water and may only be used and relied on by Melbourne Water for the purpose agreed between GHD and Melbourne Water as set out in Section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Melbourne Water arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the adopted scope of this project was prepared.

Once issued, this Report and associated modelling files are no longer subject to GHD's control and may include changes made by others. GHD accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon this model, or derivations of this model, by any third party. GHD accepts no liability or responsibility whatsoever for, or in respect of, any modifications, interpretation, or inappropriate application of this modelling by our client(s) or their delegates where this work is not under GHD's direction.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report and the associated modelling on the basis of information provided by Melbourne Water, as well as new data and methodologies obtained or derived from ARR 2019, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report, which were caused by errors or omissions in that information even when the information or guidelines may have been subsequently updated. It is anticipated that some (and potentially all) of the provided information will become outdated over time due to changes to development, technology, climate, knowledge and public expectations. This may occur prior to completion of the current flood mapping project. This characteristic provides much of the justification of the need for the modelling and mapping information to be updated at regular intervals.

Any use of the provided modelling results to inform the prioritisation of mitigation works should consider that the assessed catchment conditions include some allowance for anticipated future development. This potential bias towards future conditions may be more significant in areas where there are larger differences between current development and future development as anticipated by the current planning scheme zones.

There is a growing opinion that the current IFD information as obtained from the Bureau of Meteorology (BoM) website for use on this project, being derived from historic information, may not reflect more recent changes to climate and consequently may underestimate current flooding conditions including the frequency of flooding.

The precision (number of significant figures) of results and parameters documented in this report should not be taken as an indication of their accuracy (level of uncertainty).

Flood modelling is a simplification of relatively complex real-world processes, consequently the use of modelling results requires skilled interpretation with an understanding of the relevant assumptions and limitations. This modelling is not calibrated to historic events due to an absence of suitable data and relies on generally accepted approaches, guidelines, and regional data available at the time it was prepared. The adopted design floods are an estimate of an average flood for a range of annual exceedance probabilities for estimates of either current[2] or future climate and catchment conditions. The primary purpose of the modelling is to support the development of revised flood mapping to inform future planning scheme updates. As currently implemented, the planning scheme requires a single flood extent and is consequently unable to consider the various combinations and variations that may occur despite the foreseeable nature of many different future scenarios. There are many reasons why the behaviour of actual flood events may be different to the modelled design events, and floods larger (longer, more frequent or higher) than those modelled and documented are possible.

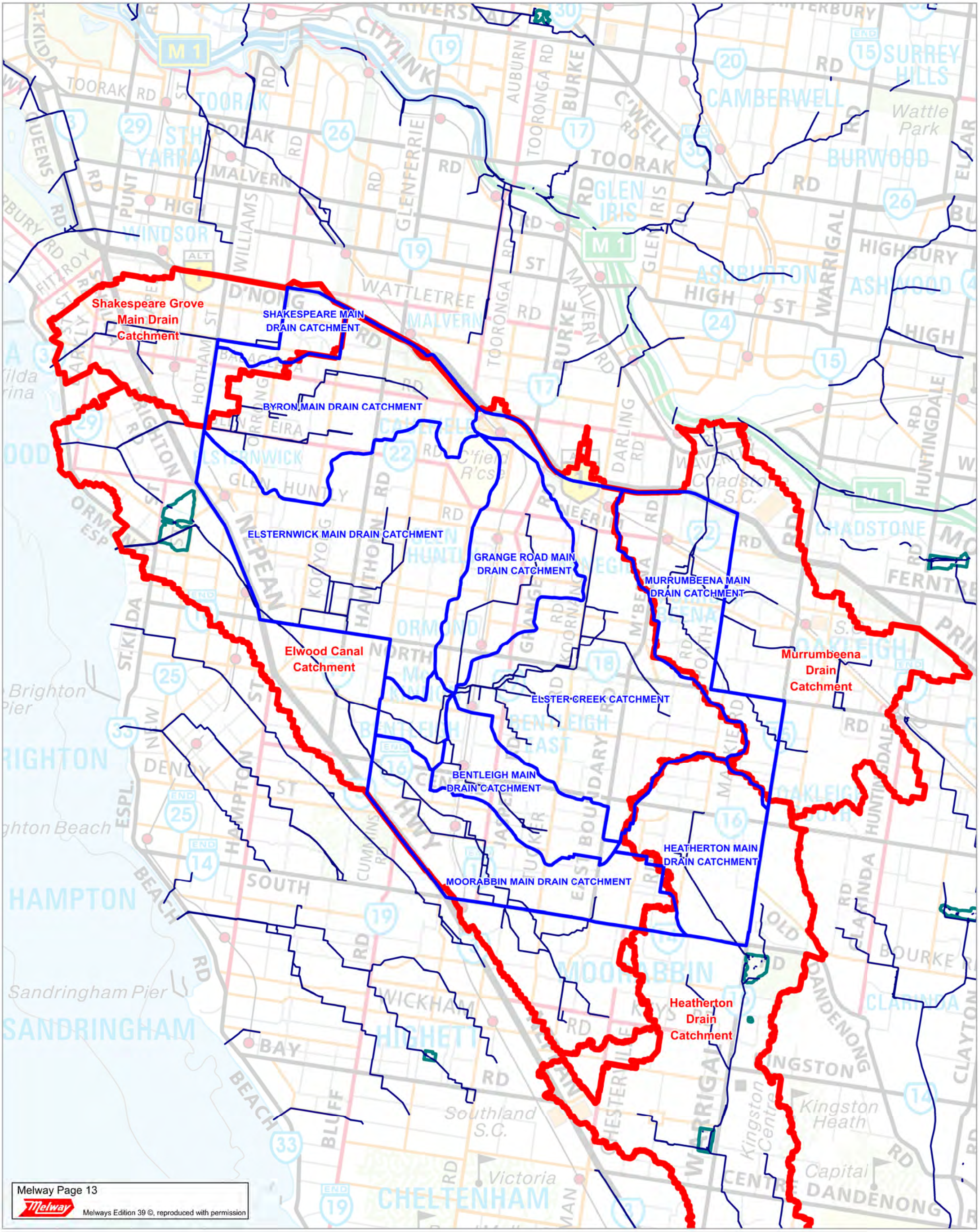
1.4 Available information

In addition to the information already held by GHD as part of the previous Elwood Canal, Murrumbeena Drain and Mordialloc Settlement Drain mapping projects, Melbourne Water provided the information listed in Table 1.2 below for use on this project.

Table 1.2 Additional data sets and use

Data Set	Date Received	Data Source	How Used
Shakespeare Grove report and RORB & TUFLOW models	21/9/2021	MWC	TUFLOW model elements adopted
2018 LiDAR tiles (flown in 2017)	16/12/2021	MWC	TUFLOW 2D domain
Glen Eira XPSWMM models	20/1/2022	MWC	Pipe & pit data adopted as 1d_nwke layers
Council pipes & pits layers	24/1/2022	MWC	Used as 1d_nwke layers outside of Glen Eira, and to supplement/confirm some Glen Eira pipes
GIS layers of Parcels and Building Footprints	26/4/2022	MWC	To define Parcels and Buildings flooded

[2] Current conditions are based on readily available data at the time of the analysis, it assumes that the system is properly maintained and blockage free. Design rainfall data obtained from the BoM and ARR is based on historic data and may not reflect recent changes in climate.



LEGEND

GECC Catchments
RORB Catchments
Melbourne Water Drains
Melbourne Water Retarding Basins

Scale 1:45,000 at A3

0 450 900 1350 1800

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME

GLEN EIRA CATCHMENTS AND MODEL CATCHMENTS

Project No. **12563171**
Revision No. **0**
Date **15/06/2023**

FIGURE 1

Data source: Melbourne Water drainage 2022; Glen Eira City Council Catchments, 2023. GHD, RORB Layers. 2022. Created by:

2. Modelling approach

2.1 General model changes

To provide a consistent set of flood mapping outputs across the Glen Eira municipality, the existing Shakespeare Grove Main Drain, Elwood Canal, Murrumbeena Drain and Heatherton Drain RORB and TUFLOW models were revised to utilise ARR 2019 data and techniques, 18.5% increase in rainfall intensities to represent Climate Change, and the latest LiDAR (flown in November 2017). These revisions included the application of different surface types and loss values in RORB and new 2D domains for the TUFLOW models.

In order to incorporate Council drainage into the existing TUFLOW models, a more significant revision of the RORB models was required, where the subarea delineation and reach networks were significantly adjusted to enable a more representative estimation and application of inflow hydrographs across the Council drainage areas. The coverage of the TUFLOW models (i.e. Code boundaries) required extending to cover the Council drainage systems, with new materials polygons, ridge lines and PO lines required in the 'extended' areas.

2.2 Key assumptions

While the existing RORB and TUFLOW models were modified as discussed above, some key underlying assumptions and aspects of the previous models remain unaltered. These included:

– The underlying default impervious fractions values used to determine subarea-weighted values.
– The k_c/d_{av} ratios of the previous RORB models.
– The adoption of previous areal reduction factors (ARFs) or point storms.
– The material polygons within the previous Code boundaries and allocation of Manning's n values to each material number.
– The representation and 1D network attributes of the Melbourne Water drains.

Details of the previous modelling and model input data can be found in in the previous flood mapping reports (as listed in Section 1.2). The following sections focus on the changes made to the models for the purposes of this project.

3. RORB modelling

3.1 Network changes

With the inclusion of Council drainage in the modelling, the subarea delineation of each RORB model was revised to better follow the Council drainage networks and enable a more appropriate determination and application of inflow hydrographs. This approach generally resulted in smaller subareas and around four to five times more subareas than the previous models. The reach networks were revised accordingly. MiRORB was used to create the revised catchment files while calculating new subarea-weighted 'total' impervious fractions and reach slopes from the new LiDAR. Hydrographs were printed for each subarea rather than just at the Melbourne Water drains.

Where some Council drains 'divert' flow between the modelled catchments, such areas and drainage were included in both adjoining TUFLOW models so that these flow splits could be appropriately represented without the need for transferring flows between models. Consequently, the subareas to such drains were replicated in the adjoining RORB models.

Plans showing the layout of each RORB model are included in Appendix A.

3.2 Surface types and loss values

ARR 2019 Data Hub and IFD information was obtained for each RORB model. Based on the 'total' impervious fractions of each subarea and the guidance in ARR 2019, portions of the following surface types were determined for each subarea:

– Effective Impervious Areas (EIA).
– Indirectly Connected Areas (ICA).
– Pervious Areas (PA).

ARR 2019 recommends that different initial loss and continuing loss values are applied to the different surface types. GHD has developed a method of applying the appropriate loss values explicitly to each surface type (without the need for calculating 'weighted' loss values), while also accounting for different responses of each surface type through the use of different reach types for the same subarea. This GHD approach to RORB and the derivation of the different surface types is detailed in Appendix A.

ARR 2019 recommends the use of pre-burst depths when using the temporal patterns obtained from the Data Hub. Median pre-burst depths have been adopted for these catchments as they all fall within 'Loss Region 2', as shown in Figure 3.1.

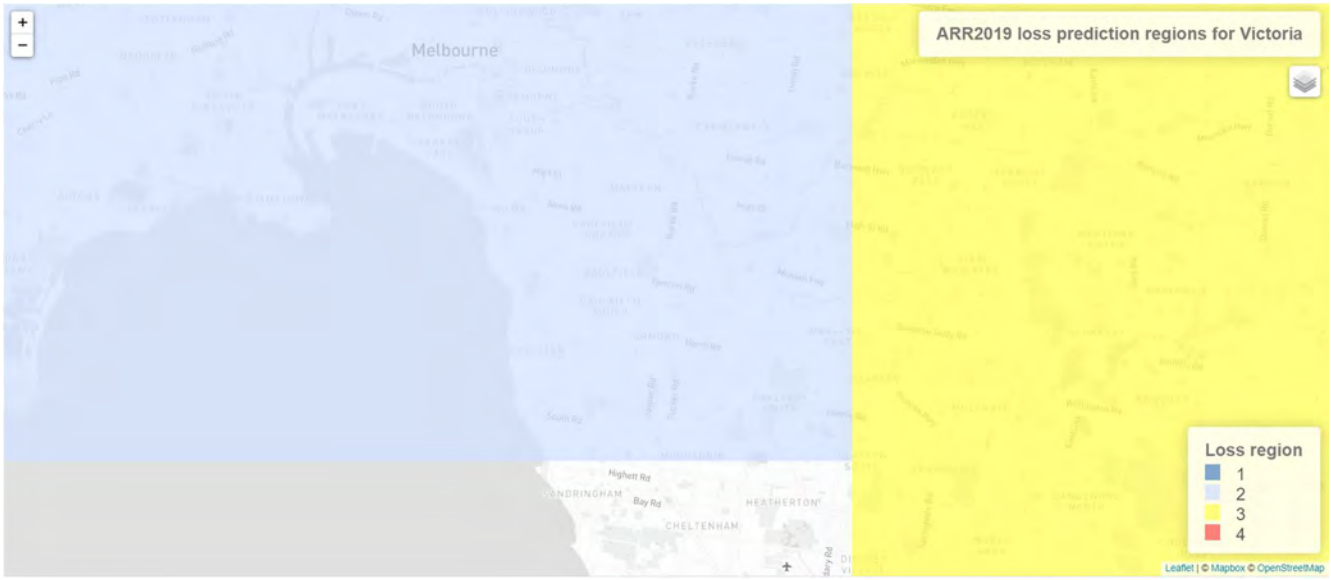


Figure 3.1 ***Loss regions for pre-burst depth application (image from http://www.arrlossregionmap.com.s3-website-ap-southeast-2.amazonaws.com/)***

3.3 Heatherton Drain specifics

The previous Heatherton Drain RORB model was one of five RORB models developed for the Mordialloc Settlement Drain Flood Mapping project (GHD, 2013). For this current project, only the uppermost parts of the Heatherton Drain RORB model (i.e. the tributaries generally upstream of Karkarook Park) were revised to account for Council drainage, although the entire Heatherton Drain RORB model was still run. The revised subareas are all prefixed with a "H" to distinguish them from the remainder of the unchanged subareas.

3.4 Elwood Canal specifics

The Byron Street Main Drain is a tributary of Elwood Canal but was included in both the previous Elwood Canal and Shakespeare Grove Main Drain flood mapping projects. The Byron Street Main Drain catchment was modelled by BMT WBM in its own RORB model. However, given it is a tributary of Elwood Canal, it has always been incorporated as part of GHD's Elwood Canal RORB modelling, and for this reason it remains in the Elwood Canal RORB model for this project.

As per the previous Elwood Canal RORB modelling, the subarea covering Caulfield Racecourse has been omitted from the RORB model based on the assumption that the racecourse would be operating a stormwater harvesting system and would attempt to retain all stormwater for track watering purposes.

3.5 Shakespeare Grove Main Drain specifics

The Shakespeare Grove Main Drain catchment remains in its own RORB model, which enables the adoption of BMT WBM's previous k_c/d_{av} ratio. Hydrographs from the Shakespeare Grove Main Drain RORB model are used as inflows to that part of the combined Elwood Canal/Shakespeare Grove TUFLOW model.

3.6 Running RORB

Version 6.45 of RORBwin includes the ability to directly read in losses, areal reduction factor equations and temporal patterns provided from the ARR Data Hub and IFD data from the BoM website. It also has the ability to vary initial loss values for each storm duration (if trying to model 'burst' initial losses) and represent the different surface types and different loss values for each surface type. However, it currently does not vary initial loss values across both duration and AEP or accurately model the different initial responses from each surface type (instead it determines an average initial loss value for each subarea). To improve the catchment response using RORB, GHD has developed a method whereby each subarea is 'split' into its relevant surface types, thus enabling the different loss values for each surface type to be explicitly applied (see discussion in Appendix A). The 'split' catchment files were then run in RORBwin, with pre-burst depths added to the design storms and k_c values based on the k_c/d_{av} ratios of the previous models (as indicated in Table 3.1).

Further details and the loss values adopted for each catchment are provided in Appendix A.

Table 3.1 Model k_c and d_{av} values

Catchment	Previous k_c	Previous d_{av}	New d_{av}	New k_c
Heatherton Drain	11	6.62 km	6.61 km	10.98
Murrumbeena Drain	5.75	4.11 km	3.8 km	5.32
Elwood Canal	17.65	7.51 km	7.44 km	17.49
Shakespeare Grove Main Drain	4.84	2.48 km	2.21 km	4.31

Internal quality assurance checks were carried out, the RORB model results were independently peer reviewed, and the modelling accepted by Melbourne Water.

4. TUFLOW modelling

4.1 Introduction

Hydraulic modelling was undertaken using TUFLOW version 2020-10-AD-iDP-w64. TUFLOW's HPC engine was adopted to produce the mapping output for this project, as agreed with Melbourne Water. In addition, TUFLOW's sub grid sampling (SGS) routines have been enabled, which provide improved definition of terrain features and 2D conveyance and storage calculations.

Adopting TUFLOW HPC for the project allows all ensemble storms to be run relatively quickly given sufficient high end computing hardware, which in turn allows the use of standard TUFLOW utilities to determine the median flood result for each storm duration, then the maximum of those median results for an AEP on every model cell. This calculation intensive approach removes potential ambiguity around whether or not the results in a particular location come from the correct storm. It also enables the median (or 'representative') flood surface to be produced in a consistent and repeatable manner using standard tools subject to the availability of sufficient computational resources. The selection of representative results from the hydraulic model (rather than from the hydrologic model) is typically preferred when the area being mapped is relatively large and represents a significant proportion of the contributing catchment.

Plans showing the layout of each TUFLOW model are included in Appendix B.

4.2 General model changes

4.2.1 2D Domain

4.2.1.1 Terrain

The 2D domain of each TUFLOW model was updated to represent the latest LiDAR (flown in November 2017). The locations and elevations of previous 'ridge' lines were reviewed and new ridge lines created in areas where the models were 'extended' to cover the Council drainage. Previous 'gully' lines were also reviewed but no new gully lines were necessary. These adjustments considered the influence of adopting HPC with SGS on the representation of terrain features.

4.2.1.2 Roughness

The materials polygons and definitions of Manning's n values of the previous models were adopted without revision, as agreed with Melbourne Water. New materials polygons were created in areas where the models were 'extended' to cover the Council drainage, based on property boundaries and aerial photography, and with materials numbers allocated in a manner consistent with the previous models.

4.2.2 1D Network

4.2.2.1 Melbourne Water pipes

The representation of the Melbourne Water pipes in the 1D network layers of the previous models, both spatially and in terms of attributed data, was generally adopted. The only changes made included the splitting of some Melbourne Water pipes to enable connections with the Council pipes. This splitting typically required lengths, invert levels and loss values to be adjusted accordingly.

4.2.2.2 Glen Eira Council pipes

Glen Eira Council pipe details were extracted from the six provided XPSWMM models. Link details such as conduit shapes, lengths, roughness, upstream and downstream invert levels, diameters, bottom widths and number of barrels were exported to GIS layers, which in turn were converted to TUFLOW 1D network layers. These details were generally adopted, except where cover and invert issues were identified by the QA tool. Some sections of pipe in the Heatherton Drain model were found to be around 8 m lower than the adjoining upstream and downstream invert levels. In these instances, the adjoining upstream and downstream pipe inverts matched the inverts in the "DR_Council_pipe" layer provided by Melbourne Water so were assumed to be correct. The inverts of the sections of pipe that were significantly lower than expected were then raised accordingly.

4.2.2.3 Glen Eira Council pits

Glen Eira Council pit details were extracted from the six provided XPSWMM models. Node details such as invert levels and 'ponding type' (which identifies if a pit is connected to the 2D domain) were exported to GIS layers, which in turn were converted to TUFLOW 1D network layers. Where the 'ponding type' indicated a connection to the surface (most of the pits), these were modelled as 3 m wide 'W' pits to be consistent with the pit representation of the previous models.

4.2.2.4 Other Council pipes

1D network layers of other Council pipes were created based on the "DR_Council_pipe" layer provided by Melbourne Water. Where sizes were available, these were adopted. Where sizes were unavailable, these were estimated based on adjoining pipe sizes or a 300 mm diameter otherwise. With the vast majority of invert levels missing, all other Council pipes were regraded from points of known invert levels (typically at the Melbourne Water system) while maintaining appropriate cover and ensuring all pipes graded in the correct direction. Further adjustments were made to address issues identified by the QA tool.

4.2.2.5 Other Council pits

1D network layers of other Council pits were created based on the "DR_Council_pit" layer provided by Melbourne Water. Given that the vast majority of Glen Eira Council pits were previously modelled as connections to the surface in the XPSWMM models, all other Council pits were modelled as 3 m wide 'W' pits to be consistent with the pit representation of the previous TUFLOW models.

4.2.2.6 Losses

To maintain consistency with the previous modelling, form loss coefficients were estimated throughout the pipe network based on standard pit loss tables (Melbourne Water, 2022). Pit loss coefficients were assigned to the downstream pipe as a 'form loss', rather than in the pits themselves. For Melbourne Water pipes, these were adopted from the previous models. While the loss coefficients are generally conservative, no allowance has been made for blockage of the network. In order to apply this method of form loss application, the command "Manholes at All Culvert Junctions == OFF" was added to the model ECF file. By adding this command, TUFLOW's default approach of applying Engelund loss values to automatically create manholes is deactivated.

4.2.3 Boundary conditions

4.2.3.1 Inflows

Given that the RORB model networks have been revised as part of this project to accommodate the modelling of Council drainage, the inflow polygons in the TUFLOW models have also been revised accordingly. Inflows to the piped parts of the drainage systems have been applied via either 1d_bc polygons (which apply flows to the bottom of all pits/nodes within a polygon) or 2d_sa polygons (which apply flow to the tops of all pits within a polygon when the "Read SA PITS" command is used). Some inflows have been applied directly on to the surface via 2d_sa polygons.

The careful selection of where and how inflow hydrographs are applied in TUFLOW, in conjunction with the definition of the RORB network and locations of hydrograph printouts, reduces the potential of distorting the flow distribution and/or double counting attenuation and routing effects.

4.2.3.2 2D initial water levels

A set of initial water level points was also applied to the 2D domain of each model in order to prefill minor undrained depressions. Such minor land-locked depressions are prefilled to remove storage from the model that has already been implicitly accounted for in the RORB rainfall loss model. Flood flows which reach these initial 'puddles' are able to traverse the prefilled geometry rather than being at least partially lost in an undrained depression. Initial 'puddles' not touched during a flood event are removed from the final results.

4.3 Heatherton Drain specifics

4.3.1 Model coverage

The previous TUFLOW model from the Mordialloc Settlement Drain Flood Mapping project covered three parallel Melbourne Water catchments to enable a hydraulic representation of cross catchment flows towards the southern end of the model near Mordialloc Creek. Given that the parts of the previous model located within the City of Glen Eira are at the upper most part of the Heatherton Drain catchment and well away from those cross catchment flows, the previous model has been cut down to remove parts of the model not required for the results within Glen Eira, which significantly speeds up model run times. Based on the previous Climate Change 1% AEP modelling results, the model has been cut at Fairchild Street, which is immediately downstream of Karkarook Park (South Road Retarding Basin) and a location of no flooding in that event. This location provides a model boundary downstream of a significant storage and well downstream of the Glen Eira municipal boundary.

The inclusion of Council drainage in the model results in some Council pipes taking flow out of the 'catchment', while some bring flow into the 'catchment'. The TUFLOW model has been extended to cover both of these situations, with additional inflow and downstream outflow boundaries included accordingly.

4.3.2 Downstream Boundaries

Several 2D boundaries are applied around the model boundary to allow overland flows to spill into the neighbouring Elwood Canal and Mordialloc Settlement Drain catchments and other tributaries of the Heatherton Drain catchment. These were setup as "HQ" boundaries, with slopes based on the general ground surface at each location.

There are also several pipe systems included in the model that 'divert' flow into those neighbouring catchments. The TUFLOW model representation of each of these systems extend far enough downstream that the required results (for the climate change 1% AEP event within Glen Eira) are insensitive to the adopted tailwater levels. The downstream boundary conditions on each of these systems were modelled as "HT" boundaries in a 1d_bc layer, with fixed tailwater levels set to the respective ground levels. These levels are listed in Table 4.1 below and also form part of the bc_dbase file (refer to Figure B.1 in Appendix B for locations). Being significantly downstream of the area of interest, the main pipe outlet of the model at Fairchild Street was modelled as a "HT" boundary set to the pipe obvert level. The pipe obvert level was adopted at this location, instead of the ground level, as there was no flooding evident in Fairchild Street from previous mapping.

Table 4.1 Heatherton Drain model 1D fixed tailwater levels on pipe outlets

Name	Level (m AHD)	Location
Fairchild	38.27	Melbourne Water pipe obvert level at Fairchild Street (south of Karkarook Park)
Centre	58.02	Centre Road at Jack Road (in the Mordialloc Settlement Drain catchment)
Bypass	46	Approx pipe obvert level at outlet adjacent to Dingle Bypass at Old Dandenong Road
King1	37.67	In industrial properties near Joel Court (Heatherton Drain catchment)
Bignell	36.84	Bignell Road north of Winston Court (Heatherton Drain catchment)
Nellbern	36.78	Nellbern Road west of Bignell Road (Heatherton Drain catchment)
Gardiners	48	Gardiners Road near Monash Medical Centre (Elwood Canal catchment)

4.3.3 Initial water levels

Instead of applying a global initial water level throughout the entire model, initial water levels were applied in specific locations as dictated by physical conditions. Apart from the 2d_iwl points used to prefill land-locked depressions, other locations include the Karkarook Park lake and wetlands and all 1D network pipe outlets. The fixed tailwater levels listed in Table 4.1 were also applied back along the respective pipe systems as initial water levels to avoid water from rushing back up empty pipes at the start of a simulation.

4.4 Murrumbeena Drain specifics

4.4.1 Model coverage

The inclusion of Council drainage in the model results in some Council pipes taking flow out of the 'catchment', while some bring flow into the 'catchment'. The TUFLOW model has been extended to cover both of these situations, with additional inflow and downstream outflow boundaries included accordingly.

4.4.2 Downstream Boundaries

Several 2D boundaries are applied around the model boundary to allow overland flows to spill into the neighbouring Elwood Canal, Heatherton Drain, Mordialloc Settlement Drain, and other neighbouring catchments. These were set up as "HQ" boundaries, with slopes based on the general ground surface at each location.

There are also several pipe systems included in the model that 'divert' flow into those neighbouring catchments. The TUFLOW model representation of each of these systems extend far enough downstream that the required results (for the climate change 1% AEP event within Glen Eira) are insensitive to the adopted tailwater levels. The downstream boundary conditions on each of these systems were modelled as "HT" boundaries in a 1d_bc layer, with fixed tailwater levels set to the respective ground levels. These levels are listed in Table 4.2 below and also form part of the bc_dbase file (refer to Figure B.2 and Figure B.3 in Appendix B for locations).

Other 1D and 2D boundaries along and near Gardiners Creek were maintained from the previous modelling ("HT" boundaries with fixed levels).

Table 4.2 Murrumbeena Drain Model 1D fixed tailwater levels on pipe outlets

Name	Level (m AHD)	Location
Woolai	53.89	Woolai Avenue (in the Heatherton Drain Catchment)
Tranmere	44.75	Tranmere Avenue at McLaurin Road (in the Elwood Canal Catchment)
Neerim	45.25	Neerim Road near Belsize Avenue (Elwood Canal Catchment)
Waverley	33.25	Waverley Road at Ivanhoe Grove (Scotchmans Creek catchment)
Carwell	57.75	Properties between Carwell Court and Farm Road (Mordialloc Settlement Drain catchment)
Farm	57.5	Farm Road south of Riley Street (Mordialloc Settlement Drain catchment)
Huntingdale	65	Huntingdale Road at Railway Avenue (Mordialloc Settlement Drain catchment)
Fenton	75	Fenton Street at Beauford Street (Mordialloc Settlement Drain catchment)
Connell	70.5	Connell Road at Atherton Road (Scotchmans Creek catchment).
North	65	In North Road near Haughton Road and in Clarendon Avenue near Haughton Road (Mordialloc Settlement Drain catchment)
Waverley_W	33.25	Waverley Road west of Sutherland Street (East Malvern Drain catchment)

4.4.3 Initial water levels

Apart from the 2d_iwl points used to prefill land-locked depressions, the previously modelled global initial water levels relating to the Gardiners Creek boundaries and 2d_iwl polygons were adopted. The fixed tailwater levels listed in Table 4.2 were also applied back along the respective pipe systems as initial water levels to avoid water from rushing back up empty pipes at the start of a simulation.

4.5 Elwood Canal specifics

4.5.1 Model coverage

As a result of including Council drainage, it was agreed with Melbourne Water to combine the previous Elwood Canal (GHD, 2019) and Shakespeare Grove Main Drain (BMT WBM, 2012) TUFLOW models into a single model. This avoided the need to duplicate the Council drainage of the Byron Street Main Drain catchment in two separate models. The inclusion of Council drainage in the model results in some Council pipes taking flow out of the 'catchment', while some bring flow into the 'catchment'. The TUFLOW model has been extended to cover both of these situations, with additional inflow and downstream outflow boundaries included accordingly.

4.5.2 Terrain representation

The previous Elwood Canal TUFLOW model contained a representation of level crossing removal works where Melbourne Water drains crossed the Frankston Railway Line at Murray Road and just south of Centre Road. A part of those works included a representation of flood walls as 'thin' z shape lines, which raised the elevations along the sides of model cells to match the flood wall elevations. With the modelling now adopting TUFLOW's sub grid sampling (SGS), and with the inclusion of Council drainage, it became apparent through inspection of some initial model results that further terrain manipulation was required along the Frankston Railway line in some locations.

In some locations, water was incorrectly flowing around flood walls due to SGS picking up low points from the low/protected side of the flood walls (within the railway cuttings) and applying these to the conveyance calculations for flows around the outside of the railway cutting. To avoid this, the elevations of the cells along the flood walls were raised to match the actual terrain elevations on the 'high' side of the flood walls through the use of 'thick' z shape lines. Some additional 'fixes' to the terrain of road crossing the railway line were also made to improve the representation of flowpaths along those roads.

4.5.3 Inflows

Inflow hydrographs to the combined TUFLOW model have been taken from the separate Elwood Canal and Shakespeare Grove revised RORB models. These RORB models are edge-matched to each other, so there are no overlapped hydrographs.

4.5.4 Downstream Boundaries

4.5.4.1 Port Phillip Bay

The Elwood Canal and Shakespeare Grove Main Drain both outlet directly to Port Phillip Bay. Previous modelling of Elwood Canal adopted tide curves as the downstream boundary condition of the model without consideration of the timing of the peaks. With pre-burst rainfall depths now being added to the RORB modelling, the timing of the burst hydrographs vary considerably between design storms. The simulation start times of the TUFLOW model have also been varied accordingly, to minimise simulation run times, and as such the application of the previous tide curves has been reconsidered.

The sensitivity of mapping results to changes in bay levels was assessed and documented in Appendix C. This analysis found that within the expected tidal ranges, flooding in the City of Glen Eira is not tidally influenced for the events being modelled. As a result, a fixed tailwater level of 1.22 m AHD (based on the 'mean higher high water' (MHHW) level plus 0.8 m to account for sea level rise due to climate change) was adopted for all Climate Change events, while a fixed tailwater level of 0.42 m AHD (MHHW level) was adopted for all Base Case events as shown in Table 4.3.

Table 4.3 Adopted Tailwater levels

Event	Adopted tailwater level
Climate Change 1% AEP	1.22 m AHD (MHHW plus 0.8 m)
Climate Change 20% AEP	1.22 m AHD (MHHW plus 0.8 m)
Base Case 1% AEP	0.42 m AHD (MHHW)
Base Case 20% AEP	0.42 m AHD (MHHW)

4.5.4.2 External catchments

Several 2D boundaries are applied around the model boundary to allow overland flows to spill into the neighbouring Murrumbeena Drain, Heatherton Drain, and other neighbouring catchments. These were set up as "HQ" boundaries, with slopes based on the general ground surface at each location.

There are also several pipe systems included in the model that 'divert' flow into those neighbouring catchments. The TUFLOW model representation of each of these systems extend far enough downstream that the required results (for the climate change 1% AEP event within Glen Eira) are insensitive to the adopted tailwater levels. The downstream boundary conditions on each of these systems were modelled as "HT" boundaries in a 1d_bc layer, with fixed tailwater levels set to the respective ground levels. These levels are listed in Table 4.4 below and also form part of the bc_dbase file (refer to Figure B.4 to Figure B.10 in Appendix B for locations).

Table 4.4 Elwood Canal Model 1D fixed tailwater levels on pipe outlets

Name	Level (m AHD)	Location
Downes	11.5	Downes Avenue near Elwood Street (Meek Street Drain catchment)
Male	19.5	Male Street at Bay Street (Meek Street Drain catchment)
Ward	24	Ward Street near Florence Street (Meek Street Drain catchment)
Meek	30.75	Connection to the Meek Street Drain near Exley Drive
Wilson	33.25	Wilson Street near Charwood Lane (Heatherton Drain catchment)
Sullivan	40	Sullivan Street near Ebden Street (Heatherton Drain catchment)
Dandenong	39.75	Dandenong Road west of Orrong Road (Essex Street Main Drain catchment)
Neerim	44.5	Neerim Road at Tranmere Avenue (Murrumbeena Drain catchment)
Ames	46.25	Ames Avenue between Phillips Avenue and Neerim Road (Murrumbeena Drain catchment).
Murrumbeena	42.5	Murrumbeena Road at Frogmore Road (Murrumbeena Drain catchment)

Name	Level (m AHD)	Location
Boynton	49.5	Between properties north of Boynton Street (Heatherton Drain catchment)
Chesterville	48.75	Chesterville Road south of Boynton Street (Heatherton Drain catchment)
Brady	48.25	Brady Road near Millard Street (Heatherton Drain catchment)
Normdale	49.75	Normdale Road at Blamey Street (Heatherton Drain catchment)
Blamey	48.75	Blamey Street between Normdale Road and Brosnan Road (Heatherton Drain catchment)
Bignell	49	Bignell Road at Brosnan Road (Heatherton Drain catchment)
Kinlock	49.5	Kinloch Avenue between Brett Street and Reid Street (Murrumbeena Drain catchment).
Oakdene	45.75	Oakdene Crescent south of Blackwood Street (Murrumbeena Drain catchment).
Lindsay	43.25	Between properties north of Lindsay Avenue (Murrumbeena Drain catchment)
Castlewood	53	Between properties south of Castlewood Street (Heatherton Drain catchment)

4.5.5 Initial water levels

Apart from the 2d_iwl points used to prefill land-locked depressions, global initial water levels were set to match the Port Phillip Bay fixed tailwater levels.

The fixed tailwater levels listed in Table 4.4 were also applied back along the respective pipe systems as initial water levels to avoid water from rushing back up empty pipes at the start of a simulation.

4.6 TUFLOW HPC quality control

Internal quality assurance checks related to model performance and stability were carried out and the TUFLOW model results were independently peer reviewed and accepted by Melbourne Water and Council.

4.7 Qualifications relating to Flood Mapping Output

The hydraulic model and its results extend beyond the region being ‘mapped’ to achieve a number of objectives, including:

– To improve the distribution of model inflows.
– To reduce the significance of downstream boundary conditions.
– To facilitate flow diversions.

Therefore, the flood mapping output described in the following sections, and provided to Melbourne Water in accordance with the Guidelines and Technical Specifications for Flood Mapping Projects, September 2016 (Melbourne Water, 2016), have been trimmed to a “Mapping Limit” line. This line designates the extent of meaningful results. Outside of the “Mapping Limit” the model results may be misleading due to a number of reasons, including:

– The influence of boundary conditions.
– Incomplete representation of drainage assets.

All modelling results require appropriate interpretation. It should be noted that the smaller, more frequent events, such as the 20% and 10% AEP results, are produced using a hydraulic model established primarily for the purpose of modelling the Climate Change (at 2100) 1% AEP event. The implication of this is that, particularly for these smaller events, the modelling results will need to be appropriately interpreted with an understanding of their limitations.

Despite these limitations, the results for the smaller, more frequent events are believed to be the best currently available.

The accuracy of the final results is in part a function of the underlying terrain data and the resolution of the TUFLOW model (which uses a 4 m cell size with SGS at 1 m). Relative to a traditional TUFLOW Classic approach, the adoption of SGS and the updated turbulence formulation significantly reduce the sensitivity of the results to the adopted grid size and orientation, thus better supporting the high resolution of post-processed results. The high resolution of the post-processed results does not infer a higher accuracy or confidence in the results, both of which remain limited by the underlying data and assumptions.

5. Flood Mapping Output for Melbourne Water – Pre June 2025

5.1 Introduction

GIS flood mapping deliverables have been derived in accordance with the Melbourne Water Guidelines and Technical Specifications for Flood Mapping Projects, September 2016 (Melbourne Water, 2016) and include flood extents, flood hazards and parcels flooded.

Flood modelling results from hydraulic modelling often include small amounts of water such as shallow water or small, isolated puddles. To maintain the focus on more significant flooding, Melbourne Water has developed filtering guidelines which include criteria such as:

– Water depths less than 5 cm are excluded; and
– Isolated areas of inundation smaller than 100 square metres are excluded.

Melbourne Water uses these rules based on the needs of its regional floodplains. Local councils may use different criteria.

Further details of the mapping output are described in the following sections.

5.2 Flood extents

Flood extents were created for each of the events listed in Table 1.1, following Melbourne Water's filtering guidelines in accordance with the Melbourne Water Guidelines and Technical Specifications for Flood Mapping Projects, September 2016 (Melbourne Water, 2016).

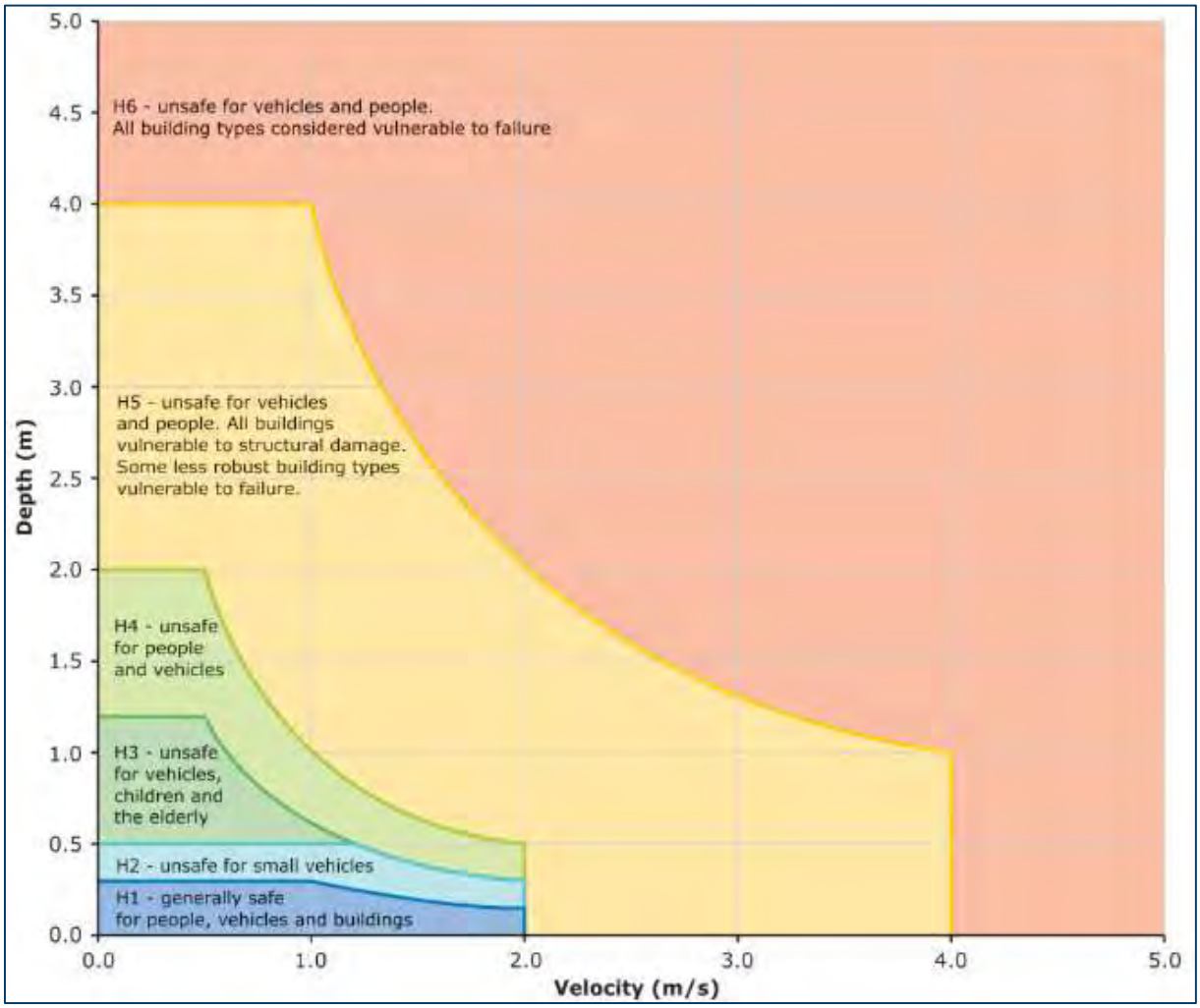
Flood level surfaces were created using the "asc_to_asc" utility, whereby median flood levels per storm duration were calculated initially, then a maximum envelope of those median flood levels created for each AEP. Melbourne Water's filtering processes as described in Section 5.1 were then applied to these results.

Following the application of the above steps, the Climate Change 1% AEP flood extent underwent a demarcation process whereby the extent was initially trimmed to the Glen Eira municipal boundary then split to indicate areas of "Melbourne Water" flooding and "Council" flooding by agreement between Melbourne Water and the Glen Eira City Council. GHD had no direct involvement in the demarcation process between Council and Melbourne Water. The demarcated flood extents formed the basis of trimming the flood extents for other AEPs and selecting and trimming some other GIS outputs.

The Climate Change 1% AEP flood extents showing the provided demarcation between Melbourne Water and Council are presented in Appendix D.

5.3 Flood Hazard Polygons

Flood hazard polygons were created for each of the events listed in Table 1.1 based on the hazard categories defined in ARR 2019 (Ball, et al., 2019). Hazard categories are defined as shown in Figure 5.1 below.



Copy of Figure 6.7.8 from Book 6, Chapter 7 of ARR 2019 (Ball, et al., 2019)

Figure 5.1 Flood Hazard Categories

TUFLOW is able to calculate hazard category throughout the model simulation in its “ZAEM1” output. The flood hazard polygons are based on the ‘maximum of median’ hazard values from all “ZAEM1” results for each event.

5.4 Parcels flooded

MapInfo layers of parcels flooded were created from the Parcels layer provided by Melbourne Water, where parcels were touched by the respective demarcated Climate Change 1% AEP flood extents. Similar layers were created for the Base Case Scenario, based on parcels touched by the Base Case 1% AEP flood extent.

For each scenario, the following flood information was assigned to each 'flooded' parcel polygon (where available):

– Highest 1%, 2%, 5%, 10% and 20% AEP flood levels within the parcel polygon (from the 'maximum of median' "h" results).
– Lowest 1% AEP flood level within the parcel polygon (from the 'maximum of median' "h" results).
– Maximum 1% AEP velocity within the parcel polygon (from the 'maximum of median' "v" results).
– Maximum 1%, 2%, 5%, 10% and 20% AEP depths within the parcel polygon (based on the 'maximum of median' "h" results).
– Maximum 1%, 2%, 5%, 10% and 20% AEP velocity-depth values within the parcel polygon (from the 'maximum of median' "z0" results).

Where a parcel was not affected by a smaller event, a data value of "-9999" was assigned.

The total number of parcels flooded within the entire Glen Eira municipality for the Climate Change 1% AEP and Base Case 1% AEP events are shown in Table 5.1.

Table 5.1 Total number of parcels flooded within the City of Glen Eira

Event	Total Number of Parcels Flooded in 'Melbourne Water' Flood Extent	Total Number of Parcels Flooded in 'Council' Flood Extent*
Climate Change 1% AEP	10,706	21,063
Base Case 1% AEP	9,611	17,775

* these numbers relate to the Glen Eira 'Council' flood extent created using Melbourne Water's processes as discussed in Section 5.2.

6. Updated parcel polygons - June 2025 revision

All previous work relating to the “Parcels Flooded” layers and other ‘demarcated’ layers described in Chapter 5 relied on a “Parcels” layer provided by Melbourne Water in April 2022. In conjunction with the Glen Eira City Council, Melbourne Water requested GHD to revise some mapping output layers based on more recent parcel boundaries. The more recent boundaries not only incorporate subdivisions that have occurred during the last three years, but also a spatial shift in some boundaries made as part of the Victorian Digital Cadastre Modernisation Project. An updated parcels layer was provided by Melbourne Water on 27 May 2025 in ESRI geodatabase format in GDA2020, with attributes aligned with Melbourne Water’s “Parcels Flooded” layer.

Using the updated parcels layer as a basis, the scope of this revision was to re-create some of the flood mapping deliverables, including the Base Case 1% AEP and Climate Change (at 2100) 1% AEP flood extents and parcels flooded layers for both Melbourne Water and Council areas.

7. Conclusions

The climate change guidance in ARR v4.1 represented the widely adopted industry standard at the time the modelling for this project commenced. Subsequently, the guidance for assessing climate change impacts was updated with the release of ARR v4.2. It is expected that updated guidelines will be adopted for future periodic model updates. Although the approaches for estimation of future climate change impacts now recommended in ARR v4.2 may predict more widespread flooding by 2100 than indicated by current modelling results, the results of the current study provide an improved representation of areas most at risk of flooding and will remain valid for some time.

The findings from this study may support future decisions regarding flood risk management, catchment planning, risk mitigation strategies, and emergency planning.

8. References

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Appendices

Appendix A

RORB Modelling

ARR 2019 Methodology

GHD RORB Approach

Heatherton Drain RORB Model Layout (Figure A.9)

Murrumbeena Drain RORB Model Layout (Figure A.10)

Elwood Canal RORB Model Layout (Figure A.11)

Shakespeare Grove Main Drain RORB Model Layout (Figure A.12)

ARR Data Hub Output

A-1 ARR 2019 Methodology

A-1-1 Spatial Patterns of Rainfall

ARR 2019 recommends that a single non-uniform spatial pattern of rainfall be applied to catchments with an area greater than 20 km^2. The non-uniform spatial pattern of rainfall should be derived with the aim of replicating the spatial variability that would be expected across the catchment during rainfall events of a similar AEP to the design floods that are being estimated. The Elwood Canal catchment (40 km^2) is the only catchment in this project that meets above criterion, however it has 1358 subareas, which exceeds RORBwin's limit for inputting spatial rainfall. Previous modelling of the Elwood Canal catchment by GHD using our custom approaches was able to use spatially varying IFD values however given that the variation from north to south is typically less than 3% and up to 3 mm, we decided to use the standard version of RORBwin and not model the relatively minor variations in IFD across the catchment.,

A-1-2 Losses and Surface Types

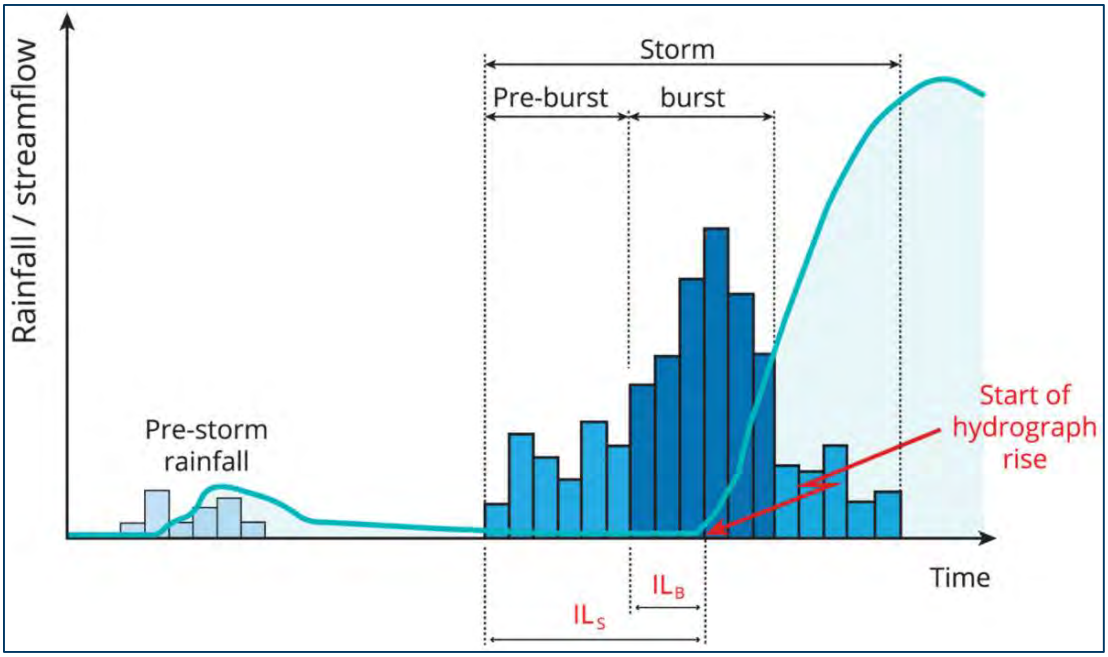
Book 5, Chapter 3 of ARR 2019 (Ball, et al., 2019) describes the derivation and use of losses in urban areas. Different loss values are recommended based on different surface types and whether complete storms or storm bursts are being modelled.

The temporal patterns provided in the ARR 2019 Data Hub are for storm bursts, and the IFD data provided by the BoM are also not based on complete storms, however the Data Hub provides an initial loss value for 'rural' areas to be applied to a complete storm. The Data Hub therefore also provides tables of pre-burst depths that vary with AEP and storm duration, which need to be suitably accounted for in hydrologic modelling. As discussed in Section 3.2, median pre-burst depths have been adopted for this project. Figure A.1 below demonstrates the concept of pre-burst, burst and entire storms.

ARR 2019 also recognises that harder surfaces experience less loss than pervious surfaces and that different loss values should be applied to different surface types. Three surface types are defined for urban catchments:

– Effective Impervious Areas (EIA).
– Indirectly Connected Areas (ICA).
– Pervious Areas (PA).

Table A.1 summarises the definition of each surface type and the 'storm' initial loss (IL_s) and continuing loss (CL) values recommended by ARR 2019. Further details on how the differing surface types and loss values have been used in RORB are provided in Appendix A-2.



Copy of Figure 5.3.5 from Book 5, Chapter 3 of ARR 2019 (*Ball et al. 2016*)

Figure A.1 Distinction between Storm and Burst Initial Loss

Table A.1 ARR 2019 Recommended Loss Values for each Urban Surface Type

Surface Type	Definition	Recommended Loss Values
EIA (Effective Impervious Area)	Generally considered as that part of the catchment that produces a rapid runoff response. It includes the Directly Connected Impervious Area (DCIA) and the rapidly responding portion of the Indirectly Connected Impervious Area (ICIA). The rapidly responding portion of ICIA included is the portion of impervious area that drains to a drainage network via a pervious area, which is rapidly saturated and subsequently behaves as if it were well connected, such as a footpath discharging to kerb drain via a sloping nature strip that is rapidly saturated (Book 5, Section 3.4.1.1 of ARR 2019). EIA can be expressed as a factor of Total Impervious Area (TIA), with an EIA/TIA ratio of 50%-70% considered appropriate for most urban catchments but could increase as TIA increases (Book 5, Section 3.4.2.2.2 of ARR 2019)	IL_s = 1 to 2 mm. CL = 0 mm/h. (Book 5, Section 3.5.3.1.2 of ARR 2019)
ICA (Indirectly Connected Area)	This relatively slow responding area includes all portions of a catchment not classified as EIA or Pervious Area (PA). It consists of the slower responding portion of the Indirectly Connected Impervious Area (ICIA) and Pervious Areas that interact with the ICIA (Book 5, Section 3.4.1.1 of ARR 2019)	IL_s = 60% to 80% of rural catchment IL_s. (Book 5, Section 3.5.3.2.1 of ARR 2019) CL = 2.5 mm/h. (Book 5, Section 3.5.3.2.2 of ARR 2019)
PA (Pervious Area)	Pervious areas consisting of parklands and bushland that do not interact with impervious areas (Book 5, Section 3.4.1.1 of ARR 2019)	Rural catchment IL_s and CL values from ARR Data Hub. (Book 5, Section 3.5.3.3 of ARR 2019)

In the definitions above:

– Directly Connected Impervious Area (DCIA) is described in ARR 2019 as “impervious areas (e.g. roofs and paved areas) which are directly connected to the drainage system”.

– Indirectly Connected Impervious Area (ICIA) is described in ARR 2019 as “impervious areas which are not directly connected, runoff from which flows over pervious surfaces before reaching the drainage system (e.g. a roof that discharges onto a lawn)”.

A-2 GHD RORB Approach

A-2-1 Representation of Surface Types

Based on the definitions of each surface type and the losses to be applied to each surface type (discussed in Appendix A-1-2 above), the initial RORB catchment files created via MiRORB (and edited to include necessary printouts) were modified to split each original subarea into separate subareas representing its relevant different surface types. Each ‘split’ subarea is categorised as being either ‘EIA’, ‘ICA’ or ‘PA’ based on the following general rules:

– A subarea was considered to be totally PA if the weighted impervious fraction was 0.15 or less. For each catchment we have assumed that a subarea can only be either PA or a mix of EIA/ICA, but not all three surface types.
– If a subarea is not PA, EIA was determined based on the curve shown below in Figure A.2:
  - EIA/TIA ratio of 60% when the weighted percent impervious is 80% or less.
  - Increasing EIA/TIA ratio as the weighted percent impervious increases above 80%.
  - TIA (total impervious area) = area of subarea x weighted percent impervious.
– If a subarea is not PA, ICA was simply determined as the area of subarea minus EIA.

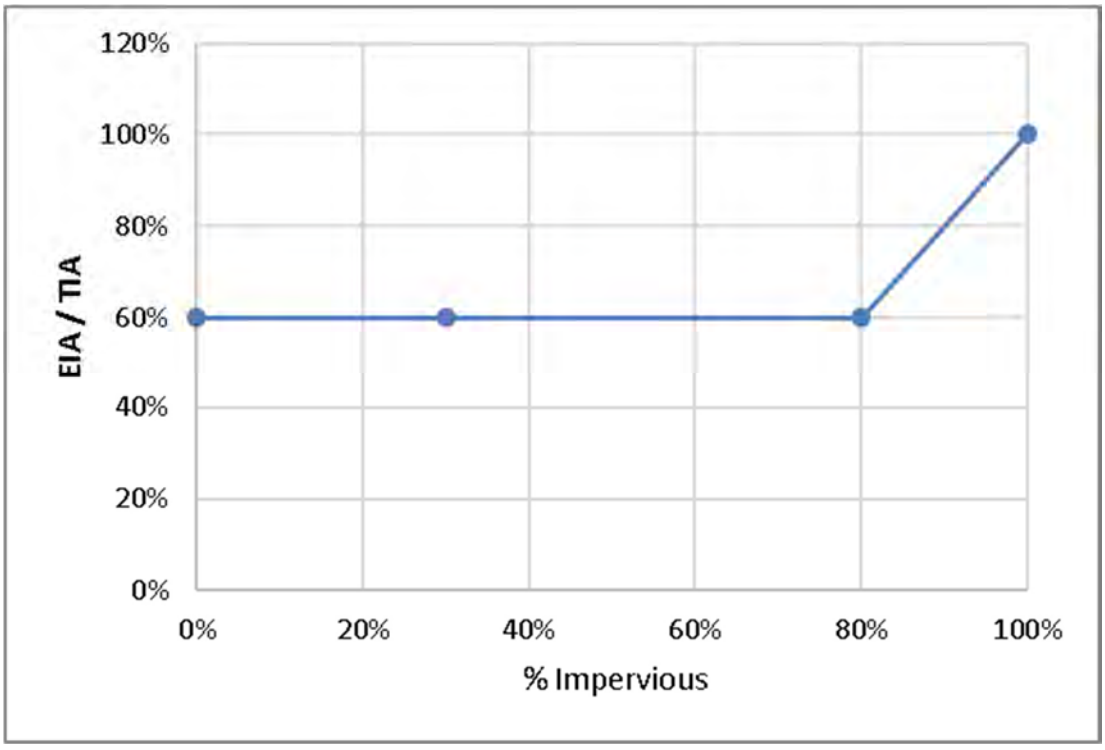


Figure A.2 EIA/TIA Ratio vs Weighted Percent Impervious

This approach is needed to allow the following key surface type characteristics to be modelled:

– The actual loss values suggested in ARR 2019 for each surface type can be applied directly to each 'split' subarea by utilising RORBwin’s directly and indirectly connected impervious fractions. Importantly this avoids RORBwin’s weighting of initial loss values, which dampens and distorts the initial catchment response.
– Different reach types can be used to represent variable response time of these surface types.

The initial RORB vector code was modified as described in Table A.2 to enable the models to run and utilise standard RORBwin features.

Table A.2 Conversion of initial catchment file to 'split' catchment file

Subarea Surface Type	EIA	ICA	PA
RORB Code Changes	Code representing generation of runoff and initial routing from each subarea was duplicated, with one being labelled "EIA" and the other labelled "ICA" (to highlight what surface type each subarea represents) - an example of this change is shown in Figure A.3.		Code representing generation of runoff and initial routing from each subarea was copied and simply labelled "PA" (to highlight what surface type the subarea represents).
Reach Type*	The "EIA" subarea was assigned a reach type 3 regardless of underlying land use to represent rapid response from this surface type.	The "ICA" subarea was assigned the reach type of the initial reach, based on the underlying land use (typically type 2).	The "PA" subarea was assigned the reach type of the initial reach, based on the underlying land use (typically type 2).
Areas	The areas of the "EIA" and "ICA" subareas were adjusted to represent the area of the respective surface type within the original subarea.		The area of the "PA" subarea was left to match that of the original subarea.
Impervious fractions for correct losses to be applied	Directly Connected Impervious Fraction = 1 Indirectly Connected Impervious Fraction = 0	Directly Connected Impervious Fraction = 0 Indirectly Connected Impervious Fraction = 1	Directly Connected Impervious Fraction = 0 Indirectly Connected Impervious Fraction = 0

* Reach types of the initial RORB models were based on the underlying land use (typically reach type 2 (unlined) for flow through properties or across grassed surfaces, reach type 3 (lined) for flow along roads and other hard surfaces, and reach type 1 (natural) for flow through golf courses, as per previous modelling)

Figure A.3 RORB code changes for representing EIA/ICA subareas

Initial Code

```
1, 2, 0.103, 2.29,-99       ,Gen rain-xs h'graph from sub-area I & route through next sto
5, 3, 0.22, 0.868,-99       ,Route running h'graph through next storage reach from I1
3                           ,Store the current running hydrograph.
```

Revised Code

```
1, 3, 0.103, 2.29,-99       ,EIA part Gen rain-xs h'graph from sub-area I & route through next sto
7
I_EIA
3
1, 2, 0.103, 2.29,-99       ,ICA part Gen rain-xs h'graph from sub-area I & route through next sto
7
I_ICA
4
7
I
5, 3, 0.22, 0.868,-99       ,Route running h'graph through next storage reach from I1
3                           ,Store the current running hydrograph.
```

A-2-2 Running RORB

Each RORB model was run using the k_c/d_{av} ratio and ARFs adopted from the previous modelling. More information on these can be found in the previous flood mapping reports. The 'storm' initial loss and continuing loss values for each surface type were applied in conjunction with median pre-burst depths and a pre-burst temporal pattern based on underlying data for RORB default temporal patterns (i.e. from Jordan, et al, 2005 and GSAM, 1999). The adopted pre-burst temporal patterns are summarised in Figure A.4. Catchment specific details regarding losses and pre-burst depths are described in the following sections. An 'm' value of 0.8 and embedded burst filtering was adopted for every model.

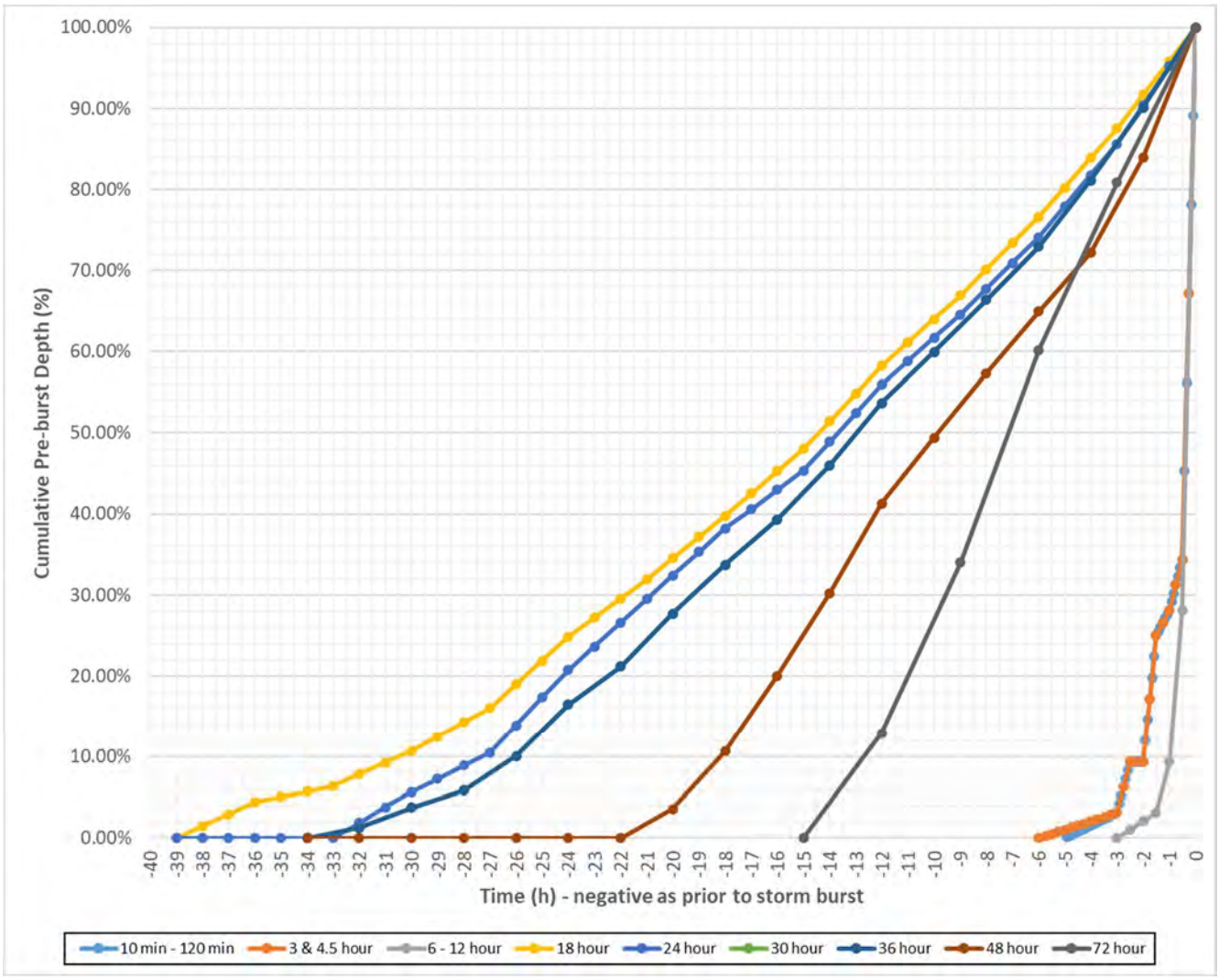


Figure A.4 Adopted Pre-Burst Temporal Patterns

A-2-3 Heatherton Drain Loss Values

The ARR Data Hub provided the loss values and median pre-burst depths for the Heatherton Drain catchment at coordinates 37.96 S, 145.079 E (full Data Hub output for the catchment is presented at the end of Appendix A). The loss values provided by the Data Hub are shown in Table A.3, and are relevant for 'rural' areas only (or 'PA' surface type). Median pre-burst depths are shown in Table A.4. Continuing loss values 0 mm/h and 2.5 mm/h were applied to EIA and ICA surface types respectively.

Table A.3 ARR 2019 Data Hub Rural Loss Values for Heatherton Drain Catchment

Pervious Area Storm Initial Loss (mm)	Pervious Area Continuing Loss (mm/h)
26	4.4

Table A.4 ARR 2019 Data Hub Median Pre-burst Depths (mm) for Heatherton Drain Catchment

Duration (m)	Duration (h)	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
60	1	2.8	2.5	2.2	1.6	1.1
90	1.5	2.6	2.8	2.9	2.3	1.8
120	2	2.4	2.4	2.4	1.6	1
180	3	2.2	2.4	2.5	3.1	3.6
360	6	3	3.6	4.1	4.7	5.2
720	12	1	1.6	2.1	4	5.4
1080	18	0.5	0.9	1.2	1.7	2
1440	24	0	0	0	0.7	1.3
2160	36	0	0	0	0	0
2880	48	0	0	0	0	0
4320	72	0	0	0	0	0

For storm durations not provided in the table above, median pre-burst depths were interpolated and extrapolated within each AEP. The full set of the adopted median pre-burst depths for all AEPs and durations for the Heatherton Drain catchment are presented in Figure A.5.

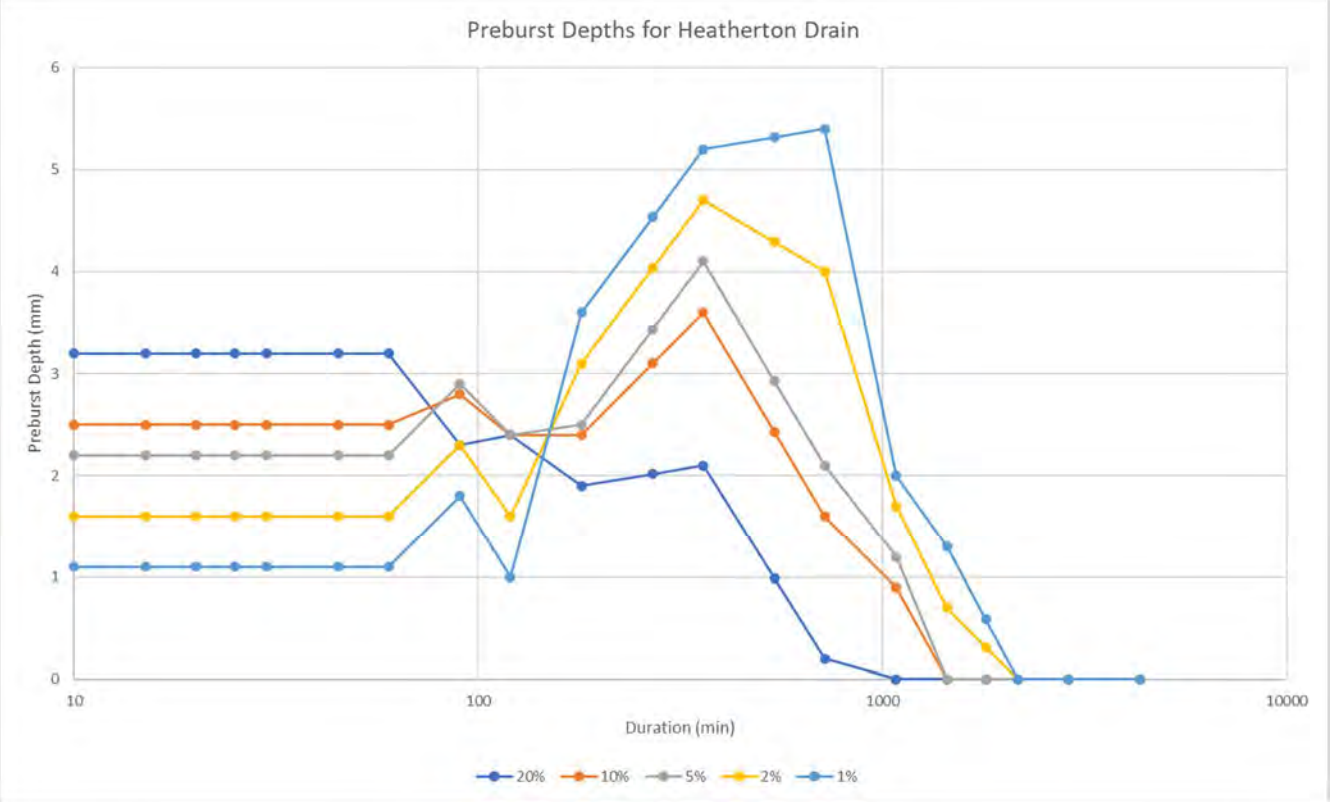


Figure A.5 Median Pre-burst Depths (mm) for Heatherton Drain Catchment

The pre-burst depths from Figure A.5 were applied at the start of the standard storm bursts using the temporal patterns presented in Figure A.4 and the losses outlined in Table A.5.

Table A.5 Adopted Heatherton Drain RORB Losses

Surface Type	Storm Initial Loss (mm)	Continuing Loss (mm/hr)
Pervious area (PA Surface Type using our approach)	26	4.4
Directly connected impervious area (EIA Surface Type using our approach)	1.5	0
Indirectly connected impervious area (ICA Surface Type using our approach)	18.2 (70% of 'PA' IL_s)	2.5

A-2-4 Murrumbeena Drain Loss Values

The ARR Data Hub provided the loss values and median pre-burst depths for the Murrumbeena Drain catchment at coordinates 37.901 S, 145.073 E (full Data Hub output for the catchment is presented at the end of Appendix A). The loss values provided by the Data Hub are shown in Table A.6, and are relevant for 'rural' areas only (or 'PA' surface type). Median pre-burst depths are shown in Table A.7. Continuing loss values 0 mm/h and 2.5 mm/h were applied to EIA and ICA surface types respectively.

Table A.6 ARR 2019 Data Hub Rural Loss Values for Murrumbeena Drain Catchment

Pervious Area Storm Initial Loss (mm)	Pervious Area Continuing Loss (mm/h)
20	3.3

Table A.7 ARR 2019 Data Hub Median Pre-burst Depths (mm) for Murrumbeena Drain Catchment

Duration (m)	Duration (h)	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
60	1	2.9	2.5	2.2	1.6	1.1
90	1.5	2.9	2.7	2.4	2.1	1.8
120	2	3.1	2.8	2.4	1.6	1.1
180	3	2.8	2.6	2.4	3.8	4.8
360	6	2.4	2.7	3	4.6	5.8
720	12	1.3	2	2.7	4.8	6.3
1080	18	0.6	1	1.3	2.6	3.5
1440	24	0.3	0.5	0.6	0.6	0.6
2160	36	0	0	0	0.1	0.1
2880	48	0	0	0	0	0
4320	72	0	0	0	0	0

For storm durations not provided in the table above, median pre-burst depths were interpolated and extrapolated within each AEP. The full set of the adopted median pre-burst depths for all AEPs and durations for the Murrumbeena Drain catchment are presented in Figure A.6.

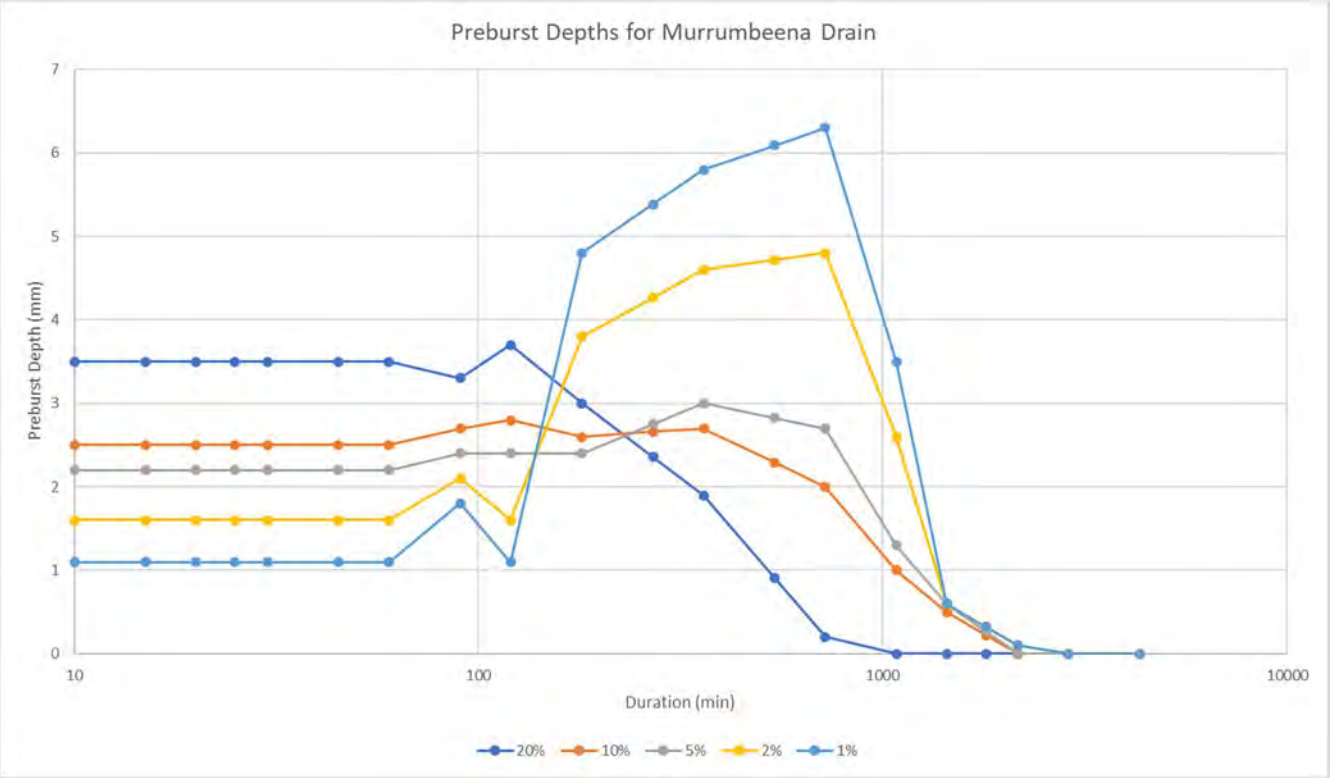


Figure A.6 Median Pre-burst Depths (mm) for Murrumbeena Drain Catchment

The pre-burst depths from Figure A.6 were applied at the start of the standard storm bursts using the temporal patterns presented in Figure A.4 and the losses outlined in Table A.8.

Table A.8 Adopted Murrumbeena Drain RORB Losses

Surface Type	Storm Initial Loss (mm)	Continuing Loss (mm/hr)
Pervious area (PA Surface Type using our approach)	20	3.3
Directly connected impervious area (EIA Surface Type using our approach)	1.5	0
Indirectly connected impervious area (ICA Surface Type using our approach)	14 (70% of 'PA' IL_s)	2.5

A-2-5 Elwood Canal Loss Values

The ARR Data Hub provided the loss values and median pre-burst depths for the Elwood Canal catchment at coordinates 37.9 S, 145.035 E (full Data Hub output for the catchment is presented at the end of Appendix A). The loss values provided by the Data Hub are shown in Table A.9 and are relevant for 'rural' areas only (or 'PA' surface type). Median pre-burst depths are shown in Table A.10. Continuing loss values 0 mm/h and 1.9 mm/h were applied to EIA and ICA surface types respectively.

Table A.9 ARR 2019 Data Hub Rural Loss Values for Elwood Canal Catchment

Pervious Area Storm Initial Loss (mm)	Pervious Area Continuing Loss (mm/h)
12	1.9

Table A.10 ARR 2019 Data Hub Median Pre-burst Depths (mm) for Elwood Canal Catchment

Duration (m)	Duration (h)	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
60	1	2.9	2.5	2.1	1.5	1.1
90	1.5	3.2	3	2.9	2.1	1.5
120	2	3.3	2.8	2.4	1.7	1.2
180	3	2.9	2.8	2.7	4.2	5.3
360	6	2.7	3	3.4	4.8	6
720	12	1	1.6	2.2	4.1	5.6
1080	18	0.3	0.5	0.7	1.6	2.2
1440	24	0.2	0.4	0.5	0.6	0.6
2160	36	0	0	0	0	0.1
2880	48	0	0	0	0	0
4320	72	0	0	0	0	0

For storm durations not provided in the table above, median pre-burst depths were interpolated and extrapolated within each AEP. The full set of the adopted median pre-burst depths for all AEPs and durations for the Elwood Canal catchment are presented in Figure A.7.

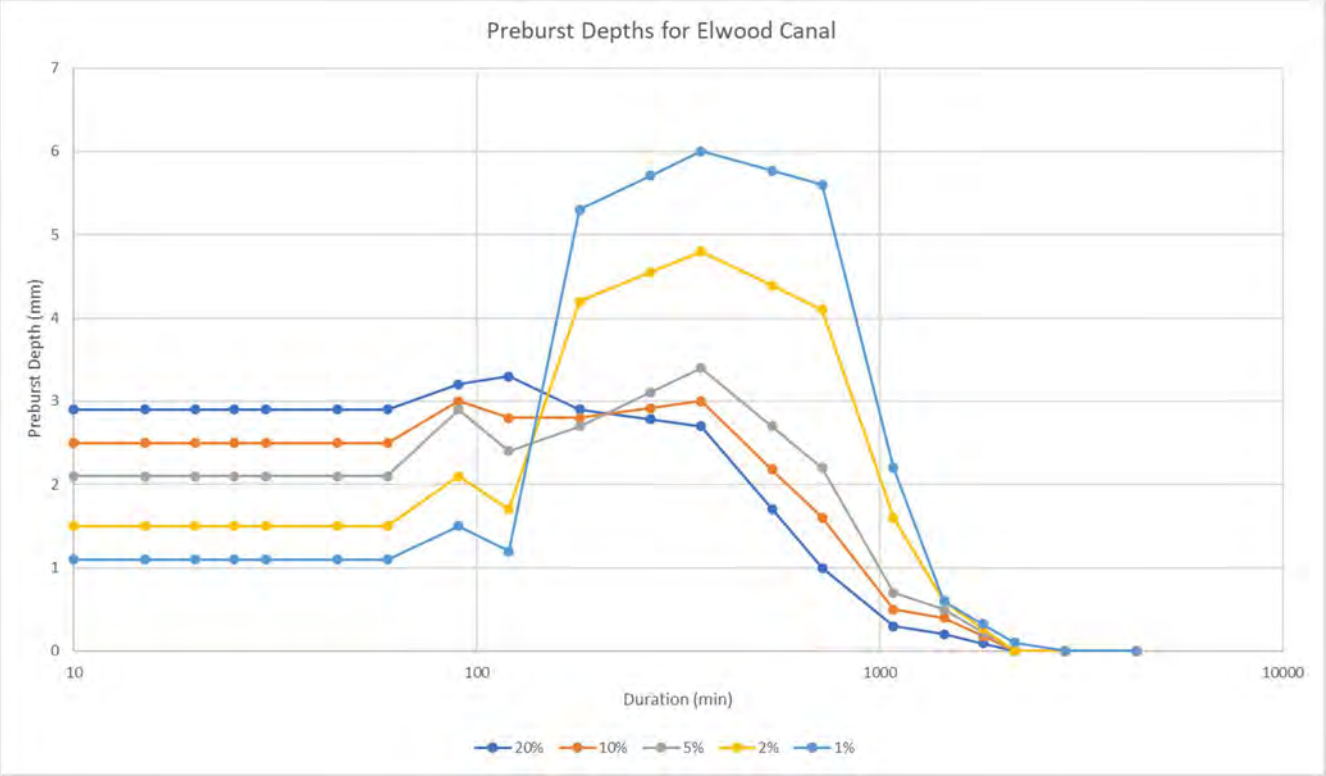


Figure A.7 Median Pre-burst Depths (mm) for Elwood Canal Catchment

The pre-burst depths from Figure A.7 were applied at the start of the standard storm bursts using the temporal patterns presented in Figure A.4 and the losses outlined in Table A.11.

Table A.11 Adopted Elwood Canal RORB Losses

Surface Type	Storm Initial Loss (mm)	Continuing Loss (mm/hr)
Pervious area (PA Surface Type using our approach)	12	1.9
Directly connected impervious area (EIA Surface Type using our approach)	1.5	0
Indirectly connected impervious area (ICA Surface Type using our approach)	8.4 (70% of 'PA' IL_s)	1.9

A-2-6 Shakespeare Grove Main Drain Loss Values

The ARR Data Hub provided the loss values and median pre-burst depths for the Shakespeare Grove Main Drain catchment at coordinates 37.866 S, 144.995 E (full Data Hub output for the catchment is presented at the end of Appendix A). The loss values provided by the Data Hub are shown in Table A.12, and are relevant for 'rural' areas only (or 'PA' surface type). Median pre-burst depths are shown in Table A.13. Continuing loss values 0 mm/h and 1.9 mm/h were applied to EIA and ICA surface types respectively.

Table A.12 ARR 2019 Data Hub Rural Loss Values for Shakespeare Grove Main Drain Catchment

Pervious Area Storm Initial Loss (mm)	Pervious Area Continuing Loss (mm/h)
12	1.9

Table A.13 ARR 2019 Data Hub Median Pre-burst Depths (mm) for Shakespeare Grove Main Drain Catchment

Duration (m)	Duration (h)	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
60	1	2.9	2.5	2.1	1.5	1.1
90	1.5	3.2	3	2.9	2.1	1.5
120	2	3.3	2.8	2.4	1.7	1.2
180	3	2.9	2.8	2.7	4.2	5.3
360	6	2.7	3	3.4	4.8	6
720	12	1	1.6	2.2	4.1	5.6
1080	18	0.3	0.5	0.7	1.6	2.2
1440	24	0.2	0.4	0.5	0.6	0.6
2160	36	0	0	0	0	0.1
2880	48	0	0	0	0	0
4320	72	0	0	0	0	0

For storm durations not provided in the table above, median pre-burst depths were interpolated and extrapolated within each AEP. The full set of the adopted median pre-burst depths for all AEPs and durations for the Shakespeare Grove Main Drain catchment are presented in Figure A.8.

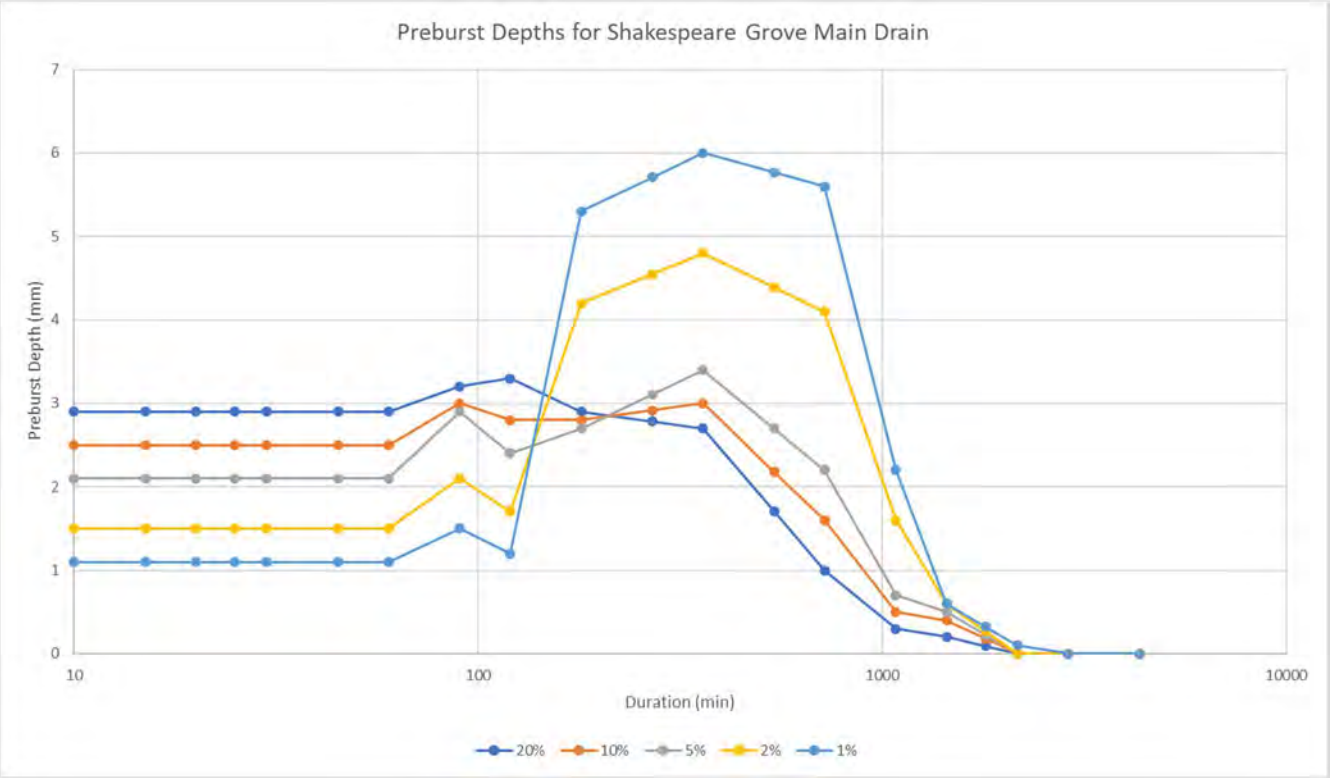
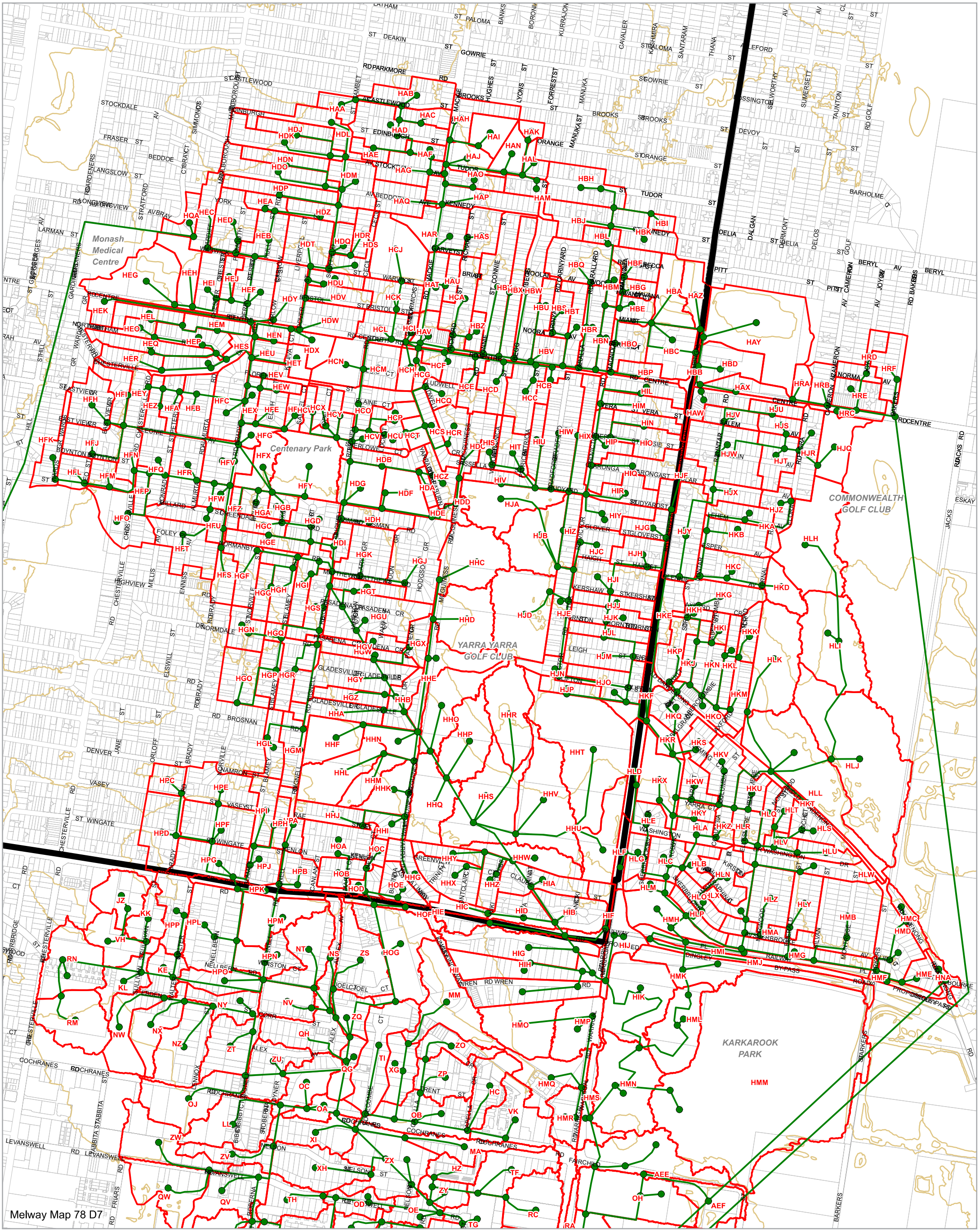


Figure A.8 *Median Pre-burst Depths (mm) for Shakespeare Grove Main Drain Catchment*

The pre-burst depths from Figure A.8 were applied at the start of the standard storm bursts using the temporal patterns presented in Figure A.4 and the losses outlined in Table A.14.

Table A.14 *Adopted Shakespeare Grove Main Drain RORB Losses*

Surface Type	Storm Initial Loss (mm)	Continuing Loss (mm/hr)
Pervious area (PA Surface Type using our approach)	12	1.9
Directly connected impervious area (EIA Surface Type using our approach)	1.5	0
Indirectly connected impervious area (ICA Surface Type using our approach)	8.4 (70% of 'PA' IL_s)	1.9



LEGEND

- Glen Eira Boundary
- Properties
- 5 m Ground Contours
- RORB Subarea
- RORB Node
- RORB Reach

Scale 1:10,000 at A3

0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME

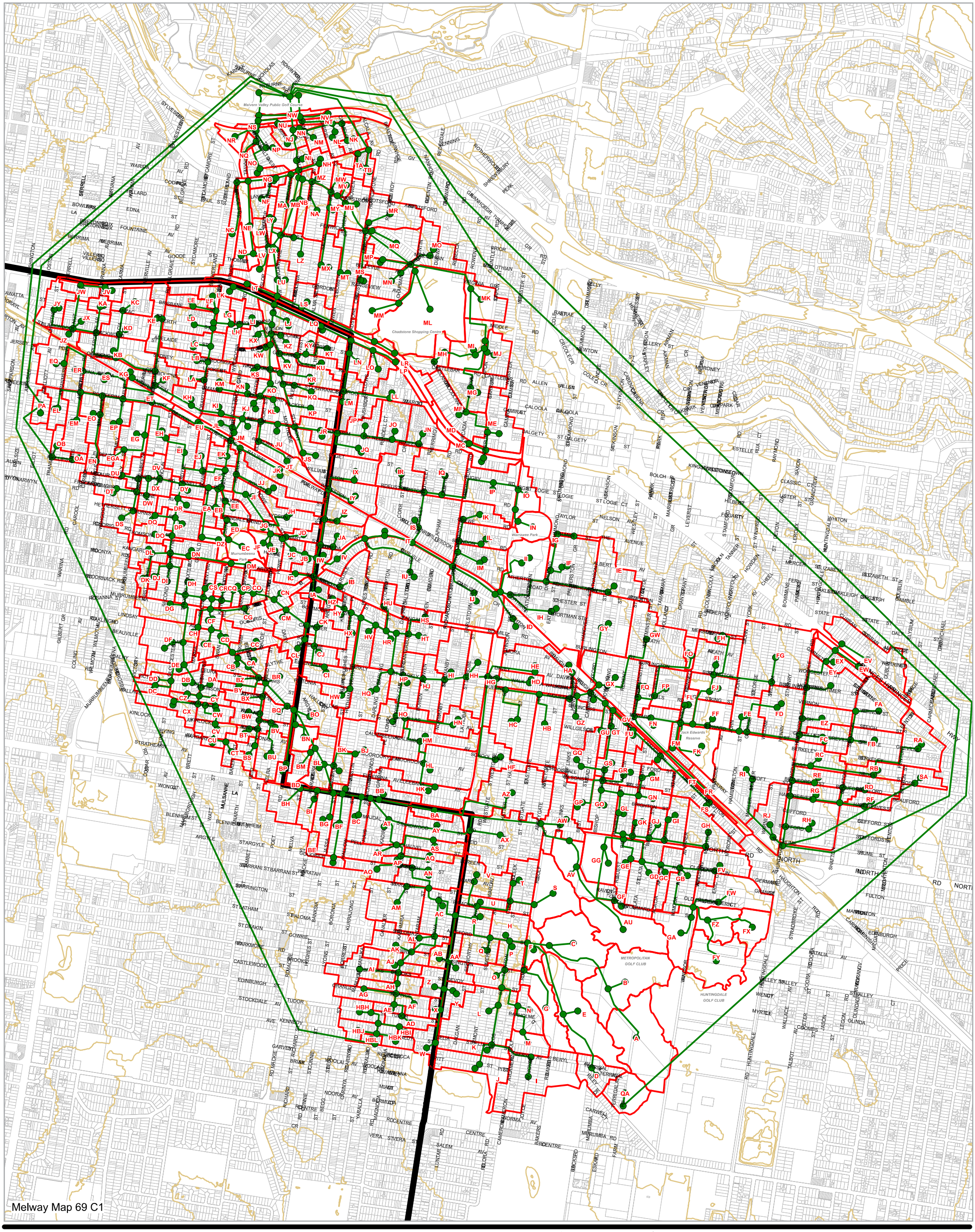
HEATHERTON DRAIN
RORB MODEL LAYOUT

Project No. **12563171**
Revision No. **0**
Date **16/06/2023**

FIGURE A.9

G:\31\12563171\FigA.9 RORB Hea.WOR

Data source: Melbourne Water, drainage, properties, contours, 2022. GHD, RORB Layers, 2022. Created by:



LEGEND

- Glen Eira Boundary
- Properties
- 5 m Ground Contours
- RORB Subarea
- RORB Node
- RORB Reach

Scale 1:17,500 at A3

0 175 350 525 700

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME

MURRUMBEENA DRAIN
RORB MODEL LAYOUT

Project No. **12563171**
Revision No. **0**
Date **16/06/2023**

FIGURE A.10

G:\31\12563171\FigA.10 RORB Mur.WOR

Data source: Melbourne Water, drainage, properties, contours, 2022. GHD, RORB Layers, 2022. Created by:

Melway Map 67 A2

LEGEND

- Glen Eira Boundary
- Properties
- 5 m Ground Contours
- RORB Subarea
- RORB Node
- RORB Reach

Scale 1:30,000 at A3

0 300 600 900 1200

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME

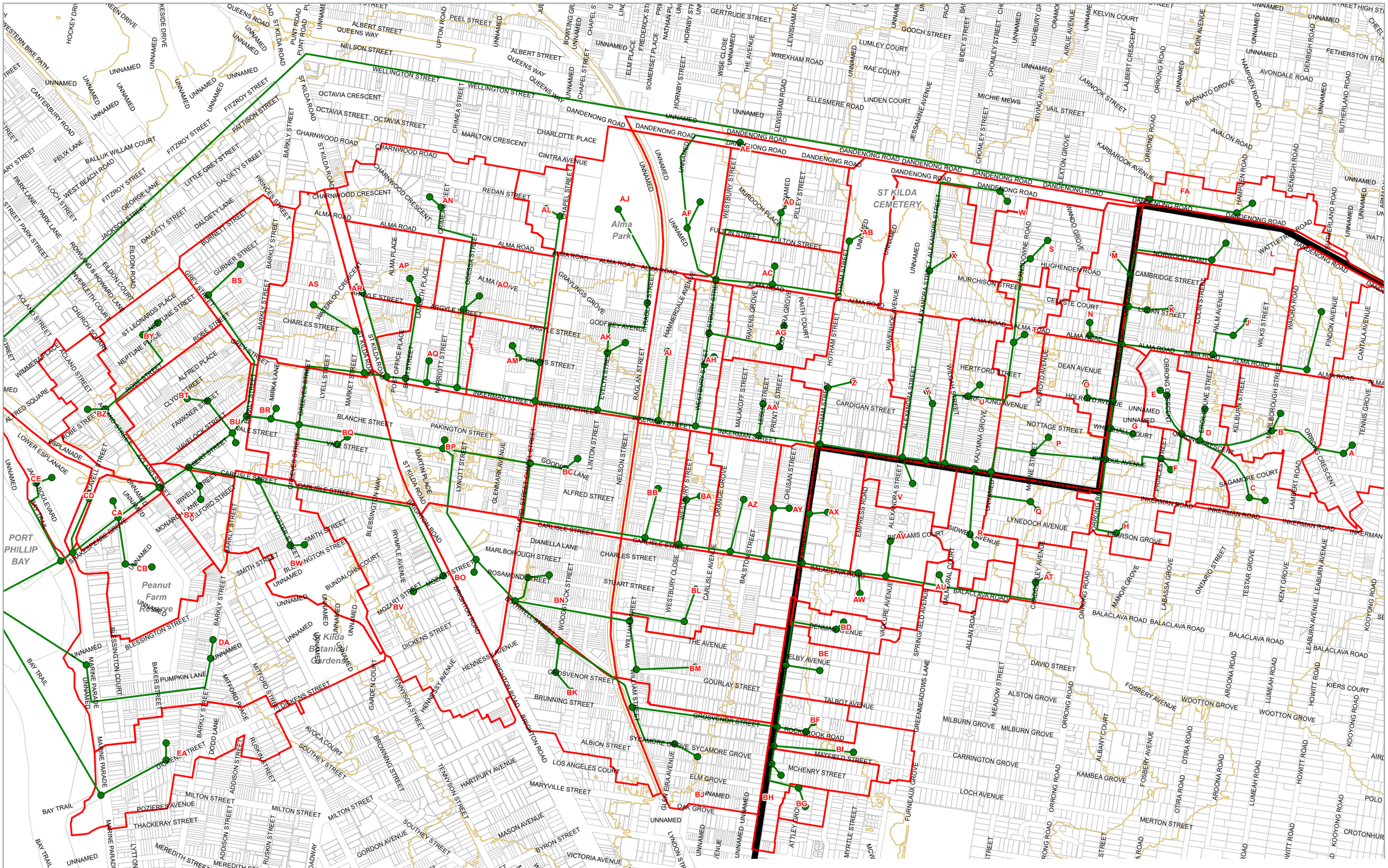
ELWOOD CANAL
RORB MODEL LAYOUT

Project No. **12563171**
Revision No. **0**
Date **16/06/2023**

FIGURE A.11

G:\31\12563171\FigA.11 RORB Elw.WOR

Data source: Melbourne Water, drainage, properties, contours, 2022. GHD, RORB Layers, 2022. Created by:



Melway Map 57 K11

LEGEND

- Glen Eira Boundary
- Properties
- 5 m Ground Contours
- RORB Subarea
- RORB Node
- RORB Reach

Scale 1:10,000 at A3

0 100 200 300 400 Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME

SHAKESPEARE GROVE MAIN DRAIN RORB MODEL LAYOUT

Project No. **12563171**
Revision No. **0**
Date **16/06/2023**

FIGURE A.12

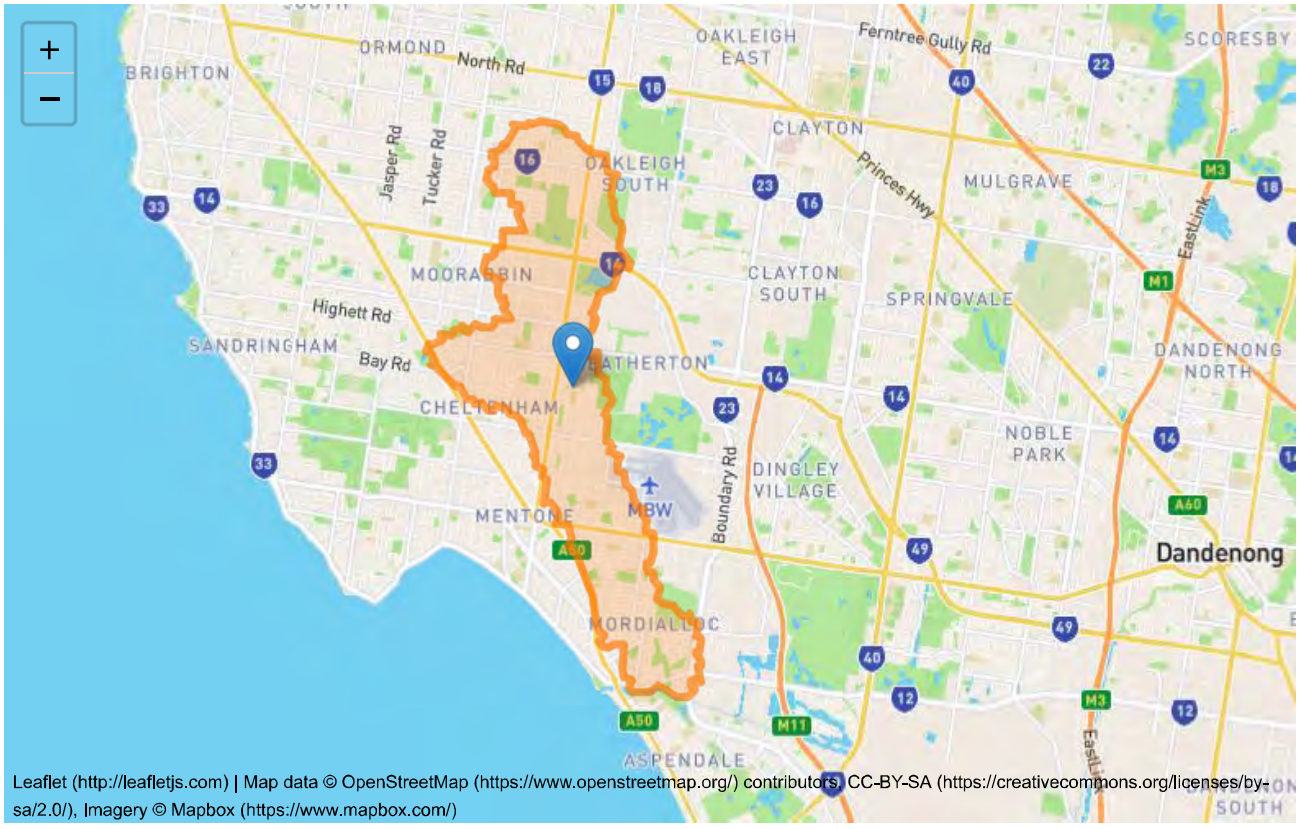
G:\31\12563171\Fig\A.12 RORB Sha.WOR

Data source: Melbourne Water, drainage, properties, contours, 2022. GHD, RORB Layers, 2022. Created by:

Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	145.079
Latitude	-37.96
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Interim Climate Change Factors	show



Data

River Region

Division	South East Coast (Victoria)
River Number	5
River Name	Bunyip River
Shape Intersection (%)	100.0

Layer Info

Time Accessed	19 January 2022 05:41PM
Version	2016_v1

ARF Parameters

$$ARF = Min\left\{1, \left[1 - a\left(Area^{b} - c\log_{10}Duration\right)Duration^{-d} + eArea^{f}Duration^{g}\left(0.3 + \log_{10}AEP\right) + h10^{iArea\frac{Duration}{1440}}\left(0.3 + \log_{10}AEP\right)\right]\right\}$$

Zone	a	b	c	d	e	f	g	h	i	Shape Intersection (%)
Southern Temperate	0.158	0.276	0.372	0.315	0.000141	0.41	0.15	0.01	-0.0027	100.0

Short Duration ARF

$$ARF = Min\left[1, 1 - 0.287\left(Area^{0.265} - 0.439\log_{10}(Duration)\right).Duration^{-0.36} + 2.26\ \text{x}\ 10^{-3}\ \text{x}\ Area^{0.226}.Duration^{0.125}\left(0.3 + \log_{10}(AEP)\right) + 0.0141\ \text{x}\ Area^{0.213}\ \text{x}\ 10^{-0.021\frac{(Duration-180)^2}{1440}}\left(0.3 + \log_{10}(AEP)\right)\right]$$

Layer Info

Time Accessed	19 January 2022 05:41PM
Version	2016_v1

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

Storm Initial Losses (mm)	26.0
Storm Continuing Losses (mm/h)	4.4

Layer Info

Time Accessed	19 January 2022 05:41PM
Version	2016_v1

Temporal Patterns | Download (.zip) (static/temporal_patterns/TP/SSmainland.zip)

code	SSmainland
Label	Southern Slopes (Vic/NSW)
Shape Intersection (%)	100.0

Layer Info

Time Accessed	19 January 2022 05:41PM
Version	2016_v2

Areal Temporal Patterns | Download (.zip) (./static/temporal_patterns/Areal/Areal_SSmainland.zip)

code	SSmainland
arealabel	Southern Slopes (Vic/NSW)
Shape Intersection (%)	100.0

Layer Info

Time Accessed	19 January 2022 05:41PM
Version	2016_v2

BOM IFDs

Click here (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-37.9602149844&longitude=145.078846353&sdmin=true&sdhr=true&sdday=true&user_label=) to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

Time Accessed	19 January 2022 05:41PM

Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	3.2 (0.173)	2.8 (0.111)	2.5 (0.084)	2.2 (0.063)	1.6 (0.039)	1.1 (0.024)
90 (1.5)	2.3 (0.108)	2.6 (0.091)	2.8 (0.083)	2.9 (0.076)	2.3 (0.050)	1.8 (0.035)
120 (2.0)	2.4 (0.100)	2.4 (0.077)	2.4 (0.066)	2.4 (0.058)	1.6 (0.033)	1.0 (0.019)
180 (3.0)	1.9 (0.072)	2.2 (0.063)	2.4 (0.058)	2.5 (0.054)	3.1 (0.057)	3.6 (0.058)
360 (6.0)	2.1 (0.062)	3.0 (0.068)	3.6 (0.071)	4.1 (0.072)	4.7 (0.070)	5.2 (0.068)
720 (12.0)	0.2 (0.004)	1.0 (0.018)	1.6 (0.025)	2.1 (0.029)	4.0 (0.046)	5.4 (0.055)
1080 (18.0)	0.0 (0.000)	0.5 (0.008)	0.9 (0.012)	1.2 (0.014)	1.7 (0.017)	2.0 (0.018)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.7 (0.007)	1.3 (0.010)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	19 January 2022 05:41PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	19 January 2022 05:41PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.002)	0.0 (0.001)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.1 (0.001)	0.1 (0.002)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	19 January 2022 05:41PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	11.3 (0.603)	12.9 (0.518)	14.0 (0.474)	15.0 (0.438)	11.6 (0.283)	9.0 (0.195)
90 (1.5)	9.5 (0.443)	11.5 (0.408)	12.9 (0.388)	14.2 (0.369)	13.7 (0.299)	13.3 (0.258)
120 (2.0)	11.8 (0.499)	13.2 (0.426)	14.1 (0.389)	15.0 (0.359)	14.6 (0.296)	14.3 (0.258)
180 (3.0)	10.5 (0.390)	12.2 (0.348)	13.3 (0.326)	14.4 (0.307)	17.3 (0.315)	19.5 (0.317)
360 (6.0)	8.7 (0.260)	12.5 (0.287)	15.0 (0.297)	17.4 (0.301)	19.9 (0.294)	21.8 (0.288)
720 (12.0)	3.1 (0.075)	8.3 (0.151)	11.7 (0.183)	14.9 (0.205)	19.2 (0.223)	22.4 (0.231)
1080 (18.0)	2.7 (0.058)	6.8 (0.108)	9.4 (0.129)	12.0 (0.143)	14.7 (0.146)	16.7 (0.148)
1440 (24.0)	2.2 (0.043)	5.4 (0.078)	7.5 (0.093)	9.6 (0.103)	10.6 (0.095)	11.4 (0.091)
2160 (36.0)	0.9 (0.015)	1.5 (0.019)	1.9 (0.021)	2.3 (0.022)	3.6 (0.028)	4.6 (0.031)
2880 (48.0)	0.0 (0.000)	0.3 (0.003)	0.5 (0.005)	0.6 (0.005)	1.4 (0.010)	2.0 (0.012)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.2 (0.001)	0.3 (0.002)

Layer Info

Time Accessed	19 January 2022 05:41PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	23.2 (1.239)	27.7 (1.115)	30.8 (1.046)	33.7 (0.984)	28.8 (0.706)	25.2 (0.544)
90 (1.5)	19.9 (0.925)	22.6 (0.799)	24.5 (0.735)	26.2 (0.681)	26.8 (0.587)	27.2 (0.529)
120 (2.0)	24.2 (1.024)	28.0 (0.905)	30.5 (0.843)	33.0 (0.790)	44.2 (0.897)	52.6 (0.951)
180 (3.0)	22.0 (0.816)	27.5 (0.785)	31.1 (0.763)	34.7 (0.740)	40.3 (0.733)	44.5 (0.723)
360 (6.0)	20.2 (0.603)	24.4 (0.560)	27.1 (0.536)	29.7 (0.516)	36.1 (0.533)	40.9 (0.539)
720 (12.0)	22.2 (0.532)	25.3 (0.462)	27.3 (0.428)	29.2 (0.402)	34.1 (0.396)	37.8 (0.391)
1080 (18.0)	17.6 (0.373)	19.4 (0.310)	20.6 (0.281)	21.7 (0.259)	26.2 (0.262)	29.6 (0.262)
1440 (24.0)	12.5 (0.243)	17.3 (0.251)	20.5 (0.253)	23.6 (0.253)	25.1 (0.225)	26.2 (0.208)
2160 (36.0)	14.4 (0.250)	14.9 (0.190)	15.3 (0.164)	15.7 (0.145)	24.1 (0.186)	30.4 (0.208)
2880 (48.0)	9.4 (0.151)	7.6 (0.088)	6.4 (0.063)	5.3 (0.044)	11.5 (0.081)	16.1 (0.100)
4320 (72.0)	1.0 (0.015)	2.0 (0.021)	2.6 (0.023)	3.2 (0.024)	14.8 (0.093)	23.6 (0.131)

Layer Info

Time Accessed	19 January 2022 05:41PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

Interim Climate Change Factors

	RCP 4.5	RCP6	RCP 8.5
2030	**0.648 (3.2%)**	0.687 (3.4%)	**0.811 (4.0%)**
2040	**0.878 (4.4%)**	0.827 (4.1%)	**1.084 (5.4%)**
2050	**1.081 (5.4%)**	1.013 (5.1%)	**1.446 (7.3%)**
2060	**1.251 (6.3%)**	1.229 (6.2%)	**1.862 (9.5%)**
2070	**1.381 (7.0%)**	1.460 (7.4%)	**2.298 (11.9%)**
2080	**1.465 (7.4%)**	1.691 (8.6%)	**2.719 (14.2%)**
2090	**1.496 (7.6%)**	1.906 (9.7%)	**3.090 (16.3%)**

Layer Info

Time Accessed	19 January 2022 05:41PM
Version	2019_v1
Note	ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

Download TXT (downloads/2480de44-654a-408b-8d6f-6d3989e6504f.txt)

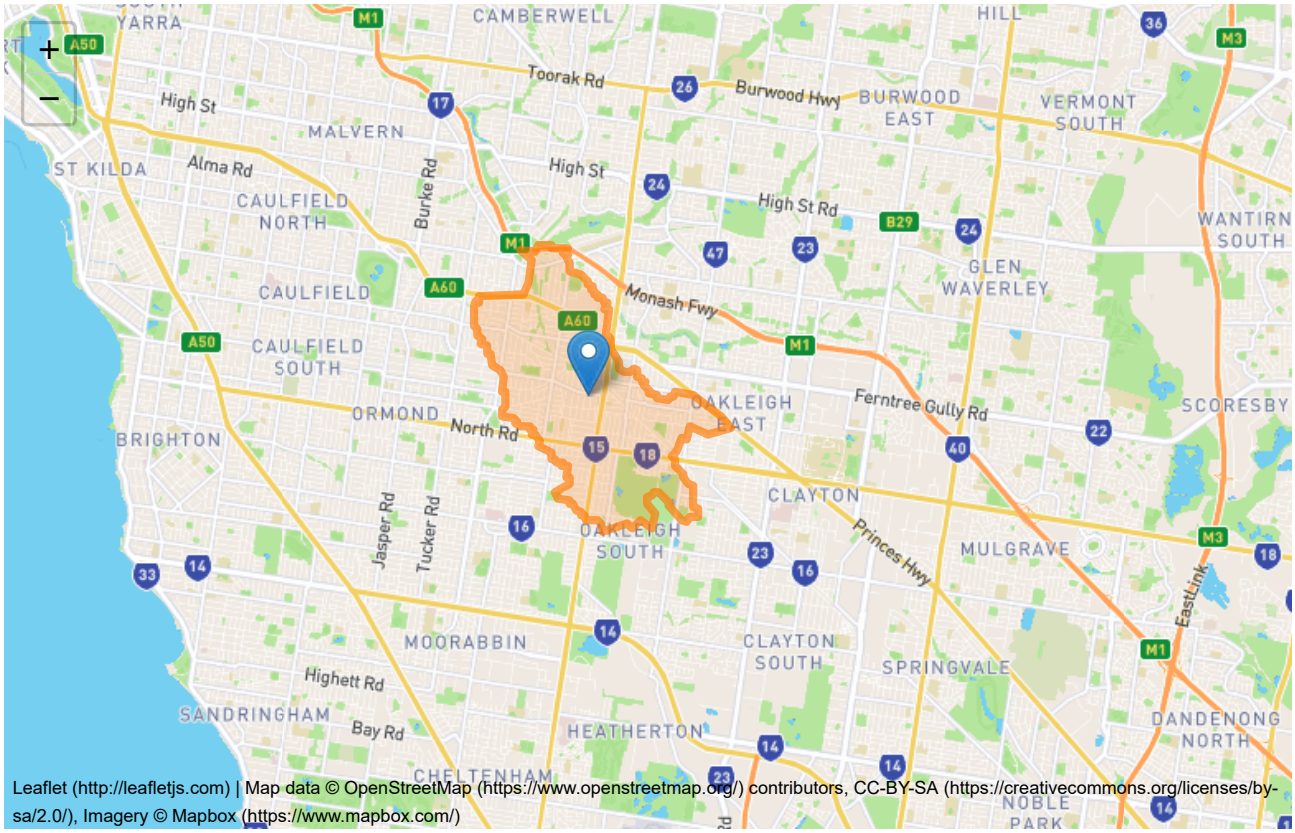
Download JSON (downloads/fa7f0494-413e-49b3-b8b8-fe1bb2ac74ad.json)

Generating PDF... (downloads/f77cd1d1-5cda-4307-bc87-a4a183a11164.pdf)

Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	145.083
Latitude	-37.901
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Interim Climate Change Factors	show



Data

River Region

Division	South East Coast (Victoria)
River Number	5
River Name	Bunyip River
Shape Intersection (%)	56.0

Layer Info

Time Accessed	13 January 2022 10:19AM
Version	2016_v1

ARF Parameters

$$ARF = Min\left\{1, \left[1 - a\left(Area^{b} - c\log_{10}Duration\right)Duration^{-d} + eArea^{f}Duration^{g}\left(0.3 + \log_{10}AEP\right) + h10^{iArea\frac{Duration}{1440}}\left(0.3 + \log_{10}AEP\right)\right]\right\}$$

Zone	a	b	c	d	e	f	g	h	i	Shape Intersection (%)
Southern Temperate	0.158	0.276	0.372	0.315	0.000141	0.41	0.15	0.01	-0.0027	100.0

Short Duration ARF

$$ARF = Min\left[1, 1 - 0.287\left(Area^{0.265} - 0.439\log_{10}(Duration)\right).Duration^{-0.36} + 2.26\ \text{x}\ 10^{-3}\ \text{x}\ Area^{0.226}.Duration^{0.125}\left(0.3 + \log_{10}(AEP)\right) + 0.0141\ \text{x}\ Area^{0.213}\ \text{x}\ 10^{-0.021\frac{(Duration-180)^2}{1440}}\left(0.3 + \log_{10}(AEP)\right)\right]$$

Layer Info

Time Accessed	13 January 2022 10:19AM
Version	2016_v1

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

Storm Initial Losses (mm)	20.0
Storm Continuing Losses (mm/h)	3.3

Layer Info

Time Accessed	13 January 2022 10:19AM
Version	2016_v1

Temporal Patterns | Download (.zip) (static/temporal_patterns/TP/SSmainland.zip)

code	SSmainland
Label	Southern Slopes (Vic/NSW)
Shape Intersection (%)	100.0

Layer Info

Time Accessed	13 January 2022 10:19AM
Version	2016_v2

Areal Temporal Patterns | Download (.zip) (./static/temporal_patterns/Areal/Areal_SSmainland.zip)

code	SSmainland
arealabel	Southern Slopes (Vic/NSW)
Shape Intersection (%)	100.0

Layer Info

Time Accessed	13 January 2022 10:19AM
Version	2016_v2

BOM IFDs

Click here (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-37.901266825&longitude=145.083447397&sdmin=true&sdhr=true&sdday=true&user_label=) to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

Time Accessed	13 January 2022 10:19AM

Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	3.5 (0.190)	2.9 (0.118)	2.5 (0.086)	2.2 (0.063)	1.6 (0.038)	1.1 (0.024)
90 (1.5)	3.3 (0.158)	2.9 (0.105)	2.7 (0.081)	2.4 (0.063)	2.1 (0.045)	1.8 (0.034)
120 (2.0)	3.7 (0.161)	3.1 (0.103)	2.8 (0.077)	2.4 (0.058)	1.6 (0.033)	1.1 (0.019)
180 (3.0)	3.0 (0.114)	2.8 (0.079)	2.6 (0.063)	2.4 (0.051)	3.8 (0.068)	4.8 (0.077)
360 (6.0)	1.9 (0.056)	2.4 (0.055)	2.7 (0.053)	3.0 (0.052)	4.6 (0.068)	5.8 (0.076)
720 (12.0)	0.2 (0.005)	1.3 (0.023)	2.0 (0.031)	2.7 (0.037)	4.8 (0.055)	6.3 (0.064)
1080 (18.0)	0.0 (0.000)	0.6 (0.009)	1.0 (0.013)	1.3 (0.016)	2.6 (0.025)	3.5 (0.030)
1440 (24.0)	0.0 (0.000)	0.3 (0.004)	0.5 (0.006)	0.6 (0.007)	0.6 (0.005)	0.6 (0.005)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.1 (0.000)	0.1 (0.001)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	13 January 2022 10:19AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	13 January 2022 10:19AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.002)	0.0 (0.001)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.1 (0.002)	0.0 (0.001)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.001)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.1 (0.002)	0.2 (0.003)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	13 January 2022 10:19AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	11.0 (0.603)	12.6 (0.512)	13.6 (0.465)	14.6 (0.426)	11.4 (0.277)	9.0 (0.192)
90 (1.5)	10.6 (0.506)	12.2 (0.435)	13.2 (0.399)	14.2 (0.368)	13.7 (0.298)	13.3 (0.256)
120 (2.0)	16.6 (0.718)	15.9 (0.520)	15.4 (0.429)	15.0 (0.359)	14.6 (0.295)	14.4 (0.256)
180 (3.0)	11.6 (0.438)	12.5 (0.359)	13.0 (0.320)	13.5 (0.289)	17.4 (0.314)	20.3 (0.326)
360 (6.0)	13.0 (0.390)	15.5 (0.357)	17.1 (0.338)	18.6 (0.322)	20.1 (0.294)	21.2 (0.276)
720 (12.0)	6.6 (0.158)	9.7 (0.177)	11.8 (0.183)	13.7 (0.187)	19.8 (0.227)	24.3 (0.248)
1080 (18.0)	2.6 (0.055)	6.1 (0.096)	8.4 (0.112)	10.6 (0.124)	15.0 (0.148)	18.4 (0.160)
1440 (24.0)	4.6 (0.088)	5.2 (0.074)	5.5 (0.067)	5.9 (0.062)	9.6 (0.084)	12.3 (0.096)
2160 (36.0)	0.1 (0.002)	1.4 (0.017)	2.2 (0.023)	3.0 (0.027)	7.3 (0.055)	10.5 (0.070)
2880 (48.0)	0.0 (0.000)	0.5 (0.006)	0.8 (0.008)	1.1 (0.009)	2.5 (0.017)	3.5 (0.021)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.5 (0.003)	0.8 (0.004)

Layer Info

Time Accessed	13 January 2022 10:19AM
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Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	24.7 (1.348)	27.6 (1.122)	29.5 (1.008)	31.3 (0.916)	27.8 (0.675)	25.2 (0.536)
90 (1.5)	26.0 (1.235)	26.1 (0.932)	26.1 (0.790)	26.2 (0.680)	26.8 (0.584)	27.3 (0.524)
120 (2.0)	35.3 (1.525)	34.3 (1.122)	33.6 (0.934)	33.0 (0.790)	44.5 (0.896)	53.1 (0.946)
180 (3.0)	27.4 (1.035)	29.7 (0.855)	31.1 (0.766)	32.6 (0.695)	39.8 (0.719)	45.3 (0.726)
360 (6.0)	20.3 (0.609)	26.3 (0.606)	30.2 (0.597)	33.9 (0.587)	45.1 (0.660)	53.5 (0.696)
720 (12.0)	16.9 (0.403)	22.0 (0.399)	25.3 (0.393)	28.5 (0.388)	35.1 (0.402)	40.1 (0.408)
1080 (18.0)	12.1 (0.251)	16.3 (0.257)	19.2 (0.257)	21.9 (0.257)	28.2 (0.276)	32.8 (0.286)
1440 (24.0)	17.9 (0.341)	20.0 (0.284)	21.3 (0.257)	22.6 (0.238)	27.6 (0.243)	31.4 (0.244)
2160 (36.0)	3.8 (0.064)	8.6 (0.106)	11.8 (0.123)	14.8 (0.134)	23.8 (0.180)	30.5 (0.204)
2880 (48.0)	2.6 (0.041)	6.0 (0.068)	8.3 (0.079)	10.5 (0.086)	20.9 (0.143)	28.7 (0.174)
4320 (72.0)	3.1 (0.044)	5.5 (0.056)	7.1 (0.060)	8.6 (0.063)	16.2 (0.099)	21.9 (0.118)

Layer Info

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Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

Interim Climate Change Factors

	RCP 4.5	RCP6	**RCP 8.5**
2030	**0.648 (3.2%)**	0.687 (3.4%)	**0.811 (4.0%)**
2040	**0.878 (4.4%)**	0.827 (4.1%)	**1.084 (5.4%)**
2050	**1.081 (5.4%)**	1.013 (5.1%)	**1.446 (7.3%)**
2060	**1.251 (6.3%)**	1.229 (6.2%)	**1.862 (9.5%)**
2070	**1.381 (7.0%)**	1.460 (7.4%)	**2.298 (11.9%)**
2080	**1.465 (7.4%)**	1.691 (8.6%)	**2.719 (14.2%)**
2090	**1.496 (7.6%)**	1.906 (9.7%)	**3.090 (16.3%)**

Layer Info

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Note	ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

Download TXT (downloads/9443ea65-4811-412b-9082-9786a23cb81c.txt)

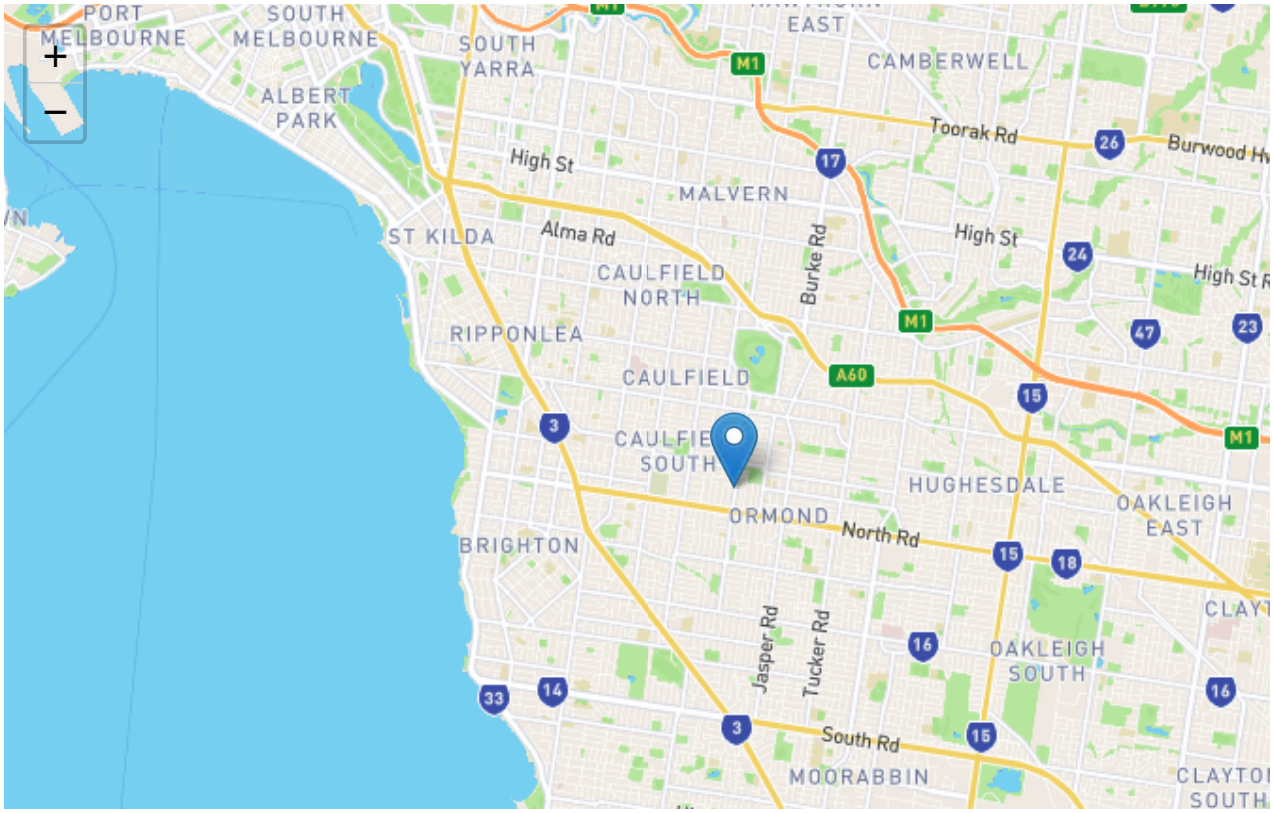
Download JSON (downloads/dd269105-1724-4923-9d01-49643025f9ea.json)

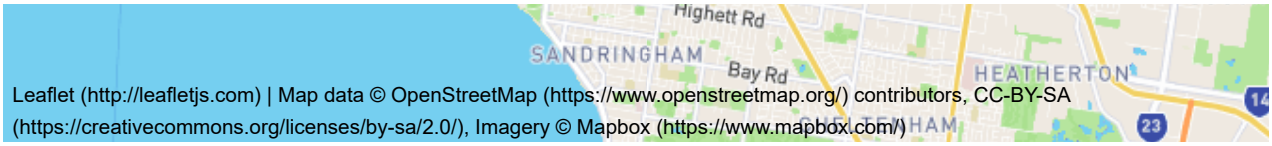
Generating PDF... (downloads/ed50c0a3-2018-46c7-a251-09201348c2a1.pdf)

Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	145.035
Latitude	-37.9
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Interim Climate Change Factors	show





Data

River Region

Division	South East Coast (Victoria)
River Number	5
River Name	Bunyip River

Layer Info

Time Accessed	29 August 2022 11:29AM
Version	2016_v1

ARF Parameters

$$ARF = Min\left\{1, \left[1 - a\left(Area^{b} - c\log_{10}Duration\right)Duration^{-d} + eArea^{f}Duration^{g}\left(0.3 + \log_{10}AEP\right) + h10^{iArea\frac{Duration}{1440}}\left(0.3 + \log_{10}AEP\right)\right]\right\}$$

Zone	a	b	c	d	e	f	g	h	i
Southern Temperate	0.158	0.276	0.372	0.315	0.000141	0.41	0.15	0.01	-0.0027

Short Duration ARF

$$ARF = Min\left[1, 1 - 0.287\left(Area^{0.265} - 0.439\log_{10}(Duration)\right).Duration^{-0.36} + 2.26\ \text{x}\ 10^{-3}\ \text{x}\ Area^{0.226}.Duration^{0.125}\left(0.3 + \log_{10}(AEP)\right) + 0.0141\ \text{x}\ Area^{0.213}\ \text{x}\ 10^{-0.021\frac{(Duration-180)^2}{1440}}\left(0.3 + \log_{10}(AEP)\right)\right]$$

Layer Info

Time Accessed	29 August 2022 11:29AM
Version	2016_v1

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

Note: As this point is in Victoria the advice provided on losses and pre-burst in the VIC specific tab of the ARR Data Hub should be considered.

ID	8741.0
Storm Initial Losses (mm)	12.0
Storm Continuing Losses (mm/h)	1.9

Layer Info

Time Accessed	29 August 2022 11:29AM
Version	2016_v1

Temporal Patterns | Download (.zip) (static/temporal_patterns/TP/SSmainland.zip)

code	SSmainland
Label	Southern Slopes (Vic/NSW)

Layer Info

Time Accessed	29 August 2022 11:29AM
Version	2016_v2

Areal Temporal Patterns | Download (.zip) (./static/temporal_patterns/Areal/Areal_SSmainland.zip)

code	SSmainland
arealabel	Southern Slopes (Vic/NSW)

Layer Info

Time Accessed	29 August 2022 11:29AM
Version	2016_v2

BOM IFDs

Click here (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-37.9&longitude=145.035&sdmin=true&sdhr=true&sdday=true&user_label=) to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

Time Accessed	29 August 2022 11:29AM

Median Preburst Depths and Ratios

Note: As this point is in Victoria the advice provided on losses and pre-burst in the VIC specific tab of the ARR Data Hub should be considered.

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	3.5 (0.190)	2.9 (0.117)	2.5 (0.085)	2.1 (0.061)	1.5 (0.037)	1.1 (0.024)
90 (1.5)	3.3 (0.158)	3.2 (0.113)	3.0 (0.092)	2.9 (0.076)	2.1 (0.046)	1.5 (0.029)
120 (2.0)	3.9 (0.170)	3.3 (0.107)	2.8 (0.079)	2.4 (0.058)	1.7 (0.035)	1.2 (0.021)
180 (3.0)	3.0 (0.114)	2.9 (0.084)	2.8 (0.070)	2.7 (0.059)	4.2 (0.076)	5.3 (0.084)
360 (6.0)	2.2 (0.066)	2.7 (0.062)	3.0 (0.060)	3.4 (0.058)	4.8 (0.071)	6.0 (0.077)
720 (12.0)	0.1 (0.002)	1.0 (0.018)	1.6 (0.025)	2.2 (0.030)	4.1 (0.047)	5.6 (0.057)
1080 (18.0)	0.0 (0.000)	0.3 (0.005)	0.5 (0.007)	0.7 (0.009)	1.6 (0.015)	2.2 (0.019)
1440 (24.0)	0.0 (0.000)	0.2 (0.003)	0.4 (0.004)	0.5 (0.005)	0.6 (0.005)	0.6 (0.005)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.1 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	29 August 2022 11:29AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	29 August 2022 11:29AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.1 (0.005)	0.1 (0.002)	0.0 (0.001)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.1 (0.003)	0.0 (0.001)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.1 (0.002)	0.2 (0.003)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	29 August 2022 11:29AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	11.1 (0.606)	12.8 (0.521)	13.9 (0.476)	15.0 (0.438)	11.7 (0.282)	9.2 (0.194)
90 (1.5)	10.6 (0.504)	12.2 (0.436)	13.2 (0.400)	14.2 (0.369)	14.1 (0.305)	14.0 (0.266)
120 (2.0)	14.9 (0.644)	14.9 (0.490)	15.0 (0.417)	15.0 (0.360)	14.8 (0.297)	14.6 (0.259)
180 (3.0)	11.6 (0.438)	12.8 (0.371)	13.6 (0.337)	14.4 (0.309)	19.0 (0.342)	22.5 (0.358)
360 (6.0)	9.5 (0.286)	13.3 (0.308)	15.8 (0.314)	18.2 (0.315)	20.7 (0.303)	22.6 (0.293)
720 (12.0)	6.0 (0.144)	9.8 (0.179)	12.4 (0.193)	14.8 (0.202)	18.5 (0.213)	21.4 (0.217)
1080 (18.0)	6.2 (0.129)	8.3 (0.130)	9.6 (0.129)	10.9 (0.128)	14.6 (0.143)	17.3 (0.151)
1440 (24.0)	3.7 (0.071)	5.5 (0.079)	6.7 (0.081)	7.9 (0.083)	10.2 (0.090)	11.9 (0.093)
2160 (36.0)	0.0 (0.000)	1.9 (0.023)	3.1 (0.032)	4.3 (0.039)	4.9 (0.037)	5.3 (0.035)
2880 (48.0)	0.0 (0.000)	0.5 (0.006)	0.9 (0.009)	1.3 (0.010)	2.0 (0.014)	2.6 (0.016)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.5 (0.003)	0.9 (0.005)

Layer Info

Time Accessed	29 August 2022 11:29AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	23.4 (1.275)	26.9 (1.097)	29.3 (1.002)	31.5 (0.921)	28.2 (0.681)	25.6 (0.542)
90 (1.5)	23.6 (1.122)	24.8 (0.887)	25.5 (0.773)	26.2 (0.682)	27.1 (0.588)	27.8 (0.530)
120 (2.0)	29.1 (1.258)	30.8 (1.012)	32.0 (0.890)	33.0 (0.792)	45.0 (0.903)	53.9 (0.954)
180 (3.0)	31.7 (1.200)	32.7 (0.947)	33.4 (0.823)	34.0 (0.727)	41.5 (0.746)	47.1 (0.749)
360 (6.0)	20.4 (0.612)	26.3 (0.610)	30.3 (0.601)	34.1 (0.589)	45.2 (0.660)	53.5 (0.693)
720 (12.0)	19.7 (0.471)	23.8 (0.433)	26.4 (0.413)	29.0 (0.396)	35.0 (0.401)	39.4 (0.401)
1080 (18.0)	21.1 (0.441)	21.2 (0.335)	21.3 (0.286)	21.3 (0.251)	26.8 (0.263)	30.8 (0.269)
1440 (24.0)	14.4 (0.274)	21.2 (0.301)	25.7 (0.311)	30.0 (0.316)	28.5 (0.251)	27.3 (0.213)
2160 (36.0)	6.0 (0.102)	10.1 (0.125)	12.8 (0.134)	15.4 (0.140)	25.0 (0.190)	32.3 (0.216)
2880 (48.0)	1.6 (0.025)	5.3 (0.060)	7.8 (0.074)	10.2 (0.083)	12.3 (0.084)	13.9 (0.084)
4320 (72.0)	0.9 (0.013)	2.5 (0.026)	3.6 (0.030)	4.6 (0.033)	16.2 (0.099)	24.9 (0.135)

Layer Info

Time Accessed	29 August 2022 11:29AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

Interim Climate Change Factors

	RCP 4.5	RCP6	**RCP 8.5**
2030	**0.648 (3.2%)**	0.687 (3.4%)	**0.811 (4.0%)**
2040	**0.878 (4.4%)**	0.827 (4.1%)	**1.084 (5.4%)**
2050	**1.081 (5.4%)**	1.013 (5.1%)	**1.446 (7.3%)**
2060	**1.251 (6.3%)**	1.229 (6.2%)	**1.862 (9.5%)**
2070	**1.381 (7.0%)**	1.460 (7.4%)	**2.298 (11.9%)**
2080	**1.465 (7.4%)**	1.691 (8.6%)	**2.719 (14.2%)**
2090	**1.496 (7.6%)**	1.906 (9.7%)	**3.090 (16.3%)**

Layer Info

Time Accessed	29 August 2022 11:29AM
Version	2019_v1
Note	ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

Download TXT (downloads/6b4c37a1-e8b6-4bb7-96eb-083945adf633.txt)

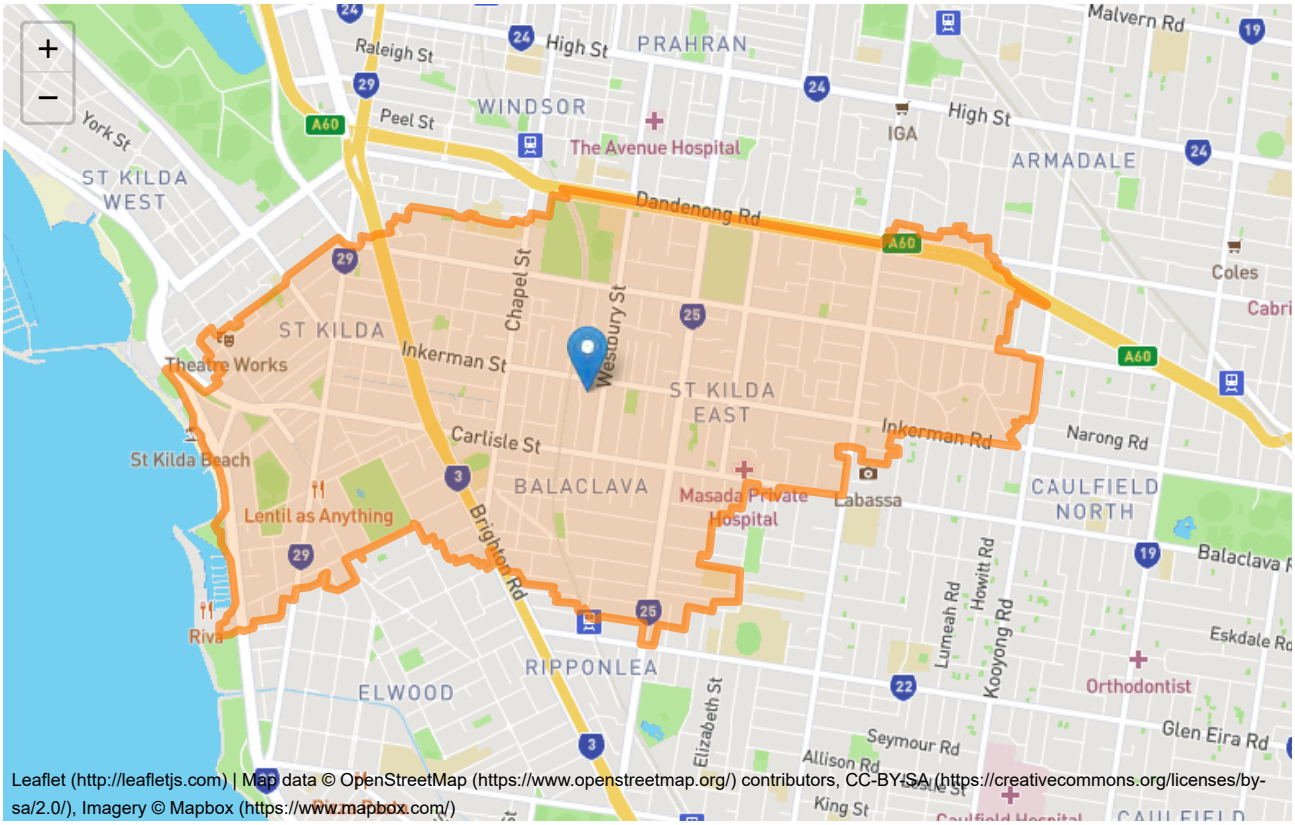
Download JSON (downloads/02604ea6-cca5-462d-b931-20f6c1c3bf82.json)

Generating PDF... (downloads/81120a61-7c58-4b80-994d-623ffe24c891.pdf)

Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	144.995
Latitude	-37.866
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Interim Climate Change Factors	show



Data

River Region

Division	South East Coast (Victoria)
River Number	6
River Name	Yarra River
Shape Intersection (%)	99.9

Layer Info

Time Accessed	15 July 2022 09:29AM
Version	2016_v1

ARF Parameters

$$ARF = Min\left\{1, \left[1 - a\left(Area^{b} - c\log_{10}Duration\right)Duration^{-d} + eArea^{f}Duration^{g}\left(0.3 + \log_{10}AEP\right) + h10^{iArea\frac{Duration}{1440}}\left(0.3 + \log_{10}AEP\right)\right]\right\}$$

Zone	a	b	c	d	e	f	g	h	i	Shape Intersection (%)
Southern Temperate	0.158	0.276	0.372	0.315	0.000141	0.41	0.15	0.01	-0.0027	100.0

Short Duration ARF

$$ARF = Min\left[1, 1 - 0.287\left(Area^{0.265} - 0.439\log_{10}(Duration)\right).Duration^{-0.36} + 2.26\ \text{x}\ 10^{-3}\ \text{x}\ Area^{0.226}.Duration^{0.125}\left(0.3 + \log_{10}(AEP)\right) + 0.0141\ \text{x}\ Area^{0.213}\ \text{x}\ 10^{-0.021\frac{(Duration-180)^2}{1440}}\left(0.3 + \log_{10}(AEP)\right)\right]$$

Layer Info

Time Accessed	15 July 2022 09:29AM
Version	2016_v1

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

Storm Initial Losses (mm)	12.0
Storm Continuing Losses (mm/h)	1.9

Layer Info

Time Accessed	15 July 2022 09:29AM
Version	2016_v1

Temporal Patterns | Download (.zip) (static/temporal_patterns/TP/SSmainland.zip)

code	SSmainland
Label	Southern Slopes (Vic/NSW)
Shape Intersection (%)	100.0

Layer Info

Time Accessed	15 July 2022 09:29AM
Version	2016_v2

Areal Temporal Patterns | Download (.zip) (./static/temporal_patterns/Areal/Areal_SSmainland.zip)

code	SSmainland
arealabel	Southern Slopes (Vic/NSW)
Shape Intersection (%)	100.0

Layer Info

Time Accessed	15 July 2022 09:29AM
Version	2016_v2

BOM IFDs

Click here (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-37.8663964451&longitude=144.995057315&sdmin=true&sdhr=true&sdday=true&user_label=) to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

Time Accessed	15 July 2022 09:29AM

Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	3.5 (0.194)	2.9 (0.119)	2.5 (0.085)	2.1 (0.061)	1.5 (0.037)	1.1 (0.024)
90 (1.5)	3.3 (0.161)	3.2 (0.115)	3.0 (0.093)	2.9 (0.076)	2.1 (0.046)	1.5 (0.029)
120 (2.0)	3.9 (0.174)	3.3 (0.109)	2.8 (0.080)	2.4 (0.058)	1.7 (0.034)	1.2 (0.021)
180 (3.0)	3.0 (0.116)	2.9 (0.085)	2.8 (0.070)	2.7 (0.059)	4.2 (0.075)	5.3 (0.083)
360 (6.0)	2.2 (0.067)	2.7 (0.063)	3.0 (0.061)	3.4 (0.058)	4.8 (0.070)	6.0 (0.076)
720 (12.0)	0.1 (0.002)	1.0 (0.018)	1.6 (0.025)	2.2 (0.029)	4.1 (0.047)	5.6 (0.056)
1080 (18.0)	0.0 (0.000)	0.3 (0.005)	0.5 (0.007)	0.7 (0.009)	1.6 (0.015)	2.2 (0.019)
1440 (24.0)	0.0 (0.000)	0.2 (0.003)	0.4 (0.004)	0.5 (0.005)	0.6 (0.005)	0.6 (0.005)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.1 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	15 July 2022 09:29AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	15 July 2022 09:29AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.1 (0.005)	0.1 (0.002)	0.0 (0.001)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.1 (0.003)	0.0 (0.001)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.1 (0.002)	0.2 (0.003)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	15 July 2022 09:29AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	11.1 (0.616)	12.8 (0.528)	13.9 (0.480)	15.0 (0.439)	11.7 (0.281)	9.2 (0.193)
90 (1.5)	10.6 (0.513)	12.2 (0.442)	13.2 (0.404)	14.2 (0.371)	14.1 (0.304)	14.0 (0.263)
120 (2.0)	14.9 (0.656)	14.9 (0.497)	15.0 (0.420)	15.0 (0.361)	14.8 (0.296)	14.6 (0.256)
180 (3.0)	11.6 (0.446)	12.8 (0.376)	13.6 (0.339)	14.4 (0.309)	19.0 (0.340)	22.5 (0.353)
360 (6.0)	9.5 (0.291)	13.3 (0.311)	15.8 (0.315)	18.2 (0.315)	20.7 (0.300)	22.6 (0.288)
720 (12.0)	6.0 (0.146)	9.8 (0.180)	12.4 (0.193)	14.8 (0.201)	18.5 (0.211)	21.4 (0.215)
1080 (18.0)	6.2 (0.131)	8.3 (0.130)	9.6 (0.129)	10.9 (0.128)	14.6 (0.142)	17.3 (0.149)
1440 (24.0)	3.7 (0.072)	5.5 (0.079)	6.7 (0.081)	7.9 (0.082)	10.2 (0.089)	11.9 (0.092)
2160 (36.0)	0.0 (0.000)	1.9 (0.023)	3.1 (0.032)	4.3 (0.039)	4.9 (0.037)	5.3 (0.035)
2880 (48.0)	0.0 (0.000)	0.5 (0.006)	0.9 (0.009)	1.3 (0.010)	2.0 (0.014)	2.6 (0.016)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.5 (0.003)	0.9 (0.005)

Layer Info

Time Accessed	15 July 2022 09:29AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	23.4 (1.297)	26.9 (1.111)	29.3 (1.010)	31.5 (0.924)	28.2 (0.679)	25.6 (0.537)
90 (1.5)	23.6 (1.143)	24.8 (0.900)	25.5 (0.779)	26.2 (0.684)	27.1 (0.586)	27.8 (0.524)
120 (2.0)	29.1 (1.283)	30.8 (1.026)	32.0 (0.897)	33.0 (0.795)	45.0 (0.899)	53.9 (0.943)
180 (3.0)	31.7 (1.223)	32.7 (0.960)	33.4 (0.830)	34.0 (0.728)	41.5 (0.741)	47.1 (0.740)
360 (6.0)	20.4 (0.624)	26.3 (0.616)	30.3 (0.604)	34.1 (0.589)	45.2 (0.654)	53.5 (0.683)
720 (12.0)	19.7 (0.478)	23.8 (0.435)	26.4 (0.413)	29.0 (0.394)	35.0 (0.398)	39.4 (0.396)
1080 (18.0)	21.1 (0.446)	21.2 (0.335)	21.3 (0.286)	21.3 (0.250)	26.8 (0.261)	30.8 (0.266)
1440 (24.0)	14.4 (0.277)	21.2 (0.302)	25.7 (0.310)	30.0 (0.315)	28.5 (0.249)	27.3 (0.211)
2160 (36.0)	6.0 (0.102)	10.1 (0.125)	12.8 (0.134)	15.4 (0.140)	25.0 (0.189)	32.3 (0.216)
2880 (48.0)	1.6 (0.025)	5.3 (0.060)	7.8 (0.074)	10.2 (0.083)	12.3 (0.084)	13.9 (0.085)
4320 (72.0)	0.9 (0.013)	2.5 (0.026)	3.6 (0.030)	4.6 (0.034)	16.2 (0.100)	24.9 (0.136)

Layer Info

Time Accessed	15 July 2022 09:29AM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

Interim Climate Change Factors

	RCP 4.5	RCP6	RCP 8.5
2030	**0.648 (3.2%)**	0.687 (3.4%)	**0.811 (4.0%)**
2040	**0.878 (4.4%)**	0.827 (4.1%)	**1.084 (5.4%)**
2050	**1.081 (5.4%)**	1.013 (5.1%)	**1.446 (7.3%)**
2060	**1.251 (6.3%)**	1.229 (6.2%)	**1.862 (9.5%)**
2070	**1.381 (7.0%)**	1.460 (7.4%)	**2.298 (11.9%)**
2080	**1.465 (7.4%)**	1.691 (8.6%)	**2.719 (14.2%)**
2090	**1.496 (7.6%)**	1.906 (9.7%)	**3.090 (16.3%)**

Layer Info

Time Accessed	15 July 2022 09:29AM
Version	2019_v1
Note	ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

Download TXT (downloads/eb5ef49e-41da-4f97-b859-679b39b0c164.txt)

Download JSON (downloads/7c074f6a-9202-4b1c-b273-fa617908e77a.json)

Generating PDF... (downloads/f899cd6a-8892-419f-8e5e-676b5dd5248e.pdf)

Appendix B

TUFLOW Modelling

Heatherton Drain TUFLOW Model Layout (Figure B.1)

Murrumbeena Drain TUFLOW Model Layout (Figure B.2 & Figure B.3 – 2 sheets)

Elwood Canal TUFLOW Model Layout (Figure B.4 to Figure B.10 – 7 sheets)

Monash Medical Centre

Centenary Park

YARRA YARRA GOLF CLUB

COMMONWEALTH GOLF CLUB

KARKAROOK PARK

Glen Eira Boundary
Properties
Code Boundary
PO Lines

2D Inflows
1D Inflows
2D Boundaries
1D Boundaries

MW Pits
MW Pipes
GECC Pits
GECC Pipes
Other Pits
Other Pipes

Melway Map 78 D7

Scale 1:10,000 at A3

0 100 200 300 400
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA
CITY COUNCIL PLANNING SCHEME

HEATHERTON DRAIN
TUFLOW MODEL LAYOUT

Project No. 12563171
Revision No. 0
Date 16/06/2023

FIGURE B.1

G:\31\12563171\FigB.1 TUFLOW Hea.WOR

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW Layers, 2022. Created by:

Glen Eira Boundary
Properties
Code Boundary
PO Lines

2D Inflows
1D Inflows
2D Boundaries
1D Boundaries

MW Pits
MW Pipes
GECC Pits
GECC Pipes
Other Pits
Other Pipes

Melway Map 69 D5

Scale 1:12,500 at A3

0 125 250 375 500
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

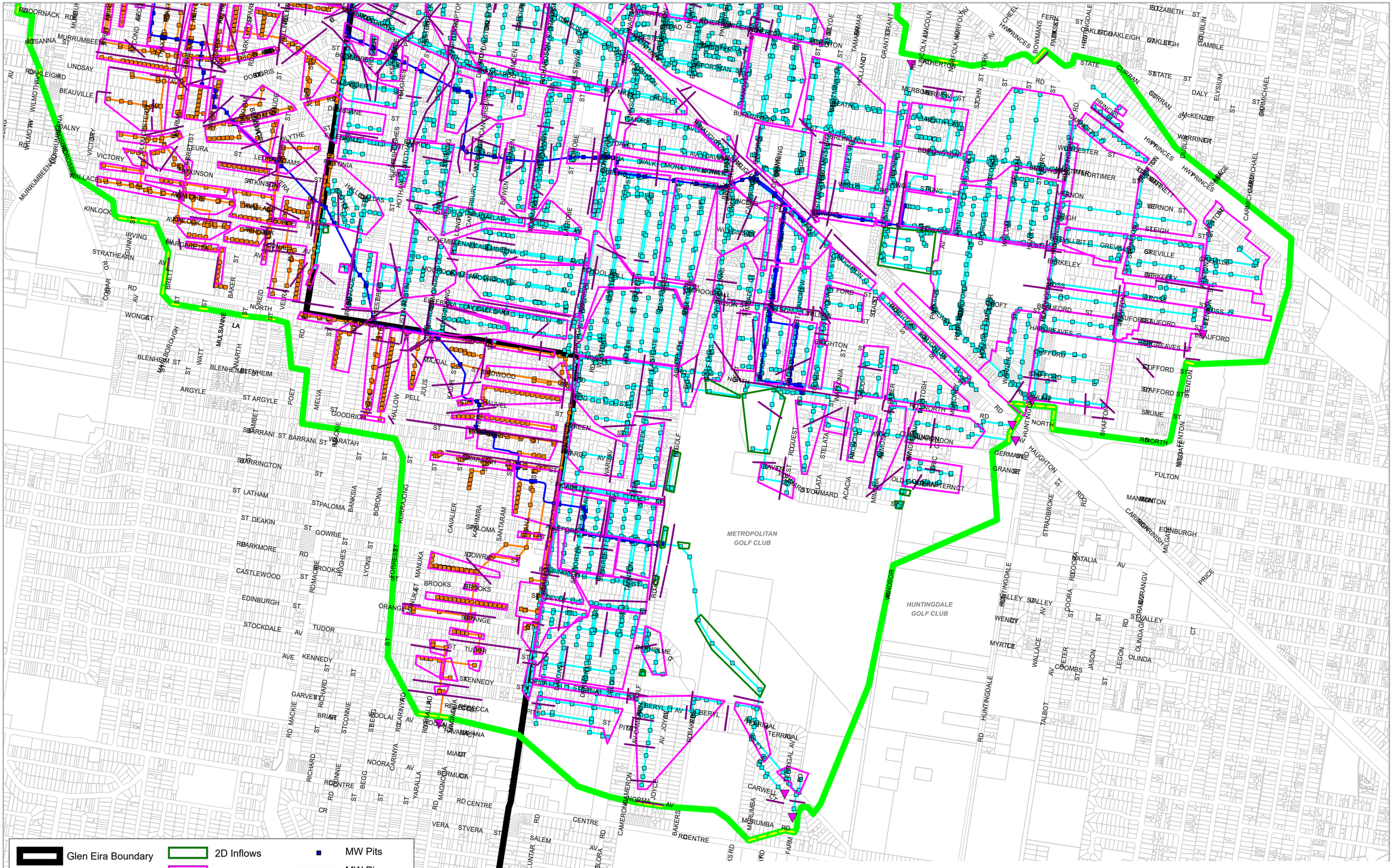
MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME
MURRUMBEENA DRAIN TUFLOW MODEL LAYOUT SHEET 1 OF 2

Project No. **12563171**
Revision No. **0**
Date **16/06/2023**

FIGURE B.2

G:\31\12563171\Fig\B.2 TUFLOW Mur.WOR

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW Layers, 2022. Created by:



Scale 1:12,500 at A3

0 125 250 375 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME

MURRUMBEENA DRAIN TUFLOW MODEL LAYOUT SHEET 2 OF 2

Project No. **12563171**
Revision No. **0**
Date **16/06/2023**

FIGURE B.3

G:\31\12563171\FigB.2 TUFLOW Mur.WOR

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW Layers, 2022. Created by:

Glen Eira Boundary
Properties
Code Boundary
PO Lines

2D Inflows
1D Inflows
2D Boundaries
1D Boundaries

MW Pits
MW Drains
GECC Pits
GECC Pipes
Other Pits
Other Pipes

Melway Map 67 F1

Scale 1:12,500 at A3

0 125 250 375 500
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA
CITY COUNCIL PLANNING SCHEME

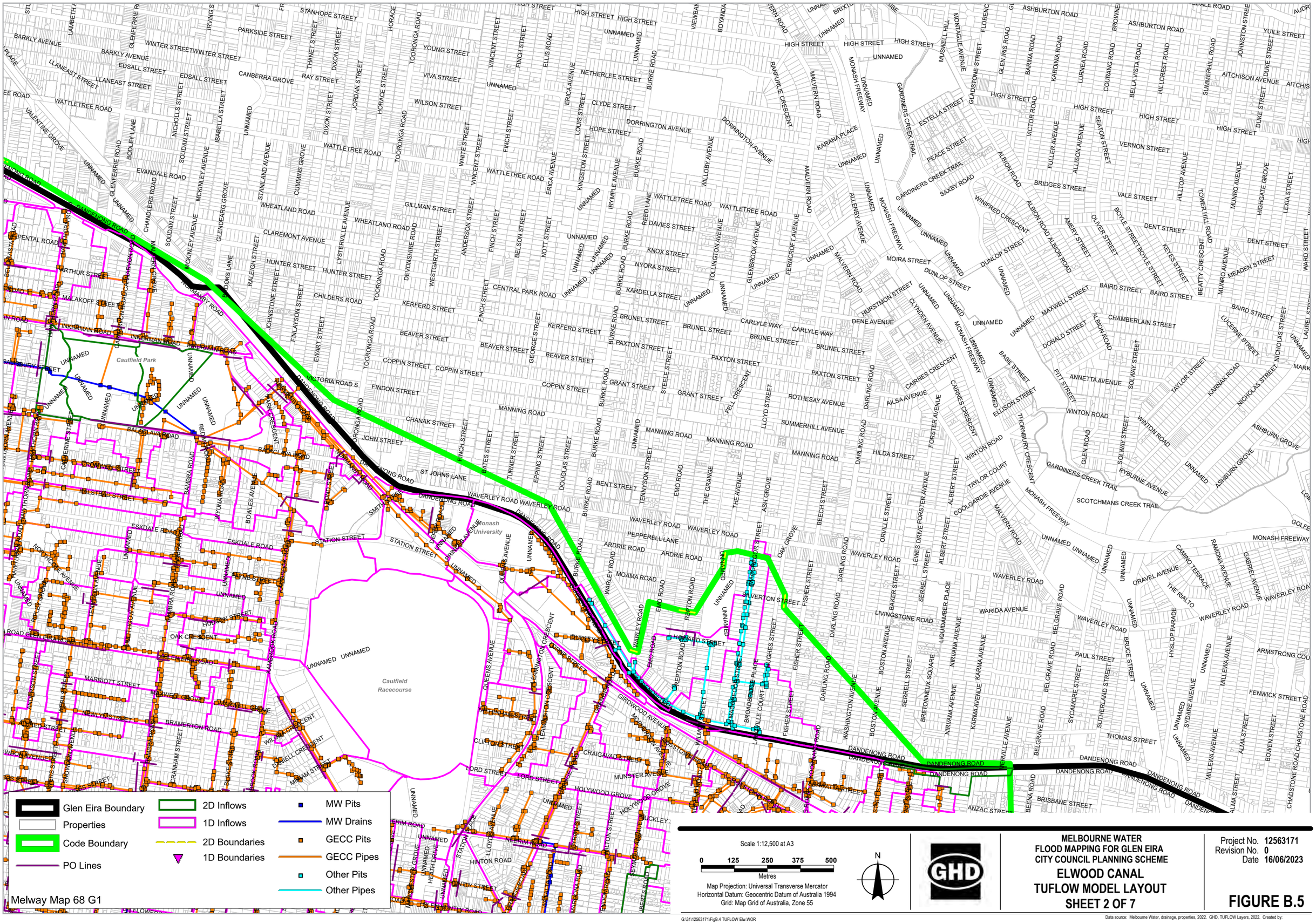
ELWOOD CANAL
TUFLOW MODEL LAYOUT
SHEET 1 OF 7

Project No. **12563171**
Revision No. **0**
Date **16/03/2023**

FIGURE B.4

G:\31\12563171\Fig\B.4 TUFLOW Elw.WOR

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW Layers, 2022. Created by:



Scale 1:12,500 at A3

0 125 250 375 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME

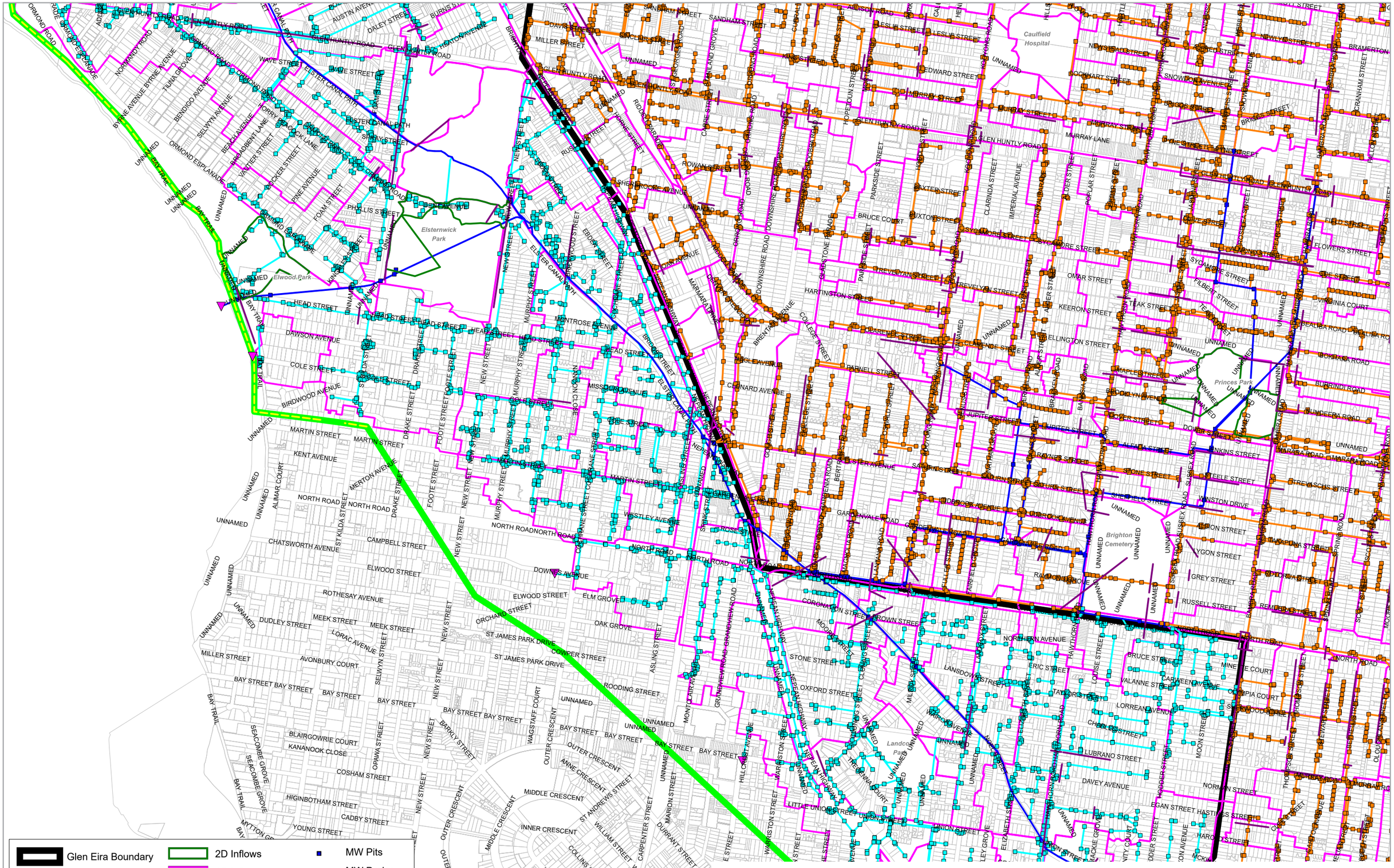
ELWOOD CANAL TUFLOW MODEL LAYOUT SHEET 2 OF 7

Project No. **12563171**
Revision No. **0**
Date **16/06/2023**

FIGURE B.5

G:\31\12563171\FigB.4 TUFLOW Elw.WOR

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW Layers, 2022. Created by:


Glen Eira Boundary
Properties
Code Boundary
PO Lines
2D Inflows
1D Inflows
2D Boundaries
1D Boundaries
MW Pits
MW Drains
GECC Pits
GECC Pipes
Other Pits
Other Pipes
Melway Map 67 G7
Elsternwick Park
Elwood Park
Caulfield Hospital
Princes Park
Brighton Cemetery
Landcare Park
BAY TRAIL
ELSTER CANAL PATH
GLEN HUNTLY ROAD
NORTH ROAD
ORMOND ESPLANADE
ORMOND ROAD
HEAD STREET
DAWSON AVENUE
COLE STREET
BIRDWOOD AVENUE
MARTIN STREET
KENT AVENUE
NORTH ROAD
CHATSWORTH AVENUE
ELWOOD STREET
ROTHESAY AVENUE
MEEK STREET
DUDLEY STREET
MILLER STREET
AVONBURY COURT
BAY STREET
BLAIRGOWRIE COURT
KANANOOK CLOSE
COSHAM STREET
HIGINBOTHAM STREET
CADBY STREET
YOUNG STREET
ST JAMES PARK DRIVE
COWPER STREET
ROODING STREET
WESTLEY AVENUE
DOWNES AVENUE
ELM GROVE
OAK GROVE
ORCHARD STREET
CORONATION STREET
BROWN STREET
STONE STREET
OXFORD STREET
NORTHERN AVENUE
LANSDOWNE STREET
DAVEY AVENUE
EGAN STREET
HASTINGS STREET
NORMAN STREET
LUBRANO STREET
TRECENNA COURT
LITTLE UNION STREET
UNION STREET
INNER CRESCENT
MIDDLE CRESCENT
OUTER CRESCENT
ANNE CRESCENT
WILLIAM STREET
COLLINS STREET
WILSON STREET
CARPENTER STREET
DURRANT STREET
MARION STREET
ST ANDREWS STREET
LINDSAY STREET
BOXSHALL STREET
BLACK STREET
Scale 1:12,500 at A3
0 125 250 375 500
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55
N
GHD
MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA
CITY COUNCIL PLANNING SCHEME
ELWOOD CANAL
TUFLOW MODEL LAYOUT
SHEET 3 OF 7
Project No. 12563171
Revision No. 0
Date 16/06/2023
FIGURE B.6
G:\31\12563171\FigB.4 TUFLOW Elw.WOR
Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW Layers, 2022. Created by:


Glen Eira Boundary
Properties
Code Boundary
PO Lines
2D Inflows
1D Inflows
2D Boundaries
1D Boundaries
MW Pits
MW Drains
GECC Pits
GECC Pipes
Other Pits
Other Pipes
Melway Map 68 G7
Lord Reserve
Koornang Park
EE Gunn Reserve
Packer Park
Joyce Park
Duncan Mackinnon Reserve
McKinnon Secondary College
DANDENONG ROAD
NEERIM ROAD
NORTH ROAD
OAKLEIGH ROAD
MURRUMBEENA ROAD
KANGAROO ROAD
GLEN HUNTLY ROAD
MUNRO AVENUE
LYONS STREET
MORGAN STREET
PARK AVENUE
MACKAY AVENUE
WATTLE AVENUE
CENTRE ROAD
HOLLOWAY STREET
WIMMERA STREET
LEILA ROAD
WALLEN ROAD
LIBNA STREET
PORTLAND STREET
LORD STREET
PRESTON STREET
SHREWSBURY
SHELLEY STREET
MOLDEN STREET
LORAN AVENUE
WALNUT STREET
BLACKSHAW STREET
HUDSON STREET
LANGSHAW STREET
ELWYN
Scale 1:12,500 at A3
0 125 250 375 500
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55
N
GHD
MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA
CITY COUNCIL PLANNING SCHEME
ELWOOD CANAL
TUFLOW MODEL LAYOUT
SHEET 4 OF 7
Project No. 12563171
Revision No. 0
Date 16/06/2023
FIGURE B.7
G:\31\12563171\Fig\B.4 TUFLOW Elw.WOR
Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW Layers, 2022. Created by:

Glen Eira Boundary
Properties
Code Boundary
PO Lines

2D Inflows
1D Inflows
2D Boundaries
1D Boundaries

MW Pits
MW Drains
GECC Pits
GECC Pipes
Other Pits
Other Pipes

Melway Map 77 B1

Scale 1:12,500 at A3

0 125 250 375 500
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME

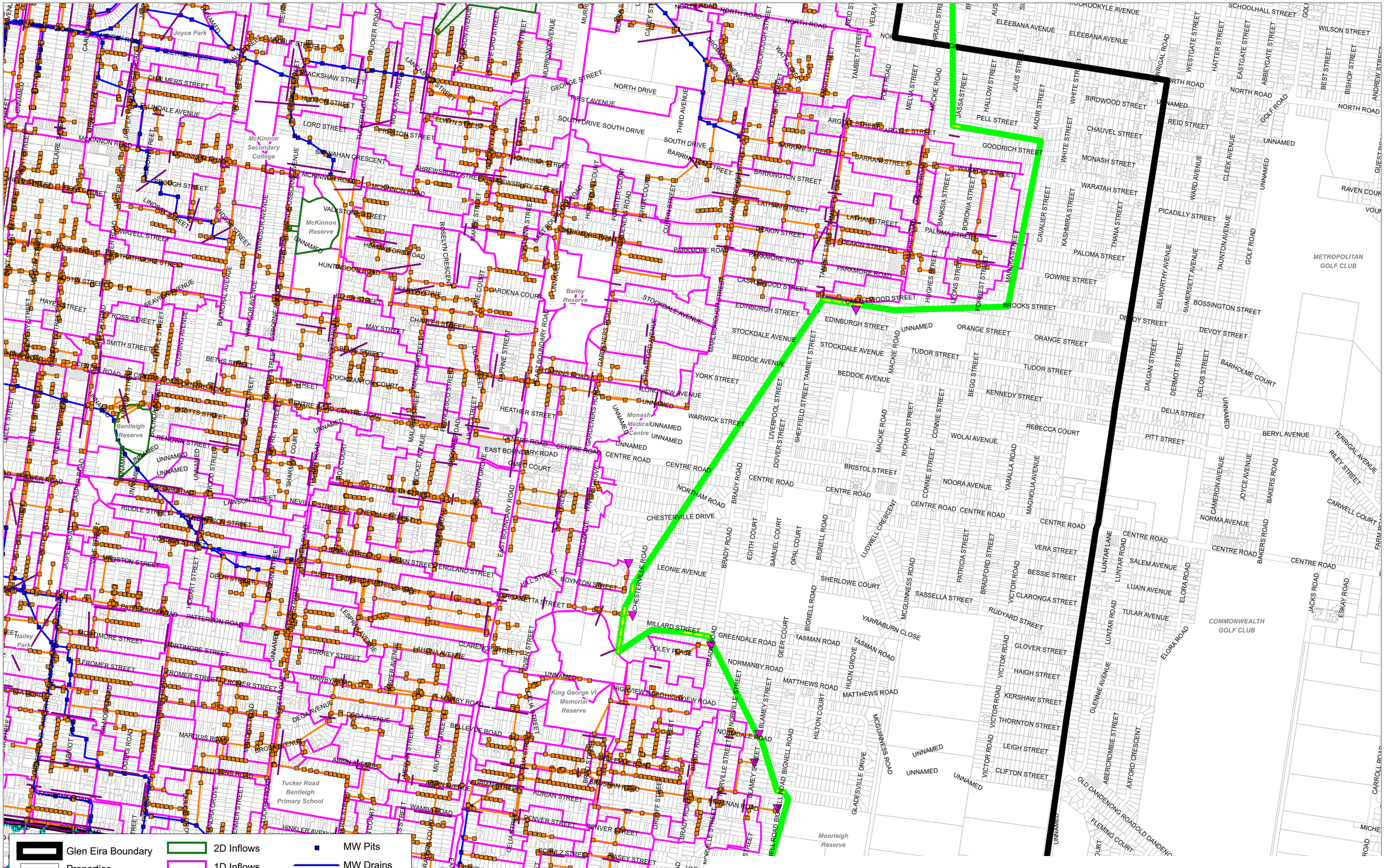
ELWOOD CANAL TUFLOW MODEL LAYOUT SHEET 5 OF 7

Project No. **12563171**
Revision No. **0**
Date **16/06/2023**

FIGURE B.8

G:\31\12563171\FigB.4 TUFLOW Elw.WOR

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW Layers, 2022. Created by:



Scale 1:12,500 at A3

0 125 250 375 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME

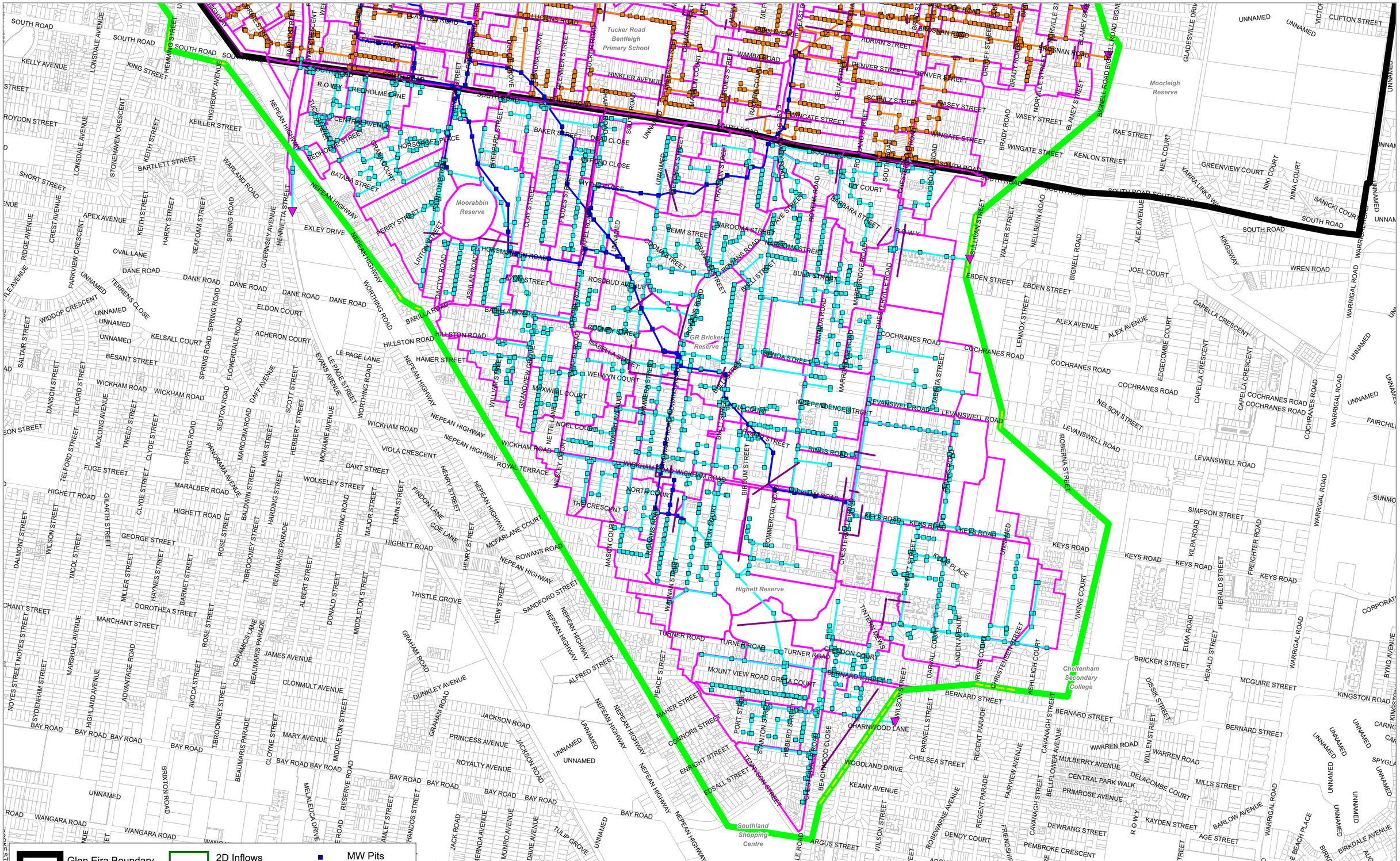
ELWOOD CANAL TUFLOW MODEL LAYOUT SHEET 6 OF 7

Project No. **12563171**
Revision No. **0**
Date **16/06/2023**

FIGURE B.9

G:\31\12563171\FigB.4 TUFLOW Elw.WOR

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW Layers, 2022. Created by:


Tucker Road Bentleigh Primary School
Moorleigh Reserve
Moorabbin Reserve
EGR Bricker Reserve
Highett Reserve
Southland Shopping Centre
Cheltenham Secondary College
SOUTH ROAD
NEPEAN HIGHWAY
WARRIGAL ROAD
WORTHING ROAD
HILLSTON ROAD
BARILLA ROAD
DANE ROAD
BAY ROAD
WICKHAM ROAD
HIGHETT ROAD
KEYS ROAD
COCHRANES ROAD
LEVANSWELL ROAD
BERNARD STREET
CHARNWOOD LANE
Glen Eira Boundary
Properties
Code Boundary
PO Lines
2D Inflows
1D Inflows
2D Boundaries
1D Boundaries
MW Pits
MW Drains
GECC Pits
GECC Pipes
Other Pits
Other Pipes
Melway Map 77 H7
Scale 1:12,500 at A3
0 125 250 375 500
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55
N
GHD
MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME
ELWOOD CANAL
TUFLOW MODEL LAYOUT
SHEET 7 OF 7
Project No. 12563171
Revision No. 0
Date 16/06/2023
FIGURE B.10
G:\31\12563171\Fig\B.4 TUFLOW Elw.WOR
Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW Layers, 2022. Created by:

Appendix C

Elwood Canal DVM Pre-screening Analysis

Elwood Canal Design Variable Method Pre-screening Analysis

Climate Change 1% AEP 180m t21 design storm (Figure C.1)

Climate Change 1% AEP 90m t27 design storm (Figure C.2)

Climate Change 1% AEP 45m t30 design storm (Figure C.3)

C-1 Elwood Canal Design Variable Method Pre-screening Analysis

Given that mapping within the City of Port Phillip was not in the scope of this project, and based on guidance in ARR 2019 on the interaction of coastal and catchment flooding, we have undertaken the Design Variable Method (DVM) pre-screening analysis. The Elwood Canal TUFLOW model was run with a fixed tailwater level of 1.22 m AHD (which equates to the 'mean higher high water' (MHHW) level plus 0.8 m to account for sea level rise due to climate change) for all Climate Change 1% AEP design storms (lower tailwater level), with a 'maximum of median' flood level envelope produced.

Critical Climate Change 1% AEP storms from this process were identified along the Glen Eira municipal boundary at three locations:

– Nepean Highway near Gardenvale Road – 180m t21.
– Hotham Road at Grosvenor Street – 90m t27.
– Hotham Road at Inkerman Street – 45m t30.

These three critical storms were then re-run with a higher tailwater level of 2.24 m AHD, which equates to the peak '1% AEP sea level rise' bay level as derived by WaterTechnology modelling and reported in recent versions of Melbourne Water's 'Tech Specs' (higher tailwater level). A comparison of the flood levels for those three critical storms with the two different tailwater levels indicate that the flooding within the City of Glen Eira is not tidally influenced in the Climate Change 1% AEP event (refer to the following afflux plots in Figures C.1 to C.3).

As a result of this DVM pre-screening analysis, a fixed tailwater level of 1.22 m AHD was adopted to model the Climate Change 1% AEP event for the combined Elwood Canal/Shakespeare Grove Main Drain TUFLOW model.

Similar analyses were also undertaken for the Climate Change 20% AEP, Base Case 1% AEP and Base Case 20% AEP events, where the impact of different tailwater levels (as listed in Table C.1) were compared at the same three locations noted above for their respective critical design storms.

Table C.15 Tailwater levels tested in DVM pre-screening analysis

Event	Lower tailwater level	Higher tailwater level
Climate Change 1% AEP	1.22 m AHD (MHHW plus 0.8 m)	2.24 m AHD (sea level rise tidal peak)
Climate Change 20% AEP	1.22 m AHD (MHHW plus 0.8 m)	1.9 m AHD (sea level rise tidal peak)
Base Case 1% AEP	0.42 m AHD (MHHW)	1.43 m AHD (tidal peak)
Base Case 20% AEP	0.42 m AHD (MHHW)	1.075 m AHD (tidal peak)

Afflux (m) - 2.24 m AHD tailwater minus 1.22 m AHD tailwater

< -0.1	-0.03 to <-0.02	0.02 to <0.03	> .1	Glen Eira Boundary
-0.1 to <-0.05	-0.02 to <-0.01	0.03 to <0.04	was wet now dry	
-0.05 to <-0.04	-0.01 to <0.01	0.04 to <0.05	was dry now wet	
-0.04 to <-0.03	0.01 to <0.02	0.05 to <0.1	Roads	

Scale 1:20,000 at A3

200 0 200 400 600 m

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME
ELWOOD CANAL
TAILWATER LEVEL COMPARISON
CC 1% AEP 180m t21 AFFLUX

Project No. **12563171**
Revision No. **0**
Date. **21/06/2023**

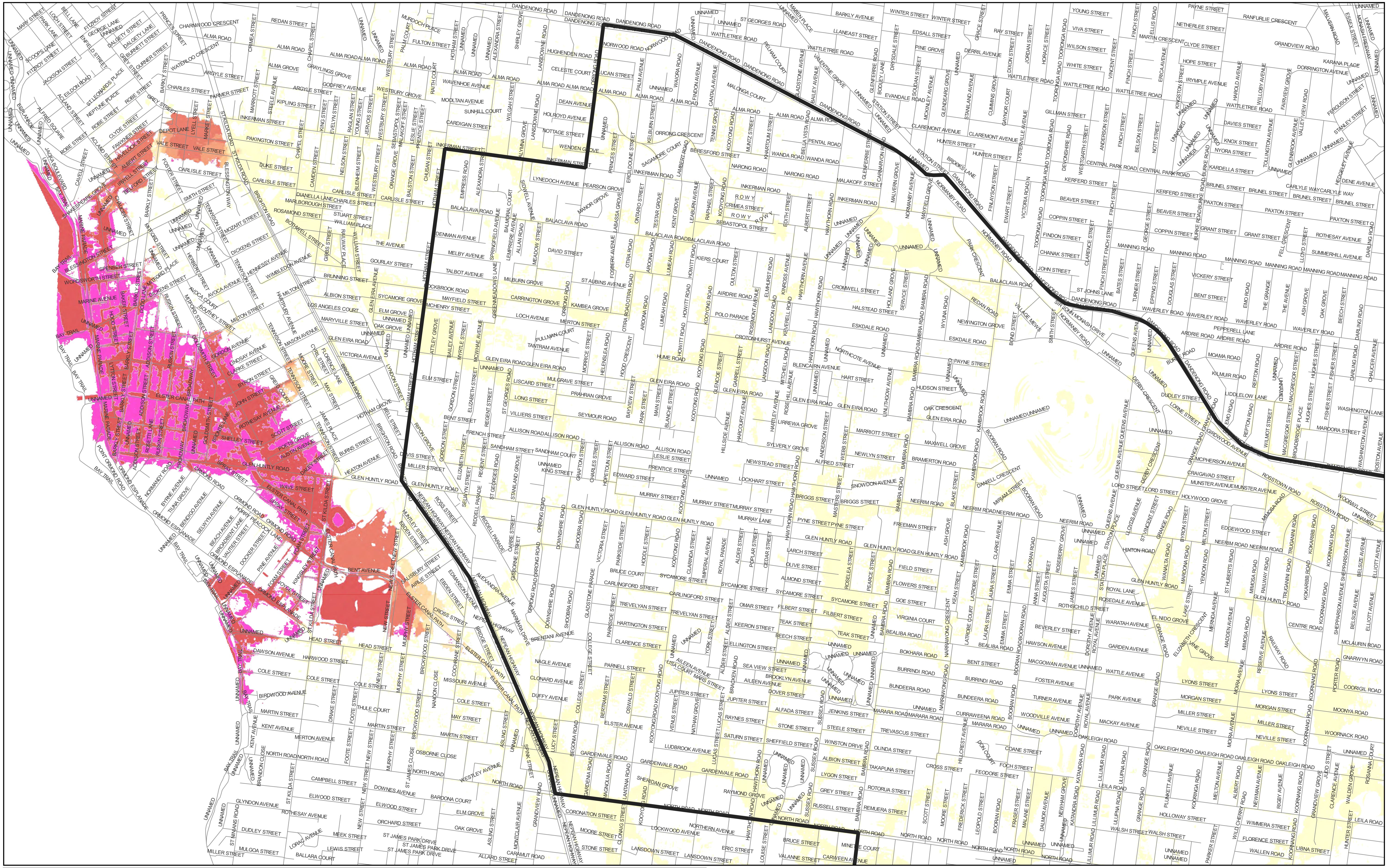
FIGURE C.1

Document Path: G:\31\12563171\GIS\Maps\Elwood Afflux.qgz

Print Date:

Data source: Melbourne Water, drainage, properties, contours, 2022. GHD, TUFLOW Layers, flooding, 2022.

Created By:



Afflux (m) - 2.24 m AHD tailwater minus 1.22 m AHD tailwater

< -0.1	-0.03 to <-0.02	0.02 to <0.03	> .1	Glen Eira Boundary
-0.1 to <-0.05	-0.02 to <-0.01	0.03 to <0.04	was wet now dry	
-0.05 to <-0.04	-0.01 to <0.01	0.04 to <0.05	was dry now wet	
-0.04 to <-0.03	0.01 to <0.02	0.05 to <0.1	Roads	

Scale 1:20,000 at A3

200 0 200 400 600 m

N

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 55

Document Path: G:\31\12563171\GIS\Maps\Elwood Afflux.qgz

Print Date:

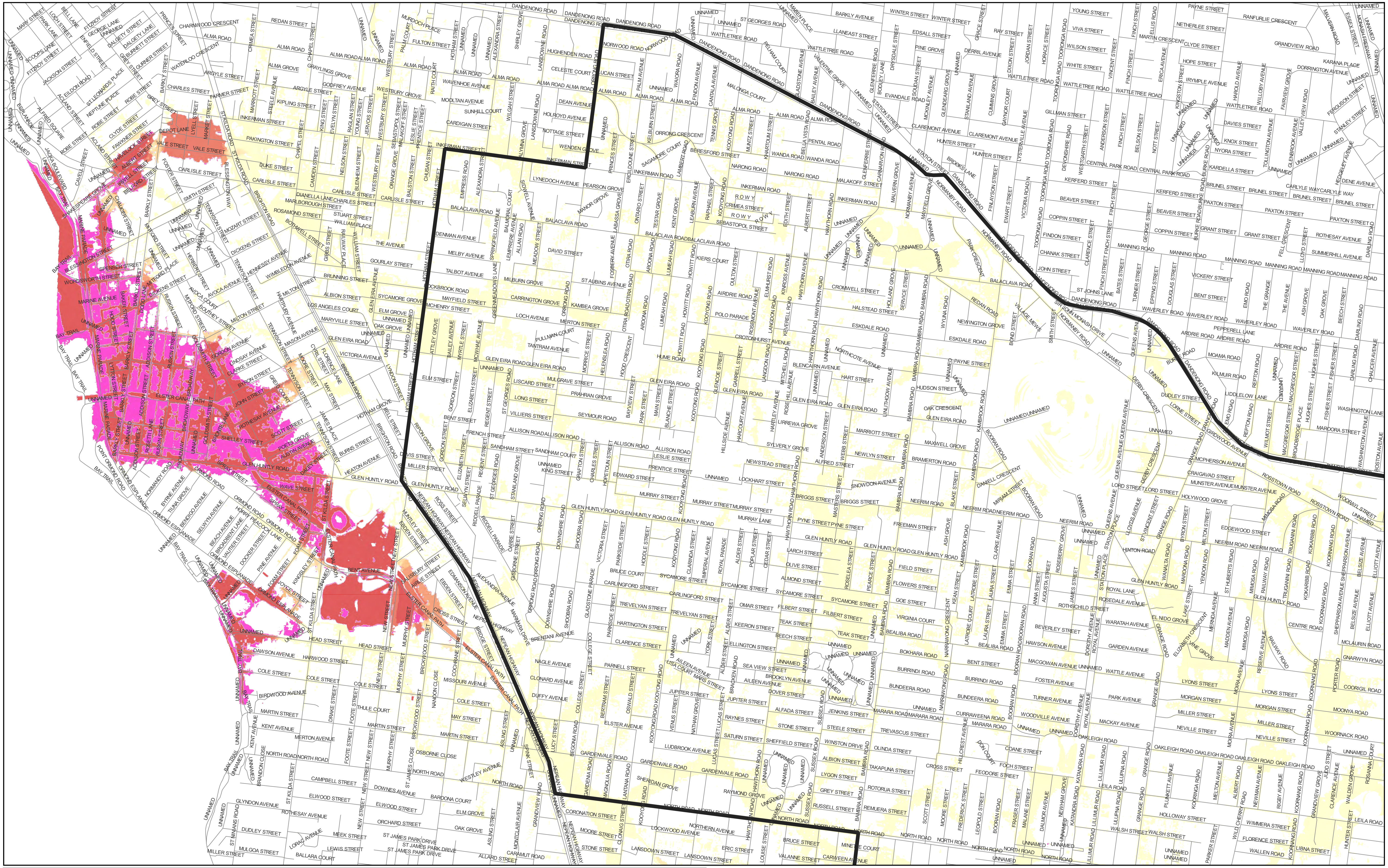
MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME
ELWOOD CANAL
TAILWATER LEVEL COMPARISON
CC 1% AEP 90m t27 AFFLUX

Project No. 12563171
Revision No. 0
Date. 21/06/2023

FIGURE C.2

Data source: Melbourne Water, drainage, properties, contours, 2022. GHD, TUFLOW Layers, flooding, 2022.

Created By:



Afflux (m) - 2.24 m AHD tailwater minus 1.22 m AHD tailwater

< -0.1	-0.03 to <-0.02	0.02 to <0.03	> .1
-0.1 to <-0.05	-0.02 to <-0.01	0.03 to <0.04	was wet now dry
-0.05 to <-0.04	-0.01 to <0.01	0.04 to <0.05	was dry now wet
-0.04 to <-0.03	0.01 to <0.02	0.05 to <0.1	Roads

Glen Eira Boundary

Scale 1:20,000 at A3

200 0 200 400 600 m

N

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 55

Document Path: G:\31\12563171\GIS\Maps\Elwood Afflux.qgz

Print Date:

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME
ELWOOD CANAL
TAILWATER LEVEL COMPARISON
CC 1% AEP 45m t30 AFFLUX

Project No. 12563171
Revision No. 0
Date. 21/06/2023

FIGURE C.3

Data source: Melbourne Water, drainage, properties, contours, 2022. GHD, TUFLOW Layers, flooding, 2022.

Created By:

Appendix D

Flood Maps

Climate Change 1% AEP Flood Extents (Figure D.1 to Figure D.8 – 8 sheets)

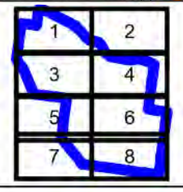
D-1 Flood Mapping Notes

1. This data should be read in conjunction with the latest revision of the Report entitled “Flood Mapping for the City of Glen Eira Final Report” and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to GHD Pty Ltd.
2. Local flooding of other areas, or in excess of the extents shown, may occur. The extent of flooding shown relates to flooding from mapped reaches of Melbourne Water and City of Glen Eira drains and does not generally include private drainage systems.
3. Areas where the flood extents are shown as an outline only (i.e. outside of the City of Glen Eira) were modelled for the purpose of estimating appropriate and consistent flood extents within the City of Glen Eira.
4. Flood information shown relates only to floodwaters emanating from the catchments of the mapped drainage systems. Greater flood levels, depths and/or velocities than those shown may result from flood events on neighbouring waterways. Flood levels greater than those shown may occur:
    a. upstream of the upstream mapping limits of each mapped drain.
    b. along private or other drains, either within or outside the extents of land liable to flooding shown.
    c. as the result of a larger flood event.
5. The approximate extents of land liable to flooding have been based on survey data available at the time of preparation. The exact extent of flooding for individual properties can only be determined by a licensed surveyor.
6. Local increases in flood extents, levels, depths and/or velocities shown may result from local factors such as drain blockages, and local obstructions to overland flows such as fences, buildings and cars.
7. Climate change extents make an allowance for an anticipated future impact of climate change. Many aspects of the future are inherently uncertain and despite using the widely accepted approaches current at the time of the analysis, it is anticipated that future estimates and impacts will differ from the current estimates.
8. 1% AEP (annual exceedance probability) flood extents shown are expected to be reached during a flood event with a 1 in 100 chance of being equalled or exceeded in any one year under the physical and topographic conditions modelled. This flood may occur more than once per year.
9. The extents should be taken as indicative only. It is likely that the flooding experienced during a real rainfall event may differ to the design events indicated on these maps.
10. Cadastral boundaries and drain locations have been supplied by Melbourne Water and the City of Glen Eira, and have not been independently verified.

LEGEND

- Glen Eira Boundary
- MW CC 1pc AEP Extent
- GECC CC 1pc AEP Extent
- MW Drains
- GECC Pipes
- Other Pipes
- CC 1pc AEP Extent (outside Glen Eira)

Melway Map 58 K12



This data should be read in conjunction with the latest revision of the Report entitled 'Flood Mapping for Glen Eira City Council Planning Scheme' and is subject to the assumptions and qualifications contained therein. If this report is yet to be released, these assumptions and qualifications must be confirmed by reference to GHD Pty Ltd.

Scale 1:10,000 at A3

0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME
CLIMATE CHANGE 1% AEP FLOOD EXTENTS
SHEET 1 OF 8

Project No. **12563171**
Revision No. **0**
Date **19/06/2023**

FIGURE D.1

G:\12563171\GIS\... Esri 8.3 MXD

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW & Flooding Layers, 2022. Created by:

LEGEND

- Glen Eira Boundary
- MW CC 1pc AEP Extent
- GECC CC 1pc AEP Extent
- MW Drains
- GECC Pipes
- Other Pipes
- CC 1pc AEP Extent (outside Glen Eira)

Melway Map 59 K12

1	2
3	4
5	6
7	8

This data should be read in conjunction with the latest revision of the Report entitled 'Flood Mapping for Glen Eira City Council Planning Scheme' and is subject to the assumptions and qualifications contained therein. If this report is yet to be released, these assumptions and qualifications must be confirmed by reference to GHD Pty Ltd.

Scale 1:10,000 at A3

0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

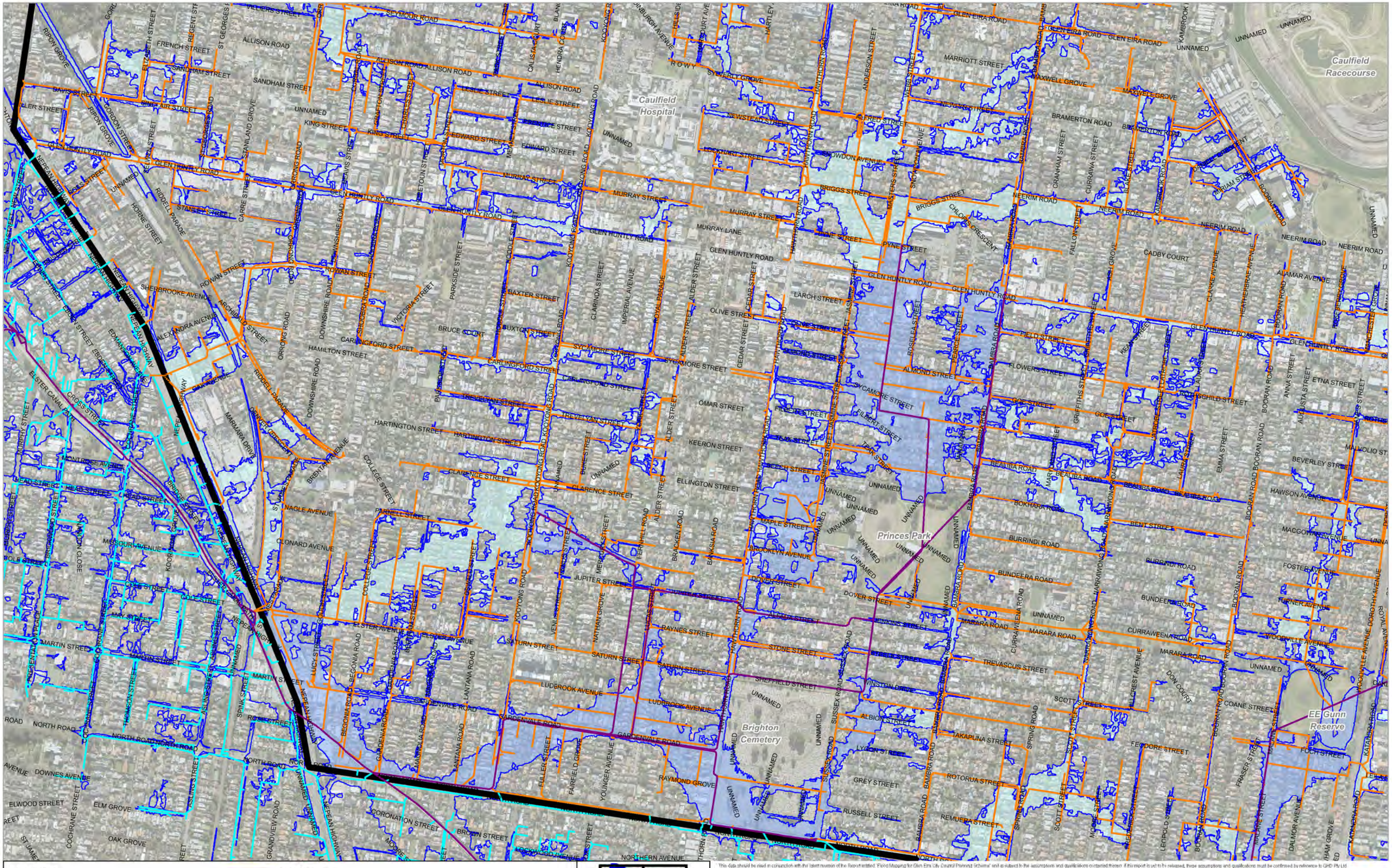
MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME
CLIMATE CHANGE 1% AEP FLOOD EXTENTS
SHEET 2 OF 8

Project No. **12563171**
Revision No. **0**
Date **19/06/2023**

FIGURE D.2

G:\12563171\GIS\Maps\MW_Flood_Mapping_Glen_Eira_City_Council_Planning_Scheme_Climate_Change_1pc_AEP_Flood_Extents_Sheet_2_of_8.mxd

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW & Flooding Layers, 2022. Created by:



LEGEND

- Glen Eira Boundary
- MW CC 1pc AEP Extent
- GECC CC 1pc AEP Extent
- MW Drains
- GECC Pipes
- Other Pipes
- CC 1pc AEP Extent (outside Glen Eira)

Melway Map 67 K6

1	2
3	4
5	6
7	8

This data should be read in conjunction with the latest revision of the Report entitled 'Flood Mapping for Glen Eira City Council Planning Scheme' and is subject to the assumptions and qualifications contained therein. If this report is yet to be released, these assumptions and qualifications must be confirmed by reference to GHD Pty Ltd.

Scale 1:10,000 at A3

0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME
CLIMATE CHANGE 1% AEP FLOOD EXTENTS
SHEET 3 OF 8

Project No. **12563171**
Revision No. **0**
Date **19/06/2023**

FIGURE D.3

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Data source: Melbourne Water: drainage, properties, 2022. GHD: TUFLOW & Flooding Layers, 2022. Created by:

LEGEND

- Glen Eira Boundary
- MW CC 1pc AEP Extent
- GECC CC 1pc AEP Extent
- MW Drains
- GECC Pipes
- Other Pipes
- CC 1pc AEP Extent (outside Glen Eira)

Melway Map 68 K6

1	2
3	4
5	6
7	8

This data should be read in conjunction with the latest revision of the Report titled "Flood Mapping for Glen Eira City Council Planning Scheme" and is subject to the assumptions and qualifications contained therein. If this report is yet to be released, these assumptions and qualifications must be confirmed by reference to GHD Pty Ltd.

Scale 1:10,000 at A3

0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

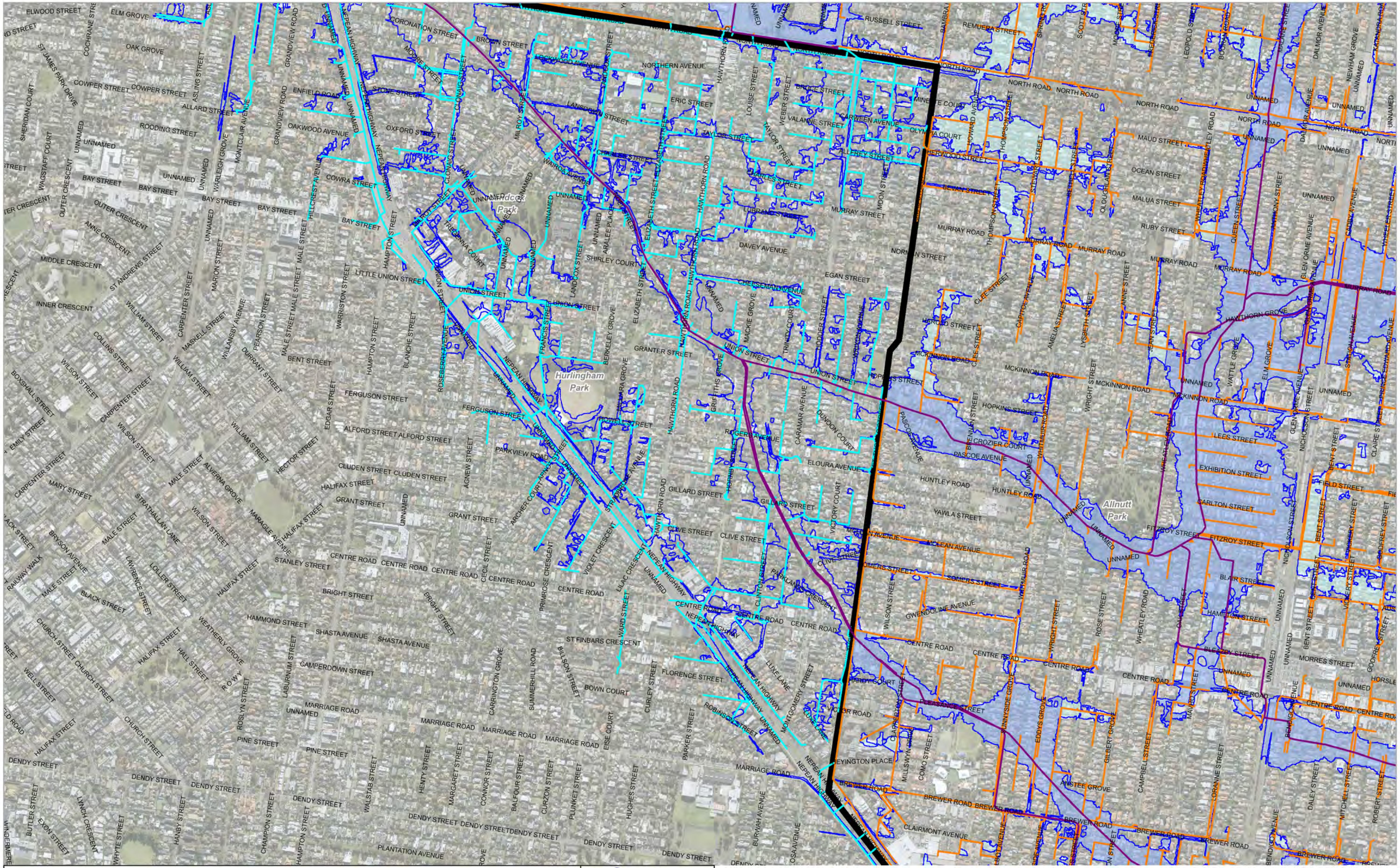
MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA
CITY COUNCIL PLANNING SCHEME
CLIMATE CHANGE 1% AEP
FLOOD EXTENTS
SHEET 4 OF 8

Project No. 12563171
Revision No. 0
Date 19/06/2023

FIGURE D.4

G:\12563171\GIS\Maps\Exhibition\MXD\...

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW & Flooding Layers, 2022. Created by:



LEGEND

Glen Eira Boundary

MW CC 1pc AEP Extent

GECC CC 1pc AEP Extent

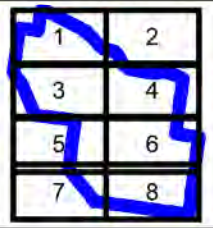
Melway Map 67 K11

MW Drains

GECC Pipes

Other Pipes

CC 1pc AEP Extent (outside Glen Eira)



This data should be used in conjunction with the latest revision of the Report entitled "Flood Mapping for Glen Eira City Council Planning Scheme" and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to GHD Pty Ltd.

Scale 1:10,000 at A3

0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME
CLIMATE CHANGE 1% AEP FLOOD EXTENTS
SHEET 5 OF 8

Project No. **12563171**
Revision No. **0**
Date **19/06/2023**

FIGURE D.5

G:\31\12563171\FigD1 Extents.WOR

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW & Flooding Layers, 2022. Created by:

LEGEND

- Glen Eira Boundary
- MW CC 1pc AEP Extent
- GECC CC 1pc AEP Extent
- MW Drains
- GECC Pipes
- Other Pipes
- CC 1pc AEP Extent (outside Glen Eira)

Melway Map 68 K11

1	2
3	4
5	6
7	8

This data should be read in conjunction with the latest revision of the Report entitled 'Flood Mapping for Glen Eira City Council Planning Scheme' and is subject to the assumptions and qualifications contained therein. If the report is yet to be released, these assumptions and qualifications must be confirmed by reference to GHD Pty Ltd.

Scale 1:10,000 at A3

0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA CITY COUNCIL PLANNING SCHEME
CLIMATE CHANGE 1% AEP FLOOD EXTENTS
SHEET 6 OF 8

Project No. **12563171**
Revision No. **0**
Date **19/06/2023**

FIGURE D.6

G:\12563171\GIS\Maps\MXD\...

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW & Flooding Layers, 2022. Created by:

LEGEND

- Glen Eira Boundary
- MW CC 1pc AEP Extent
- GECC CC 1pc AEP Extent
- MW Drains
- GECC Pipes
- Other Pipes
- CC 1pc AEP Extent (outside Glen Eira)

Melway Map 76 K4

1	2
3	4
5	6
7	8

This data should be read in conjunction with the latest revision of the Report entitled "Flood Mapping for Glen Eira City Council Planning Scheme" and as subject to the assumptions and qualifications contained therein. If this report is yet to be released, these assumptions and qualifications must be confirmed by reference to GHD Pty Ltd.

Scale 1:10,000 at A3

0 100 200 300 400 Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA
CITY COUNCIL PLANNING SCHEME
CLIMATE CHANGE 1% AEP
FLOOD EXTENTS
SHEET 7 OF 8

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Date 19/06/2023

FIGURE D.7

G:\12563171\GIS\Maps\MW_Flood_Mapping_Report_Figures\MW_Flood_Mapping_Report_Figures.aprx

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW & Flooding Layers, 2022. Created by:

LEGEND

- Glen Eira Boundary
- MW CC 1pc AEP Extent
- GECC CC 1pc AEP Extent
- MW Drains
- GECC Pipes
- Other Pipes
- CC 1pc AEP Extent (outside Glen Eira)

Melway Map 77 K4

1	2
3	4
5	6
7	8

This data should be read in conjunction with the latest revision of the Report entitled "Flood Mapping for Glen Eira City Council Planning Scheme" and as subject to the assumptions and qualifications contained therein. If this report is yet to be released, these assumptions and qualifications must be confirmed by reference to GHD Pty Ltd.

Scale 1:10,000 at A3

0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

MELBOURNE WATER
FLOOD MAPPING FOR GLEN EIRA
CITY COUNCIL PLANNING SCHEME
CLIMATE CHANGE 1% AEP
FLOOD EXTENTS
SHEET 8 OF 8

Project No. 12563171
Revision No. 0
Date 19/06/2023

FIGURE D.8

G:\12563171\GIS\Maps\MXD\Figure D.8 Sheet 8.MXD

Data source: Melbourne Water, drainage, properties, 2022. GHD, TUFLOW & Flooding Layers, 2022. Created by:

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