West Gippsland
Catchment Management Authority

WGCMA FLOODPLAIN MAPPING PROGRAM

Floodplain mapping for Glengarry/Eaglehawk Creek

August 2023

DOCUMENT DETAILS

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GLOSSARY OF TERMS

Annual exceedance probability (AEP)	The probability or likelihood of an event occurring or being exceeded within any given year, usually expressed as a percentage.
Australian height datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
Average recurrence interval (ARI)	A statistical estimate of the average number of years between the occurrence of a flood of a given size or larger.
Australia Rainfall and Runoff (ARR)	ARR is a national guideline for the estimation of design flood characteristics in Australia published by Engineers Australia. ARR aims to provide reliable estimates of flood risk to ensure that development does not occur in high risk areas and that infrastructure is appropriately designed.
Bureau of Meteorology (BOM)	The BOM is Australia's national weather, climate and water agency.
Catchment	The area draining to a site. Relates to a particular location and may include the catchments of tributary streams as well as the main stream.
Design flood	A design flood is a probabilistic or statistical estimate, being generally based on some form of probability analysis of flood or rainfall data, which is used to decide which level of risk should be adopted. An average recurrence interval or exceedance probability is attributed to the estimate.
Digital elevation model (DEM)	A DEM is a matrix of cells (or pixels) organized into rows and columns (or a grid), or a raster, representation of a continuous surface, usually referencing the surface of the earth. Cell-based DEM are the most common digital data of the shape of the earth's surface.
Discharge	The rate of flow of water measured in terms of volume over time.
FLIKE	Flood frequency analysis (FFA), or extreme value analysis, package that calculates the probability of flood events based on historical records.

Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or runoff before entering a watercourse. Results in the inundation of land that is usually dry.
Flood class levels	The terms *Minor*, *Moderate* and *Major* flooding are used in flood warnings to give a general indication of the types of problems expected with a flood.
Flood frequency analysis (FFA)	Procedures that use recorded and related flood data to identify underlying probability model of flood peaks at a particular location in the catchment.
Flood hazard	Potential loss of life, injury or economic loss caused by future flood events. The degree of hazard varies with the severity of flooding and is affected by flood behaviour (extent, depth, velocity, isolations, rate of rise of floodwaters, duration), topography and emergency management.
Flood risk	The potential risk of flooding to people, their social setting, and their built and natural environment. The degree of risk varies with circumstances across the full range of floods.
Floodplain	Area of land which is subject to inundation by floods up to, and including, the largest probable flood event.
Floodway overlay (FO)	The FO is applied by the local government planning scheme to designate areas which convey active flood flows or store floodwater.
FloodZoom	A web-based tool that brings together flood forecasts, flood mapping, real-time river height gauges and property data to provide flood response agencies with improved knowledge of likely flood impacts.
GDA94	The Geocentric Datum of Australia 1994 (GDA94) is Australia's official geodetic datum. The standard map projection associated with GDA94 is the Map Grid of Australia 1994 GDA94 / MGA zone 55.
Geographical Information System (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data. Specifically ArcGIS 10.4.
Hydraulics	The study of water flow in waterways, in particular the evaluation of flow parameters such as water level, extent and velocity.

Hydrograph	A graph that shows how the discharge changes with time at any particular location.
Hydrology	The study of the rainfall and runoff process, including the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
Hyetograph	A graph that shows rainfall or rainfall intensity changes over time.
Intensity Frequency Duration (iFD)	Intensity Frequency Duration, method of determining design rainfalls according to procedures in ARR. This includes total rainfall for a given design storm event and the pre-determined temporal pattern over which this rainfall is distributed.
Light detection and ranging (LiDAR)	Spot land surface heights collected via aerial LiDAR survey. The distance to an object is determined by measuring the time delay between transmission of a pulse and detection of the reflected signal. The spot heights are converted to a gridded digital elevation model dataset for use in modelling and mapping.
Land subject to inundation overlay (LSIO)	The LSIO is applied by the local government planning scheme to designate areas of mainstream flooding. In general, areas covered by LSIO have a lower flood risk than Floodway overlay (FO) areas.
Peak flow	The maximum discharge occurring during a flood event.
RORB	A hydrological modelling tool used in this study to calculate the runoff generated from historic and design rainfall events.
Runoff	The component of rainfall that runs off into the waterway / drainage network. Also known as rainfall excess.
Topography	A surface which defines the ground level of a chosen area.
TUFLOW	A hydraulic modelling tool used in this study to simulate the flow of flood water through the floodplain. The model uses numerical equations to describe the water movement.
Victorian State Emergency Service (VICSES)	VICSES is the control agency during emergency responses to floods, storms, earthquakes and tsunamis in Victoria. A volunteer-based organisation, VICSES provides emergency assistance to the community 24 hours a day, seven days a week.

West Gippsland Catchment Management Authority (WGCMA)	Under the Water Act 1989, catchment management authorities have management powers over regional waterways, floodplains, drainage and environmental water. The WGCMA is responsible for waterway and catchment management across the south-east corner of Victoria.

SECTION A INTRODUCTION

1 PURPOSE

This study is an update of the existing flood information produced in 2015 as part of the Student Floodplain Mapping Program run by the West Gippsland Catchment Management Authority. The 2015 flood study of the Eaglehawk Creek had a number of issues with it that needed to be resolved.

The focus area for this study are the waterways Eaglehawk Creek and Four Mile Creek and covers the township of Glengarry and surrounding rural areas.

2 OBJECTIVE

This flood study seeks to produce detailed flood mapping for the township of Glengarry and surrounding rural areas.

This flood study will produce results for;

- Flood Extent
- Flood water depth
- Flood water velocity
- Water surface elevation

These results will cover the design flood events of 20%, 10%, 5%, 2% and 1% AEP.

The results of this study transition into the 2015 Latrobe River Flood Study by Cardno overlapping at the downstream of this study area.

The information presented in this report has been compiled for use by West Gippsland Catchment Management Authority (WGCMA) for statutory planning, community education/preparedness, flood risk for insurance purposes and emergency management purposes.

The study has been completed in accordance with the guidance provided in AR&R 2019. As such, this study represents the best available flood risk information for this area.

3 CATCHMENT DESCRIPTION

The Eaglehawk Creek Catchment is predominantly rural, covering an area of approximately 129 square kilometres. The most upstream section of the catchment runs along the Cowwarr-Walhalla Road and the catchment finishes at the inflow of the Eaglehawk and Four Mile Creek into the Latrobe River (refer to Figure 1 for a map detailing the Eaglehawk Creek Catchment).

In terms of topography, the Traralgon Creek catchment rises to 405 metres AHD down to 20 metres AHD at the confluence with the Latrobe River. Rainfall across this catchment differs significantly across the catchment in most rainfall events, with a majority of the rainfall falling in the north of the catchment in the hills.

The channels and tributaries within the North half of the catchment are all well-defined, due to the steep elevation and grade of the terrain. The primary land use of this portion of the catchment is tree plantations, whereas the northern half of the catchment is primarily flat floodplains which is used primarily for farming.

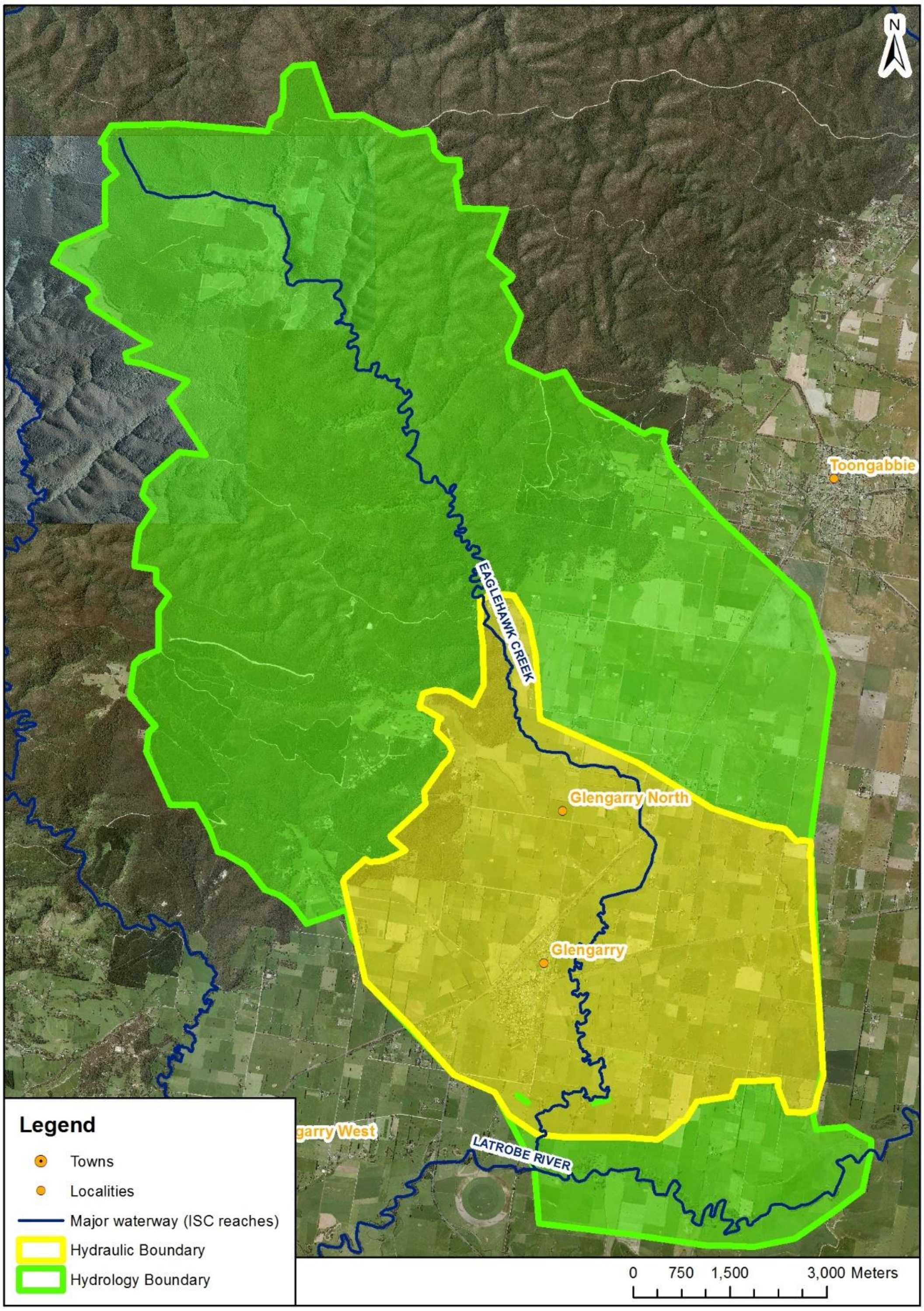

Figure 1 Eaglehawk Creek Catchment

4 FLOOD DATA REVIEW

4.1 Flow and rainfall gauge data

As part of the initial desktop analysis, an investigation into the availability of the flow gauges was performed. There are no flow gauges on the Eaglehawk Creek, so therefore a detailed calibration of the hydrology is not possible at this time.

4.2 Previous decision-related data

Figure 2 shows the previous decision-related flood information for this area. It has been coloured by the different reliability ratings. As seen in Figure 2, the reliability for the previous flood information for Eaglehawk Creek was deemed to be medium in reliability, however a review of the data has since been completed and found issues with the previous mapping of the Eaglehawk Creek and found it to be low in reliability.

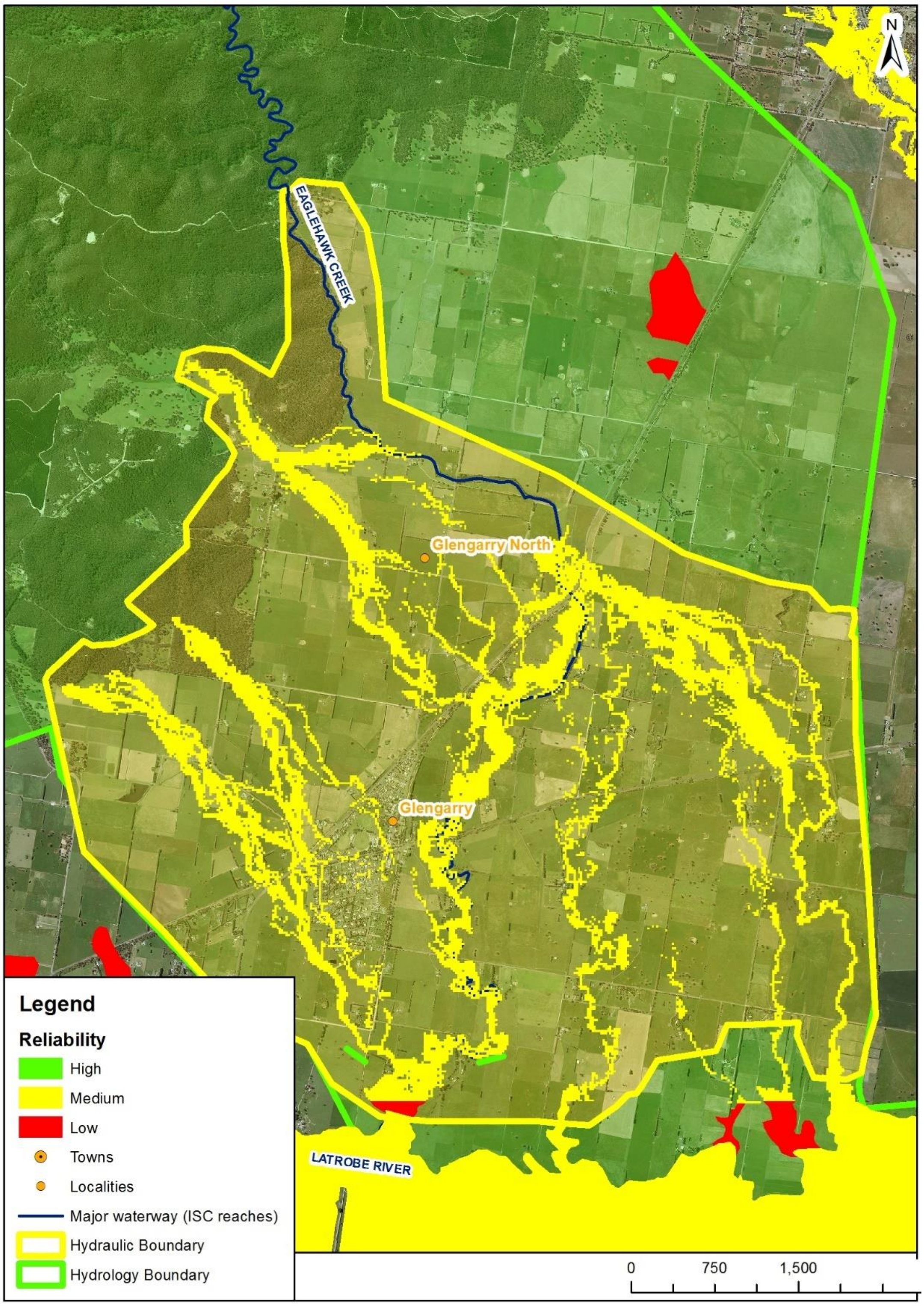

Figure 2 Previous Decision Related Data

SECTION B HYDROLOGY

The hydrology component of this study was used to estimate the amount of flow produced across the catchment during different sized events. These flows were then used as inputs in the hydraulic component of the study.

There were three different hydrology approaches that were adopted as part of the hydrology modelling processes, these were;

- Flood frequency analysis using the ARR's online RFFE Model (Commonwealth of Australia: Engineers Australia, n.d.)
- Hydrology modelling using RORB

The RORB hydrology model was used to produce hydrographs at key locations across the catchment. The RORB model was developed in accordance with best practice from the data from the ARR Datahub and BOM IFD and verified to align with the results from and RFFE Model results.

1 CATCHMENT DELINEATION

The first stage of the flood study was to define the catchment area of Eaglehawk Creek that will be modelled as part of this study. The catchment of the Eaglehawk Creek was defined using the following sets of data.

1.1 Aerial photography

There are several different datasets for aerial photography available to the WGCMA for this area. These datasets and their corresponding date flown, and resolution have been listed in Table 1. Where possible, the datasets that were the most recent and with the highest resolution were used in preference.

Table 1 Available data - Aerial photography

Dataset Name	Date Flown	Resolution
Latrobe_2014nov03_air_vis_15cm_mga55	November 2014	15cm
Wellington_2014oct18_air_vis_15cm_mga55	October 2014	15cm

These datasets were used in combination with the elevation data and waterways and catchment mapping layers to digitise the reaches and subareas for this catchment model.

1.2 Elevation data

There were three different elevation datasets that were used for this study, the details of these can be found in Table 2.

Table 2 Available data - Elevation data

Dataset Name	Date	Resolution	Vertical Accuracy	Horizontal Accuracy
West Gippsland Riparian	September 2011	1 metre	0.19 metre at 67% Confidence Interval	0.2 metre at 78% Confidence Interval
West Gippsland Floodplain	February 2011	1 metre	Target 0.10m at 67 % Confidence Interval	Actual 0.19m at 67 % Confidence Interval
Vicmap Elevation DTM 10m	1974 – 2006	10 metres	5 metres	12.5 metre

As seen in Table 2, the West Gippsland Riparian and the West Gippsland Floodplain datasets are significantly more accurate and has a much higher resolution than the VicMap DTM. The limitation of these more accurate datasets is that these datasets only cover the floodplain of the Eaglehawk and Four Mile Creek, whereas the VicMap DTM has complete coverage of the Catchment. The extents of these different layers can be seen in Figure 3. When formulating the subareas for the catchment file, the VicMap DTM was the primary source of information, due to the VicMap DTM's coverage.

Another component important consideration when defining the catchment file for the RORB model is the extent of the hydraulic model. Due to constraints regarding grid resolution and accuracy, the hydraulic model did not use the VicMap DTM and was limited to the coverage of the West Gippsland Riparian and Floodplain datasets. The RORB hydrology model needed to meet the recommendations stated within the RORB manual, which is that there needs to be at least 5 sub-areas upstream of the intersection between a RORB reach and the hydraulic model boundary (Laurenson, Mein, & Nathan, 2010).

The above considerations were used in combination with the aerial imagery, waterway layers and catchment mapping layers to digitize the reaches and subareas for this catchment model.

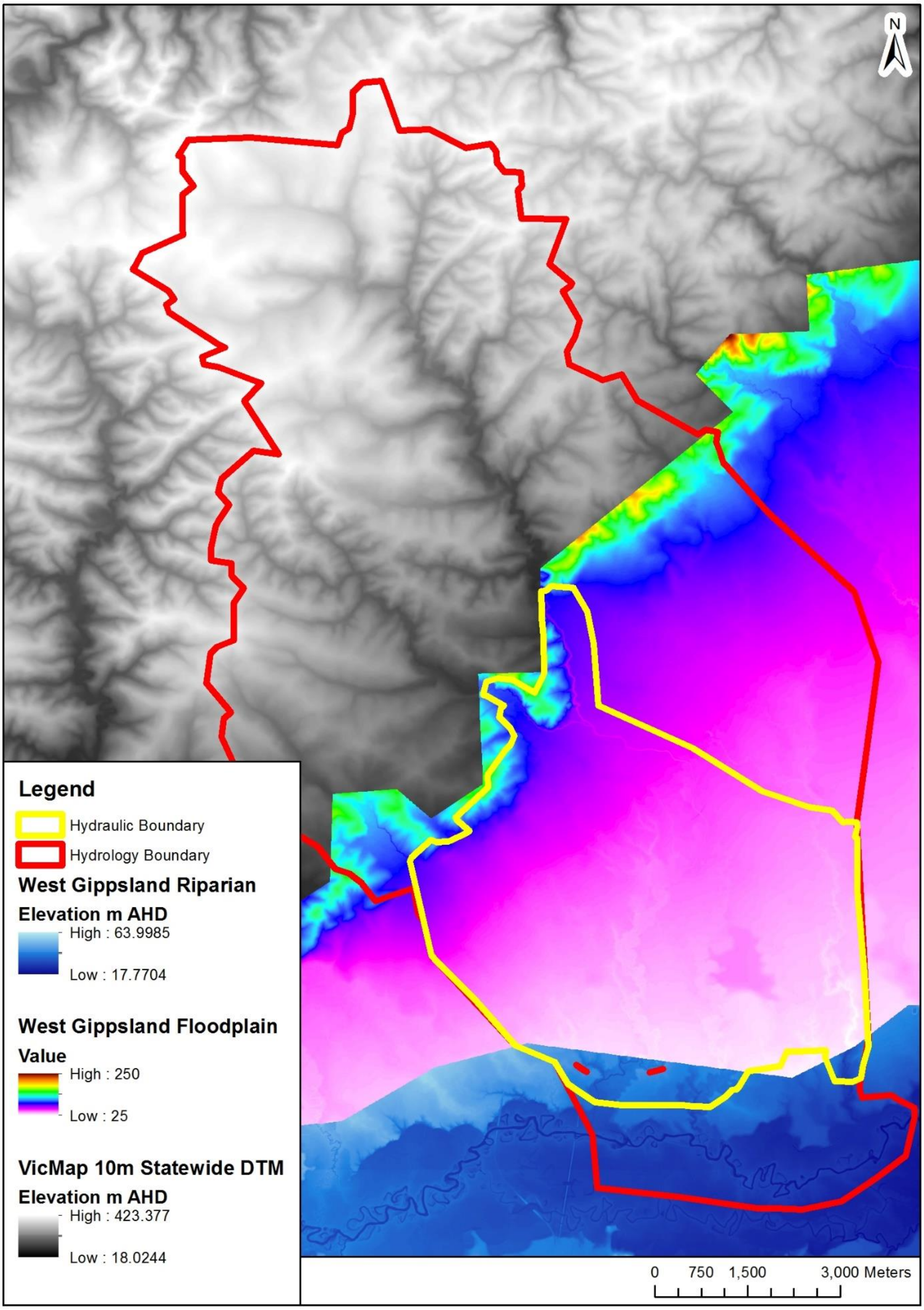

Figure 3 Available Data - Elevation Data

1.3 Catchment area

Figure 4 shows the catchment area defined by this flood study.

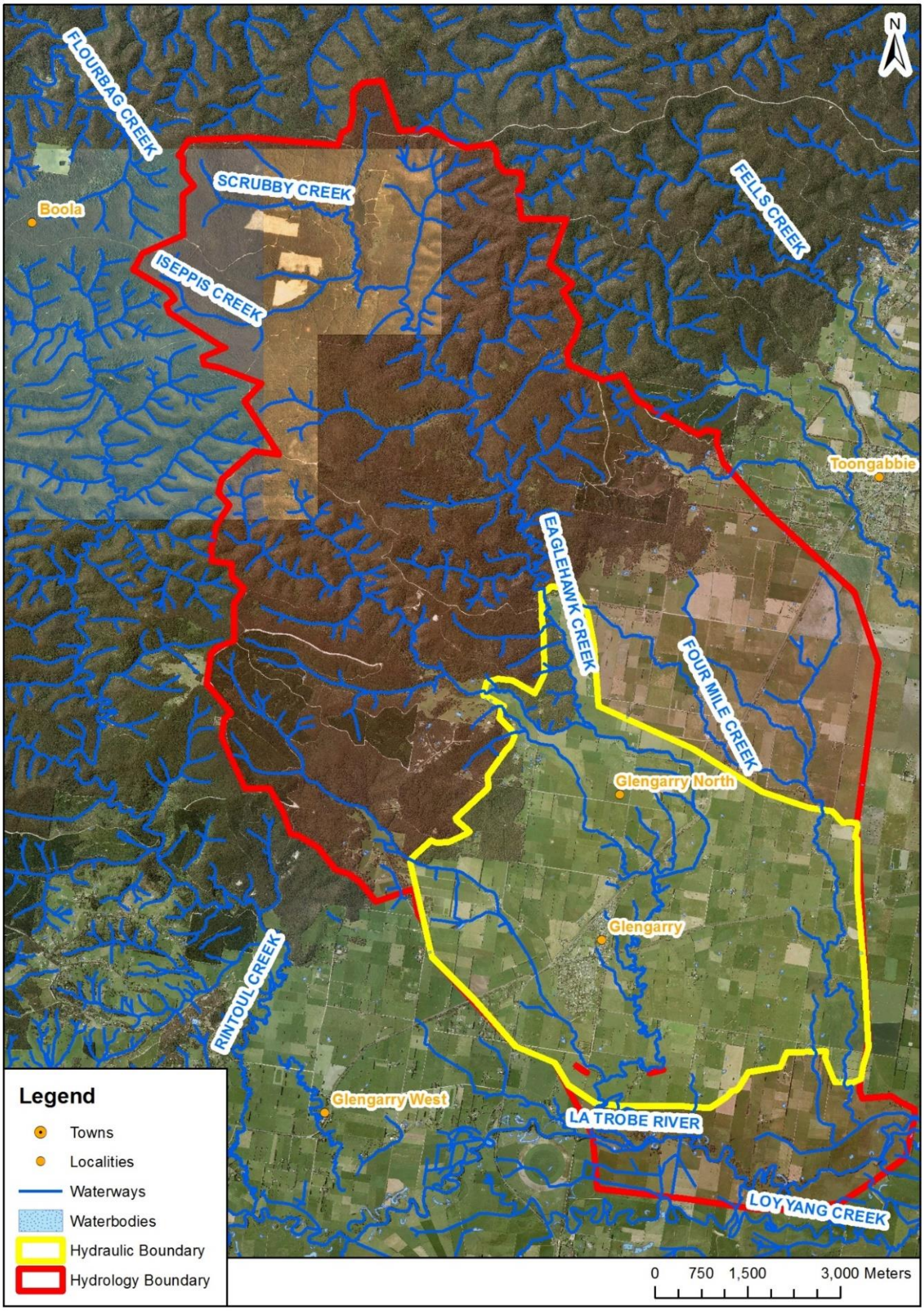

Figure 4 Traralgon Creek Catchment Area

2 RORB HYDROLOGIC MODEL

RORB is the standard hydrology model used by the West Gippsland Catchment Management Authority (WGCMA). It is an interactive runoff and streamflow routing program (Laurenson, Mein, & Nathan, 2010) and has traditionally been used by the WGCMA to calculate streamflow hydrographs at location within a stream from rainfall events. These hydrographs are usually input into a hydraulic model (e.g. TUFLOW) to represent the rainfall occurring within the catchment during a specific AEP event.

2.1 Sub-area and reach delineation

The catchment file for RORB was set up using HARC's ArcRORB tool. The sub-areas and reaches were defined from the elevation data sets.

The sub areas were delineated in a way to ensure that all print nodes intended to be used to generate hydrographs for TUFLOW had at least 5 subareas upstream of any nodes that results are required (Laurenson, Mein, & Nathan, 2010).

The Vicmap DTM was once again the primary elevation dataset used to delineate the sub-areas and reaches.

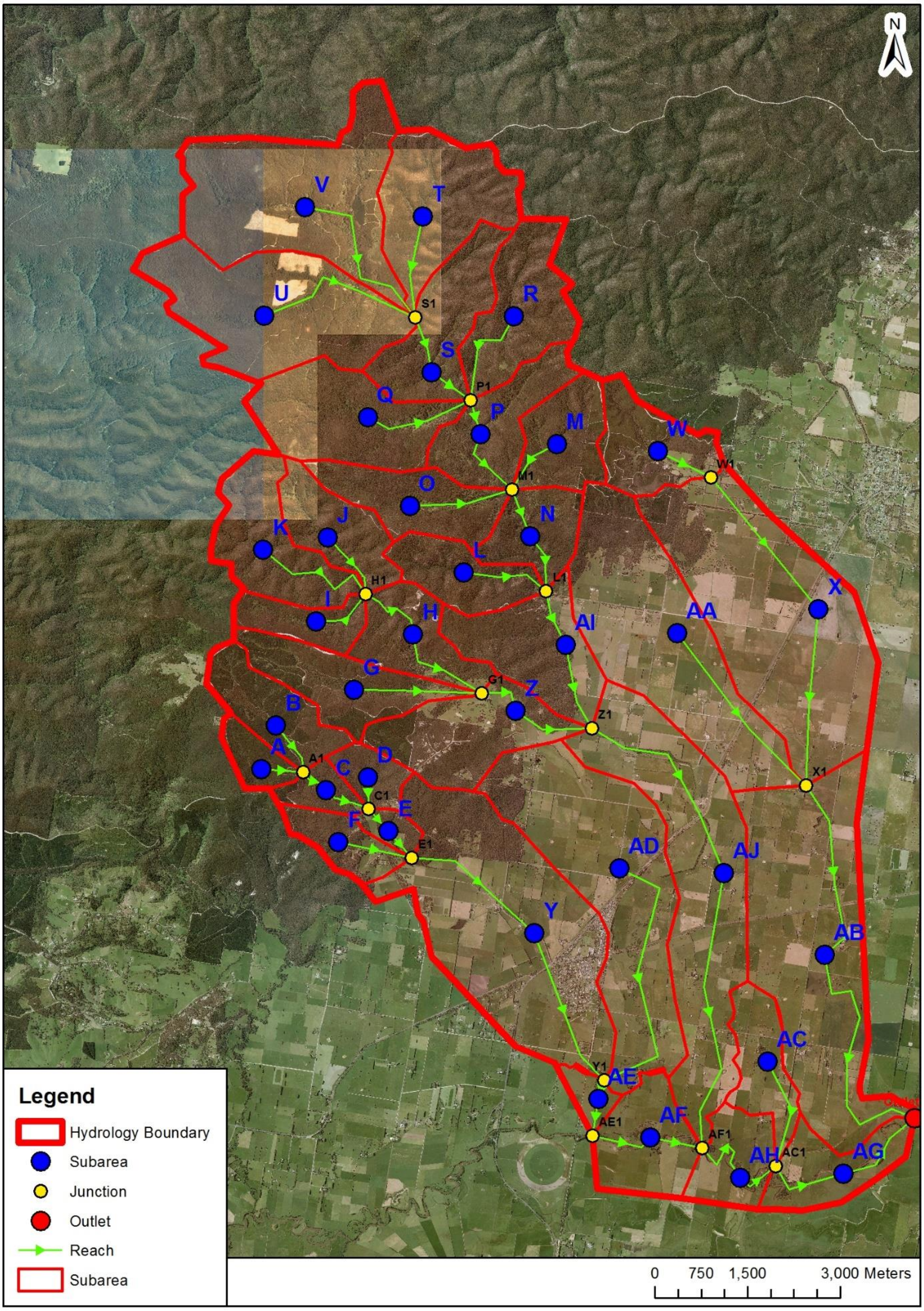

Figure 5 RORB Hydrology Model

2.2 Initial Parameters

2.2.1 *Storm loss parameters*

The initial parameters that were used were based off values given from the Australian Rainfall & Runoff's Data Hub (Ball, et al., 2016). The catchment data from coordinates of 146.53 longitude and -38.08 latitude were inputted into the Data Hub (location shown in Figure 6) on the 9th of February 2021.

The Data Hub prescribed a Storm Initial Loss of **25.0** millimeters and a Storm Continuing Loss of **3.6** millimeters.

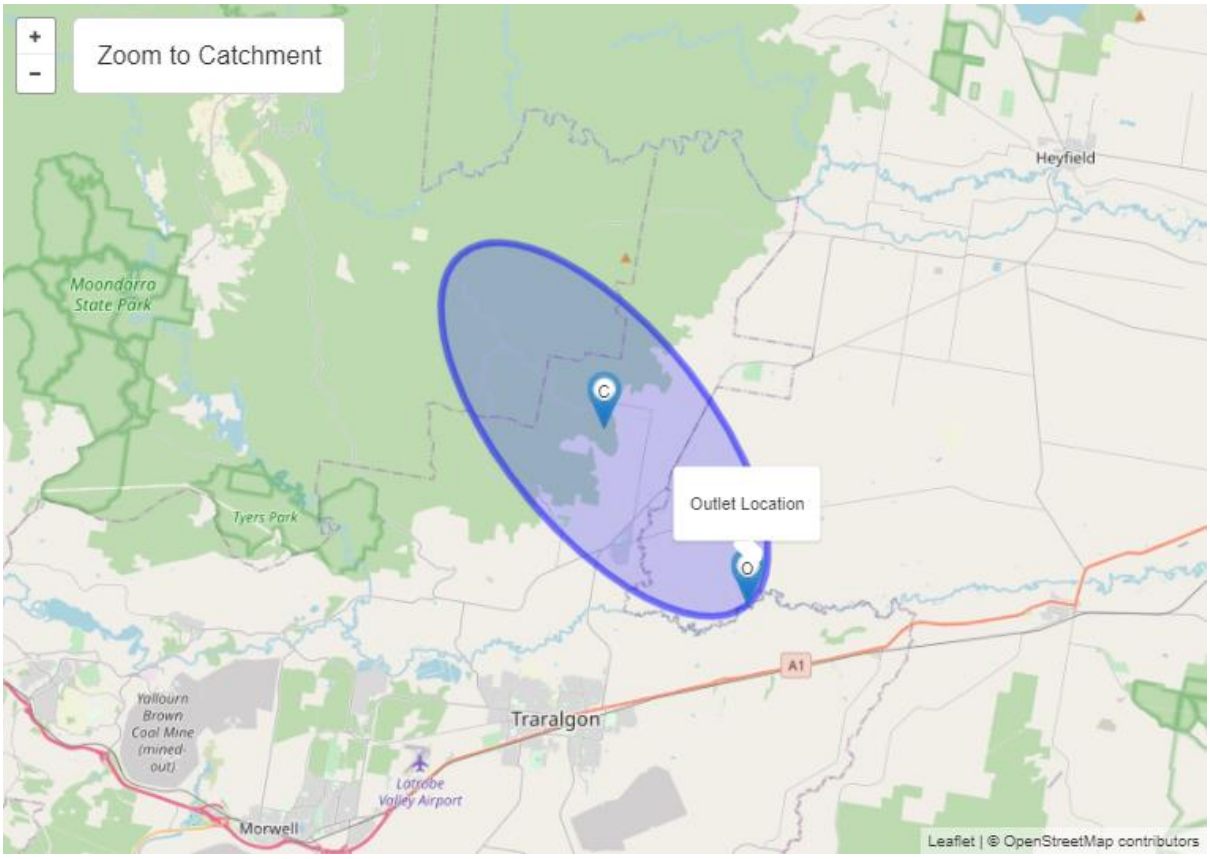

Figure 6 Map from the ARR Datahub showing catchment centroid

2.2.2 *Kc*

Kc is a flow routing parameter used by RORB, kc is an empirical coefficient applicable to the catchment (or, more rarely, a subcatchment) and stream network, (Laurenson, Mein, & Nathan, 2010). This parameter effects the time it takes for the water to move through the catchment model.

The initial estimates for kc, were based on the regional estimation equations in ARR2016.

The guidelines suggested by the 2016 ARR for the eastern parts of Victoria is that the Vic (MAR>800mm) equation is a suitable equation for working out the Kc of the catchment, MAR being the mean annual rainfall for the catchment (Book 7 Chapter 6 6.2.1.3 ARR 2016).

Recommendations from HARC is that the Pearse equation is more suitable for this application as it takes into consideration the average distance from sub-area centroid to outlet in its calculations (Stephens, 2019).

The adopted kc parameter for this model was 17.47 based on the Pearse equation.

2.2.3 *m*

The industry standard for the non-linearity parameter (m) is 0.8 (Book 7 Chapter 6.2 ARR 2016). There was not adequate data provided to indicate that the m value should be adjusted from this industry standard, therefore the value for m used for RORB was 0.8.

2.3 Monte-Carlo

The use of Monte-Carlo modelling follows the ARR's recommendation for reducing any bias of estimated flood probabilities (Nathan & Ling, 2016). In a Monte Carlo simulation, influential modelling parameters are stochastically varied across each run. For Eaglehawk Creek, 10,000 individual runs are performed during each simulation.

Rather than outputting a series of hydrographs, the Monte Carlo simulation outputs just the peak flows of each of the 10,000 individual runs along with the parameters used to create them, forming a flood frequency curve.

This process was used to identify the critical storm parameters for each event size, these parameters included:

- Critical storm duration.
- Temporal pattern shape.
- Continuous loss percentage.

2.3.1 *Input Data*

The following sections present the alternative data that is used during the design run stages of the RORB hydrology modelling.

2.3.1.1 Intensity Frequency Duration tables

The Intensity Frequency Duration (IFD) tables were used by RORB to define the total amount of rainfall depth expected during an event of a certain size and duration.

The IFD table that was used as part of this study has been displayed in Table 3. The left column relates to the total duration of the rainfall event, the top row is the size or AEP % of the rainfall event and the remaining numbers are the depth of rainfall expected for a rainfall event of a given duration and event.

Table 3 Traralgon Creek Catchment IFD Chart

Duration	63.20%	50%	0.5EY	20%	0.2EY	10%	5%	2%	1%	1 in 200	1 in 500
1 min	1.41	1.64	1.82	2.4	2.45	2.97	3.58	4.44	5.15	5.84	6.85
2 min	2.33	2.69	2.98	3.9	3.97	4.78	5.7	7	8.08	9.19	10.7
3 min	3.16	3.65	4.05	5.3	5.41	6.52	7.78	9.57	11.1	12.6	14.7
4 min	3.89	4.5	4.99	6.56	6.69	8.07	9.66	11.9	13.8	15.7	18.3
5 min	4.53	5.25	5.83	7.67	7.82	9.47	11.3	14	16.3	18.5	21.6
10 min	6.88	8.01	8.89	11.8	12	14.6	17.6	21.9	25.4	28.8	33.8
15 min	8.44	9.83	10.9	14.5	14.8	18	21.7	27	31.4	35.6	41.7
20 min	9.6	11.2	12.4	16.5	16.8	20.5	24.6	30.7	35.6	40.4	47.4
25 min	10.5	12.2	13.6	18	18.4	22.4	26.9	33.5	38.9	44.1	51.7
30 min	11.3	13.1	14.6	19.3	19.7	23.9	28.8	35.7	41.5	47.1	55.2
45 min	13.1	15.2	16.9	22.2	22.6	27.4	32.8	40.7	47.1	53.5	62.7
1 hour	14.5	16.7	18.6	24.3	24.8	29.9	35.8	44.1	51.1	58	67.9
1.5 hour	16.6	19.1	21.2	27.4	27.9	33.6	40	49.2	56.9	64.6	75.6
2 hour	18.3	21	23.3	29.8	30.4	36.4	43.3	53.2	61.3	69.6	81.5
3 hour	21.1	24	26.6	33.7	34.4	41	48.6	59.4	68.5	77.6	91
4.5 hour	24.5	27.6	30.7	38.4	39.2	46.5	54.9	67.1	77.1	87.4	102
6 hour	27.2	30.7	34.1	42.4	43.2	51.1	60.3	73.5	84.5	95.7	112
9 hour	31.8	35.7	39.7	49	50	58.9	69.4	84.5	97	110	129
12 hour	35.6	39.9	44.3	54.6	55.7	65.5	77.1	93.8	108	122	143
18 hour	41.5	46.6	51.7	63.7	65	76.4	89.7	109	125	142	166
24 hour	46.1	51.9	57.6	71	72.5	85.2	99.9	121	139	158	185
30 hour	49.9	56.2	62.3	77.1	78.6	92.4	108	131	150	171	201
36 hour	53	59.7	66.3	82.2	83.8	98.6	116	140	160	183	215
48 hour	58	65.4	72.6	90.2	92	108	127	153	175	200	234
72 hour	64.6	72.9	81	101	103	121	141	171	194	221	258
96 hour	68.7	77.5	86.1	107	109	128	149	180	205	232	270
120 hour	71.6	80.5	89.3	110	112	131	154	185	211	238	277
144 hour	73.6	82.4	91.5	111	114	133	155	187	213	240	280
168 hour	75.2	83.7	92.9	112	114	133	155	188	214	240	281

2.3.1.2 Temporal Patterns

A temporal pattern is a unit hyetograph which is used by RORB to temporally vary the rainfall input into a hydrology model.

The temporal pattern was used to multiply each percentage increment in the temporal pattern by the total storm intensity specified by the IFD table across the duration of the storm, giving a hyetograph.

The 2016 ARR guidelines recommends that at a minimum 10 temporal patterns are ran through a hydrology model and the most suitable of the 10 be selected for use within the design runs. The set 10 temporal patterns have been supplied by the ARR via the ARR datahub (Babister, Trim, & Retallick, 2017).

These temporal patterns can be found in the ARR datahub website.

2.3.1.3 Areal Reduction Factors

The Areal Reduction Factor (ARF) is another parameter that comes from the Data Hub. The ARF value that was used was based off the area of the entire catchment to the outlet. Well into the hydraulic modelling phase, advice from Hydrology and Risk Consulting (HARC) was delivered around the ARF factor. This advice was that the ARF should be calculated based off stream length and catchment areas to each print node, rather than the outlet (Stephens, 2019). In order to have each printed hydrograph feature a correct ARF, a new model would need to be ran for each print node that would require a different ARF value. This will process will be amended for future studies, but this advice was given after the modelling had been completed and was too late in the modelling process to be implemented.

2.4 Design run

The purpose of the design run stage is to produce hydrographs at key locations throughout the catchment, (shown further in the report in Figure 8). The design run stage uses the same input data as the validation stage. However, rather than running a Monte Carlo suite of varying parameters, the Design run stage only runs a singular storm event for each AEP. Results

2.5 Assumptions

2.5.1 *Validation stage using the Monte Carlo*

Much like when performing a flood frequency analysis of gauged results, RORB's Monte Carlo analysis only looks at the peak flow of each of the hydrographs produced during a simulated storm to calculate the storms AEP. The issue with this approach is that it does not take into account the overall shape of the hydrograph and favours hydrographs that are more peaked in shape.

In addition to this, analysis during the validation really should be conducted at a larger number of print locations rather than just at the outlet or gauge locations in order to find a design storm that causes the desired AEP across locations across the entirety of the catchment.

2.5.2 *Delineation of the catchment*

In order to meet recommendations around the size of subareas and the 5 subareas above a print location, a number of potential flow paths were not included in the RORB model. While these missed flow paths are unlikely to significantly affect the flooding of the Traralgon Creek, some localised inundation may have been missed.

SECTION C HYDRAULICS

1 DESCRIPTION OF HYDRAULIC MODELLING APPROACH ADOPTED

The hydraulic analysis of Eaglehawk Creek was performed through a hydraulic modelling program called TUFLOW. TUFLOW used the hydrographs produced by RORB as flow inputs into the hydraulic model. The hydraulic model of Eaglehawk Creek is primarily 2D (2-Dimensional), with only a few 1D (1-Dimensional) networks which model the more significant hydraulic structures within the system. The choice to use 2D for this model was made as generally it is quicker and more advantageous to set up a 2D model than a 1D/2D hybrid. The 2D model components consists of a 2-metre grid DEM representing elevation for Eaglehawk Creek.

Aerial photography was used to identify any hydraulic features of significance within the model extent and model these features either as hydraulic structures such as culverts, or simply as areas of increased roughness. The aerial photography was also used to check LiDAR data for any inaccuracies or errors.

2 AVAILABLE DATA

2.1 Aerial photography

The aerial photography was used primarily to define the different materials within the floodplain and to identify hydraulic structures that needed further investigation.

In addition, the aerial imagery helped identify defects within the lidar datasets, as it was able to confirm whether the presence of dense vegetation, fences or other features had possible been picked up.

2.2 Elevation data

For this component of the study, the primary concerns with the elevation datasets were the accuracy and resolution of the elevation dataset. The coverage of the elevation was less of a concern, as the hydraulic extent needed to be reduced to aid in run time anyway.

As shown in Figure 3, the Riparian and Floodplain dataset are generally limited to the floodplain area of the Eaglehawk Creek.

2.3 VicMap data

2.3.1 *Roads*

Information around the location of roads was primarily from the Road Network – Vicmap Transport layer. The roads layer was used to define the location of where road material roughness should be applied.

2.3.2 *Land-zoning*

The Vicmap Planning layers were used to determine the land usage of each of the lots and was used in conjunction with the available areal imagery to delineate the material layer across the catchment. While the Vicmap Planning layer was a good start, due to the majority of the catchments land zone being FZ, the imagery and lidar datasets where still required for much of the roughness defining process.

3 CATCHMENT EXTENT HYDRAULIC MODEL

3.1 Model extent

Figure 7 displays the extent of the boundary of the hydraulic model. The extent of the boundary was defined this way due to the following criteria.

3.1.1 *Available Elevation Data*

The feature that had the most influence on the hydraulic extent was the available lidar for this area. As discussed previously, the Vicmap DTM is not of a suitable resolution to be used for hydraulic modelling at this scale. The only elevation data that was used for the hydraulic modelling was the West Gippsland Riparian Lidar and the West Gippsland Floodplain Lidar datasets.

3.1.2 *Grid Resolution*

Grid resolution is another typical constraint when defining the amount of area able to be modelled. The grid resolution needs to be fine enough to be able to adequately represent the significant waterways, while also having a model simulation time that can be ran within a reasonable timeframe.

Recommendation from TUFLOW is that in order to adequately represent the waterway, the grid resolution must be fine enough to allow at least 3-4 cells to fit across the waterway (BMT, 2018). The resolution of the elevation grid input into TUFLOW was 2 metres. Towards the upstream sections of the catchment the stream width varies between 3-4 metres, which is less than the acceptable levels.

3.1.3 *Flood data*

After taking the above criteria into consideration, and performing some initial runs, the extent of the hydraulic model was refined further to remove section of the model that had not received any flooding. This was done to further reduce the run time of the model.

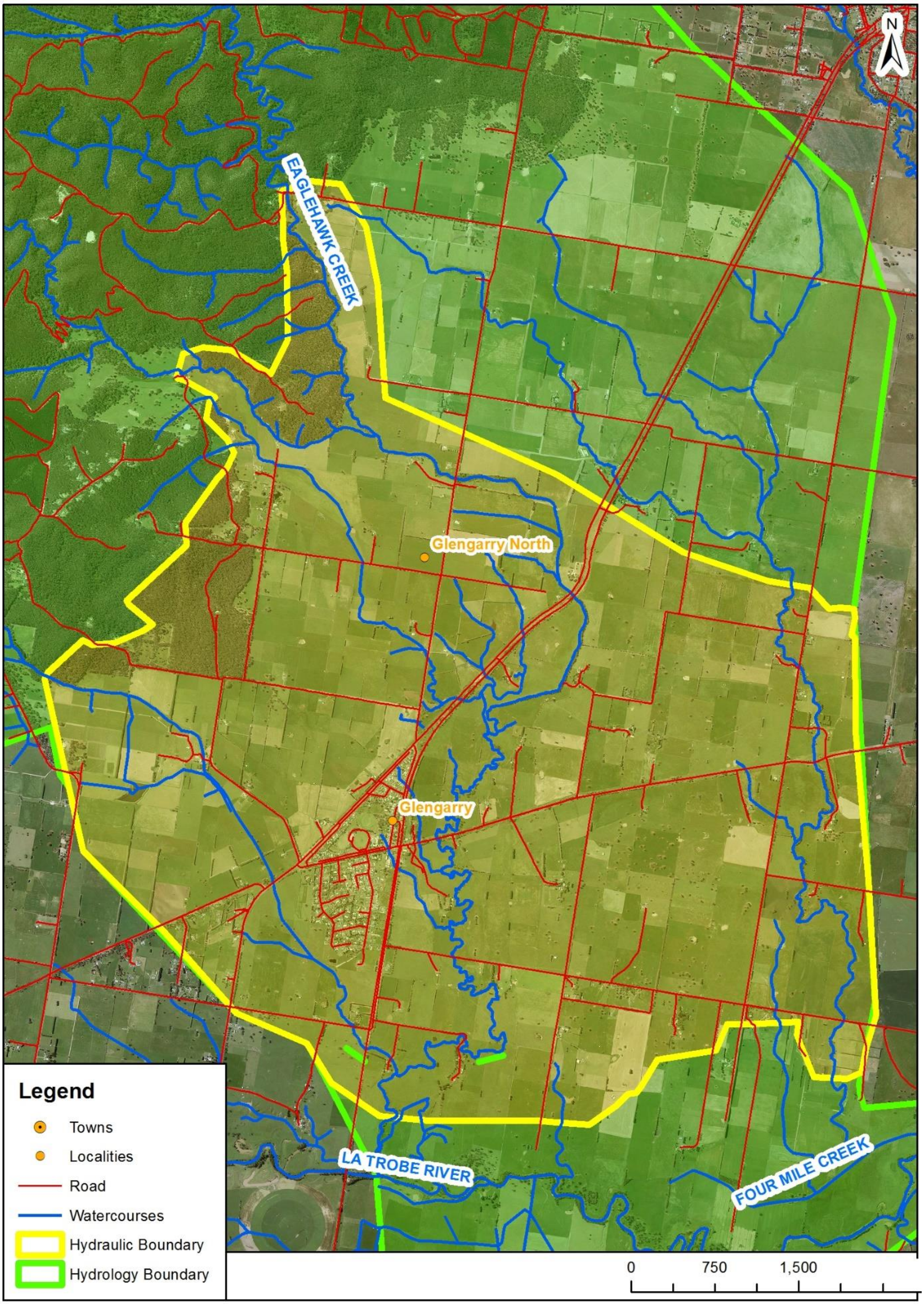

Figure 7 Hydraulic Model Extent

3.2 Input data

3.2.1 *Gridded elevation data*

Almost all the topography data input into TUFLOW was done using a Digital Elevation Model (DEM). As mentioned above, the DEM input into TUFLOW had a 2-metre resolution. The DEM was generated by resampling the West Gippsland Riparian Lidar Dataset from a 1-metre resolution to a 2-metre resolution. The resampling was performed within TUFLOW.

The resampling was necessary as to reduce the run time to a practical duration. The cell size still satisfies the recommendations from TUFLOW that the resolution should be fine enough to be able to fit 3 cells across the width of the river at the point of interest.

The digital elevation grid was altered using TUFLOW's zsh shapes and commands. The bridges had been removed from the Riparian dataset as part of its post processing and the zsh commands raised the elevation around the bridges to the equivalent height of the bridge deck.

3.2.2 *Flow data*

As mentioned previously in this report, the flow hydrographs generated from RORB were input into the hydraulic model. The flow data was input into TUFLOW using either a 2D boundary condition line (2d_bc_L) or a 2D source area polygon (2D_SA_R), these shape files referenced flow vs time plots from external csv directed by the boundary condition data base (bc_dbase).

2D_bc_Ls and 2D_SA_Rs were used based on whether or not the source of flow originated from inside or outside of the hydraulic boundary area. Figure 8 describes the locations of inflow into the hydraulic model.

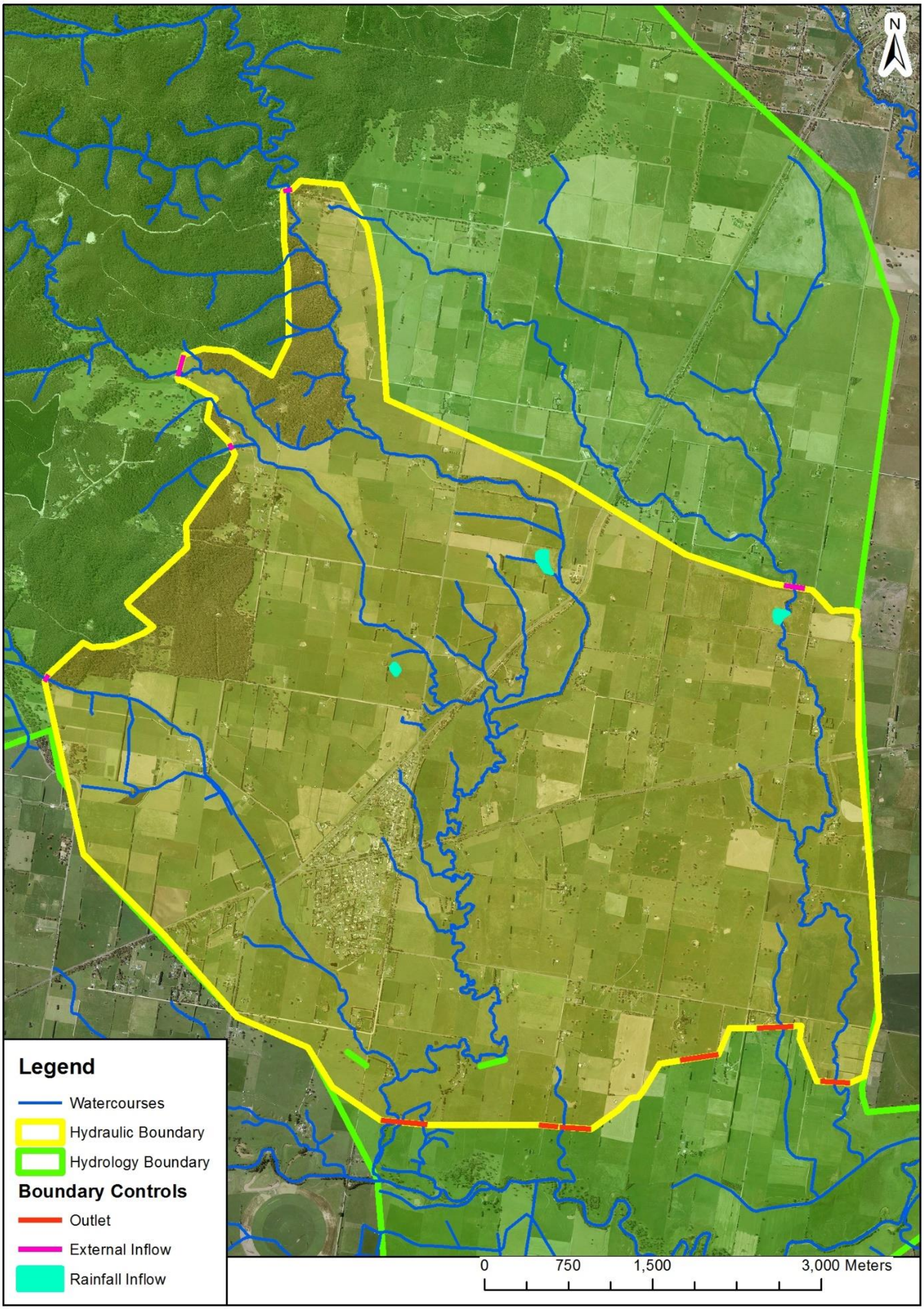

Figure 8 Location of model inflows and outflows

3.2.3 *Materials*

The material layers and tables were used to define the Manning's roughness coefficients across the hydraulic model. The Manning's coefficients were varied spatially through the use of material shape files (shown in Figure 9). The model was divided up into 4 different material types, Table 4 displays the different material types and values used.

The digitisation of these material types was done primarily using the areal imagery, with the land use layers helping define residential and road materials.

Table 4 Material Parameters

Material ID	Manning's n	Description
1	0.03	Veg – Low
2	0.04	Veg – High
11	0.01	Road
13	99	Building

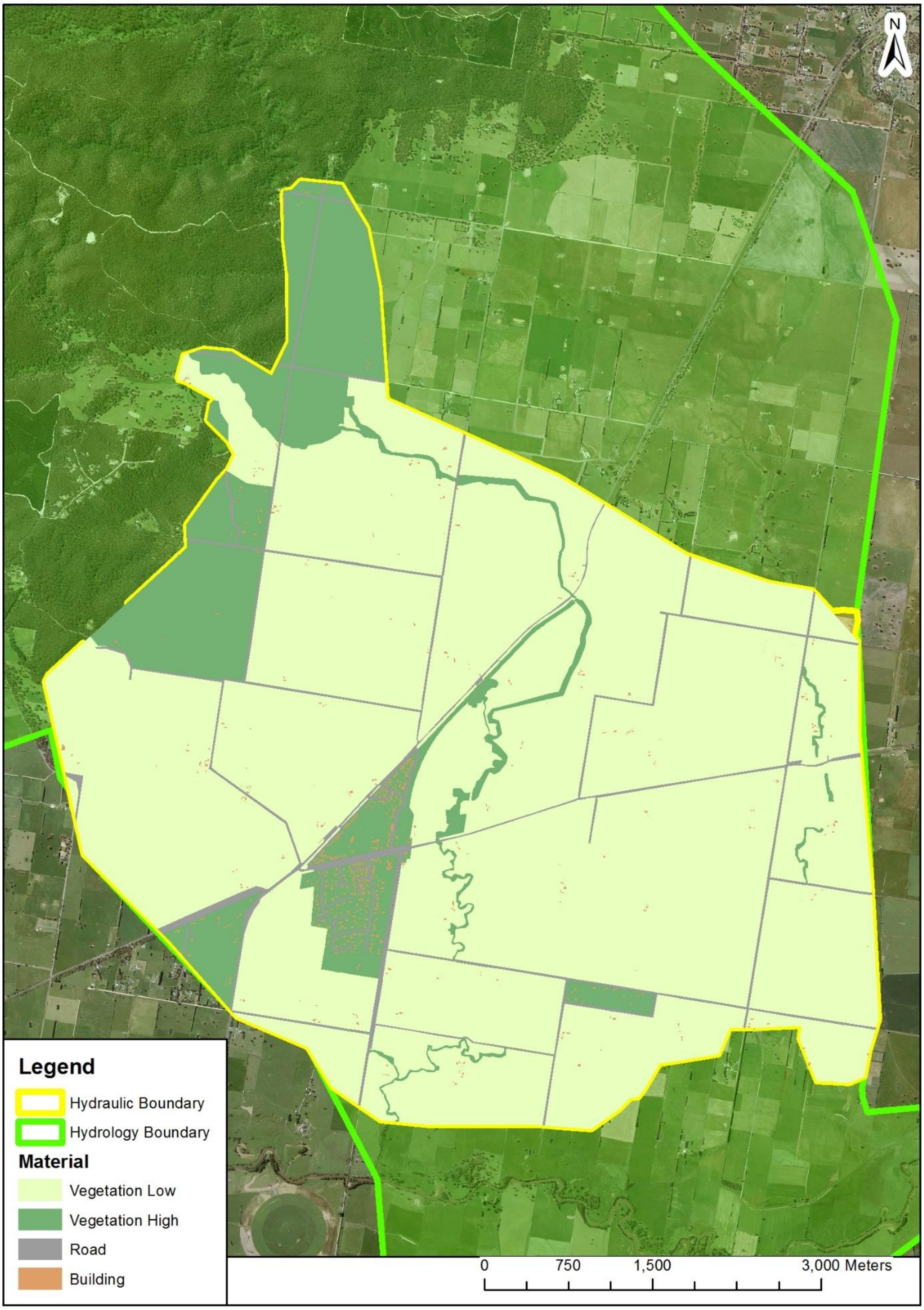

Figure 9 Material Layer

3.3 Assumptions

3.3.1 *Loss model*

Losses were modelled during the hydrology modelling stage, not within the hydraulic model. This means that all water that enters the hydraulic model will either exit the model through the outlet or remain in the model until the simulation finishes. This can cause water to remain trapped in small depressions in the model, potentially acting as an unintentional additional loss that was not accounted for during the hydrology modelling phase. However, the volume of water "lost" as a result of this is likely to be negligible.

3.3.2 *Waterway delineation*

As mentioned previously, the assumptions made during the delineating of waterways as part of the hydrology phase has caused some minor flow paths into the main Eaglehawk Creek channel to be omitted. While this may result in some localised inundation around the edges of the model being missed, omitting these flow paths is unlikely to have a significant effect on the overall flood behaviour of the Traralgon Creek.

3.3.3 *Flow application*

The applications of flow are defined in Figure 9. Of particular concern is the internal flow sources which use Source Area polygons (2d_SA) to define the location of runoff when the centroid of a subarea falls within the boundaries of the hydraulic model.

In reality, runoff would be spread out across the subarea, taking fine flow paths into the Traralgon Creek channel. Whereas the application of the flow using a SA polygon was restricted to often a 16 square metre area, typically placed directly within the main channel of the Eaglehawk Creek. This approach has the potential to artificially reduce the time that the catchment takes to convert runoff from rainfall and to miss possible flow paths. However, as shown by the hydrographs in 0, the amount of runoff produced by subareas with centroids within the hydraulic boundaries tend to be less significant.

3.3.4 *Roughness model*

The roughness model used by the study applies a singular Manning's value to a particular material type. It is likely that the roughness of the catchment material would change due to factors like; the depth of flood waters, vegetation being flattened during larger events, and growth or removal of vegetation.

Additionally, the accuracy of the definition of material type is dependent largely on how the catchment has changed since the capture of the imagery datasets.

3.4 Parameters and settings

TUFLOWs HPC simulation mode uses an adaptive timestep.

3.5 Sensitivity analysis

The hydraulic model was tested to see how sensitive it was to certain parameters. The parameters that were tested are as follows;

The Manning's roughness coefficient within the material csv. The Manning's coefficient was adjusted by ±20%.

The hydraulic slope of the downstream HQ boundary, which was also adjusted by ±20%.

The changes to the parameters listed above have had little effect on the hydraulic results. The effect being changes in maximum velocity by less than ±0.3 m/s, maximum depth by less than ±0.1 meters and maximum water surface elevations by less than ±0.1 meters. These effects are slight when compared to the effect that the results from the hydrologic model have on the hydraulics in terms of hydrograph shape and peak flows and the uncertainty involved when producing these hydrographs.

3.6 Results

The results from this flood study are available in GIS form, located in a SDS compliant geodatabase.

The results feature raster datasets showing flood depths, velocities, water surface elevation and the digital terrain model used. In addition to the raster data, flood extent polygons and water surface elevation contours are also available.

Time series xmdf layers and animation videos are also available, which show the flood across time.

SECTION D CONCLUSION AND RECOMMENDATIONS

1 CONCLUSION

The Eaglehawk Creek floodplain mapping provides an analysis and review of existing and future potential flood risks along the areas around Glengarry.

Key outcomes from the study identify that the Eaglehawk catchment has a broad floodplain, which is prone to flooding to some degree during floods in all magnitude ARI events. Due to the land use of the catchment area being predominately farming, a large number of rural properties are subjected to flooding however minimal residential structures are likely to be impacted.

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