Final Study Report

Latrobe River Flood Study

LJ5792:RM2418

Prepared for
West Gippsland CMA

March 2015

West Gippsland
Catchment Management Authority

Cardno
Shaping the Future

Contact Information

Cardno Victoria Pty Ltd
ABN 47 106 610 913

150 Oxford Street,
Collingwood
VIC 3066
Australia

Telephone: +61 3 8415 7777
Facsimile: +61 3 8415 7788

In association with:

Michael Cawood & Associates Pty Ltd
8 Stanley Street
Chirnside Park
VIC 3166

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    - Wellington Shire Council, with special thanks to: Robyn Olsen; and
    - Department of Environment and Primary Industries (DEPI formerly known as DSE), with special thanks to Simone Wilkinson.
- Michael Cawood for his contributions to the flood warning and emergency management components of the study.
- The Bureau of Meteorology for supplying the hydrological models used in the study and information on the current flood warning service and flow gauges.

Executive Summary

Background

The Latrobe River is the largest waterway in the West and Central Gippsland area with an extensive floodplain. Prior to this study, there was very limited information about flooding from the Latrobe River. Whilst many of the Latrobe's tributaries had been studied, the Latrobe River itself had not been and was considered the 'missing link' in relation to flood modelling. The Latrobe River Catchment has experienced significant flood events in 2012, 1993, 1978 and 1934.

Plate 1 Water overtopping the Traralgon-Maffra railway embankment in 1934 (looking North)

The flood study area includes the Moe River from Yarragon to its confluence with the Latrobe River, and the Latrobe River from Moe to Lake Wellington. Due to the region's status as Victoria's principal electricity-producing region and its proximity to Melbourne, there is demand for further development and expansion of urban areas. Pressure is growing to develop areas subject to flooding within the Latrobe basin.

Project Aims

The aim of this study is to provide detailed information on flood extents, depths and velocities. This information will be used to:

- Improve planning schemes / improve land-use planning to better manage development in flood risk areas;
- Assist emergency response; and
- Help inform the community of flood risks.

Study Team and Stakeholders

Cardno have undertaken the Latrobe River Flood Study with the assistance of Michael Cawood and Associates. Michael completed the Flood Warning System review and recommendations and developed the VICSES Municipal Flood Emergency Plan (MFEP) Appendices for this investigation.

The flood study has been managed by West Gippsland Catchment Management Authority (WGCMA) and has been overseen by a multi-agency Working Group, comprising representatives from WGCMA, Department of Environment and Primary Industries (DEPI formerly known as DSE), VicSES, and the three municipalities through which the Moe and Latrobe Rivers flow - Baw Baw Shire Council, Latrobe City Council and Wellington Shire Council.

Project Summary

As inputs to the study, data was gathered from a range of sources including: WGCMA, Councils, VicSES, BoM and Southern Rural Water. The community were engaged through public notices, surveys and direct contact by WGCMA. Consultations provided WGCMA and the study team a knowledge of previous flooding experienced which has helped verify model results and identify which mitigation options to investigate.

Design flows have been calculated for a range of average recurrence intervals by statistically analysing the frequency of floods in the gauged flow record. The flood model created in this study was calibrated to historical events and validated to these design flood events at the Thoms Bridge and Rosedale gauges. The Trafalgar East gauge was not used as the gauged data had issues thought to be caused by flow bypassing. Rather than using flows to calibrate the model, levels (which are directly measured) were used. Similarly, to validate the flood model to design events, levels were used by converting flows using gauge rating tables.

Independent peer reviewers assessed both the hydrological and hydraulic reports. Feedback provided was reviewed and the approach to addressing each comment was agreed between WGCMA and Cardno prior to making changes.

Flood damages have been calculated to help assess flood risk and provide context to assess flood mitigation options. The Annual Average Damage (AAD) has been calculated using a probability approach. The AAD attempts to quantify flood damage that a floodplain would receive on average during a single year.

A number of structural and non-structural flood mitigation options have been assessed. WGCMA nominated three structural flood mitigation schemes to be investigated as follows:

- Option 1: Large Levee Removal
- Option 2: Reinstatement of Meanders – removal of cut-offs
- Option 3: Moe River Improvements

Flood warning and planning controls offer credible non-structural mitigation opportunities to reduce flood related damages and flood related risk to safety. The use of enhanced flood warning systems, improved planning controls, and better emergency response through revision of the Municipal Emergency Management Plans (MEMP) and Local Flood Guides has been examined. .

Project Findings

- The flood model created in this study has been demonstrated to replicate levels well for both historical events (1978 and 1993 events) and the expected flood levels for design flood events.
- The key flood behaviours of the Moe and Latrobe Rivers are summarised below (upstream to downstream):
    - Once flow exceeds the Moe River capacity and enters the Moe Flats floodplain, there is little opportunity for it to re-enter the channel due to high levees. The Moe flats are characterised by very flat floodplains and flood water is retarded behind roads and levees. Floodwaters can only re-enter the Moe River channel when waters levels in the channel have dropped enough to allow drains and floodgates to operate.
    - As the Moe River and Latrobe Rivers converge they enter Lake Narracan. Downstream of the Lake, the channel is incised with floodwaters constrained. It is only in the vicinity of Thoms Bridge that flood waters return to a wider floodplain.
    - Between Thoms Bridge and Rosedale there is significant flooding including areas at the northern edge of the Traralgon and Rosedale urban areas. Major flooding does not appear to impact the current town boundaries at Traralgon, but any encroachment to the north would be impacted by Latrobe River flood flows. At Rosedale, most flooding is caused through the township as a result of Blind Joes Creek not being able to discharge freely into the Latrobe River. This results in inundation of the Princes Freeway.
    - The flood flows between Rosedale and Lake Wellington are largely contained within the well-defined floodplain. Levels at the Swing Bridge and downstream to Lake Wellington are controlled by a combination of flows in both the Latrobe and Thomson. Increased flows activate larger remnant flowpaths and the low-lying morass areas south of Sale are filled by

floodwaters. Downstream of the Swing Bridge, water flows through the Heart and Dowds Morasses and into Lake Wellington.

- A range of datasets and mapping outputs have been developed based on a discussion of requirements between stakeholders. Outputs include maps, GIS datasets and animations. In addition to the typical flood study maps of depth, velocity and water surface elevation, a number of innovative flood timing maps have been prepared to assist in emergency response planning. These timing maps include: duration of inundation above threshold, time from rainfall to start of flooding and time from rainfall to flood peak.
- The AAD for the study area is approximately **$1.3 million**. Residential damages incurred from flows associated only with the tributaries of the Latrobe and Moe Rivers have been excluded from the damages assessment. These include areas such as Traralgon and Rosedale where Traralgon and Blind Joes Creek are the major source of flooding and parts of Moe where Narracan Creek is the key source of flooding.
- The structural options investigated did not significantly mitigate flooding on the Moe and Latrobe River floodplains.

Project Recommendations

- Whilst the flood model replicated expected levels at Thoms Bridge and Rosedale well, there were discrepancies in the flow suggesting potential issues with the rating curves at these sites (particularly at high flows). A review of the rating curves for these gauges is recommended as further works.
- Alternative structural flood mitigation options such as fill pads and mitigation works on tributaries could be considered as viable alternatives.
- It is recommended that the following non-structural options are implemented:
    - Enhancement of the flood warning service for the Latrobe Basin;
    - Updates to the MEMP and Local Flood Guides are recommended to incorporate the findings of the study;
    - Updates of the Floodway Overlay and Land Subject to Inundation Overlay in the planning schemes of Baw Baw Shire, Latrobe City and Wellington Shire Councils based on the results of this study.

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1 Introduction

1.1 Background

The Latrobe River is the largest waterway in the West and Central Gippsland area with an extensive floodplain. Prior to this study, there was very limited information about flooding from the Latrobe River. Whilst many of the Latrobe's tributaries had been studied, the Latrobe River itself had not been and was considered the 'missing link' in relation to flood modelling.

West Gippsland Catchment Management Authority (WGCMA) is the key agency responsible for catchment management in the West Gippsland region. The flood study area includes the Moe River from Yarragon to its confluence with the Latrobe River, and the Latrobe River from Moe to Lake Wellington. The catchment includes areas within Baw Baw Shire Council, Latrobe City Council and Wellington Shire Council as shown on Figure 1.1.

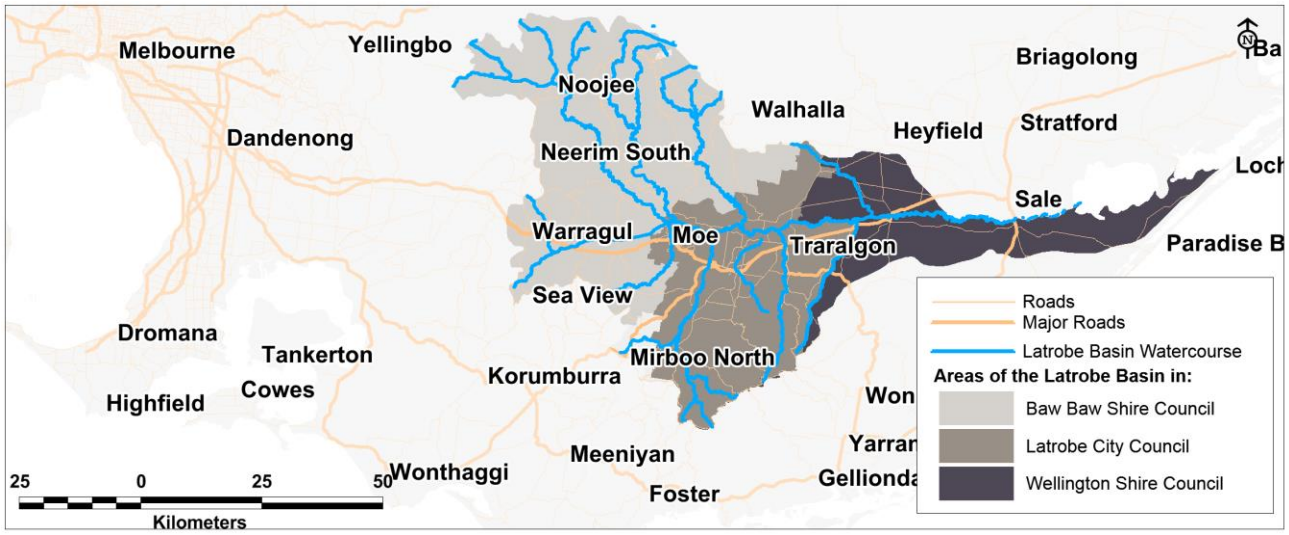


Figure 1.1 Latrobe River Catchment, showing Flood Study Area and Councils

Due to the region's status as Victoria's principal electricity-producing region and its proximity to Melbourne, there has been considerable pressure for further development and expansion of urban areas.

Within the Latrobe Valley, much of the area to the south of the Princes Highway has either been utilised for coal mining for power generation or is quarantined for similar uses in the future. Town planners and developers have therefore been looking to the north of towns such as Traralgon, Morwell and Moe for new areas to develop. Further east at Sale, development is constrained by the Macalister Irrigation District to the north and the Latrobe floodplain to the south. Increasingly, this means that new development is interacting with areas that are subject to flooding.

The Moe River is a highly modified waterway. It was constructed in the 1880s to drain what was then known as the Moe Swamp. The 'drain' section of the river is approximately 19 kilometres long, has been completely straightened and is severely constricted by levees along both banks. Straightening of the watercourse shortened it and as a result it has become highly erosive. Over the years, the bed of the river has deepened considerably, which has caused slumping of the banks along most of its length. This bank slumping has led to the partial closure of North Canal Road, which was constructed parallel to the river, and in some places, on the levee bank.

Figure 1.2 shows the Latrobe River catchment and its tributary river systems. The key river flow monitoring gauges have been highlighted, based on the length and quality or record available. The Latrobe River runs east to Lake Wellington. The key contributing tributaries are the Moe River, Tanjil River, Tyers River, Narracan Creek, Morwell River and Traralgon Creek.

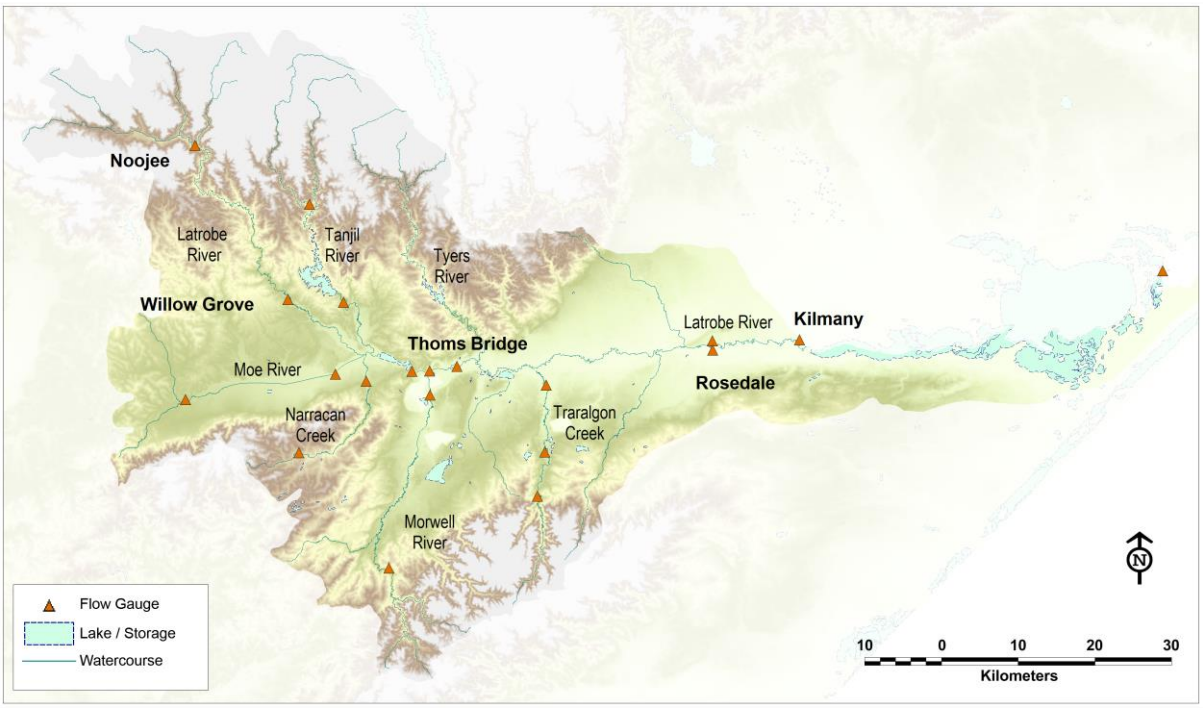


Figure 1.2 Latrobe River Catchment, showing key flow gauges

1.2 Aims and Objectives

The aim of this study is to provide detailed information on flood extents, depths and velocities. This information will be used to:

- Improve planning schemes / improve land-use planning to better manage development in flood risk areas;
- Assist emergency response; and
- Help inform the community of flood risks.

1.3 Study Team and Stakeholders

Cardno have undertaken the Latrobe River Flood Study with the assistance of Michael Cawood and Associates. Michael completed the Flood Warning System review and recommendations and developed the VICSES Municipal Flood Emergency Plan (MFEP) Appendices for this investigation.

The flood study has been managed by West Gippsland Catchment Management Authority (WGCMA) and has been overseen by a multi-agency Working Group, comprising representatives from WGCMA, Department of Environment and Primary Industries (DEPI formerly known as DSE), VicSES, and the three municipalities through which the Moe and Latrobe Rivers flow - Baw Baw Shire Council, Latrobe City Council and Wellington Shire Council.

1.4 Constituent Reports

This report should be considered a summary of the study with further details provided in the following constituent reports:

- Hydrology Report which can be found at Annex A;
- Hydraulics Report which can be found at Annex B; and
- Flood Damage and Mitigation Report which can be found at Annex C

In addition to the constituent reports, the Latrobe River Flood Study has delivered Draft Municipal Flood Emergency Plan (MFEP) Appendices. As these are 'live' documents, they are not contained in this report. To obtain the most up-to-date MFEP appendices, please contact the relevant Council.

2 Available Information Search and Consultation

2.1 Available Information Search

2.1.1 Data from WGCMA, Councils and VICSES

As part of project inception, the following information was requested from WGCMA, Latrobe City, Baw Baw Shire Council, Wellington Shire Council and VICSES:

- Survey information for crossings, topography, property flood levels, structures (incl. levee alignments). This includes private structures if available;
- Historic flood data (photographs, documented levels/depths/hazardous areas, road closures, etc.)
- Any relevant previous studies; and
- Relevant GIS datasets (such as requests for assistance from VICSES).

In response, WGCMA provided the following information:

- Topographic data:
    - Latrobe River Topographical Survey (1994)
    - LiDAR data in a geo-database from 2008 - 2010;
    - Moe flood plain cross sections (1984)
- Various previous studies, referred to throughout this report;
- GIS data including Victorian Flood Database data, VIC land cover information & VicMap data (Hydro, planning, property and transport).

Use of this data is discussed within the details of the constituent reports (refer Section 1.4).

2.1.2 Data from Bureau of Meteorology

The Bureau of Meteorology (BoM) was contacted and supplied the following information for use in the study:

- Latrobe River and Thomson River URBS hydrological models (Unified River Basin Simulator);
- Raw gauged level data from the June 2012 storms; and
- Daily total and pluviograph information quality assured to 2011.

2.1.3 Data from Southern Rural Water

Southern Rural Water operates Lake Narracan on the Latrobe River to provide reservoir water supplies for power companies. They were contacted and provided sufficient operational details of the reservoir to allow it to be appropriately represented in the flood modelling.

2.1.4 Flow Data from Various Sources

The key sources of flow data are shown below and their use is referred to throughout the Hydrology Report and Hydraulics Report (Annex A and Annex B respectively):

- “Red Book” (1987) flow and gauge information which was obtained from DSE (Department of Sustainability and Environment), now DEPI (Department of Environment and Primary Industries);
- Gauged records downloaded from the Victorian Water Resources Data Warehouse website. Due to the data warehouse’s quality assurance process, at the time of this study data was available for dates up until 1 April 2011;
- Level data downloaded for the June 2012 flood event, which was converted to flow data using rating curves (obtained from BoM). This data has not undergone the data warehouse’s quality assurance.
- Data from documents such as:

- B.S. Newell (for Department of Conservation and Environment, Victoria),"Hydrodynamics of the Latrobe River Estuary" (1991)
- Geo-Eng Australia (for Yallourn Energy),"Morwell River Diversion Preliminary Hydraulic Analysis - Vol 3 Model Results" (1998)
- Geo-Eng Australia (for Yallourn Energy),"Morwell River Diversion Preliminary Hydraulic Analysis - Vol 4, Drawings" (1998)
- GHD (for City of Traralgon),"Traralgon Creek Flood Study" (1979)
- GHD (for Latrobe Region Water Authority),"Water Supply Options for the Lower Latrobe River Wetlands" (1991)
- GHD (for Shire of Traralgon),"Traralgon - Maffra Road, Report on the Latrobe River Crossing" (1983)
- Ivars Reinfelds, Ian Rutherfurd & Paul Bishop, "History and Effects of Channelisation on the Latrobe River, Victoria" (1995)
- Latrobe Valley Water & Sewage Board, "Report on Floods in the Latrobe River Catchment from 1st-16th June 1978 - with Particular Reference to the flood 2nd-5th June 1978" (1978)
- Natural Resources and Environment, “Flood Data Transfer Project, River Basin Report - Latrobe Basin" (2000)
- SMEC (for Roche Thiess Joint Venture),"Alternative river Diversion Extent of Flooding on the Latrobe River Floodplain" (2001)
- SMEC (for Thiess),"VicRoads South Gippsland Highway Swing Bridge Replacement Project - Hydrology and Hydraulics Study report" (2000)
- SMEC (for TRUenergy),"Latrobe River Diversion Flood Study" (2008)
- SMEC, "Alternative River Diversion - Extent of Flooding on the Latrobe River Flood Plain" (2001)
- State Development Committee, "Development of the Lands bordering the Latrobe River between Yallourn and Lake Wellington" (1957)
- State Rivers and Water Supply Commission, "Latrobe River between Moe and Yallourn (an assessment of the 1934 flood) " (1981)
- State Rivers and Water Supply Commission, "Proposed Remodelling of the South Gippsland Highway across the Flood Plains of the Latrobe and Thomson River" (1978)
- State Rivers and Water Supply Commission, "Traralgon Creek Flood Study - Summary Report" (1984)
- Water Technology, “Narracan Creek Flood Study” (2007)

- Data from Thiess Services, specifically for the Rosedale gauges where they revised the rating curves and updated the gauge record including removal of a mistake in the 1953 event. They were also contacted to get general background information on the gauged data in the Latrobe River region.

2.2 Consultation

Survey forms were prepared to obtain the following types of information from floodplain residents:

- Baseline property information including address, property type, length of occupation and resident details;
- Details of any flooding experienced; and
- Community expectations on flood mitigation options.

A total of 530 survey forms were mailed out to floodplain residents by WGCMA with cover letters and postage-paid return envelopes. Public notices were also published in the Latrobe Valley (LV) Express, the Gippsland Times and the Warragul Gazette.

Of the 530 surveys sent, 142 were returned. Data from the surveys were tabulated by WGCMA. This table is provided in Appendix A. Residents who provided contact details were sent follow up letters and individually contacted directly by WGCMA. Consultations provided WGCMA and the study team a knowledge of previous flooding experienced which has helped verify model results and identify which mitigation options to investigate.

Throughout the project, information was gathered from stakeholders during project meetings, phonecalls and emails. Key information gathered from stakeholders included catchment behaviours, details of flooding experienced, the representativeness of flood modelling results, the current arrangements for flood response and details of existing hydraulic structures such as levees.

3 Topographic Data

A Digital Elevation Map (DEM) was prepared for use in the flood modelling based on the following data:

- Latrobe River Topographical Survey (1994)
- LiDAR data in a geo-database from 2008 - 2010;
- Moe flood plain cross sections (1984); and
- GIS centrelines of roads and levees provided as part of the VicMap and VFD datasets respectively.

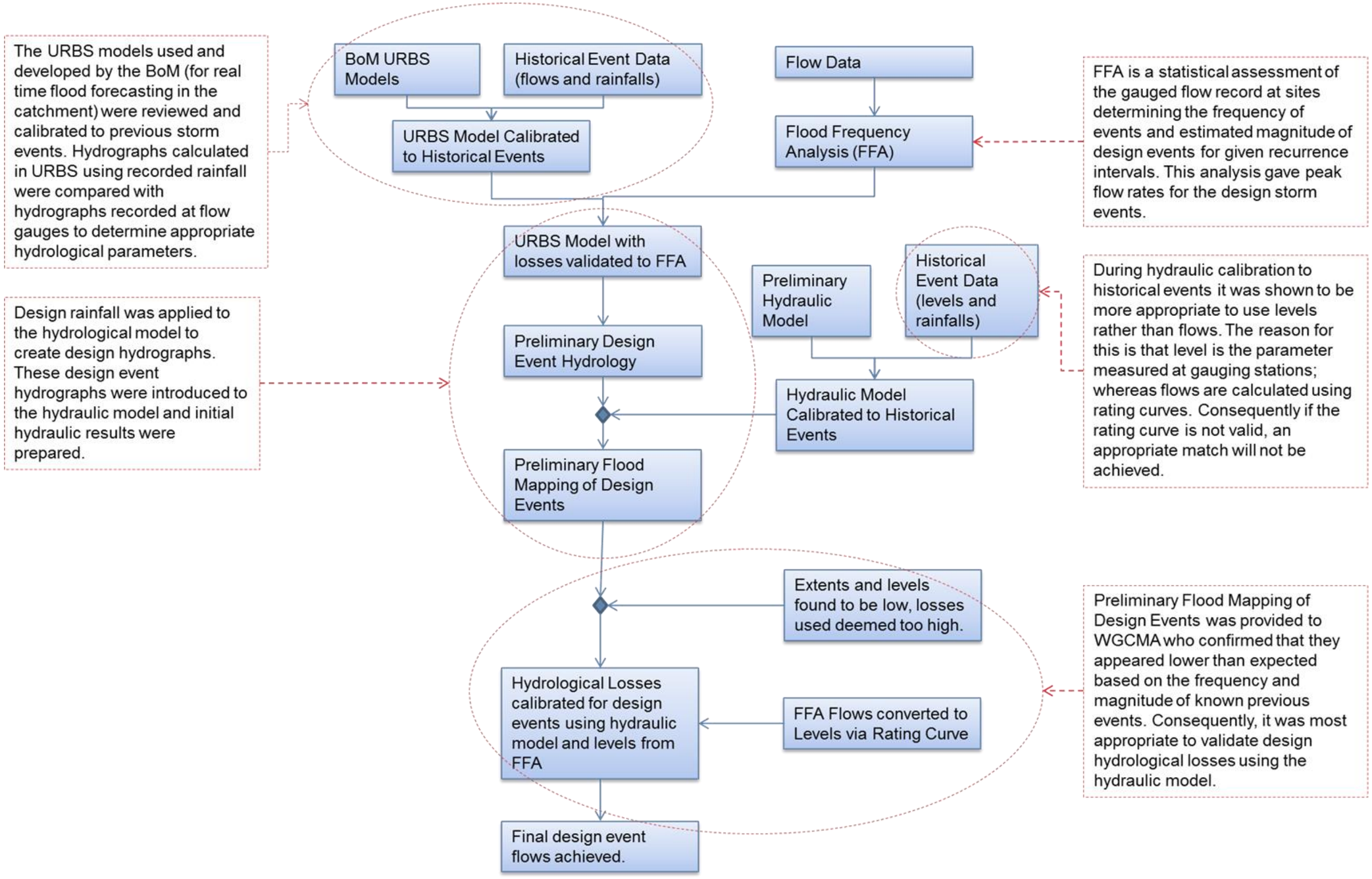
A summary of the topographic DEM creation process is shown below and detailed in the Hydrology Report (Annex B Section 2):

- A 40 x 40 m DEM was initially created from the LiDAR 1 m points based on average elevation;
- Where survey data was available it was deemed more accurate and given a higher weighting than the LiDAR;
- Where the grid intersected roads or levees, the highest LiDAR point from within the grid cell was used, effectively raising the roads and levees above the surrounding floodplain (where the average levels were used);
- Allowance was made for the interaction between the 2D floodplain and the 1D channels;
- Where bridge and river crossing structures did not interact with the peak flood waters the topography was lowered to provide an opening equivalent to the structure.

A detailed review of the DEM was conducted as part of the model testing to ensure all barriers to overland flows and flood storage were appropriately represented.

4 Flood Modelling

The chart beneath shows the process undertaken to achieve the design flows used in the production of flood mapping outputs. Further details can be found in the Hydrology Report and Hydraulics Report (Annex A and Annex B respectively):



4.1 Hydrological Model

4.1.1 FFA

Flood Frequency Analysis (FFA) was undertaking using flow data specified in Section 2.1.4. The FFAs have been completed using the Log Pearson Type III (LPIII) distributions, consistent with procedures from Australian Rainfall and Runoff (AR&R) Volume 1 Book 4 Section 2. Distributions were fitted to the annual maximum peak flow rates. At each gauge, the expected flow rate was determined for a range of average recurrence intervals (ARI).

Table 4-1 FFA Gauges

Gauge Name	Gauge ID
Latrobe River at Noojee	226205
Latrobe River at Willow Grove	226204
Latrobe River at Thoms Bridge	226005
Latrobe River at Rosedale (main channel and anabranch)	226228 & 226224
Latrobe River at Kilmany	226227
Moe River at Darnum	226209
Moe River at Trafalgar East	226402
Narracan Creek at Moe	226021
Morwell River at Yallourn	226408
Tanjil River at Tanjil Junction	226226
Traralgon Creek at Traralgon (Princes Hwy)	226023

The Hydrology Report (Annex A Section 2) details the FFA undertaken for each gauge, key events, data sources, record length, statistical outliers (and treatment of these) and the analysis result.

4.1.2 URBS

The Latrobe River hydrological URBS model was provided by the BoM. The Latrobe URBS model was broken into six sub-models shown in Figure 4.1. The six sub-models functioned independent of each other, with the possibility of feeding the results of one into the next. Within URBS, the six sub-models are further divided into a number of sub-catchments.

Figure 4.2 shows the sub-catchments of each of the sub-models and how they are linked.

Each sub-model was reviewed, modified and calibrated for use in the Latrobe River flood study as detailed in the Hydrology Report (Annex A Section 4). For the purposes of this study, the structure of each sub-model was maintained. Each was run independently, as the modelled outflows at key locations were used as inputs to the hydraulic model.

4.1.3 Calibration

The separate URBS models shown in Figure 4.1 were used to analyse the hydrological behaviour of the Latrobe River catchment.

Rainfall initial and continuing losses were used to derive the hydrological inflows. The rainfall loss parameters were assumed to be consistent within the sub-model. That is, each URBS model has an individual set of continuing losses.

The URBS models were modified as appropriate to include consideration of the travel times for large flood events based on recorded flood data. The only change made to the existing BoM URBS models was the modification of the stream lag factors.

Rainfall and pluviograph data was obtained from the BoM for calibration purposes. The daily total rain gauges had a better spatial coverage than the pluviographs. However, the pluviograph had better temporal information. As a result, both the daily totals and pluviograph data were used to achieve temporal and spatial resolution. This data has been referenced and provided in the Hydrology Report.

River gauged data which corresponded with the calibration events was obtained from the Victoria Water Resource Data Warehouse. This river gauged data was converted into URBS format for use in the hydrological model calibration. Rainfall was evenly distributed both temporally and spatially within the sub-models. The temporal patterns adopted are in accordance with AR&R. The spatial rainfall patterns have been applied uniformly within each of the six sub-catchments.

In both the Thoms Bridge and Rosedale sub-models, the calibration process needed to consider flows from upstream catchments. Gauged flows recorded during flood events were introduced to these downstream sub-models for calibration. It was considered appropriate to utilise recorded data rather than model outputs (from upstream sub-models) to avoid compounding any small errors.

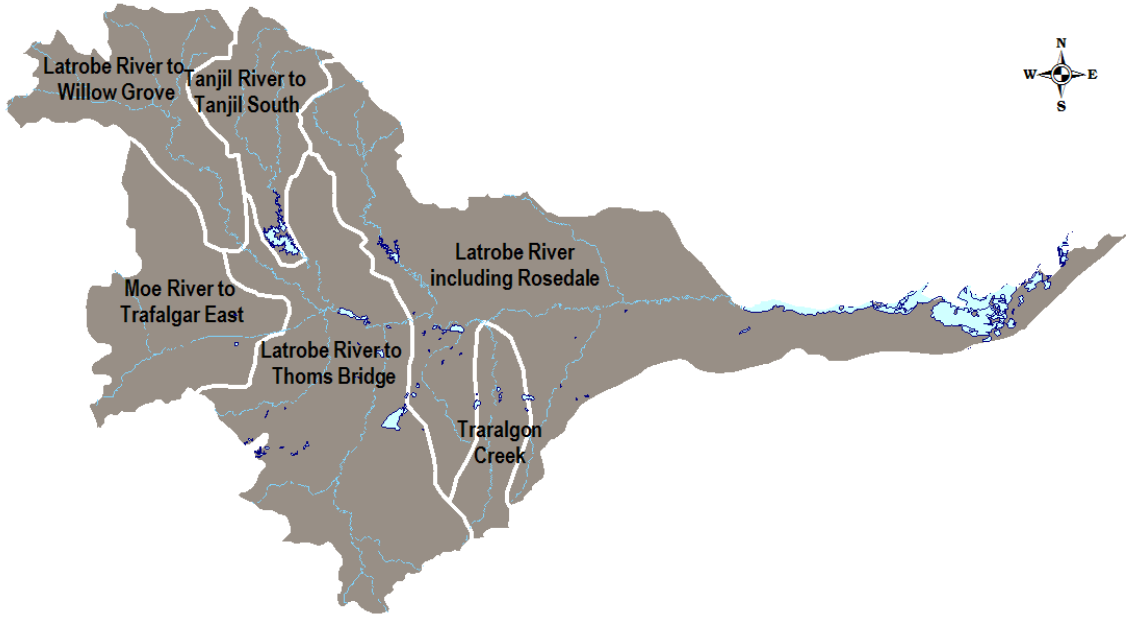


Figure 4.1 URBS sub-models

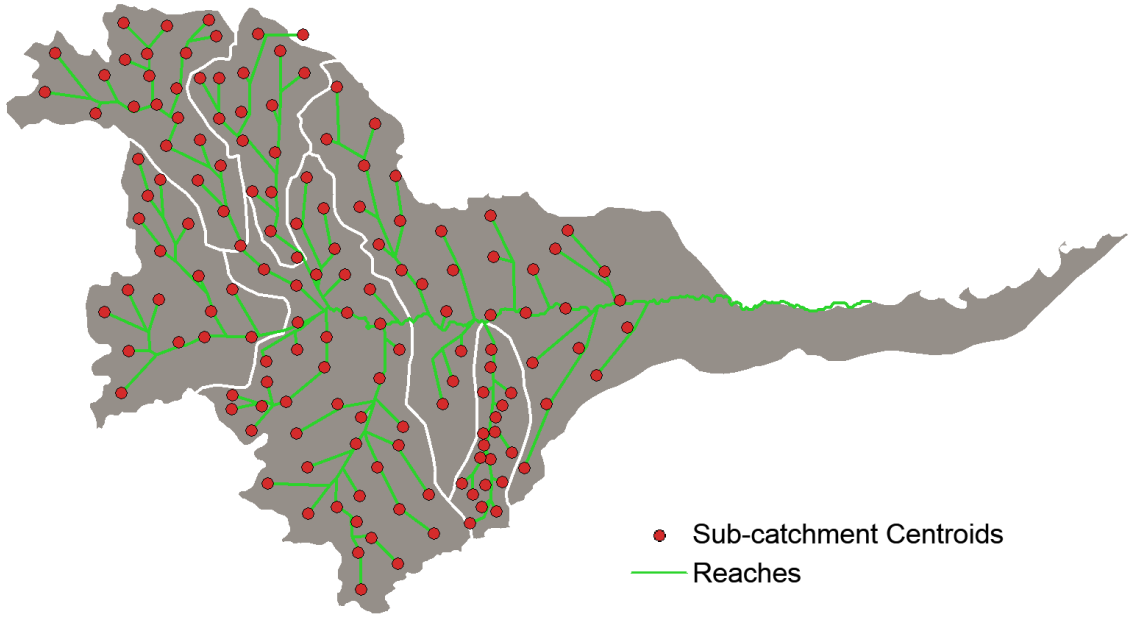


Figure 4.2 URBS Structure Overview

4.1.4 Design

The calibrated URBS models were used to generate design flood hydrographs.

Design rainfalls derived using Intensity Frequency Duration (IFD) curves were applied to the hydrological model as inputs. IFD curves were sampled from thirty one (31) locations throughout the catchment. For each of the six sub-catchments within the URBS models the appropriate IFD relation was chosen from these 31 locations based on proximity as shown in Figure 4.3. The IFD parameters used in the analysis can be found in the Hydrology Report (Annex A Section 5).

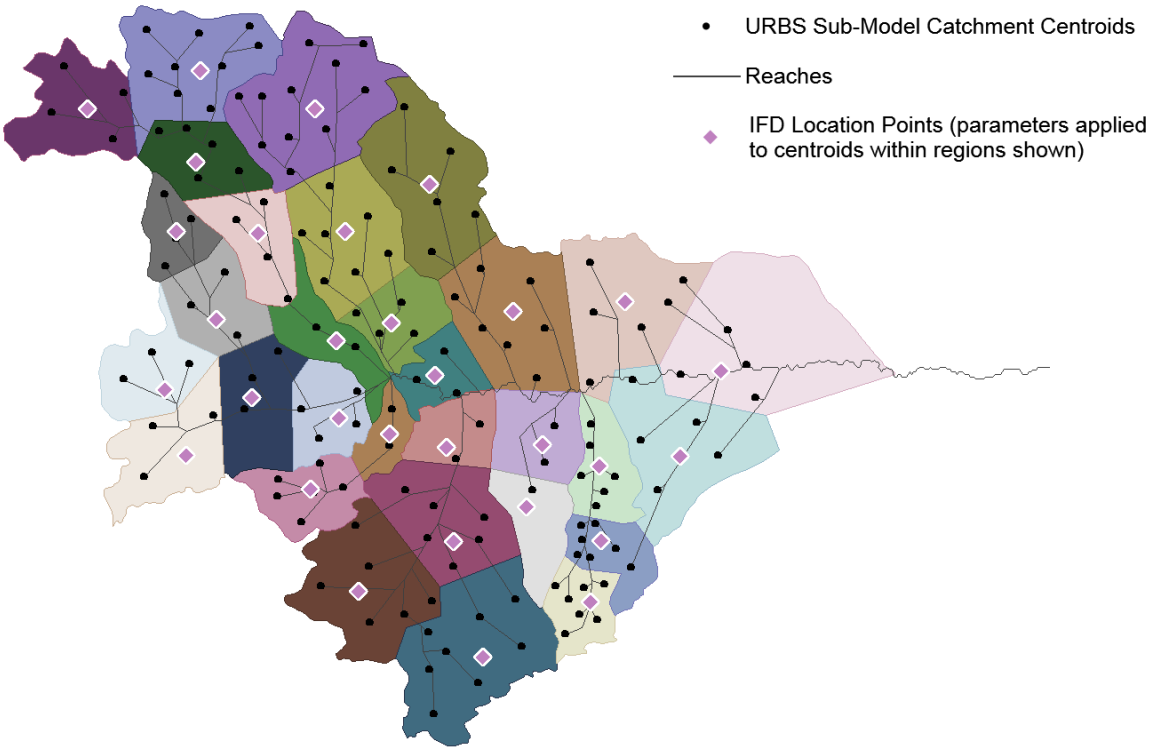


Figure 4.3 IFD Locations

The Areal Reduction Factors (ARF) used for the design events were determined using the method of Siriwardena and Weinmann (Grayson et al, 1996), which is used throughout Victoria.

The design storms considered were single storms affecting the entire Latrobe River catchment rather than individual storms affecting each of the sub-catchments. The areal reduction factors for each design event were calculated using the total catchment area of the Latrobe River to Thoms Bridge and are provided in the Hydrology Report (Annex A Section 5).

4.1.5 Gauge Validation

During hydraulic calibration to historical events, it was demonstrated that it was more appropriate to use levels rather than flows. The reason for this is that level is the parameter measured at gauging stations; flows are calculated using rating curves. Consequently, if the rating curve is not valid, an appropriate match will not be achieved. Advice from Thiess Services and information from the Red Book indicated that the gauges at Thoms Bridge and Rosedale had not been measured at high stages; rather the flows in the rating curve were estimated. This can lead to significant errors in the rating curves at high flows.

Flood Frequency flows calculated based on rating curves have been taken back to levels based on the rating curve. In effect, this 'removed' the effect of the rating curve based on the assumption that the same rating curve was used in the conversion to and from flow.

A constant initial loss of 20 mm was adopted for each catchment. The continuing loss rate was varied to achieve an appropriate match to the FFA peaks. All loss parameters tested were within the AR&R recommended ranges for Victoria.

4.2 Hydraulic Model

The 1D2D modelling system, SOBEK, was used to compute the channel (1D) and overland flow (2D) components of the study. SOBEK is a professional software package developed by Deltares, one of the largest independent hydraulic institutes in Europe (situated in The Netherlands) and has been in wide use in Australia for more than ten years. The overland flow is dynamically computed based on the capacity of the channel system: once this is exceeded, the resultant overland flow patterns are then determined from the two-dimensional hydraulic model.

4.2.1 1D and 2D Model Components

The hydraulic models consist of two main hydraulic elements:

- 1D elements: key watercourses and structures have been included in the 1D layer, defined based on survey and/or LiDAR information; and
- 2D elements: The surface topography & overland flow paths have been represented in the 2D layer. Water flows in the 2D elements according to the hydraulic properties of the land surface as defined by the 2D grid topography (as outlined in Section 3) and roughness.

A grid cell resolution of 40 m was required due to the magnitude of the hydraulic model area, however this is too large to capture and adequately represent the creeks and rivers throughout the study area. Consequently, these were represented as 1D elements using the known survey information and the detail knowledge of the LiDAR. All 1D elements have been assessed against the 2D topographic surface to ensure a contiguous link between the 1D and 2D elements.

The development of the 1D and 2D model components is discussed in the Hydraulics Report (Annex B Section 2)

4.2.2 Model Inflows

Hydrological inflows were generated using calibrated hydrological URBS models of the Latrobe River and its tributaries (used and developed by the BoM for real time flood forecasting in the catchment). To calibrate the URBS model, previous storm events were used. Hydrographs calculated in the model using recorded rainfall were compared with hydrographs recorded at flow gauges to select appropriate hydrological parameters. Further details of this can be found in the Hydraulics Report (Annex B Section 2).

The 1978 and 1993 events were selected for the calibration as these two events were large and spanned the entire Latrobe basin. Furthermore, the 1978 flood event was the largest flood recorded at Thoms Bridge and fourth largest flood recorded at Rosedale (main channel and anabranch). During the hydraulic model calibration, it was found more appropriate to match recorded levels than flow. Level were used as the main calibration measure rather than flow as it is directly recorded at gauges, whereas flow is back calculated using rating curves.

4.2.3 Boundary Conditions

The downstream model boundary is controlled using a fixed level boundary at Lake Wellington. This has been set using the predicted water levels at the Swing Bridge, located at the confluence of the Thomson River and the Latrobe River near Sale. This location was selected as anywhere further downstream the flood levels could be controlled by flows in the Thomson or Latrobe Rivers. The levels adopted for each event are outlined in the Hydraulics Report (Annex B Section 2).

4.2.4 Storages and Reservoirs

Within the study area, there are a number of storages that have been accounted for in the modelling process. The storages in the region include Lake Narracan and Blue Rock Lake. As discussed in the Hydrology Report, Blue Rock Lake has been represented in the hydrological model as part of the Tanjil River system. As also discussed in the Hydrology Report (Annex A Section 4), Lake Narracan has been assumed to be open and has been represented within the hydraulic model as a permanent weir structure.

4.2.5 Design Storm Events

The URBS hydrological model was run for a range of storm durations to determine the critical durations to run in the hydraulic model. It was found that either the 36 and 48 hour event was the largest at all inflow locations throughout the model at any ARI events (10 – 200 year). For the PMF event, the 48 and 72 hour

events provided the highest flows. These critical flood events were considered in the hydraulic models, Hydrology Report (Annex A Section 5).

Loss rates for design storm events were adjusted to ensure the model matched statistical estimates of flood level based on the frequency analysis and anecdotal information provided by WGCMA. The adopted loss rates and levels achieved for design storm events are shown in Table 4-2.

4.2.6 Sensitivity Testing

Analysis was undertaken on the 100 year ARI event to assess the model's sensitivity to flows, downstream boundary and hydraulic roughness. These parameters were modified within realistic brackets. In the narrower areas of floodplain such as the area around Yallourn, the depth changes were significant. Whilst depths are altered by these parameters, the flood extent is largely unchanged.

4.2.7 Calibration and Validation

Great care and time was taken in the calibration of the hydraulic model in order to achieve appropriate flood timings whilst producing the closest possible match to gauged levels.

The 1978 and 1993 events were selected for the calibration as these two events were large and spanned the entire Latrobe basin. The URBS hydrological models had been calibrated to these events as discussed in the Hydrology Report (Annex A Section 4).

The Thoms Bridge and Rosedale gauges were used to calibrate the model. As detailed in the Hydraulics Report (Annex B Section 3), the Trafalgar East gauged data showed evidence of flow bypassing. Thiess were contacted and they advised that data captured at this gauge appeared anomalous. Further analysis in the hydraulic model suggests the gauge is bypassed by floodplain flows and was not suitable for use in calibration.

In both calibration events and at both gauges, the modelled flows diverge from the observed flows at higher flow rates. A good match to levels throughout events is achieved at both gauges. This suggests the model is replicating the flood appropriately but the rating curve may not be valid at both gauges for the higher flood flows.

Discussion on the calibration and validation of the hydraulic model is provided in the Hydraulics Report (Annex B Section 3).

Table 4-2 Design Event Hydraulic Validation

Hydrological Loss	Levels at Rosedale (mAHD) 10 year ARI	20 year ARI	50 year ARI	100 year ARI	200 year ARI		Levels at Thoms Bridge (mAHD) 10 year ARI	20 year ARI	50 year ARI	100 year ARI	200 year ARI
Hydrology Report losses	13.60	13.88	14.52	15.15	15.72		35.68	36.16	36.81	37.17	37.42
IL 20 mm CL2.5 mm/hour	14.33	14.81	15.24	15.59	16.21		36.82	37.12	37.33	37.53	37.96
IL 20 mm CL2.7 mm/hour	14.24	14.72	15.16				36.76	37.07	37.29		
IL 20 mm CL3.0 mm/hour	14.13	14.58	15.05	Not assessed			36.67	37.00	37.24	Not assessed	
IL 20 mm CL3.5 mm/hour	13.97	14.38	14.84				36.46	36.86	37.15		
Expected Levels (mAHD) based on Flood Frequency Analysis											
Expected (Low)	**14.03**	**14.35**	**14.86**	**15.39**	**16.08**	**Expected**	**36.82**	**36.97**	**37.19**	**37.38**	**37.57**
Upper (Low)	14.23	14.62	15.40	16.25	17.35	**Upper**	36.92	37.12	37.42	37.64	37.92
Lower (Low)	13.88	14.18	14.54	14.90	15.36	**Lower**	36.72	36.87	37.05	37.18	37.34
Expected (High)	**14.14**	**14.52**	**15.29**	**16.15**	**17.29**						
Upper (High)	14.33	14.88	16.07	17.42	19.57			=Adopted Scenario			
Lower (High)	13.96	14.31	14.84	15.42	16.19						

4.3 Flood Modelling Results

No two floods behave in exactly the same manner, even though they may rise to the same maximum height at a given location. The information presented here should be regarded as only representing typical conditions.

It is important to note that the results presented relate to the Latrobe River and Moe River / Drain. Whilst the results extend into the lower parts of tributaries, the tributaries may experience more significant flooding associated with shorter storm durations or localised intense storms. This will not be captured as part of this study.

The calibrated model has been shown to replicate flood extents and levels associated with historical flood events. Level has been used as the main calibration measure rather than flow as it is directly recorded at gauges whereas flow is back calculated using rating curves. In addition to replicating historical levels and extents, the model has been shown to have similar travel times between gauges. The model is considered to appropriately represent flooding along the Latrobe River and Moe Drains.

The 100yr ARI flood extent is provided in Figure 4.4.to Figure 4.9. Results for other events are provided in the map atlas delivered as part of this report (refer Section 5). All deliverables provided as part of this study are listed in Appendix B.

It is important to note the storms investigated in this study are long duration events which tend to cause the worst case flooding along the Latrobe River and Moe Drains. These storms assume that the rainfall is evenly distributed both temporally and spatially across the catchment, although the total rainfall volume is calculated for each subcatchment. Consequently, results shown at tributaries may not represent worst case conditions, as these areas may be susceptible to flooding associated with localised shorter duration intense storm events.

4.3.1 Flood Behaviour – Moe River (Princes Highway to Moe)

Flooding along the Moe River area between Darnum and the confluence with the Latrobe River is characterised by floodwaters that exceed the in-bank capacity of the Moe River and its tributaries being retarded behind roads and levees. The floodwaters cannot easily re-enter the Moe River once on the floodplain due to the high levees on both sides of the drain. The floodplain is very flat so topographic restrictions and storage of floodwaters are the key controls on flood behaviour in this area.

The capacity of the Moe River is approximately equal to the 10 year ARI downstream of the Princes Highway. Flooding in the 10 year ARI event occurs mainly on the southern side of the drain west of Trafalgar and is generally shallow (< 0.3 m) until it banks up behind an obstruction such as a roadway. East of Trafalgar, significant flooding occurs both north and south of the drain, and is associated with tributary inflows, with the deepest areas of flooding east of Cummings Road. A topographic constriction here tends to pond the floodwaters.

In the 100 year ARI event, significant additional flooding occurs along both sides of the Moe River between the Princes Highway and Moe. Flood depths exceed 1 m in the vicinity of Nine Mile Road, Cummings Road, Loch's Creek Road and Millers Road. The township of Moe does not appear to be significantly impacted by the flooding associated with the Moe River and Latrobe River, although access to the township from the north is likely to be significantly restricted.

Up at the Princes Highway near Yarragon the flood peaks around 22 hours after rainfall begins. At the confluence with the Latrobe River, the Moe River peaks 46 hours after rainfall. There is a small area between the Moe River and Contour Drain which is a storage that peaks 60 hours after the rainfall begins.

Due to the hydraulic properties of the floodplain described above, it is not possible to link the flood class levels in the Moe River with inundation experienced in the Moe Flats.

4.3.2 Flood Behaviour – Latrobe River (Moe to Tyers Road)

The Moe River and Latrobe River merge, just downstream of Moe and flow into Lake Narracan. Downstream of the lake floodwaters pass Thoms Bridge and head towards Traralgon. Floodwaters are contained within the bounds of Lake Narracan and are constrained downstream of the lake, past Yallourn, by an incised river

valley. Flooding returns to the wider floodplain upstream of Thoms Bridge, near Murray Road as the channel capacity is reduced.

Downstream of Thoms Bridge, the flood extent does not vary greatly between the 10 year and 100 year ARI events although the flood depths are greatly increased. Obstructions in the floodplain at road crossings (including Tanjil East Road and Tyers Road) constrict the available flow area causing increased levels upstream of these embankments. The majority of the flooded area is rural in nature.

The flood peaks between 30 and 33 hours after rainfall begins in this area.

Analysis has been undertaken to determine the inundation associated with the Bureau of Meteorology's flood class levels at the Thoms Bridge gauge – these maps can be found in Appendix C.

4.3.3 Flood Behaviour - Latrobe River (Tyers Road to Rosedale)

There is significant flooding between Tyers Road and Rosedale, including areas that impact the northern edge of Traralgon and Rosedale. Major flooding does not appear to impact the current town boundaries at Traralgon, but any encroachment to the north would be impacted by Latrobe River flood flows. At Rosedale, most flooding is caused through the township as a result of Blind Joes Creek not being able to discharge freely into the Latrobe River. This also results in inundation of the Princes Freeway.

Between the townships, major hydraulic controls in this area include the Traralgon-Maffra Road, the old railway embankment (just east of Traralgon-Maffra Road) and a number of private levees between Stuckeys Lane and Rosedale. These levees have approximately less than a 1 in 10 year level of protection. A major private levee approximately 5 km downstream of Stuckeys Lane has a level of protection close to the 1 in 100 year ARI.

Significant flooding is shown in the Ridge Morass and this area provides for significant flood storage. In smaller flood events, the Latrobe River channel and the floodplain are separate, due to the river banks being slightly perched above the wider floodplain. This phenomenon is clearly seen between Traralgon and Stuckeys Lane, with the majority of floodplain flows occurring to the south of the river channel.

The flood peaks between 32 and 44 hours after rainfall begins in this area.

Analysis has been undertaken to determine the inundation associated with the Bureau of Meteorology's flood class levels at the Rosedale gauge – these maps can be found in Appendix C.

4.3.4 Flood Behaviour - Latrobe River (Rosedale to Lake Wellington)

The flood flows between Rosedale and Lake Wellington are largely contained within the well-defined floodplain. Levels at the Swing Bridge and downstream to Lake Wellington are controlled by a combination of flows in both the Latrobe and Thomson. In the model, these have been accounted for by using a high tailwater condition and as a result, modelled levels in this area are more uncertain than in other parts of the catchment.

The model indicates that flood flows in the 20 year ARI event flood over Bristows Lane, upstream of the Swing Bridge, with 50 year ARI flows breaking out at Magpie Lane and forming an island near McOwans Lane. As flows increase, larger remnant flowpaths are activated in this area and the low-lying morass areas south of Sale are also filled by floodwaters. It is expected that the South Gippsland Highway would be inundated in the 10 year ARI event. Downstream of the Swing Bridge, water flows through the Heart and Dowd Morasses and into Lake Wellington.

The flood peaks between 44 and 54 hours after rainfall begins in this area.

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Catchment Management Authority

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SHEET 1 OF 6

100YR ARI FLOOD EXTENT

Legend

- Town
- River Gauge
- Railway Line
- Main Road
- Tertiary Road
- River
- Stream/Creek
- Lake Narracan
- 100yr ARI Flood Extent

N

Kilometres

0 0.5 1 2 3 4

Disclaimer: No two floods behave in exactly the same manner, even though they may rise to the same maximum height at a given location.

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Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (Vic)
Date: 2014-08-21
Coordinate System: GDA 1994 MGA Zone 55
Project: LJ5792 RM2416
Version: 01

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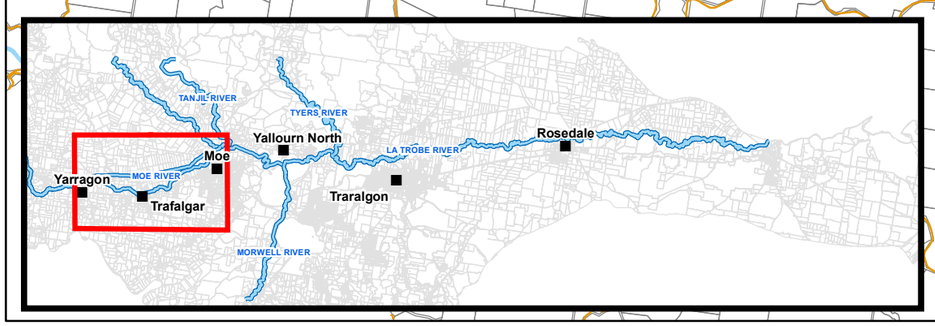

West Gippsland
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Latrobe River Flood Study

FINAL REPORT

SHEET 2 OF 6

100YR ARI FLOOD EXTENT

Legend

- Town
- River Gauge
- Railway Line
- Main Road
- Tertiary Road
- River
- Stream/Creek
- Lake Narracan
- 100yr ARI Flood Extent

N

Kilometres

0 0.5 1 2 3 4

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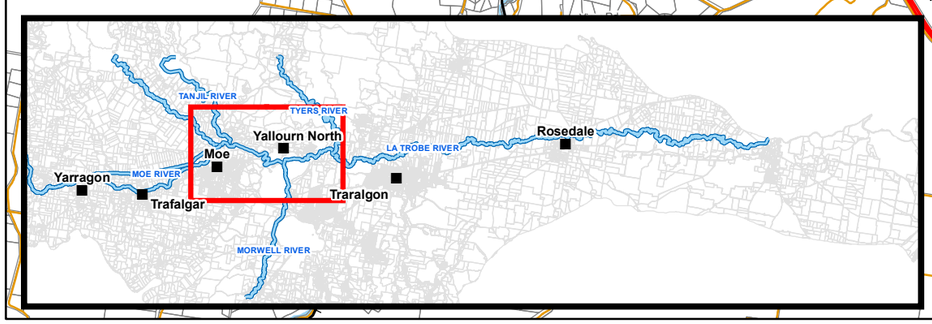

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Catchment Management Authority

Latrobe River Flood Study

FINAL REPORT

SHEET 3 OF 6

100YR ARI FLOOD EXTENT

Legend

- Town
- River Gauge
- Railway Line
- Main Road
- Tertiary Road
- River
- Stream/Creek
- Lake Narracan
- 100yr ARI Flood Extent

N

Kilometres

0 0.5 1 2 3 4

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West Gippsland
Catchment Management Authority

Latrobe River Flood Study

FINAL REPORT

SHEET 4 OF 6

100YR ARI FLOOD EXTENT

Legend

- Town
- River Gauge
- Railway Line
- Main Road
- Tertiary Road
- River
- Stream/Creek
- Lake Narracan
- 100yr ARI Flood Extent

N

Kilometres

0 0.5 1 2 3 4

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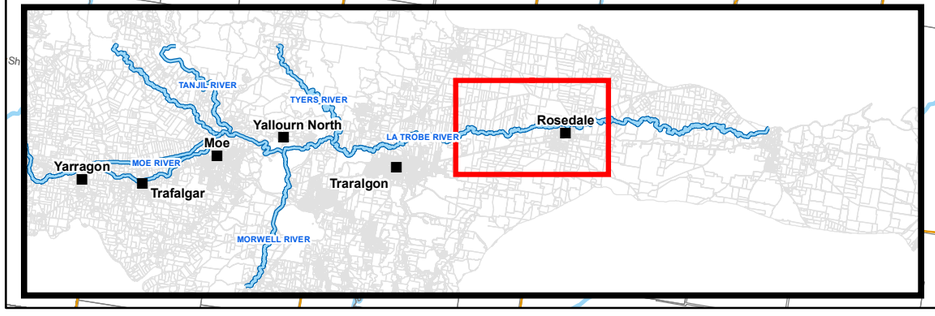

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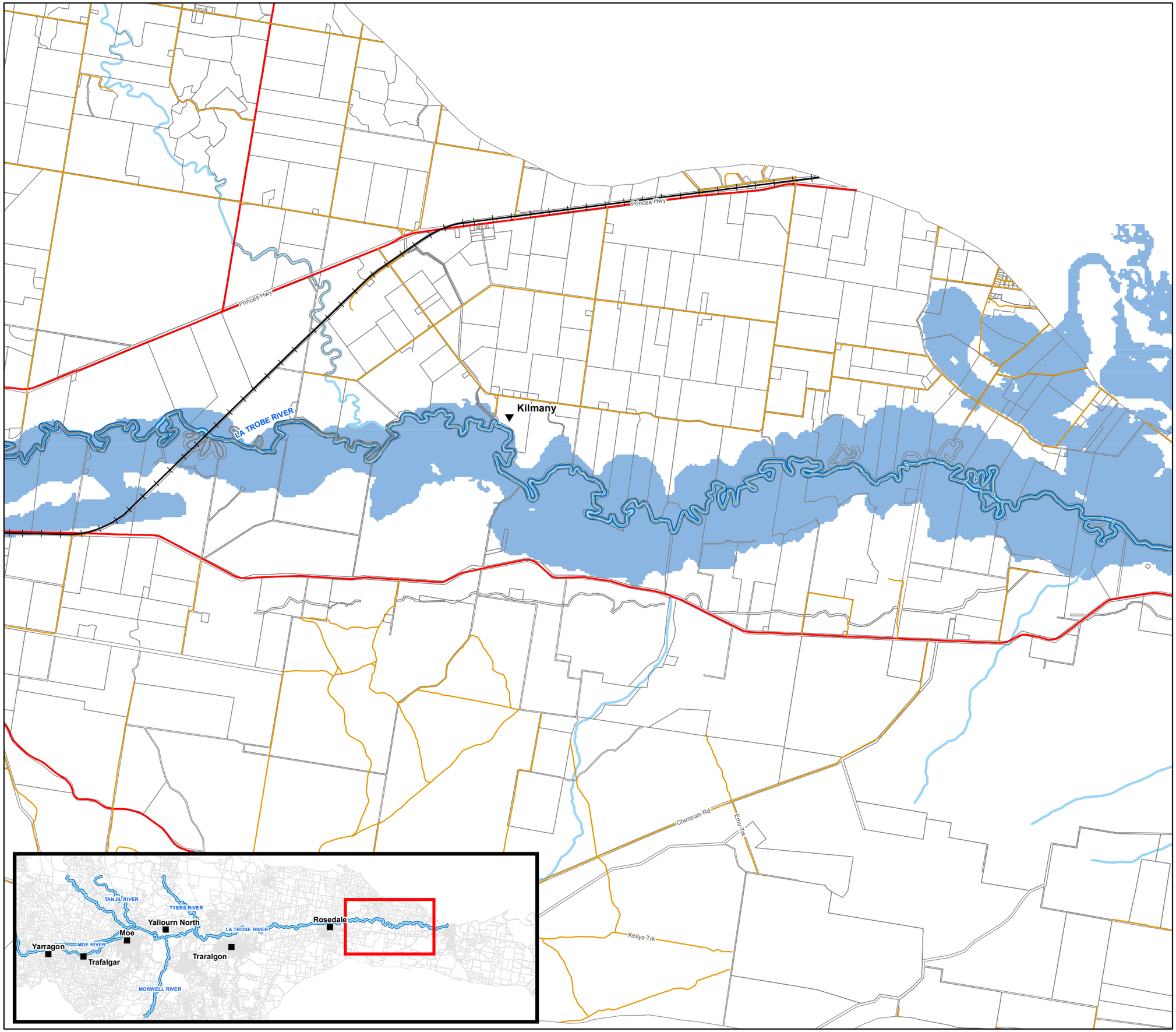
Latrobe River Flood Study

FINAL REPORT

SHEET 5 OF 6

100YR ARI FLOOD EXTENT



Legend

- Town
- River Gauge
- Railway Line
- Main Road
- Tertiary Road
- River
- Stream/Creek
- Lake Narracan
- 100yr ARI Flood Extent

N

Kilometres

0 0.5 1 2 3 4

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West Gippsland
Catchment Management Authority

Latrobe River Flood Study

FINAL REPORT

SHEET 6 OF 6

100YR ARI FLOOD EXTENT

Legend

- Town
- River Gauge
- Railway Line
- Main Road
- Tertiary Road
- River
- Stream/Creek
- Lake Narracan
- 100yr ARI Flood Extent

N

Kilometres

0 0.5 1 2 3 4

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LA TROBE RIVER
Cobb Rd
Clancys Rd
Garretts Rd
East Rd
Longford - Loch Sport Rd
Johnsons Rd
Leggets Rd
Mcnaughtons Rd

TANJIL RIVER
TYERS RIVER
Yallourn North
Rosedale
Moe
LA TROBE RIVER
Yarragon
MOE RIVER
Trafalgar
Traralgon
MORWELL RIVER

5 Datasets and Mapping

Following the delivery of the hydraulic model results, a meeting was hosted at WGCMA and attended by the study team and stakeholders (Refer Section 1.3). During this meeting, a number of animations and maps were presented as examples. A range of datasets and mapping outputs have been developed based on this discussion of requirements. Outputs include maps, GIS datasets and animations. In addition to the typical flood study maps of depth, velocity and water surface elevation, a number of innovative flood timing maps have been prepared to assist in emergency response planning. These timing maps include: duration of inundation above threshold, time from rainfall to start of flooding and time from rainfall to flood peak.

The deliverables provided as part of this study are listed in Appendix B.

6 Assess and Treat Risk

Flood damages have been calculated to help assess flood risk and provide context to assess flood mitigation options. A number of structural and non-structural flood mitigation options have been assessed. The sections that follow outline the flood damage and mitigation assessment. Further details can be found in Flood Damage and Mitigation Report (Annex C).

6.1 Flood Damages

6.1.1 Economic Analysis

The flood damages analysed in this assessment are property damage, building damage and road damage. Indirect damages are not included in the assessment.

The Annual Average Damage (AAD) has been calculated using a probability approach. The AAD attempts to quantify flood damage that a floodplain would receive on average during a single year. Based on existing conditions, the AAD for the study area is approximately **$1.3 million**. Residential damages incurred from flows associated only with the tributaries of the Latrobe and Moe Rivers have been excluded from the damages assessment. These include areas such as Traralgon and Rosedale where Traralgon and Blind Joes Creeks are the source of flooding and parts of Moe where Narracan Creek is the key source of flooding.

Table 6-1 Damages (ex GST)

Recurrence Interval	10yr ARI	20yr ARI	50yr ARI	100yr ARI	200yr ARI
Property Damage					
Urban Property Damages	*$26,000*	*$26,000*	*$25,000*	*$25,000*	*$29,000*
Rural Property Damages	*$485,295*	*$511,920*	*$561,164*	*$605,354*	*$639,646*
Building Damage					
Total building damages	$1,927,425	$2,647,948	$4,385,463	$6,956,731	$8,991,422
Road Damage					
Total road damages	*$1,936,669*	*$2,424,571*	*$3,105,362*	*$3,931,144*	*$4,630,903*
Bridge damages	*$398,256*	*$398,256*	*$398,256*	*$398,256*	*$398,256*
Total	***$4,773,645***	***$6,008,695***	***$8,475,245***	***$11,916,485***	***$14,689,228***

6.2 Structural Mitigation Options

West Gippsland Catchment Management Authority (WGCMA) have been collaboratively involved in the flood mapping aspects of the project and visited a large number of floodplain residents to understand community expectations. WGCMA nominated three mitigation schemes to be investigated. Cardno liaised with WGCMA to determine the most appropriate method to examine the three mitigation options.

The 3 structural mitigation options examined are shown in Table 6-2.

Table 6-2 Structural Mitigation options examined

Option 1: Large Levee Removal
Description: A model scenario was tested where readily identifiable levees in the floodplain of the Latrobe River, downstream of Lake Narracan, were removed. No road or railway embankments were changed as part of this process. Levees on the Moe River (including Trafalgar and Yarragon Flats) were retained, as it was considered likely that flooding would increase on the Moe Flats should these levees be removed.
Findings: The removal of levees in the Latrobe River floodplain had only a very minor impact on flood levels and virtually no impact on peak flood flows for the range of flood events modelled. This is because most of the levee systems overtop in the 10 year ARI event. Furthermore, the removal of a large levees north of Flynn results in flooding east of Loy Yang Creek in all events from the 10 – 200 year ARI.
Option 2: Reinstatement of Meanders – removal of cut-offs
This option was proposed by WGCMA as a result of earlier works (Reinfelds, 1998) which suggests artificial meander cut-offs have reduced the length of the lower Latrobe River by an estimated 25% since 1925. A study conducted by SKM (2009) showed the meander cut-offs resulted in '*accelerated bank erosion on bends downstream of the artificial cut-offs, deepening and widening of the river and a major decline in ecological function*'. As this option focussed on the channel only and the majority of flood flows investigated in this study are contained in the floodplain, this option has been assessed in a qualitative manner.
Findings: The reinstatement of meanders is likely to have no impact on the overall flood levels in events greater than the existing bankfull flow (approximately equivalent to the 2.5 year ARI). It is possible that some local areas may flood more frequently due to the proposed works, but this effect can be mitigated through careful design.
Option 3: Moe River Improvements
For environmental flow purposes, bed control structures to reduce flow velocity have been proposed along the Moe River channel by Alluvium (2011). WGCMA requested that this option be tested within the flood model to determine the approximate channel cross section area required to compensate for the shallowed gradient / slowed flow. This option has been assessed using an abbreviated version of the model.
Findings: The improvement works proposed for the Moe River do have the effect of lowering the velocity of flow in the Moe River Channel. This reduction may not be sufficient to lessen erosion during high flow events. Flow velocities are generally reduced by less than 0.2 m/s. Flood levels in the Moe River are slightly elevated as a result of the proposed works, but it is considered that the change in water level is not sufficient to require additional channel works to offset the increase. The location of the weirs in the Moe River needs to be carefully considered to ensure that the backwater effects do not limit the drainage function of the Moe Flats.

The structural options investigated failed to significantly mitigate flooding of the Moe and Latrobe River floodplains. It is suggested that other structural mitigation options may provide greater opportunities to protect residences from flooding, for example:

- **Fill pads:** Given the size of the floodplain, consideration should be given to allowing individual properties on rural land within the floodplain to be raised on fill pads above the flood level.
- **Address Tributary Flooding:** The majority of flooding in the townships adjacent to the Latrobe River floodplain is due to excess flows from tributaries of the Latrobe River that flow toward it. Consideration of flood mitigation strategies for waterways such as Traralgon and Blind Joes Creeks would likely provide greater opportunities for protecting residences from flooding.

6.3 Non-Structural Mitigation Options

As the structural options investigated failed to significantly mitigate flooding on the Moe and Latrobe River floodplains, the validity of non-structural options is highlighted. Flood warning and planning controls offer credible non-structural mitigation opportunities to reduce flood related damages and flood related risk to safety.

As Australia moves toward a risk based flood management approach, and the socio-economic benefits of floodplain development are being recognised, a greater emphasis is being placed on non-structural 'softer' solutions. The value of floodplains to the community, State and National economies is well recognised in Australia (e.g. DNRE, 1998; EMA, 2009; ARMCANZ, 2000). It is also recognised that the benefits associated with the use and habitation of floodplains come at some costs. The challenge is to reduce those costs while maintaining the benefits, to make it easier for communities to live with flooding.

The sections that follow outline the use of flood warning systems and development controls in the Latrobe river Basin to mitigate the impact of flooding on the affected communities.

6.3.1 Flood Response Plan

Michael Cawood completed the Flood Warning System review and recommendations and developed the VICSES Municipal Flood Emergency Plan (MFEP) Appendices for this investigation. Flood warning remains applicable as an effective and credible non-structural mitigation measure for the study area as it offers opportunities to reduce flood related damages and flood related risk to personal safety. Flood warning systems are also integral to the objective of a risk based approach to floodplain management and the emphasis on modifying how floodplains are developed (i.e. the human interface) rather than on modifying the floodplain so that it can be developed.

An effective flood warning system comprises much more than a data collection network, forecasting tool or model and flood level (or flow) prediction. It is made up of several building blocks. Each building block represents an element of the Total Flood Warning System (TFWS). The blocks (derived from EMA, 2009) along with the basic tools to facilitate delivery against each of the TFWS elements are presented in the Flood Damage and Mitigation Report (Annex C Section 4)

A flood warning system currently exists for the Moe and Latrobe Rivers within the study area and for a number of tributary streams (eg. Traralgon, Morwell, Tanjil and Narracan). It is apparent that not all TFWS elements are fully developed. While there may be opportunities to improve the forecasting element of the system, it is suggested that the intelligence delivered by this study provide improvement opportunities that are not capital intensive and that assist in building community resilience.

Specific recommendations are as follows:

a) Council to approach BoM to request that additional river level sites within and adjacent to the study area are routinely accessed and loaded to the BoM website data tables and maps (e.g. Lake Narracan, Yallourn Weir, Narracan Creek at Moe).

b) Council (and/or WGCMA) to develop "rule-of–thumb" or indicative quick look tools that use readily available data from rain gauges in the upstream catchment and / or upstream river levels in order to determine at an early stage the likelihood and scale of possible flooding at key locations in ARI terms. This will facilitate a direct link to the inundation maps produced by the Latrobe River Flood Study and assist flood response. It must however be recognised that such tools are indicative only as the upstream catchment is hydrologically complex.

c) Council in conjunction with VICSES and WGCMA to revisit flood class levels for Thoms Bridge and Rosedale with due regard for the consequences of flooding in the adjacent river reaches as shown by the flood inundation mapping delivered by the current study. It should be noted that, flood class levels refer to that part of the watercourse where the flood effects can be related to the gauge reading. The occurrence of a certain class of flooding at one point in a catchment will not necessarily lead to the same class of flooding at other points. Flood class levels can only be considered as a guide to flood severity, as factors such as rate of rise, duration and extent are also important.

d) Council in conjunction with VICSES and WGCMA to review the flood forecast performance requirements for Thoms Bridge and Rosedale (in terms of forecast lead time, critical levels on the rising limb, accuracy of forecasts of those critical levels and the peak level, critical levels on the recession limb, etc) and jointly formally advise BoM of these requirements.

e) Using either FloodZoom or another GIS based system, Council with input from VICSES, to match up flood forecasts with the inundation mapping from the current study in order to dynamically identify properties and other assets likely to be inundated or experience high hazard flooding. The GIS could also extract the addresses of properties and / or other assets likely to be flooded over-floor together with the names / locations of streets likely to experience hazardous flood conditions (i.e. where the velocity – depth product is (say) greater than 0.3).

f) To enable community members to determine the likely effects of a potential flood, Council to make the flood inundation maps and relevant Appendices of the MFEP readily available to study area communities. This will also inform their development of individual flood response plans.

g) Council to review, and if considered appropriate, promote the Early Warning Network (www.ewn.com.au) within the community[1]. This will need to be preceded by a decision within Council on how the EWN will be used.

h) As an extension to the above or, as a stand-alone improvement aimed at extending the alert and notify reach of the existing flood warning system, Council to extend the Xpedite VoiceREACH system and FM-88 broadcasts to include properties / areas identified through the Latrobe River Flood Study as being at risk of flooding.

i) VICSES in consultation with Council and others to complete evacuation arrangements / planning for the study area (i.e. Appendix E of the MFEP).

j) Council in conjunction with VICSES to encourage and assist residents and businesses to develop individual flood response plans. A package that assists businesses and individuals is available from VICSES and provides an excellent model for community use.

k) Council with input from VICSES and WGCMA, to develop, review and update protocols / procedures (i.e. who does what when and processes to be followed) that flood intelligence (i.e. flood characteristics, impacts, etc) is captured and loaded to the MFEP and that local alerting arrangements, response plans, local flood awareness material, etc are reviewed after every (severe) flood event. The procedures should ensure that information contained in Rapid Impact Assessments is captured to the MFEP.

l) VICSES with input from Council and WGCMA, to develop, print and distribute flood awareness material (e.g. Local Flood Guide, property specific flood depth charts, etc) using information collated for the MFEP and available within this report and more generally from the web.

m) Council to ensure that the MFEP (including the inundation and hazard maps, etc) is publicly available (Council offices, library, website). This could extend to the inclusion of a summary in Council welcome packages for new residents and business owners and possibly also with annual rate notices.

   Council to load and maintain other flood related material on their website with appropriate links to relevant useful sites (e.g. the Flood Victoria website www.floodvictoria.vic.gov.au).

n) Establish and implement protocols for routinely repeating distribution of flood awareness material.

o) Council to decide whether to alert residents and visitors to the risk of flooding in more direct ways. This could include the installation of flood depth indicator boards at strategic locations along key roads (e.g. as indicated by the flood hazard maps delivered by the Latrobe River Flood Study).

6.3.2 Flood Planning Controls

It is recommended to update both the Floodway Overlay (FO) and Land Subject to Inundation Overlay (LSIO) to reflect Latrobe River Flood Study results. However, it should be noted that results shown at tributaries may not represent worst case conditions, as these areas may be susceptible to flooding associated with localised shorter duration intense storm events. Three draft FO layers have been prepared for Councils and WGCMA to consider. The LSIO should include any areas in the 100 year ARI extent which are not covered by the final FO shape.

[1] The Early Warning Network (www.ewn.com.au) is a multi-channel (SMS, email, Facebook, Twitter, Apps) geographic based distribution system for warnings and incidents issued by government agencies and other sources. Alerts via the SmartPhone Apps and via email are free while the SMS'd alert service incurs an annual fee. A number of Councils (e.g. Brisbane City Council) pay an annual fee to provide the SMS service free to their residents. Subscription costs vary. Council can provide information to the Early Warning Network for delivery to residents in the impact area who have subscribed to the service.

7 Conclusions and Recommendations

7.1 Project Findings

- The flood model created in this study has been demonstrated to replicate levels well for both historical events (1978 and 1993 events) and design flood events;
- The key flood behaviours of the Moe and Latrobe Rivers have been determined;
- A range of datasets and mapping outputs have been developed based on a discussion of requirements between stakeholders;
- Based on existing conditions, the AAD for the study area is approximately **$1.3 million**. Residential damages incurred from flows associated only with the tributaries of the Latrobe and Moe Rivers have been excluded from the damages assessment. These include areas such as Rosedale where Blind Joes Creek is the source of flooding in the township and parts of Moe where Narracan Creek is the key source of flooding; and
- The structural options investigated did not significantly mitigate flooding on the Moe and Latrobe River floodplains.

7.2 Project Recommendations

- A review of the rating curves for the Thoms Bridge and Rosedale gauges is recommended as further work;
- Alternative structural flood mitigation options such as fill pads and mitigation works on tributaries could be considered as viable alternatives; and
- It is recommended that the following non-structural options are implemented:
    - Enhancement of the flood warning service for Latrobe Basin;
    - Updates to the MEMP and Local Flood Guides are recommended to incorporate the findings of the study;
    - Update the Floodway Overlay and Land Subject to Inundation Overlay in the planning schemes of Baw Baw Shire, Latrobe City and Wellington Shire Councils based on the results of this study.

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Latrobe River Flood Study

APPENDIX A
COMMUNITY CONSULTATION

Cardno
Shaping the Future

LATROBE RIVER FLOOD STUDY (incl Moe River)

INFORMATION AND SURVEY 2013

ANY PERSONAL INFORMATION YOU PROVIDE WILL REMAIN COMPLETELY CONFIDENTIAL.

If you have any queries, please contact:

Wayne Gilmour
West Gippsland Catchment Management Authority
Email: wayneg@wgcma.vic.gov.au
Telephone: 1300 094 262
Fax: (03) 5175 7899

Project and Survey Overview

The West Gippsland Catchment Management Authority (WGCMA), in collaboration with the Latrobe City Council and the Baw Baw and Wellington Shire Councils, has commissioned a flood study for the floodplains of the **Latrobe River** from Moe to Lake Wellington and for the **Moe River** (a major tributary of the Latrobe) from Yarragon to Moe. The WGCMA has engaged specialist consultants, Cardno, to undertake the flood study. The flood study will develop a computer-based model of the floodplains, which will enable the generation of detailed flood maps and other information for a range of flood events (from 1-in-10 to 1-in-200 year events). Ultimately, this information will be used to update planning schemes, assist emergency response activities and consider flood mitigation options.

You have been sent this survey because we have identified that your property may be affected by flooding from the Latrobe or Moe Rivers. Given that people's lives, property and livelihoods are at stake, it is important that the study is accurate and incorporates as much landowner knowledge and experience as possible. The survey should only take about 5-10 minutes to complete. We greatly appreciate any input that you are able to provide.

It is important to note that this study is based on the LATROBE RIVER and MOE RIVER only. Please do not include information relating to other water courses and local drains.

A map has been included on the last page of this document. We are looking for information that relates to flooding in the blue shaded area, which broadly represents the 1-in-100 year flood extent.

Question 1 (Optional)
Are you happy to be contacted as part of the study? (please tick)

- ☐ Yes
- ☐ No

If so, please provide us with the following details. We may wish to contact you to discuss some of the information with you.

Name: …… Daytime Ph: ……

Address: …… Email:……
……

Question 2
Is your property: (please tick)

- ☐ Owner occupied
- ☐ Occupied by a tenant
- ☐ A farm
- ☐ A business other than a farm

Question 3
How long have you lived, worked at and/or owned your property?

……...Years……Months

Question 4
How long have you lived in Gippsland?

……...Years……Months

Question 5
How many people occupy your property?

.....

Question 6

Have you ever experienced flooding since living/working at/owning this property? (please tick relevant boxes)

- ☐ Yes, floodwaters entered my house/business
- ☐ Yes, floodwaters entered my yard/property
- ☐ Yes, the road was flooded and I couldn't drive my car
- ☐ Yes, the river broke its banks
- ☐ Yes, other parts of my neighbourhood were flooded
- ☐ No, I haven't experienced a flood at this property (go to question 8)
- ☐ Other (Please specify): .....

Question 7
If you have experienced a flood, how did the flooding affect you and your family/business? (Tick relevant boxes)

- ☐ Parts of my house/business buildings were damaged
- ☐ The contents of my house/business were damaged
- ☐ Fencing was damaged
- ☐ My garden, yard, and/or surrounding property were damaged
- ☐ My car(s) was damaged
- ☐ Other property was damaged (Please specify) ……..
- ☐ I couldn't leave/return to the house/business
- ☐ Family members/work mates couldn't leave/return to the house/business
- ☐ My family had to evacuate the house/business
- ☐ The flood disrupted my daily routine
- ☐ The flood affected me in other ways (Please specify) ……...…
- ☐ The flood didn't affect me

Question 8
Have you looked for information about flooding on your property? If so, where? (Tick relevant boxes)

- ☐ Catchment Management Authority
- ☐ Council
- ☐ Department of Sustainability and Environment's online Land Use Planning
- ☐ Information from a Real Estate Agent
- ☐ Information from relatives, friends, neighbours, or the previous owner
- ☐ Other information (Please specify) ……
- ☐ No information has been sought
- ☐ I do not believe my property is affected by flooding

Question 9
Do you have any flood information or photographs of flooding that you think might be useful to the consultants undertaking the study? (Tick relevant box)

- ☐ Yes (please provide details at Q1)
- ☐ No

Question 10
What do you think are the best ways to get further information as the study progresses or to provide input to any flood management options that are considered? (Tick relevant boxes)

- ☐ CMA website
- ☐ Email
- ☐ Article in local newspaper
- ☐ Information days in the local area
- ☐ Mail outs to all residents/business owners in the study area
- ☐ Other (Please specify) .....

Question 11

As a local resident who may have witnessed flooding/drainage problems, you may have your own ideas on how to reduce flood risks.

Which of the following management options would you prefer for the Latrobe River catchment (1=least preferred, 5=most preferred)? Please also provide comments as to the location where you think the option might be suitable.

Proposed Option	Preference (Please Circle)	Location? Other Comments?
Controls on further development via planning scheme	1 2 3 4 5	
Levee bank construction	1 2 3 4 5	
Levee bank removal	1 2 3 4 5	
Flood forecasting and provision of flood warnings	1 2 3 4 5	
Bridge or culvert enlarging	1 2 3 4 5	
Construction of storage reservoirs or retarding basins - these temporarily hold water and reduce peak flood flows	1 2 3 4 5	
Improved flood flow paths, such as widening of flowpaths or removal of obstructions	1 2 3 4 5	
Education of community, providing greater awareness of potential hazards	1 2 3 4 5	
Other (please specify any options you believe are suitable). Please attach extra pages for other suggestions, if necessary.	1 2 3 4 5	

If you have any further comments or suggestions that relate to the Latrobe River Flood Study, please express them in the space below. Please feel free to attach additional pages if necessary.

……
……
……
……
……
……
……
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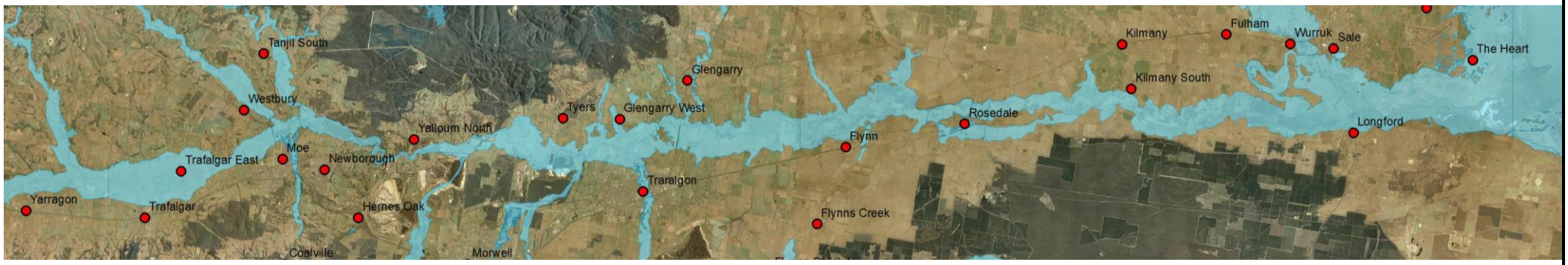
……

Thank you for providing the above information. Please remember to put these pages back in the reply paid envelope by Friday 8 February 2013. A representative from Cardno may contact you in the near future to discuss your response.



Our current understanding of the extent of a 1-in-100 year flood event is shown in blue on the above map. For greater detail in specific areas, please contact the WGCMA. Keep in mind that this study only relates to flooding on the Moe and Latrobe Rivers.

ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Comment	Attachment Ref
1													
2													
3												Property is on Tanjil River, not directly impacted by Latrobe	
4									Y			Sent flood photos	
5												Emailed flood photos. House is well above likely 1% flood level.	
6-11							No Completed Survey						
12	N	1	8m	40y	4	6		8	N	3,5		Doesn't believe property floods	
13	Y	3	13y	52y	4	2,5	12	8,9	N			Property is at junction of Latrobe & Tanjil Rivers, so has some flooding	
14	Y	1	3y 11m	25y 1m	1	5	12	2	N	4,5	a5,b3,c1,d5,e4 ,f4,g5,h3	Paddock behind his house floods	
15	Y	1	34y	70y	2	2,3,4,5	7,10	8	N	5	a2,b1,c1,d3,e1 ,f5,g5,h1,i1	Access has been affected, river should be snagged	
16	Y	3		56y	0	2,3,4,5	1,3,4,6,10,11	1,5	N	5	b1,c5,d5,g5,i5	Wants Lake Narracan to be used for mitigating floods, levees increase flooding & should be removed esp the Stuckey levee at Flynn, flood warnings unreliable, willows should be removed.	
17	Y	1,3	3y 11m	54y	2	2,4,5	3,410,11	6	N		b5,c1,f5,g5	Cattle had to be removed from property last flood. Drains and levees need to be maintained by owners.	
18	Y	1	2y2m	39y	5	4,6		1,2,3,5	Y	2	a3,b4,d4,e5,f3, g3,h2	Would like to see a levee constructed at east end of Bradman Bvd	
19	Y	1	11y 6m	74y	2	2,5	3,4	5	Y	3,4,5	b1,c5,d5,e5,h5	Streams should take their natural course and levees removed.	
20	Y	1	2y	49y 6m	2	6	1,2,8			5	a4,b1,c1,d2,e3 ,f3,g5,h3	Doesn't believe his property floods. Supports planning controls where it really does flood.	
21	Y	1	59y	63y	4	2,7	4,11	7	Y	1	b5,e2,f1,g4,h4	Floods have entered other houses in road and road flooded. Would like to see filling and piping of Contour Drain in Trafalgar, piping of 7 Mile Drain, cleaning of Loch Creek	
22	Y	3	61y	61y	2	5	12	7	N	2	g5	Floods need to drain away quicker from the Trafalgar East Flats	
23	Y	1	23y 6m	67y 4m	2	2	12	7	N	2,5	a5,b1,c1,d5,e5 ,f5,g5,h5	Affected by Traralgon Creek flooding; however, high Latrobe flows can cause backing up.	
24		1	10y	55y	0	2	12	2	N		a4,b3,c1,d2,e2 ,g4,h1	Increased runoff from new development is a concern	
25	Y	1	59y	59y	2	6		5		5	a2,b3,c3,d5,e4 ,f4,g3,h2	Had approx 100mm over property in 1934 flood	
26	N	3	5y	50y	0	4,5	3,10,11	7	N		a1,b1,c3,d3,e3 ,f2,g3,h3	Has had to move cattle	
27	Y	1	25y	42y	2	3,4,5		5,8		2,3	a4,b5,c1,d4,f4, g5	Moe Drain needs repair	
28	Y	1	33y	63y	2	2,5	12	7	N	2,5	a2,b1,c1,d4,e5 ,f3,g5,h3		
29	Y	1	35y	56y	2	2	11	5,7		5	a5,d5,f4,g3,h1	Property floods when both Traralgon Ck and Latrobe Rv are in flood. Banks of both streams need vegetating. Back paddock goes under but house is high. In 1993, floods was level with the banks of the sewerage ponds.	**9**
30	Y	1	4y 4m	4y 4m	2	2,3,4,5	3,4,5,7,10	2	Y	2	a1,b5,c1,d3,e5 ,f5,g5,h3	Drainage from Yarragon to Moe River needs to be fixed	
31	N	2	3m	52y	6	6		7	N	5	a3,b3,c3,d5,e3 ,f4,g4,h5		
32	Y	2	7y 2m	3y 8m	2	4	12	2	N	2	a4,b1,c2,d3,e4 ,f1,g2,h3		
33	Y	1	55y	76y	2	4	3,6,11	1,3	Y	6	a1,b1,c3,d5,e5 ,f5,g5,h5	Suggests SMS for info. No value in studies; need to get out and talk with farmers when flood is on.	
34	Y	1,4	13y 5m	50y	4	1,2,4	2,3,4,6,10		N	3,4,5	c1,f5,i5	Has had caravans flooded. Wants to be able to fill part of his land to protect caravan storage business.	
35	Y	1	8m	7y	2	2,5	3,4,10,11	4,5,6	Y	1,2	a3,b4,d4,f2,g4, h3	Road to Sale flooded, post-flood clean up, time spent monitoring	
36	Y	1,3	12y 2m	46y	5	2,4	3,10,11	7	Y	2	a5,b1,d5,f1,g1, h5	Latrobe flooding by itself is OK - problem when Thomson/Macalister also in flood. Access to parts of property cut	
37	Y	1,3	64y	64y	2	1,2,3,4,5	3,4,6,7,8,10,11	6	Y	4	a1,b5,c1,d5,e5 ,f5,g5,h5,i5	Should clean out rubbish in river. Difficult to transport cattle Fence and floodgate damage. Erosion a problem when willows removed.	
38	Y	1,3	60y	61y 9m	2	1,2,3,4,5	3,10,11	6	Y	1,2,3,4,6	a5,b1,c4,d5,e3 ,f1,g1,h5,i5	Need to live with floods. Would like to be visited. Has prolonged periods of flooding. Erosion and turbidity a problem in the Latrobe.	
39	Y	1	8y	34y	2	6	12	7	N	5	e5,g5		
40	Y	3	20y	60y	0	3,4,5	3,10	5	Y	2	b5,c5,d5	Repair existing levees. Investigate what can be done to alleviate prolonged flooding between Flynns Creek & Stuckeys Lane.	
41	Y	1,3	49y	49y 6m	5	2,4,5	3,6,10,11	1,5,6	Y	4,6	a4,b5,c5,d4,e4 ,f4,g3,h4,i4	Suffers financial loss to pasture, crops, weed infestation. Should contact locals for thoughts. Levees need to be managed, otherwise removed. Educate community to empower	

ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Comment	Attachment Ref
42	Y	1,3	6y 3m	17y	5	3,5	7,10	1,2	Y	2,3,4,5	a5,b1,c1,d1,e5,f1,g5,h1	Got drain cleaned out which solved problem. Culverts on Sth Canal Rd are not working and need attention.	
43	Y	3	10y 6m	10y 6m	8	2,7	5	7	N	5		Water pump has been damaged by floods	
44	Y	1,3	44y	50y	3	1,3	1,2,3,4,9	7	N	5	c5,f5	Has a hobby farm	
45	Y	1	34y	51y	3	2	11	2	N	3,5		Has lost stock to flooding. However, relevant property has since been sold.	
46	Y	1	24y	48y	2	2	12	7	Y	2	a5,b3,a1,d4,e2,f3,g2,h4	Don't allow development in flood areas	
47	Y	1,3	33y 7m	60y 2m	2	2,3,4,5	3,4,6,7,10,11		Y	6	a5,b5,c1,d3,e4,f5,g5,h5	Flooding getting worse. Moe Drain needs maintaining. Impose a levy for drainage. No studies please, just maintainenance. Photos provided.	**15**
48	Y	4	50y	80y	0	2	3	7	N	3	d3,f3	Has only a few horses.	
49	Y	1	5y	65y	2	3	12	7	Y	5	a4,b3,d4,e4,f4,g5,h3		
50	Y	2,3	23y	68y	1	7	3,6	7	N	3	f5	Flooding worse since freeway built. Fences and bridges get damaged. Last year bridge repair was $3,000.	
51	Y	1	24y	72y	2	5,6	12	7	N	5		At highest flood, only 5 acres is flooded on Sheepwash Creek.	
52	Y	3	5y 5m			2,3,4,5	4,6,10,11	4,5	Y	2,3,4,5	a1,b5,e5,f5,g5,h3	Hay and pasture damaged and cattle had to be moved 250km away. Drains and Moe River needs to be cleaned out.	
53	Y	1	2y 4m	27y 6m	2	4	12	7	Y	5	a1,b3,c1,d3,e1,f4,g3,h3,i1	Floods do not affect property	
54	Y	1	8y 1m	38y 2m	3	2,3,4,5	3,4,7,10	2	N	5	a5,b5,c1,d5,e5,f5,g5,h3	Maintenance of the Moe River and road drains has dropped off considerably. All drains need cleaning out.	
55	Y	1,3	55y	63y	3	5,6,7		1,5	N	3,5	e1,g1	Property floods from Rollo Creek and Contour Drain.	
56	Y	3	34y	55y	3	3,4,5	3,10	5	N	5	a5,b1,c5,d2,e1,f5,g5,h1	APM ponds take up floodplain. Lake Narracan could be used for retardation. Need to remove fallen trees from river.	
57	Y	3	35y	N/A	0	1,2,3,4,5	1,3,4,7,8,10	5	Y	2,5	a5,b1,c1,d5,e5,f3,g5,h3	Pastures damaged, lost production.	
58		1	18y 6m	62y 3m	2	2,4,5	3,10	5	Y	2,4,5	a1,b3,c1,d2,e2,f3,g4,h4	Removal of willows would help. Property is flooded by Tyers River rather than the Latrobe.	
59	Y	1	55y	55y	2	4	10	1	N	1,2,3	a4,b5,c2,d2,e3,f5,g5,h1	No more studies! Need drainage works on Traafalgar/Yarragon Flats urgently!	**14**
60	Y	1	24y	56y	2	2,3,5	12	1,8	N		e5,f5	Speak with the locals. Road flooded for 1 day only. Need Maxfields Rd bridge fixed to provide access.	
61	N	2	45y	61y 5m	NA	6		8	N	3	a3,b3,c1,d1,e1,f3,g5,h1		
62	Y	4				1,2,3,4	11	1,3	Y	1,2	a5,b5,g5	Gippsland Water has many assets, including the following flood-affected ones: Factory Rd sewer pump station at Yarragon, Middle Rd sewer pump station at Trafalgar, 8 Mile Rd sewer pump station at Trafalgar, Traralgon Emergency storage, Sale Water Treatment Plant. GIS files of assets are available.	
63	Y	1	8y	65y	2	2	12	8	Y	2	g5	Drain to Latrobe River needs cleaning out.	
64	Y	1,2,3	66y 11m	66y 11m	2	7	3	6		2	a4,g5,15	Floods from Sunny Ck, not Moe River. Need to talk with locals. Those responsible for development should contribute to D/S flow improvements. Need regular maintenance of drains.	**13**
65	Y	1 vacant	9y	61y	0	6		1,2,8	Y	1	a1,b1,c1,d1,e1,f1,g1,h1,i1	Property doesn't flood and current maps are wrong.	
66	Y	1	8m	3y 8m	4	2,3	1,4,7,10	2,5,6		1,2,5	b5,c1,d5,e5,f5,g5		
67	N	1,3	35y	67y 10m	2	2,3,4,5	7,8,10	5		5	a1,b5,c1,d1,e1,f1,g4,h1	Moe River levees should be raised and strengthened. Moe River bed has scoured too deeply causing bank failure.	
68	Y	1	25y	64y	1	2,4,5	4,10,11	5	N	3,4,6	a5,b5,d5,e5,f5,g5,h5	Only 2 bad floods on Moe River in 25 years - 2011 & 2012. Banks of Moe River need to be rebuilt. Water went under house and out the other side. Took palings off fence. Talk to locals.	
69	N	3	44y	67y	2	2,4,5	10		N	5	a5,b4,e5,g5,h1,i5	Suffer loss of pasture and production. Flood gates on Moe River need attention.	
70	Y		6y	59y	0	3,4	3,11	6	Y	5	a2,b1,c5,f1,g5	Involved in management of Heart Morass Rehabilitation Project, so happy to have floods.	
71	N											Claim they are not on the Latrobe River (WG note: may be protected by the Kilmany Bank)	
72	Y	1,3	60y	60y	2	4	12	7	Y		a1,b1,c1,d1,e1,f1,h2	Most mitigation has been tried and makes no difference. Thomson River flooding has a big influence on flooding at Longford. Shouldn't mess around with floodplains. Should simply live with them. Intervention causes other problems.	
73	Y	1	32y 10m	62y 10m	2	4,5,6		7	N	3,4,5	e5,g5		
74	Y	1,3	5y	25y 1m	2	2,3,4,5	7,10	7	Y	2,3,5	a2,b4,c1,d1,e2,f2,g5,h1	Drains leading to creek are choked with debris. Upstream development has led to greater flows in drains, which need to be maintained.	
75	Y	1,3	7y	37y 6m	7	3,4,5	7,8,10	3,5	Y	3,5,6	a2,b5,c2,d1,e5,f2,g5,h2,i5	Property is on higher ground and rarely flooded. Existing assets (drains, levees, flood gates) need to be adequately maintained. Responsibilities for asset management need to be made clearer. Attached his	**12**

ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Comment	Attachment Ref
												submission to the Drainage Inquiry.	
76	Y	1,3	34y	60y	2	2,3	7,10,11	2	N		a1,b1,c1,d1,e1 ,f1,g5,h1	Existing drainage system needs to be maintained.	
77	Y	3	100y		0	2,4,5	3,11	7	N	4	d5,f5,g4,h3	Suffers loss of grass	
78	Y	1,3	21y	49y 6m	4	2,4,5	3,11	1,2,5	Y		a1,b3,c1,d5,e5 ,f5,g5,h1,	Has a 1934 flood mark near property, as well as images and marks from the past 20 years.	
79	Y	4				3	12	7	N	2		APA Group have two gas transmission pipeline facilitieis that may be impacted - Gooding Compressor Station at Gooding and Tyers City Gate off Glengarry Rd, Glengarry West.	
80	Y	1,3	40y	60y	3	2,4,5	3,10	6	Y	5	a1,b3,c1,d5,e3 ,f2,g3,h2,	Would prefer flood warnings in flow rates, rather than river heights. Need maintenance of flood gates. River height is irrelevant once river spills. (WG note: Richard has a large property)	
81	Y	3	30y	30y	2	4	3	1	Y	5	a1,b5,c1,d1,e3 ,f3,g5,h1,i5	Need maintenance of Traf Flat levees and drains. Focus of CMA should be infrastructure, not environment.	
82	Y	1,3	42y	42y	17	4,5		7	N		a5,b3,c1,d4,e5 ,g2,h3		
83	Y	3	5y	21y	0	4	5,11	7	N	2	a5,b1,d3,e1,f1, g1,h3	Access bridge at rear of property damaged. Need to live with floods and not tinker.	
84	Y		1y 4m			2,3	4,6,10,11	5	N	2	a2,b5,c1,d3,e4 ,f5,g5,h3,i5	Silage and Hay damaged and had to move stock. Need existing drains maintained.	
85	Y	1,3	6y	80y	3	1,4,5	3,11				a1,b1,d2,e1,f1, g1,h1		
86	Y	1	40y	40y	2	3,5	12	7	Y	1,2,3,4	a5,b1,c4,d4,e3 ,f1,g3,h5	Need to live with floods. Shouldn't try to control flows.	
87	Y	1	18y 2m	57y 4m	2	2,5	12	7	Y	1,2,3,4,5,6	a3,b1,c4,d3,e3 ,g5,h5	Has photos of flooding. Small part of front paddock floods. Burnets Road and houses are fine, even though paddocks flood. Levees and retardation will cause problems elsewhere. Big on education. Insurance has gone up $2,000 even though house is safe!	
88	Y	1	2y 6m	7y	1	2	4	1,2	N	5	g5,h2	Cleaning and widening drains on Settlement Rad would help.	
89	Y	1,3	45y 5m	45y 5m		3,4,5	1,3,5,8,10,11	7	N	5	a1,b5,c1,d1,e1 ,f1,g5,h1,i5	Moe Drain banks need repair and maintenance. Rock chutes have caused further bank damage.	
90	Y	3	10y	9y	5	2,3	6,11	7	Y	2	a5,b4,c1,d2,e4 ,f1,g5,h2,i1	Water killed grass and weeds thrived. Levee banks need repair and maintenance.	
91	Y	1,3	60y	61y		3,4,5	3,10,11	7	N		a5,b1,c5,d5,e5 ,f1,g5,h4	Australian Paper settling ponds should be removed. Vegetatoin should be removed from river. Drains need maintaining.	
92	Y	1,3	29y 5m	29y 5m	2	2,3,5	3,4,6,10,11	1,2,5,6	Y	3,4,5	a5,b5,c1,d5,f5, g5,h3	Paddocks flooded and dead livestock. Need to improve flood flow paths.	**11**
93	Y	3	5y 4m	21y 6m	3	2,4,5	6,11	1,5	Y	2,3,5	a1,b5,c1,d1,e1 .f1,g1,h1	Lost hay, pasture and production. Banks of Moe River need repair and maintenance, as does drainage system.	**10**
94	Y	1	10y	29y 5m	2	2,3,5	3,4,7,8,9,10	1,2	Y	2,4	d5,g4,h4		
95	Y	2		50y 3m		2,3	3,4	7	Y	1,2	a4,d5	Property floods and cows were put in house yard.	
96	Y		41y 3m	74y	8	5		1,5	Y	1,5	a5,b1,c3,d5,e5 ,f3,g5,h4,i5	Developemnt in Yarragon and Trafalgar has increased flooding. Drains need maintenance. Small parts of property flood occasionally. Development should be accompanied by flow retardation.	
97	Y	1,3	63y	63y	2	2,3,4	1,3,5,11		N	5	a5,d5	Authroties don't care. Warning system is useless. Would like to talk with someone.	
98	Y	1,3	63y	85y	2	3,4,5	3,6,8,10	7		6	a5,b5,c5,d5,e5 ,f5,g1,h5,i5	Need to talk with landowners. River should be fenced. Need to remove willows and stabilise erosion.	
99		3	12y 8m	40y	2	4	10	7	Y	3,5	a4,b2,c2,d5,e4 ,f4,g4,h2		
100	Y	1	2y 5m	11y	7	6		2,4	Y	2,5	a5,b1,c1,d3,e5 ,f5,g5,h3		
101	Y	4	35y	60y	4	4	3,10	5		2	a1,b5,c1,d5,e5 ,f5,g5,h5		
102	Y	1,3	30y	56y	5	1,2,4,5	1,3,4,10	1,5	Y	2,3,4,5	a5,b3,c1,d2,e4 ,f5,g4,h4	Has lots of photos. Moe River needs regular maintenance. Flooding exacerbated from town drainage and new developments.	**1**
103	N	1	4y 4m	4y 4m	4	2,3,5	4	5	N	5	a3,b1,c1,d3,e1 ,f4,g5,h2		
104	Y	1,3	58y	58y	5	1,2,3,4,5	1,3,4,10	1,5	Y	4,5	a5,b3,c1,d3,e4 ,f5,g4,h2	Has lots of photos. Runoff from towns and new development is a major issue. Could use defunct Yarragon and Moe sewerage ponds as retarding basins.	
105	Y	1	5y	60y	3	4,5,6	12	8	N	5	a1,b1,c1,d1,e5 ,f5,g5,h5	Should create higher bridges over flood areas.	
106	Y	1,3	12y	48y	4	4,5	3,11	7	N	1,3	a3,b2,c2,d3,e1 ,f4,g4,h2	Pasture damaged. Floods are more frequent over last 2 years.	

ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Comment	Attachment Ref
107	Y	1,3	25y	56y	3	4,5	10,11	5	N	2,4,5	a1,b2,c1,d1,e1,f1,g5,h1,i5	Paddocks flooded and needed to move livestock. Existing levees and drains need maintaining.	**2**
108	N	1	35y	35y	5	6		8	N				
109	Y	1	54y	67y	2	2,3,4,5	3,4,5,6,7,8,10,11	1,2,6	N	3,4,5,6	a1,b1,c3,d5,e4,f4,g1,h5	Fencing and roads damaged. Unable to access property. No more dams or extractions should be allowed.	
110	Y	1	5y	5y	2	7	6	2,4,5	Y	2,3,5	a5,b5,c1,d3,e5,f5,g5,h3	Farmland behind property floods - to 5m of fence in 2012. Has photos	
111	Y	1,3	46y	46y	7	2,3	3,6,10	7	N	2,5	a1,b5,c1,d4,e4,f3,g5,h1	Silage pit was flooded and damaged. Roads along Moe River need repair.	
112	Y	4	50y	60y		1,2,3,4,5	1,2,3,4,7,8,10	1	Y	5	d5,f5,g5,h4		
113	Y	1	5y	53y 3m	0	2,3,4,5	3,11	5	N	5	a2,b1,c1,d5,e4,f4,g5,h4,i5	Water Factory needs to look at the amount of water they release when a flood is on? Red gum death in morrass needs to be examined. Property flooded Sep 2012 - Nov 2012	
114	Y	3	58y 11m	58y 11m	5	4,7	3,11	5		5	a4,b2,c2,d3,e5,f1,g5,h3	Flood flows have changed a lot since 1934. More care with engineering works to not obstrut floods.	
115												Hand-wrote a letter to WGCMA. Local reports are that the 1934 flood was made worse by the collapse of the Traralgon-Glengarry railway embankment. (WG note: I've heard this report many times before and it may have some credibility)	**3**
116	Y	1,3	40y 6m	40y 6m	2	6	12	8	N	5	e5,g5	Property doesn't flood but drains need clearing!	
117	Y	1,3	45y	65y 6m	2	1,2,3,4,5	10,11	1,2,5	Y	3,4,5	a5,b5,d5,f1,g5	Has some photos, Would like personal contact. Gaps cut in levees to drain Council's road cause their property to flood. Existing drains need to be maintained. Cattle had to be moved several times.	
118	Y	1,3	15y	55y 9m	2	2,3,4,5	6,10	5	N	3,4	a4,e3,g5	Pastures and lanes damaged. Drains need maintaining and enlarging, due to increased development in catchment.	
119	Y	3	34y		3	2,3,5	8,10	5	N	1,2,4,5	b4,d4,e4,g4		
120	Y	1	6y 5m	40y	4	2,4,5	3,4,11	5	N	3,5	a3,b1,c1,d5,e3,f1,g5,h1	Stock had to be removed. Weeds proliferated. Parts of farm inaccessible.	
121	Y	1	27y	35y		2,3,4,5	4,7,8,10	5	Y	5,6		Has some photos. Should talk with her and locals. Property is adjacent to wetlands and wouldn't want to see them changed.	
122	N	3	50y 3m	50y 3m	2	3,5	10,11	5	N	5	a5,b3,c1,d2,e2,f2,g5,h2,i5	Had to move cattle to high ground. Needed 4WD to access property. Urban development of Trafalgar is a concern. 1934 flood came mainly from Shady Creek, whereas 2012 flood thought ot be result of tail water backing up from seven mile Road and Lochs Creek Road or Moe River flood gate not operating properly	
123	Y	1								5	a5,b4,c1,d5,e5,f3,g5,h5	WG note: Didn't get all of his faxed survey form.	
124	Y	3	5y	36y	2	1,2,3,4,5	1,3,4,7,10	1,3	Y	4,5	a1,b5,c1,d43,e1,f1,g5,h2	Pasture destroyed. Moe River is in deplorable state.	
125	Y	1	8y	36y		1,2,4,5	1,2,4,5,6,10,11	1,2,3	Y	5	a3,b5,d2,e5,f2,g5,h2,i5	Contour drain needs urgent attention.	
126	Y		67y	67y	2	1,2,3,4,5	2,3,48,10		Y	2,3,4,5	a1,b5,c1,d5,e4,f1,g5,h1	Lost hay bales and machinery damaged. Moe River levees should be built higher. Fallen trees need to be removed from river. Runoff from new development is a problem. Drains need to be maintained. Residents of Trafalgar Flats paid for cleaning of tributaries into Moe River, dramatic improvement	
127	Y	1,3	89y 5m	89y 5m	5	2,3,4,5	8,9,10	7	N	3,5	a1,b5,c1,d3,g5,h2	All trees in the river need to be removed.	**4**
128	Y	3	42y 5m	54y	2	4,5	3,4,6,10	7	N	3,4,5	a4,b5,c1,d1,e1,f1,g5,h1,i5	Drainage system needs enlarging due to urban growth and then maintaining. Moe River needs repairing and cleared of debris. Need a levy to pay for maintenance. Should spend $ on work, rather than studies.	
129	Y	1,2,3	75y 2m	75y 2m	3	2,3,4,5	4,6,7,8,10	5	Y	3,4,5	b5,d4,e4,f5,g5	Driveway is damaged every flood. Moe River is full of fallen trees. Worst flood was 1934. Floods also occurred in 1975, 1976, 1977, 1989, 1990, 1991, 1993, 1995, 1996. In 1934, the Plozzas had to live in roof space for several weeks, until rescued by police boat.	
130	Y	1,3	50y	69y 3m	2	2,3,4,5	3,4,6,7,8,10	2	Y	3,4,5	a5,b5,c1,d2,e5,f1,g5,h2	River and road side drains need to be cleared of weed and tree growth. Drainage from new urban development needs controlling. Photos attached.	**5**
131	Y	4	10y	10y	25+	1,2,3,4,5	1,2,3,4,5,6,7,9,10,11	1,2	Y	1,2,5	a3,b5,c1,d3,e5,f5,g5,h3		
132	Y								Y			His property, on the north side of Flooding Creek south of Sale, floods mainly from the Thomson/Macalister system. 1952 was the biggest flood to hit Sale, followed by 1978. Concerned about flood impact of new South Gippsland Hwy.	**6**
133	Y	1,3	62y 8m	62y 8m	1	2,3,4,5	1,4,6	1,2	Y	1,2,5	a5,b5,c3,d5,e3,f5,g5,h3	Need to build-up and maintain levee along South Canal Road. Couldn't access property, even with 4WD. Hay rolls were flood-damaged. Up to 200mm through sheds. Photos attached.	**7**
134	Y	1,3	76y	76y	4	4	3	7	Y	5	a4,b3,d4,e3,f2,g4,h2	Stock had to be moved to high ground. Junction of Tyers River is just D/S and, if there's a high flow in Tyers, it retards the Latrobe.	
135	Y	1,3,4	37y		2	2,4,5		2,3			b5, g5	Paddocks are under water for weeks. Moe and Latrobe Rivers are full of timber and obstructions and need cleaning out. Moe River banks need restoring.	

ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Comment	Attachment Ref
136	Y	1,4	13y 5m	31y 3m	2	6		8	N	2,4	e5,g5	Dead trees in Latrobe should be removed.	
137		3	20y	58y 1m	0	1,2,3,4,5	3,10,11			1,2,3	a2,b3,c1,d5,f5, g5,h2	Has had to move stock to agistment. Washouts along river bank in neighbouring property need repairing.	
138	Y	1,3	6y 6m	57y 4m	2	2,3,4,5	7,10	2,4,5	Y	4,5	a5,b5,d1,e5,f4, g5,h1	Drains and levees need to be maintained. Floods cause weeds to invade pastures. Drainage from new development needs to be controlled. Vegetation and debris needs be cleaned from all drains.	
139	Y	3	9y 4m	50y	4	5	11	2	Y	5	b5, f5,g4	Need dams in the upper catchments. Couldn't keep stock on part of property.	
140	Y	3	20y	21y	4	2,4,5	3,4,6,10,11	1,2,3,5	Y	1,2,3,5	a3,b5,c3,d4,e4 ,f3,g5,h3	Has photos. Pastures and irrigation equipment damaged. Fallen trees should be removed from river.	
141	Y	1,3	62y	83y 7m	1	2,3,4,5	3,10,11	5	Y		a4,b3,c1,d3,e3 ,f5,g5,h2	Has needed to buy fodder and agistment. South Gippsland Hwy will be a major flood problem.	
142	Y	3				2,7	3,4,6	1	Y	2	a4,b1,c4,d4,e4 ,f2,g5,h5		
143	N												
144	Y	3	10y	33y	0	2,3,4	3,6,10	7	Y	2,4,5,6	a3,b5,c1,d3,e3 ,f5,g5,h3	Shoul call affected people. Major concern around Stuckey's Lane, Flynn.	
145	Y	1,3	1y 8m	23y 10m	2	1,2,3,5,7	3,10	1,2,3,4,5,6	Y	1,2,3,5	a1,b5,c1,d1,e5 ,f5,g5,h1	Floodwaters entered shed. Couldn't graze paddocks for 4-5 months. Extra 45 minutes to get to work.	
146	Y	2,3	30y	76y	1	2,4,5	12		N	5	a1,b1,c1,d1,e1 ,f1,g1,h1	Floods do a lot of good.	
147	Y	1	4y 4m	61y 2m	2	5	12	2	Y	2,5	a5,g5,h5	Development should be kept off floodplain. Around edges, should be minimum floor levels. Happy that their floor level is adequate. Photos attached.	**8**
148	Y	1	1y 8m	18y	1	1,2,5	1,3,11	1,5	Y	1,2,5	a5,b5,c1,d5,e5 ,f5,g5,h5	Had to move stock out of low paddock.	
149	Y	3	10y		5	2,4	3,6,10	1,3,5	Y	1,3,4	a5,b1,c3,d5,e5 ,f5,g4	Lost livestock worth $100,000+	
150	Y	1,3	20y	35y	1	2,4	5	1	N	1,2,3,4,5		Need to repair and maintain river levees and banks.	
151	Y	1	5y	50y	3	4	12	8	Y	2,5	a3,d4		
152	Y	1								5	a5,b5,c1,d1,e1 ,f1,g5,h2		

1

If you have any further comments or suggestions that relate to the Latrobe River Flood Study, please express them in the space below. Please feel free to attach additional pages if necessary.

The Moe River needs more regular maintanance. The problem with the flooding comes from the amount of water (runoff) from the ~~tot~~ local towns. It is just amazing to see the water gushing into the River from the contour drain on our property.

Thank you for providing the above information. Please remember to put these pages back in the reply paid envelope by Friday 8 February 2013. A representative from Cardno may contact you in the near future to discuss your response.

I know you say not to include information from other water courses + drains but these drains fill up the Moe River with Runoff from all the new developments in the towns + this is when the flooding occurs !!!

(1)

If you have any further comments or suggestions that relate to the Latrobe River Flood Study, please express them in the space below. Please feel free to attach additional pages if necessary.

Clean out the drains so the water can get away quicker.

At the moment the water is getting away from the town area quicker, but nowhere for it to go when it hits the flood plains.

The drains is in urgent need of repair with spots that broke away last year, and haven't been fixed.

Also foxes + rabbits burrowing + creating holes in the bank.

Thank you for providing the above information. Please remember to put these pages back in the reply paid envelope by Friday 8 February 2013. A representative from Cardno may contact you in the near future to discuss your response.

Some of the local farmers have cleaned out the drains on their own properys, but because the drains ~~on~~ along the road (council owned) have not been cleaned out, there is nowhere for the water to go - hence more flooding.

~~So the water was off a neighbours property then~~

This is all for the Moe River.

(2)

HAVE HAD AN APPLICATION IN WITH THE WEST
IPPSLAND CATCHMENT MANAGMENT FOR SOME TIME
R A 4 LOT SUBDIVISION WITH HOME SITES THAT CAN
E FOUND ABOVE F2000 LEVELS

DOCUMENT NO - WGCMA - 16677

APPLICATION NUMBER REF - F2006 - 0375

[redacted]

3

TO MR WAYNE GILMOUR

I AM WRITING IN REGUARD TO A WEST GIPPSLAND CATCHMENT MANAGEMENT PRIHT IN THE GIPPSLAND TIMES, WANTING ANY INFORMATION LIGHT ON FLOOD MITIGATION OF 100 YEAR LATROBE RIVER 1934. I HAVE A SPECIAL INTREST IN THE 100 YEAR FLOOD OVERLAY HAVING OWNED LAND - LOT 5 CRICKET ST ROSEDALE. I HAVE A APPLICATION FOR 4 LOT SUBDIVISION, BUT CANNOT PROCEED AS THE WELLINGTON SHIRE IS APPLYING TO INCLUDE IT IN ZONE 1. RESIDENTIAL IN THERE NEW ZONING PLAN. I HAVE TO SAY I AM 78 YEAR OLD, WAS BORN IN 1934 - MY ONLY LIGHT ON THE 1934 FLOOD IS FROM AN OLD IDENTITY NOT WITH US NOW THAT FARMED A FEW COWS IN ROSEDALE YEARS AGO. HE WAS SAID TO SAY, DEZUGE IN THE LATROBE WAS PARTLY CAUSED BY A BRIDGE IN THE GLENGARY AREA GIVING AWAY AFTER BEING LOG BOOMED. I PERSONALY WOULD HAVE THOUGHT THE LATROBE FLATS WOULD HAVE BEEN A LOT DIFFERENT WITH SOME WHAT MORE HEAVLY TIMBERED RED GUM FORESTS WHICH WOULD HOLD FLOODING UP SOME-WHAT. I JUST DECIDED TO PUT PEN TO PAPER TO WHAT I KNOW AND WHAT THE LANDSCAPE MAY HAVE BEEN BEFORE BEFORE, HEAVY EQUIPMENT + HEAVY CLEARING. I HAVE RESERVATIONS ABOUT LOT 5. BEING SUITABLE FOR HEAVY HOUSING UNDER THE RIVER LEVELS AS IS. MAY BE A REDEFINING OF LEVELS COULD BE OKAY.

Trafalgar East

I have lived on the flood plain for nearly ninety years and have experienced many floods.

In the last fifty years there has been a constant deterioration of the Nor River

Trees in the drain hold back the flow of water which rushes around the back of the trees which causes slippage to the banks and the roads.

This can quite easily be seen along the river in many locations

It would seem that the first action needs to be the removal of all trees in the river

[redacted]

4

5

Factory Road, Yarragon looking north to Moe River from Reserve Rd intersection

Factory Road/ Reserve Road, Yarragon - intersection 2012

[redacted]

West Gippsland Catchment Authority
PO Box 1374
Traralgon Vic. 3844

Att. Mr Wayne Gilmour.

Dear Sir,

RE; Latrobe River Flood Study

Thank you for including me in your request for Information about flooding on the Latrobe River.

I own a small property on the north side of Flooding Creek on the southern side of Sale and flood waters in this creek come directly from the Thompson/ Macalister system. I would estimate that flood waters in the Latrobe system would contribute about 5% to the flood height on my property and that through the back up of water from the junction of the two river systems. But that would depend on the volume of water coming down the Latrobe.

In more recent years VicRoads has constructed an "All weather Highway" from Sale to Longford which includes an unbroken embankment over part of the Latrobe River flood plain; this construction has yet to be tested by a "decent" flood: I live in fear of the consequences for those who live upstream.

The year 1952 saw a very large flood hit the Sale area: the next largest was 1978 and this flood is the subject of a report of somewhat dubious worth. The draft report was far more informative.

Any information/report I have sought has been about the effect of flooding in the Thompson/Macalister river systems and specifically in the Sale area.

I wish you luck with your study but, whatever the outcome may be, the status quo will prevail.

[redacted]

6

(7)

(7)

Looking East from front of House To Eight mile Road.

Looking S/west. Toward THE HOUSE FROM END of DRIVE way.

THESE are PHOTO's 2009.

DRIVING NORTH along Eight MILE Road. Toward MOE RIVER.

Looking S/west Back of House.

(t)

(7)

DRIVING OUT of DRIVE TO Eight mile Road.

2009.

ON Eight mile Rd Looking UP THE DRIVEWAY.

HAVE seen FLood water coming OUT the DRIVE ABOUT a FOOT and a Half High WHEN water flowed OVER THE ~~Road~~ BANK of THE MOE RIVER.

LOOKING N/WEST Towards HOUSE FROM Neighbours DRIVE way

FRONT of DRIVE Way.

If you have any further comments or suggestions that relate to the Latrobe River Flood Study, please express them in the space below. Please feel free to attach additional pages if necessary.

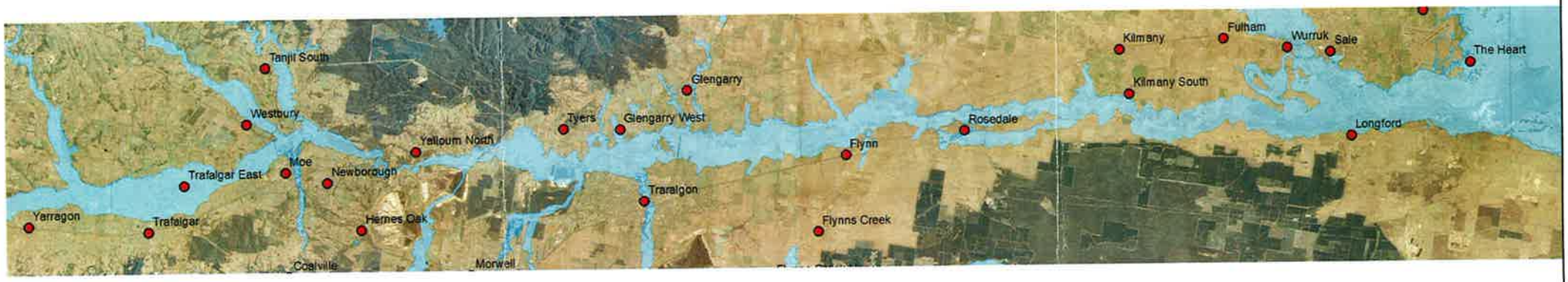
At the highest level of the flood behind our house, we did not feel concerned ~~Our house is~~ Our floor level at the back of the house is nearly a metre above ground level By our calculations, the flood water would have to have been 2 metres higher to enter our house. Our shed + garage is a bit lower than our floor level so would be impacted first in the event of a huge flood.

Thank you for providing the above information. Please remember to put these pages back in the reply paid envelope by Friday 8 February 2013. A representative from Cardno may contact you in the near future to discuss your response.

the storm water drain at intersection of Crosse's Road + Riverslea Bvd was not adequate in a huge rain event a couple of years ago. the flood extended quite a distance + entered homes.

Even though we live down the hill, we were not effected by that flood, there is another access point to subdivision so we could come + go.

8



Our current understanding of the extent of a 1-in-100 year flood event is shown in blue on the above map. For greater detail in specific areas, please contact the WGCMA. Keep in mind that this study only relates to flooding on the Moe and Latrobe Rivers.

We are located close to the junction of the Latrobe and Traralgon Creek
When both River + Creek are in flood
Our back paddock goes under water to the depth of the top of our fence posts.
Our house is never at risk as it is high above the creek flat.

9

If you have any further comments or suggestions that relate to the Latrobe River Flood Study, please express them in the space below. Please feel free to attach additional pages if necessary.

In the early 90's the flood debris was above the 6' cyclone fence around the Sewerage Dam (on Maushalls Rd) the debris was up to the 1st of 3 barb wires above the cyclone. The flood was level with the bank of the dam. (This may give you a measurement) This flooding happened ~~in~~ twice 2 years apart, at the time ~~*~~ Since the storm water drain was constructed, (back filled with blue metal) from Franklin St (explorers PARK NOW!) the wet lands which was our PROPERTY has not held water as it did. There also used to be a ground spring in that wet land.

Thank you for providing the above information. Please remember to put these pages back in the reply paid envelope by Friday 8 February 2013. A representative from Cardno may contact you in the near future to discuss your response.

(9)

If you have any further comments or suggestions that relate to the Latrobe River Flood Study, please express them in the space below. Please feel free to attach additional pages if necessary.

Because no repair work has been done to the Moe River by the WGCMA since 1995, the banks of the Moe River have become eroded and washed away. If this river system had been maintained, flood waters would have had lesser impact on surrounding properties. The inflow drains into the Moe River have had no maintenance done either and now have a lot of growth in them. The problem is that if they are cleared out the birdlife that thrive in the drains lose their environment/habitat.
If the Moe River had been properly maintained, water would be transported away quickly, roads would require less maintenance and/or use (not closed down) like Nth Canal Rd (east end).

Thank you for providing the above information. Please remember to put these pages back in the reply paid envelope by Friday 8 February 2013. A representative from Cardno may contact you in the near future to discuss your response.

The surrounding drains do work well. Water escaping from the damaged river banks compounds the flooding on properties and stresses the ability of the sourrounding drains to drain quickly.

× Priority (1) would be to repair damaged river banks along the west end of Nth Canal Rd + where houses are threatened on the east of Nth Canal Rd.

Our southern Paddocks ~~close~~ adjacent to the Moe drain are covered in flood water, as is our neighbors on both sides. We have planted new Pasture seeds on 2 occassions and have lost them to floods + waterlogging. Our shelterbelts are affected and a lot of the new plantings have died.

Large round bales of hay stored along a paddock fence were in the flooded paddocks and we lost a third of the hay to rot.

(10)

West Gippsland

Catchment Management Authority

Other options for the Little Moe River

Snig and widen the river where necessary, if possible before winter. Remove the bottle neck downstream from the Moe River Bridge. Speaking with one of the authorities, their idea is to lift the base of the river up with loads of rocks, so the water can flow out of the river onto the surrounding land to take some of the volume out of the river. This makes the surrounding land useless for farming for long periods of time. In my opinion not a good idea for most of the water will end up in the river again downstream. The Moe is now carrying more water than it has done in the last 30 years. Reason being, the Yarragon sub-divisions, Warragul sub-divisions and soon to be the Jana set up (Masters) on the east side of Warragul. In our own case the water from the Little Moe River Road has now been diverted through the front of our property, causing the water from the rain to flow down our drive towards our house, ending up a few metres away from our house and sheds (photos supplied). The water from further up the road in a west direction from here came across the Little Moe River Road and across the neighbours flats messing up our access to the back of the farm and destroys our race fences as well. It builds up against the neighbours east of us flooding across our paddocks making the paddocks unaccessable for animals. If this neighbour cleaned his share of the main creek, which flows through three neighbour's properties directly into the Moe River it would allow water to run off our land more quickly. It is an important creek to keep clean!!

The money allocated for the Moe River works, I hope it is not going to be used up in drawing up river plans and in administration and other paper work!

Just start up the diggers please, before winter comes and the flooding starts all over again.

Please find photos in closed. When finished with the photos could you please return them.

Photos scanned and returned.

20.2.13

Yours sincerely

[redacted]

(11)

[redacted]

Executive Officer
Environmental and Natural Resources Committee
Parliament House, Spring Street
East Melbourne, Vic, 3002
enrc@parliament.vic.gov.au

12

3rd January, 2013

RE: INQUIRY INTO RURAL DRAINAGE IN VICTORIAS

Dear Sir,

Thank you for the opportunity to respond to the inquiry into rural drainage in Victoria. It is without doubt that the historical drainage systems are in distress and the inquiry and actions are timely.

While it's possible (and in some ways very interesting) to be distracted and discuss the influence political root causes of the current state of degradation, the focus of this submission will be on suggested principles to fund and manage assets. A prediction of the current enquiry is most submissions of invited stake holders would be along the line of 'we have no funding'. The key issues are how to attribute asset responsibility to the correct stake holder funding source and then ensure that the funding translates into effective action in the field is a responsible and accountable manner. The current system of consolidated revenue and bureaucratic distribution of revenue is all but too far removed from the needs of the assets and one has to question the cost of the system given the lack of results in the field.

This submission is supplied on the basis of an individual undertaking and not representing any affiliated committee or organisation. I am a member of the Moe River Drainage Committee and the submission is based on personal observations affecting the progress of the committee.

My professional background is formally Mechanical Engineering but my career focus has been on Maintenance Engineering and Asset Management. My current role is an Asset Management Strategist with Plant Performance. The typical assets I look after professionally consists of rail track and large mining equipment such as stacker/reclaimers, ship loaders, bucket wheel excavators and conveyors. Clients include the power industry in the Latrobe Valley, Iron Ore in the Pilbara and Black Coal in the central coast of Queensland.

While the management of drainage assets is somewhat different in nature to mining equipment, the principles of asset management are common. My involvement with the Moe River Drainage Committee is my volunteer contribution to the community.

Background of the Moe River Drainage Committee:

The Moe River Drainage Committee is a relatively recently reformed group of landholders to manage the drainage of the Moe Swamp drainage scheme. The drainage scheme allows the use of land for agricultural purposes and encompasses the flat dairy country between Yarragon and Moe. The drainage scheme consists of:

- Local drains – for the direct drainage of farm land
- Transfer Drains – to convey run off from adjacent land to the scheme to the river
- River Channel – the channelling of the Moe River and associated levee and floodgate systems.

The drainage was once managed by a shire (Narracan Shire) based drainage committee and was funded by means of a direct tariff on land holders and contributions from the rate paying base. Governance of technical issues were under the auspice of the Shire Engineer and execution of the works, including budgeting and prioritisation, was conducted by land holders members of the committee. The scheme was successful in maintaining the drainage system but was limited in terms of environmental impact and the maintenance of the larger assets, namely the issues surrounding the Moe River.

The drainage funding and management arrangements ceased with the amalgamation of the shires and formation of catchment management authorities in the 1990's.

Observation of the new Committee:

The new committee has been operating for a little over six months and comes under the West Gippsland Catchment Management Authority (WGCMA) and are represented at committee meetings. The key issue of the committee is that while it is set up by the WGCMA there is no intent to fund the committee's activities by the WGCMA. A committee was formed but was not supported by way of a funding or asset management models. It is unfortunate and disheartening to learn that the WGCMA can only fund and execute works based on environmental objectives that are clearly progressed by political agendas of the day. The current makeup of the WGCMA makes it possible to have a river cleared of willow trees but not possible to conduct maintenance such as prevention of erosion undermining structures, cleaning clogged drains which now allow flooding and have commercial and safety impact on people. As an Authority the organisation effectiveness as a community service is not delivering value and currently does not see itself as being responsible for drainage maintenance.

It is clear, however, that the responsibility would ordinarily be with an Authority and in this case it would be the WGCMA. It is within WGCMA it is believed that the provision of policy, asset management principles, funding models, responsibility and accountability has been lost and is in need of repair/rebuild. Vision and leadership is required!

Recognition of Stake Holders & Responsibility to Contribute Funds

The Moe River Drainage Committee is represented by land holders encompassed within the drainage scheme boundary, however the presence of the land holders and their enterprises benefits more than the land holders as recognised stake holders. The local community is a beneficiary, as is the State of Victoria. All are stake holders in the success of the scheme.

Knowing the stake holders, the nature of the asset can be attributed to the stake holders in terms of the function of the components of the asset and hence allocate the funding responsibility accordingly. A suggested break up would be:

Local Drains – funded directly by land holders levee

Transfer Drains – funded by rate payers

River Channel – funded by the state (represented by the 'Authority') with some contribution from rate payers and land holders.

The provision of funding for local issues is easy to attribute responsibility for funding. The difficult issues is how does a small committee representing but one of many scheme across the state attract a fair allocation of funding from source of consolidated revenue such is the case with amalgamated local shires and the greater state of Victoria? The solution to this is through consistent asset management principles and consistent assessment of asset priority that is relatively free from short term political influence. Each scheme across the catchment and indeed the state needs to be bound by a common, measured, minimum standard in order to provide and equitable method to ensure that any funding is directed to:

- Ensure the funds are allocated against the highest priorities (functionally and environmentally)
- Funding allocated is sufficient to meet the maintenance demand of the system (while remaining viable)
- Funding being supplied is being utilised effectively and condition and results are measured

A means is required to regulate the funding allocated to a particular allocation of responsibility of works. The collection of funding needs to realise that the revenue streams potentially come from three sources and it is expected that part of the responsibility of a Catchment Management Authority would be to support the collection of funds based on the determination of the funding stake holder on a case by case basis.

Asset Management and Asset Strategy

In order for competing schemes across the state to have funding requirements and funding allocation distributed fair and equitably, common asset management policy is required. Regardless of particular Catchment Management Authority potential revenue streams, a common policy is required to determine the requirements of the assets. This policy would be at a state level and across designated Catchment Management Authority boundaries. The policy frame work envisaged would be administered (provision of governance) by the respective Catchment Management Authorities for the purpose of the determination of the collection of revenue and distribution of funds. Asset Management plans may exist at either the Committee level or Catchment Management level depending on the allocation of responsibility of the assets but importantly the process of determination of 'need/value' is a common discipline across all assets.

It is an observation at the volunteer committee level that there is no Asset Management expertise and that an models to determine a works program and budget needs are made with the best intention but would struggle to be of sufficient robustness to support and emotive free assessment of priority for funding. In simple terms, each committee must work on the following principle steps:

- Known asset register for which the respective organisation is responsible
- A strategy for the maintenance of the asset in a fit for purpose state (includes condition status)
- Costs allocated over time, formulation of projected annual budgets
- Attributed costs to the correct stake holders and budget allocation
- Delivery of works to budget and priority
- Measurement of success of the works to budget
- Measurement of the success of the strategy

A further step required at a high level is the viability of a scheme, a process that requires and asset strategy assessment in any case. This is a vital step but one that needs commonality across different schemes across the state and in reality it's a case of *'the chicken versus the egg'* as far as

Measurement of Success - Accountability

With the governance of the minimum standard for asset strategy also has the requirement to measure success of the maintenance of the asset. The auditing of the asset strategy and the asset strategy execution is the method used to ensure:

- Performance of works delivery against allocated budget
- Completeness and status of asset strategy
- Spot checks on value of the works, being fit for purpose
- That responsible organisations are lawful and delivering competency required.

Summary

The current state of degradation is not sustainable and solutions are required. Drawing upon my experience with the Moe River Drainage Committee it is clear that there are people in the community that are passionate and able to provide local ownership of the subject assets. This resource, however, is in need of leadership and the provision of asset management methods and tools in order to be successful achieving results and not being a slave to the current bureaucracy.

The current governance frame work through Catchment Management Authorities has lost it way and has clouded directives to deliver agendas that overlook many local issues of functionality of the system. The delivery of maintenance of the works must consider functional as well as environment objects on the basis of sound merit.

It is only through the leadership of the State department and subsequent Catchment Management Authorities and assembled local committees that the right process can be implemented. The implementation is carried out with Asset Management principles at the core of the policy with a closed loop process to ensure value to the community. Above all, the people who are close to the asset need to be empowered to ensure that the current situation of the bureaucracy being divorced from the asset need cannot be allowed.

Thank you for the opportunity.

Regards

[redacted]

12

If you have any further comments or suggestions that relate to the Latrobe River Flood Study, please express them in the space below. Please feel free to attach additional pages if necessary.

Any flooding on our property in my 66 yrs + my father previously has been as a result of Sunny Crk. (Eight mile drain) not being able to enter the Main Drain (Moe River) due to restrictions, before flow from other sources ie Shady Crk + Warragul Darnum water, flood the Moe Rivers! The Moe River must have unrestricted flow commencing at Yallourn Storage Dam

Thank you for providing the above information. Please remember to put these pages back in the reply paid envelope by Friday 8 February 2013. A representative from Cardno may contact you in the near future to discuss your response.

The Blue on your map is not a true indication of flooding FROM the Moe River Main Drain

Comments also apply to Survey received by

[redacted]

(13)

If you have any further comments or suggestions that relate to the Latrobe River Flood Study, please express them in the space below. Please feel free to attach additional pages if necessary.

HOW MANY MORE STUDIES DO YOU HAVE TO DO !!!!
IT'S ABOUT TIME YOU GOT BUSY AND ACTUALLY DID SOME DRAINAGE WORKS TO ALLEVIATE FLOODING ON OUR PROPERTY !!!!

Thank you for providing the above information. Please remember to put these pages back in the reply paid envelope by Friday 8 February 2013. A representative from Cardno may contact you in the near future to discuss your response.

IT'S BEEN 20 YEARS SINCE ANY DRAINAGE WORKS HAVE BEEN DONE IN OUR AREA.
ANY WONDER THE RIVER FLOODS.
PRIOR TO THAT THE DRAINAGE SCHEME WAS OPERATIONAL AND ONLY EXPERIENCED SHORT TERM FLOODING.

THE RIVER & DRAINAGE SYSTEM IS A DISGRACE

NO MORE STUDIES - USE THE MONEY INSTEAD TO DO URGENTLY NEEDED WORKS.

14

SUNNY CK BEFORE LOCALS CLEAR WILLOW BLOCKAGE (1 TREE).

AFTER SUNNY CK CLEARED BY LOCALS

15

Main Drain / Moe River photo's

MOE RIVER 2009

WARDS DRAIN SUNNY OK BLOCKED

WARDS CULVERT

WARDS CULVERT

8 MILE ROAD FLOODED WITH FLOWED EAST OVER AND ACROSS JAMES FARM

15

168 SOUTH CANAL RD

TRAF-

WATER FROM SUNNY CK

OLD SEVEN MILE
BRIDGE

WILLOW GROVE-TRAF ROADS

RIVER FLOWING OK

Latrobe River Flood Study

APPENDIX B
LIST OF DELIVERABLES

Cardno
Shaping the Future

Flood Mapping Datasets

Folder	Shapefile Name	Notes on Table Structure and Creation
Buildings_and_Properties _Flood_Affected	Buildings_Inundated	Created from data.vic.gov.au information ('address points' were predominantly used in urban areas & the 'building points' layer was used in rural areas). Ground Elevation taken from model DTM, Floor level assumed as 0.3 m above this (as per minutes of meeting 27/11/13). Water Surface Elevation (WSE) columns taken directly from model data, MaxD is the depth at floor level (i.e. MaxWSE - floor level).
	Properties_Inundated	MaxWSE and MaxD (depth) taken directly from model results.
First_Rainfall_to_Flood_ Peak_and_First_Inundated	Start_to_Flood_Peak_and_ First_Inundated	X_Coord & Y_Coord - are positions in model grid, Time Peak and Time Inund. are the times (in hours) from the start of rainfall to the peak WSE, and to the start of inundation respectively. All based on the 100 year ARI event.
Flood_Contours	CONTOUR_100y_ARI	VFD Modelled Datasets
	CONTOUR_10y_ARI	
	CONTOUR_200y_ARI	
	CONTOUR_20y_ARI	
	CONTOUR_50y_ARI	
Flood_Extents	EXTENT_100Y_ARI	
	EXTENT_10Y_ARI	
	EXTENT_200Y_ARI	
	EXTENT_20Y_ARI	
	EXTENT_50Y_ARI	
Flow_Direction	FLOW_DIRECTION	
Gridded_Results	GRD_100YR	Polygon based 'grids' containing flood results. Columns are Max_Hazard (calculated using velocity and depth criteria), Max_D (depth), Max_S (speed), Max_VxD (velocity * Depth), Max_WSE, Critical_D (storm duration that leads to the highest flood peak at cell in hours), X_Coord & Y_Coord - are positions in model grid.
	GRD_100YR_Climate_Change	
	GRD_10YR	
	GRD_200YR	
	GRD_20YR	
	GRD_50YR	
	GRD_PMP	
Historic_Data_as_Modelled	HISTORIC_CONTOUR_1978	VFD Modelled Historic Flood Event Datasets
	HISTORIC_CONTOUR_1993	
	HISTORIC_EXTENT_1978	
	HISTORIC_EXTENT_1993	
Time_of_Inundation_ Above_0_3m	Latrobe_Time_of_Inundation _Above_0_3m	Derived from model results, 'DurIn30cm' column has the duration in hours that cells are inundated above 30 cm, for the 100 year ARI event. Where values are '9999' they are > 48 hours (as shown on Map 17).
Draft_Floodway_Overlay	FO_DRAFT_DEPTH FO_DRAFT_FREQUENCY FO_DRAFT_HAZARD	Draft Floodway Overlay layers for WGCMA and Councils to consider. Refer Section 4.5.1 of the Flood Damage and Mitigation Report regarding usage.

Flood Mapping Outputs

Filename	Notes
_Overview.pdf	Overview / index map
Map_1_Depth_10yr_ARI.pdf	Maps which form part of this final study report.
Map_2_Depth_20yr_ARI.pdf	
Map_3_Depth_50yr_ARI.pdf	
Map_4__Depth_100yr_ARI.pdf	
Map_5__Depth_200yr_ARI.pdf	
Map_6_Depth_PMP.pdf	
Map_7_Depth_100yr_ARI_CC.pdf	
Map_8_Water_Surface_Elevation_10Y.pdf	
Map_9_Water_Surface_Elevation_20Y.pdf	
Map_10_Water_Surface_Elevation_50Y.pdf	
Map_11_Water_Surface_Elevation_100Y.pdf	
Map_12_Water_Surface_Elevation_200Y.pdf	
Map_13_Water_Surface_Elevation_PMP.pdf	
Map_14_Water_Surface_Elevation_100yr_CC.pdf	
Map_15_Flow_Velocity_100yr.pdf	
Map_16_Flood_Hazard_100Y.pdf	
Map_17_Time_of_Inundation_100Y.pdf	
Map_18_Time_Between_Start_Rainfall_to_Flood_Peak_100Y.pdf	
Map_19_Draft_Planning_Scheme_Overlays.pdf	
Map_20_Properties_Affected_by_Flooding_10yr.pdf	
Map_21_Properties_Affected_by_Flooding_20yr.pdf	
Map_22_Properties_Affected_by_Flooding_50yr.pdf	
Map_23_Properties_Affected_by_Flooding_100yr.pdf	
Map_24_Properties_Affected_by_Flooding_200yr.pdf	
Map_25_Flood_Response_10yr.pdf	
Map_26_Flood_Response_20yr.pdf	
Map_27_Flood_Response_50yr.pdf	
Map_28_Flood_Response_100yr.pdf	
Map_29_Flood_Response_200yr.pdf	
Map_30_Time_from_Rainfall_Start_to_Inundation_100Y.pdf	
MFEP_Rosedale_200yr.pdf	Draft MFEP maps for review.
MFEP_Rosedale_100yr.pdf	
MFEP_Rosedale_50yr.pdf	
MFEP_Rosedale_20yr.pdf	
MFEP_Rosedale_10yr.pdf	

Flood Class Level Maps – Thoms Bridge and Rosedale

Filename	Notes
Minor Moderate Major Flood Class Level maps for Thoms Bridge and Rosedale	Stored in Appendix C

Animations

Filename	Notes
Map_1.avi	Animations
Map_2_Thoms_bridge.avi	
Map_3.avi	
Map_4_Rosedale_gauge.avi	
Map_5.avi	
Moe_1993.avi	

Models

Folder	Contents
Lat_100.lit	Sobek Hydraulic Flood Model of the 100 year ARI event. Contains 'cases' for both the 48 & 36 hour storm events.
InputFiles	Contains the input files for all design events. Files are currently named using the following system: m**100**36h_Boundary.DAT, m**100**36h_Lateral.DAT where • the first (**red**) value indicates the ARI (in years); and • the second **(blue)** is the duration (in hours) If these files are to be used in the model it is necessary to rename them to 'Boundary.DAT' & 'Lateral.DAT'.

Latrobe River Flood Study

APPENDIX C
FLOOD CLASS LEVEL MAPS - THOMS BRIDGE AND ROSEDALE

Cardno
Shaping the Future

West Gippsland
Catchment Management Authority

Latrobe River Flood Study

FLOOD CLASS LEVELS
LATROBE RIVER FLOOD PLAIN

THOMS BRIDGE MINOR

Legend

- Gauge
- Town
- Railway Line
- Main Road
- Tertiary Road
- Lake Narracan
- River
- Stream/Creek

Thoms Bridge Minor Depth

- < 0.3
- 0.3 - 0.5
- 0.5 - 0.8
- 0.8 - 1
- 1 - 2
- 2 - 3
- > 3

N

Kilometres
0 0.15 0.3 0.6 0.9 1.2

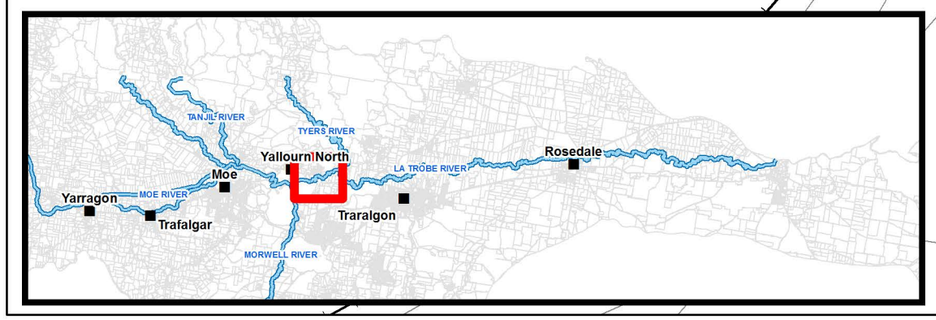
Disclaimer: No two floods behave in exactly the same manner, even though they may rise to the same maximum height at a given location.

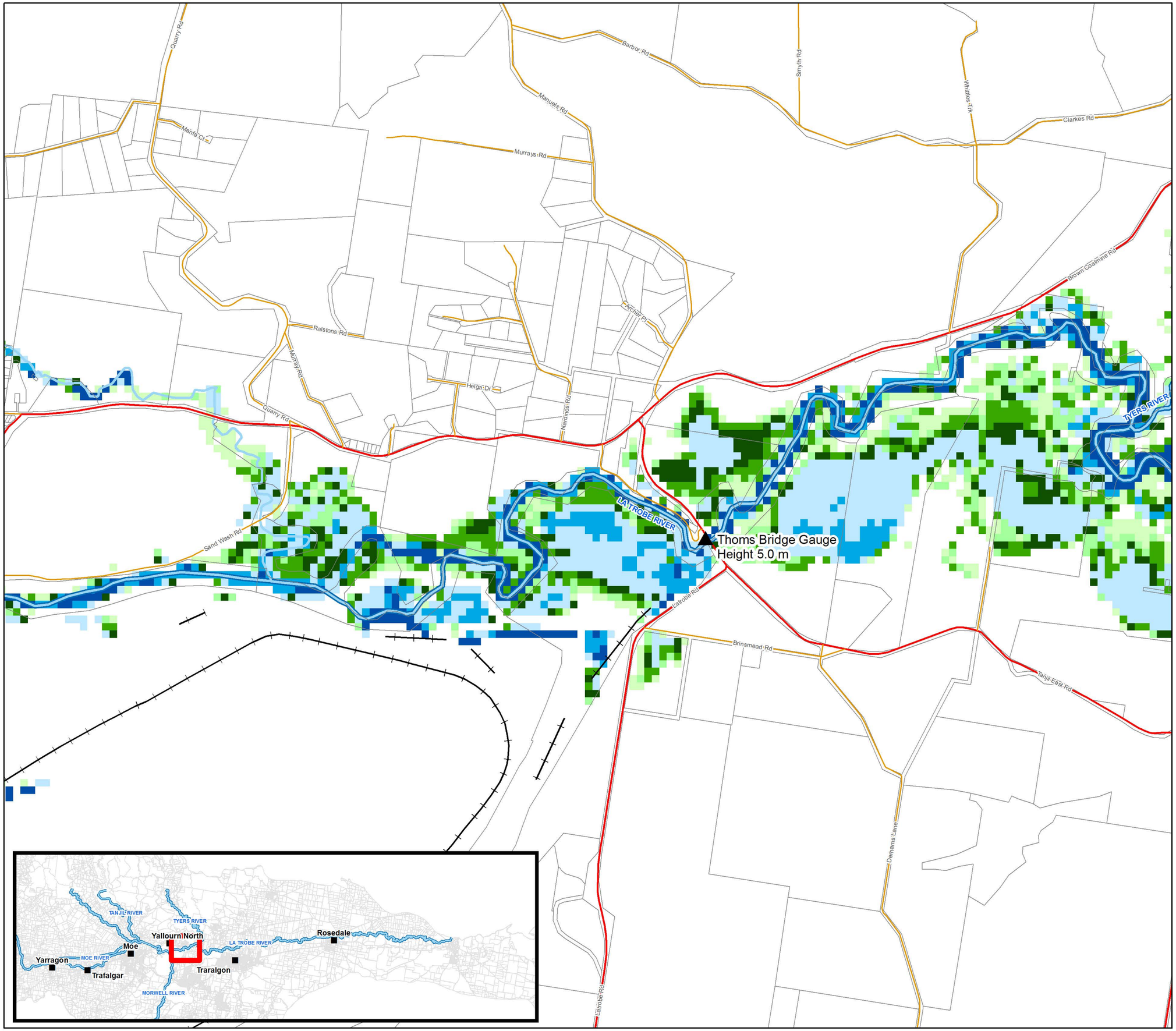
The information given shall be regarded as only representing typical conditions.

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (Vic)
Date: 2015-03-26
Coordinate System: GDA 1994 MGA Zone 55
Project: LJ5792 RM2416
Version: 02
Z:\Jobs\LJ5792_Latrobe_River\GIS\2_Mapping\Workspaces\FloodClassLevels.mxd

Thoms Bridge Gauge
Height 4.0 m





West Gippsland
Catchment Management Authority

Latrobe River Flood Study

FLOOD CLASS LEVELS
LATROBE RIVER FLOOD PLAIN

THOMS BRIDGE
MODERATE

Legend

- Gauge
- Town
- Railway Line
- Main Road
- Tertiary Road
- Lake Narracan
- River
- Stream/Creek

Thoms Bridge Moderate
Depth

- < 0.3
- 0.3 - 0.5
- 0.5 - 0.8
- 0.8 - 1
- 1 - 2
- 2 - 3
- > 3

N

Kilometres

0 0.15 0.3 0.6 0.9 1.2

Disclaimer: No two floods behave in exactly the same manner, even though they may rise to the same maximum height at a given location.

The information given shall be regarded as only representing typical conditions.

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (Vic)
Date: 2015-03-26
Coordinate System: GDA 1994 MGA Zone 55
Project: LJ5792 RM2416
Version: 02

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West Gippsland
Catchment Management Authority

Latrobe River Flood Study

FLOOD CLASS LEVELS
LATROBE RIVER FLOOD PLAIN

THOMS BRIDGE MAJOR

Legend

- Gauge
- Town
- Railway Line
- Main Road
- Tertiary Road
- Lake Narracan
- River
- Stream/Creek

Thoms Bridge Major Depth

- < 0.3
- 0.3 - 0.5
- 0.5 - 0.8
- 0.8 - 1
- 1 - 2
- 2 - 3
- > 3

N

Kilometres

0 0.15 0.3 0.6 0.9 1.2

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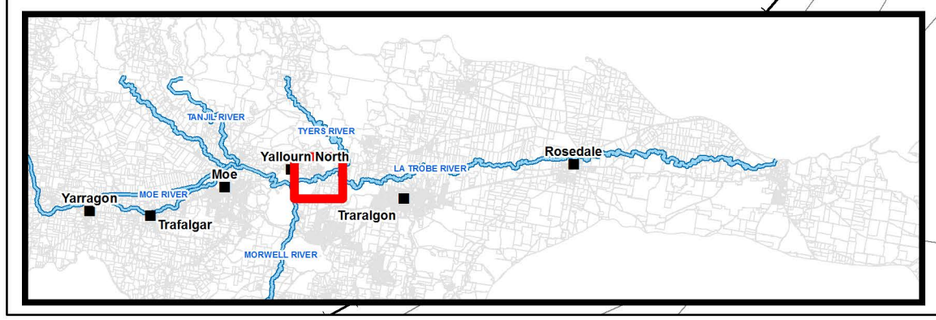
Quarry Rd
Barbor Rd
Manuels Rd
Murrays Rd
Smyth Rd
Whittles Trk
Clarkes Rd
Brown Coal Mine Rd
Manta Ct
Ralstons Rd
Murray Rd
Quarry Rd
Helga Dr
Nardinos Rd
Archer Pl
TYERS RIVER
LA TROBE RIVER
Thoms Bridge Gauge
Height 6.5 m
Sand Wash Rd
Latrobe Rd
Brinsmead Rd
Tanjil East Rd
Derhams Lane
Latrobe Rd



West Gippsland
Catchment Management Authority

Latrobe River Flood Study

FLOOD CLASS LEVELS
LATROBE RIVER FLOOD PLAIN

ROSEDALE MINOR

Legend

- Gauge
- Town
- Railway Line
- Main Road
- Tertiary Road
- Lake Narracan
- River
- Stream/Creek

Rosedale Minor
Depth

- < 0.3
- 0.3 - 0.5
- 0.5 - 0.8
- 0.8 - 1
- 1 - 2
- 2 - 3
- > 3

N

Kilometres
0 0.1 0.2 0.4 0.6 0.8

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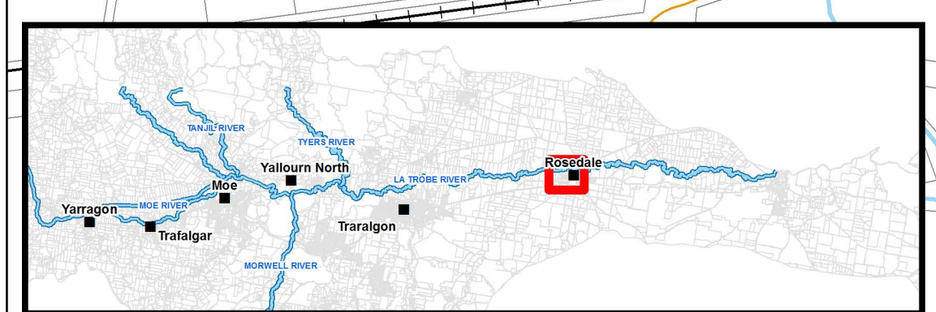
Rosedale Gauge Height of 4.0 m
LA TROBE RIVER
Rosedale
Princes Hwy
Rosedale - Heyfield Rd
Denison Rd
King St
Queen St
Prince St
Nelson St
Albert St
Duke St
Cricket St
George St
Walton St
Dawson St
Cansick St
Fawkes Rd
Huffers Lane
Budges Lane
Williams Rd
Rosedale - Stradbroke Rd
Shaws Lane
Byes Lane
Friends Rd
Ireland Ct
Mill Lane



West Gippsland
Catchment Management Authority

Latrobe River Flood Study

FLOOD CLASS LEVELS
LATROBE RIVER FLOOD PLAIN

ROSEDALE
MODERATE

Legend

- Gauge
- Town
- Railway Line
- Main Road
- Tertiary Road
- Lake Narracan
- River
- Stream/Creek

Rosedale Moderate Depth

- < 0.3
- 0.3 - 0.5
- 0.5 - 0.8
- 0.8 - 1
- 1 - 2
- 2 - 3
- > 3

N

Kilometres

0 0.1 0.2 0.4 0.6 0.8

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Rosedale Gauge Height of 4.8 m

LATROBE RIVER

Rosedale

Princes Hwy

Rosedale - Heyfield Rd

Denison Rd

King St

Queen St

Prince St

Nelson St

Albert St

Duke St

Moore St

Mackay St

Wood St

Lyons St

Hood St

Mill Lane

Ayres Ct

Rintoull Ct

Walton St

Dawson St

Duck Ct

George St

Cricket St

Byes Lane

Shaws Lane

Mcleod Ct

Rowley Ct

Ireland Ct

Latrobe St

Cansick St

Fawkes Rd

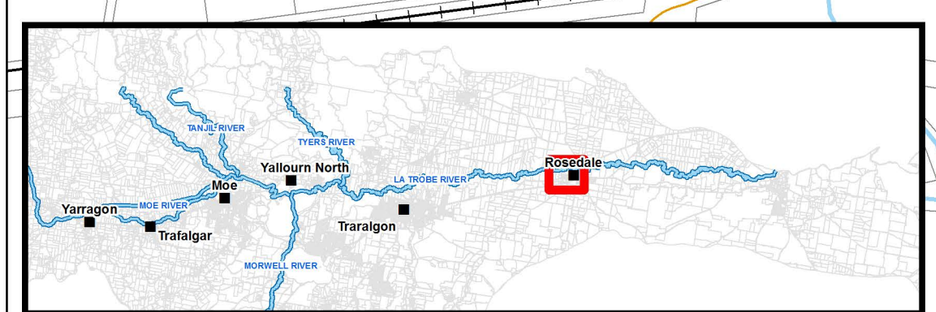
Hutters Lane

Rosedale-Stradbroke Rd

Budges Lane

Williams Rd

Friends Rd



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Latrobe River Flood Study

FLOOD CLASS LEVELS
LATROBE RIVER FLOOD PLAIN

ROSEDALE MAJOR

Legend

- Gauge
- Town
- Railway Line
- Main Road
- Tertiary Road
- Lake Narracan
- River
- Stream/Creek

Rosedale Major Depth

- < 0.3
- 0.3 - 0.5
- 0.5 - 0.8
- 0.8 - 1
- 1 - 2
- 2 - 3
- > 3

N

Kilometres

0 0.1 0.2 0.4 0.6 0.8

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Rosedale Gauge Height of 5.5 m

LA TROBE RIVER

Rosedale

Princes Hwy

Rosedale - Heyfield Rd

Denison Rd

King St

Queen St

Prince St

Nelson St

Duke St

Albert St

Cricket St

George St

Walton St

Dawson St

Cansick St

Fawkes Rd

Hufflers Lane

Budges Lane

Williams Rd

Rosedale - Stradbroke Rd

Shaws Lane

Byes Lane

Friends Rd

Ireland Ct

Mill Lane

Lyons St

Hood St

Latrobe St

Ayres Ct

Rintoull Ct

Duck Ct

Moore St

Mackey St

Wood St

McLeod Ct

Rowley Ct