Expert Report

Amendment C109 to the South Gippsland Planning Scheme

Venus Bay Dunes Pty Ltd

November 2017

Project Details

Project Name	Amendment C109 to the South Gippsland Planning Scheme
Report Prepared for	Venus Bay Dunes Pty Ltd
Instructed By	Chris Johnstone, JardineJohnstone
Authors	Warwick Bishop, Ben Tate
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15 Business Park Drive
Notting Hill VIC 3168

Telephone	(03) 8526 0800
Fax	(03) 9558 9365
ACN	093 377 283
ABN	60 093 377 283

GLOSSARY

Term	Description
Annual Exceedance Probability (AEP)	Refers to the probability or risk of a flood of a given size occurring or being exceeded in any given year. A 90% AEP flood has a high probability of occurring or being exceeded; it would occur quite often and would be relatively small. A 1% AEP flood has a low probability of occurrence or being exceeded; it would be fairly rare but it would be of extreme magnitude.
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level. Introduced in 1971 to eventually supersede all earlier datums.
Average Recurrence Interval (ARI)	Refers to the average time interval between a given flood magnitude occurring or being exceeded. A 10 year ARI flood is expected to be exceeded on average once every 10 years. A 100 year ARI flood is expected to be exceeded on average once every 100 years. The AEP is the ARI expressed as a percentage.
Catchment	The area draining to a site. It always relates to a particular location and may include the catchments of tributary streams as well as the main stream.
Design flood	A design flood is a probabilistic or statistical estimate, being generally based on some form of probability analysis of flood or rainfall data. An average recurrence interval or exceedance probability is attributed to the estimate.
Discharge	The rate of flow of water measured in terms of volume over time. It is to be distinguished from the speed or velocity of flow, which is a measure of how fast the water is moving rather than how much is moving.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or overland runoff before entering a watercourse and/or coastal inundation resulting from elevated sea levels and/or waves overtopping coastline defences.
Flood damage	The tangible and intangible costs of flooding.
Flood frequency analysis	A statistical analysis of observed flood magnitudes to determine the probability of a given flood magnitude.
Flood mitigation	A series of works to prevent or reduce the impact of flooding. This includes structural options such as levees and non-structural options such as planning schemes and flood warning systems.
Floodplain	Area of land which is subject to inundation by floods up to the probable maximum flood event, i.e. flood prone land.
Flood storages	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood.

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Term	Description
Geographical information systems (GIS)	A system of software and procedures designed to support the management, analysis and display of spatially referenced data.
Hydraulics	The term given to the study of water flow in a river, channel or pipe, in particular, the evaluation of flow parameters such as stage and velocity.
Hydrograph	A graph that shows how the discharge changes with time at any particular location.
Hydrology	The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
LiDAR	Spot land surface heights collected via aerial light detection and ranging (LiDAR) survey. The spot heights are converted to a gridded digital elevation model dataset for use in modelling and mapping.
MIKE	A hydraulic modelling tool used in this study to simulate the flow of flood water through the floodplain. The model uses numerical equations to describe the water movement.
Peak flow	The maximum discharge occurring during a flood event.
Probability	A statistical measure of the expected frequency or occurrence of flooding. For a fuller explanation see Average Recurrence Interval.
Probable Maximum Flood	The flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequence and likelihood. For this study, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
RORB	A hydrological modelling tool used in this study to calculate the runoff generated from historic and design rainfall events.
Runoff	The amount of rainfall that actually ends up as stream or pipe flow, also known as rainfall excess.
Sea Level Rise (SLR)	The predicted increase in future sea level expected due to climate change impacts.
Stage	Equivalent to 'water level'. Both are measured with reference to a specified datum.
Stage hydrograph	A graph that shows how the water level changes with time. It must be referenced to a particular location and datum.
Topography	A surface which defines the ground level of a chosen area.

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1 REPORT AUTHOR

Warwick Bishop

Senior Principal Engineer, Director
Water Technology Pty Ltd
15 Business Park Drive
Notting Hill, VIC 3168

Qualifications:

- B.E. (Hons), University of Melbourne, 1993
- MEngSci, Monash University, 2000

Affiliations:

- Chartered Professional Engineer and Fellow, Institution of Engineers, Australia
- Chair, Engineers Australia, Victorian Water Engineering Branch Committee
- Member, International Association for Hydraulic Research
- Member, Australian Water Association
- Member, River Basin Management Society
- Member, Stormwater Victoria

Experience

I am a Director of Water Technology and have over 20 years' experience in hydrologic and hydraulic investigations, specialising in the development and application of rural and urban hydrodynamic models and their application to flooding, drainage, water quality, sediment transport and environmental values. I also have extensive experience in coastal and estuary modelling including wave, current, oil spill and coastal vulnerability investigations. I have worked extensively in the Murray Darling Basin, principally on environmental hydraulic investigations for the Living Murray Program. I was recently involved in the revision of Australian Rainfall and Runoff, with particular focus on the application of 2D hydraulic models to flooding in urban and rural areas. In 2011 I worked in the Flood Intelligence Unit of SES during the January floods and have provided advice to Catchment Management Authorities over the subsequent period. As Water Technology's Regional Manager of Victoria I have overseen hundreds of rural and urban flood investigations.

2 STATEMENT OF EXPERTISE

With my qualifications and experience, I believe that I am well qualified to provide an expert opinion on the flood risk issues related to Amendment C109 to the South Gippsland Planning Scheme.

3 REPORT CONTRIBUTORS

Ben Tate

Senior Principal Engineer

Water Technology Pty Ltd

Qualifications:

- Bachelor of Engineering with Honours (Environmental), University of Melbourne, 2002
- Bachelor of Science (Environmental Science), University of Melbourne, 2002

Area of Expertise:

Key areas of expertise relevant to this report are summarised below.

- Hydrologic and hydraulic investigations of urban and rural floodplains.
- Floodplain risk management, flood response and flood warning.
- Environmental floodplain and wetland management.
- One and two-dimensional hydrodynamic modelling.
- Application of GIS for flood mapping and terrain modelling.

Scope of contribution:

Ben provided contributions to the background research and development of the report.

4 SCOPE OF REPORT

In relation to Amendment C109 to the South Gippsland Planning Scheme, I have been requested to provide an expert report on the matters listed below:

- Flood risk of the site;
- Flood risk of the accessway to the site;
- Consistency of the amendment with the objectives of relevant planning policy and floodplain risk management and emergency management policy and best practice.

5 REPORT

5.1 Amendment C109 to the South Gippsland Planning Scheme

The proposed planning Amendment C109 applies to land which is the site of the Venus Bay Caravan Park and a lot at 143B Inlet View Road, Venus Bay. The site has a total area of approximately 12 hectares and includes four titles comprising Lot 2 PS 648056H, Lot 1 TP 172550M, Lot 1 PS 648056H and Res 1 PS 54175 as shown on Figure 5-1.

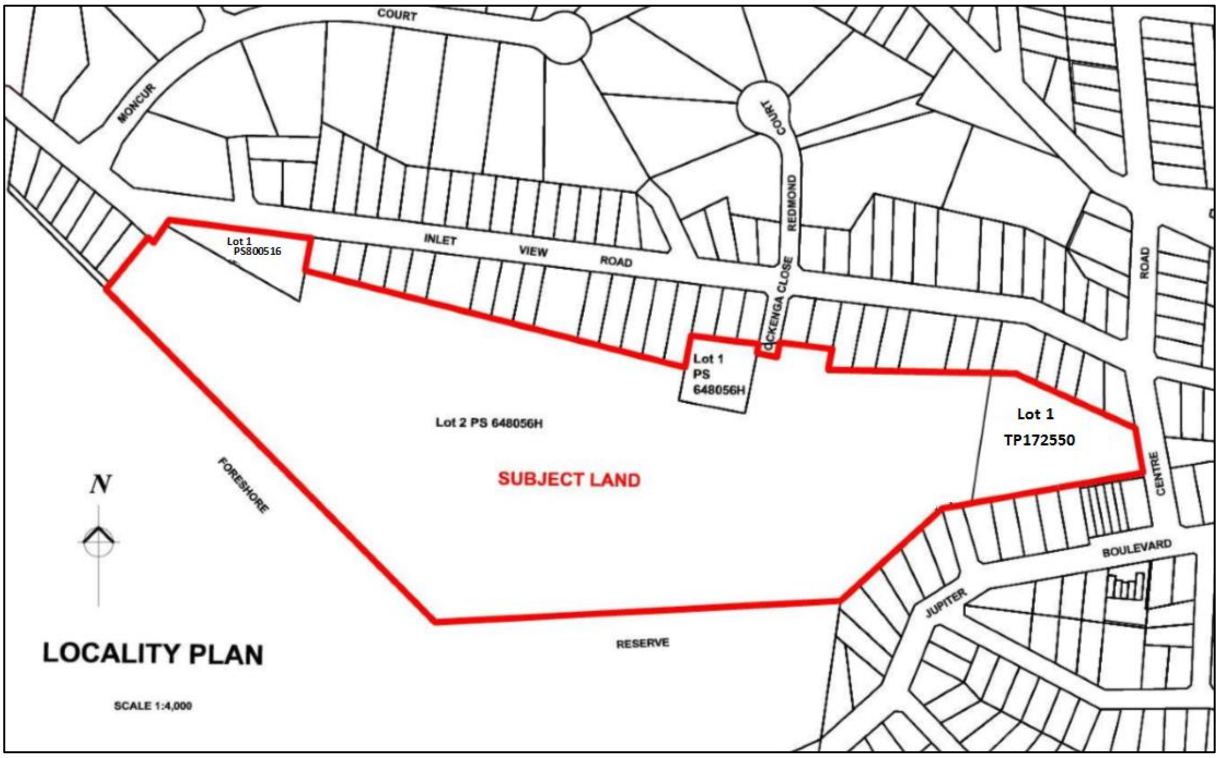

FIGURE 5-1 LAND SUBJECT TO AMENDMENT C109 TO THE SOUTH GIPPSLAND PLANNING SCHEME

The Amendment proposes to introduce new planning controls to the site to identify the current use and to seek to protect its ongoing use as a caravan park and for low density residential development on land identified as surplus to the current and future needs of the caravan park. The proposal also seeks to create an additional two Township Zone lots which are also surplus to the needs of the caravan park. The lot containing the caravan park will be zoned Special Use Zone.

5.2 Study Area and Subject Site

Venus Bay is located on a 1-2 km wide peninsula of coastal land, between Andersons Inlet on the east and Bass Strait on the west as shown in Figure 5-2. Andersons Inlet receives freshwater inflows from the Tarwin River at its southern end and connects to Bass Strait via a shallow entrance at the northern end. Venus Bay is accessed via the Inverloch-Venus Bay Road. The lower reaches of the Tarwin River are flood prone, with the Inverloch-Venus Bay Road subject to inundation north-east of Tarwin Lower in relatively frequent events, and the Inverloch-Venus Bay Road between Tarwin Lower and Venus Bay inundated in rarer events. The current Land Subject to Inundation Overlay (LSIO) in the South Gippsland Planning Scheme is shown in

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Figure 5-3. The subject property is well outside the LSIO and is situated on higher ground, with elevations from the available survey ranging between 5 to above 25 m AHD as shown in Figure 5-4.

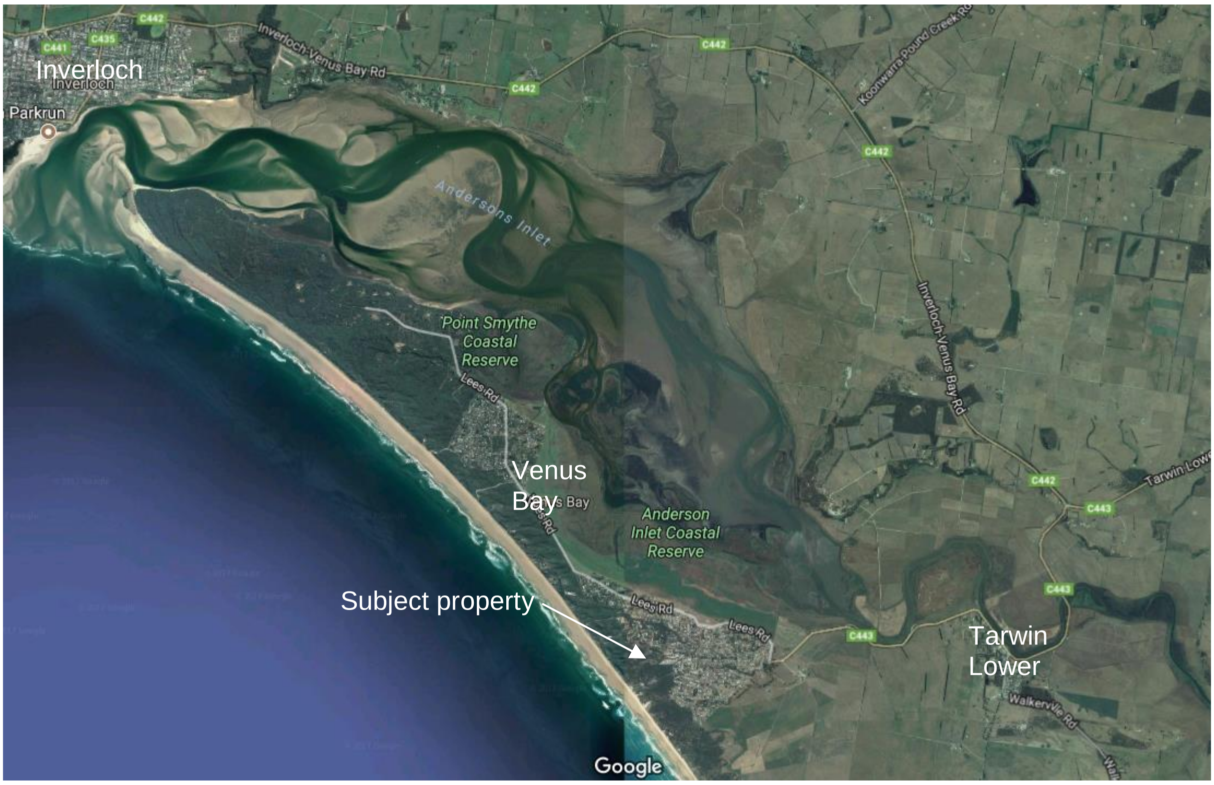

FIGURE 5-2 VENUS BAY STUDY AREA

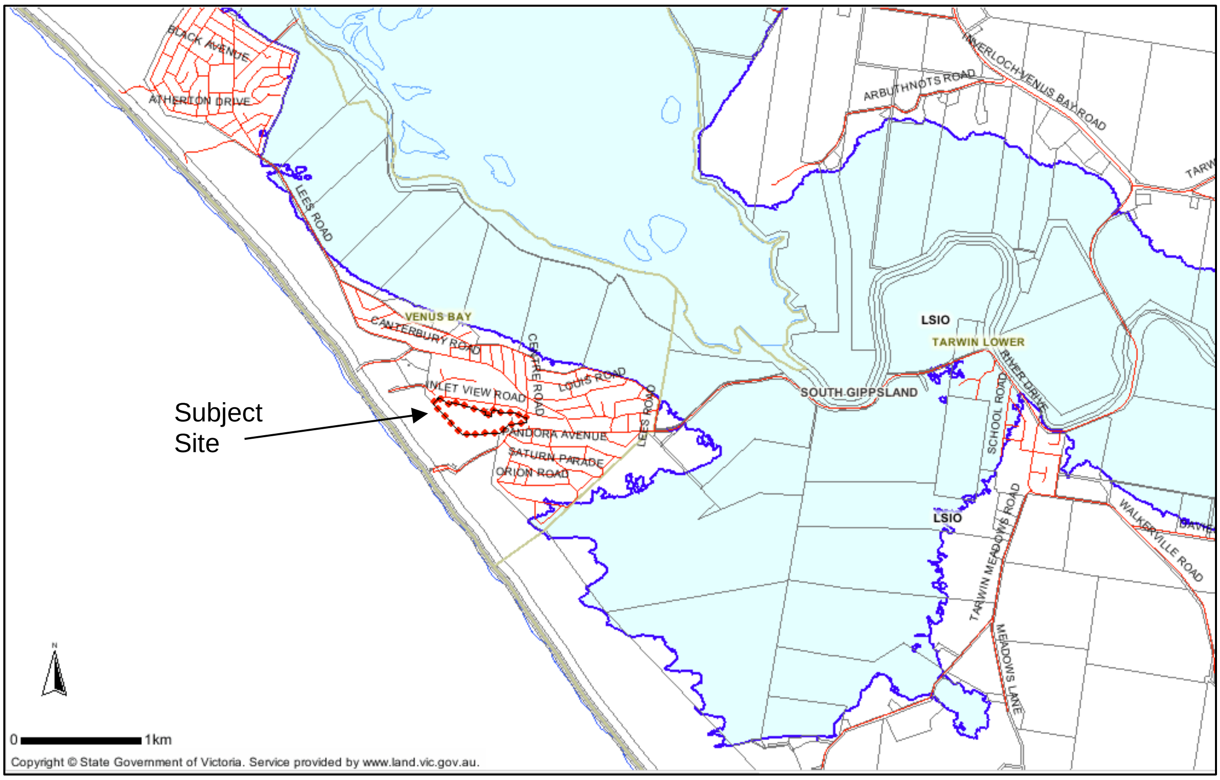

FIGURE 5-3 EXISTING FLOOD CONTROLS IN THE SOUTH GIPPSLAND PLANNING SCHEME

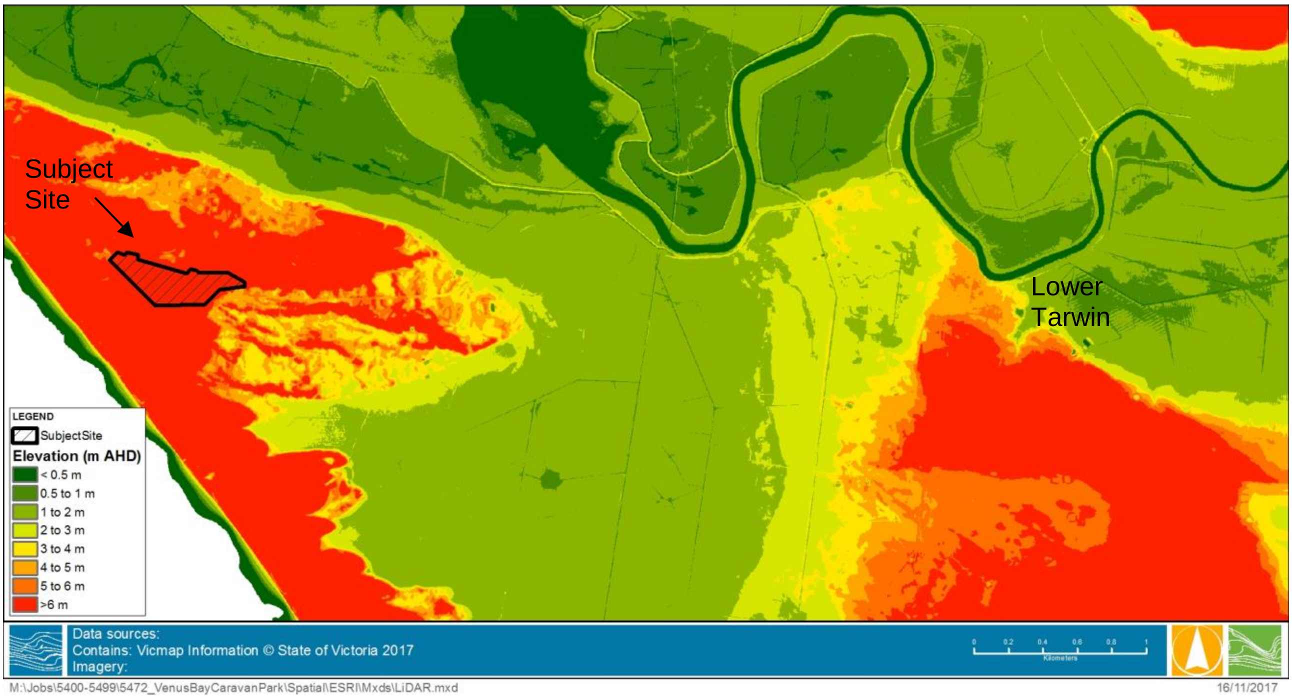

FIGURE 5-4 SITE TOPOGRAPHY

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5.3 Flood Investigation Framework

The *Victorian Floodplain Management Strategy* (DELWP, 2016) in *Section 11 Evaluating Flood Risk*, lists the components typically expected of a Flood Study in Victoria. It is noted that this is a comprehensive list of what a Flood Study should entail, and often the scope of a Flood Study as determined by a local Council, Catchment Management Authority, DELWP, or other entity, may not incorporate every element described in the *Victorian Floodplain Management Strategy*. The definition of a Flood Study within the *Victorian Floodplain Management Strategy* (FMS), whilst not explicitly stated, is generally understood to refer to a comprehensive township or locality-based study that aims to address all aspects of flood risk and outline options for structural and non-structural flood mitigation measures. These studies are typically funded jointly by local, state and federal governments.

Not all flood studies (either historic or current) have the same requirements or goals and hence the scope can vary between investigations. For example, some studies are commissioned by land-owners to address specific flood risk at the property scale.

Figure 5-5 outlines a standard approach to a Flood Study undertaken in Victoria. Depending on the scope of the study, some or all of the components may be undertaken.

Typically, a municipal Flood Study is overseen by a project steering committee, comprising a range of representatives. They often include representatives from the State Government, the relevant Catchment Management Authority, relevant Council(s), Victoria State Emergency Service (VICSES), and sometimes one or more community representatives. Other agencies that may be involved include the Bureau of Meteorology, VicRoads, VicTrack and the relevant urban or rural water authority.

The project steering committee typically meets over the course of the study; at project inception, on completion of the hydrology and/or hydraulics components, during or following the mitigation options (if included), and on completion of the investigation. The project steering committee also receives copies of the draft project reports for review prior to finalisation of each component of the study.

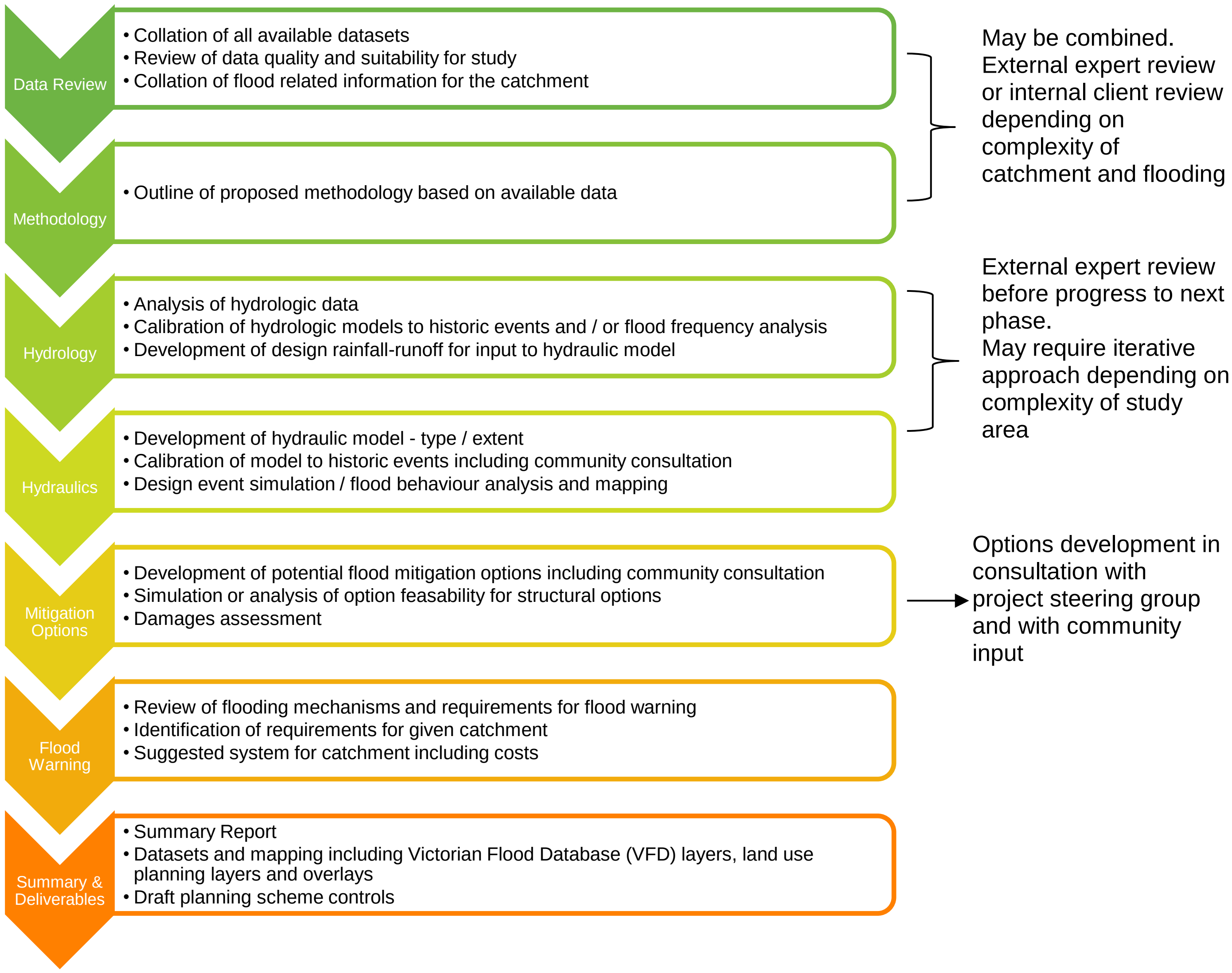

Figure 5-5 Flood Study Framework in Victoria

Industry best practice with regard to specific technical components of flood study investigations is outlined in Australian Rainfall and Runoff (ARR 2016). These guidelines are published by Geoscience Australia and contain a series of books and chapters providing technical guidance on the approaches related to hydrologic and hydraulic investigations. The latest revision process for Australian Rainfall and Runoff was completed in 2016. Prior to 2016, the 1999 version of ARR was applicable for flood investigations in Australia.

Water Technology completed the *Tarwin Lower Flood Study* in 2007. It is noted that the *Tarwin Lower Flood Study* had a limited scope that did not cover all aspects of a flood study as described in the *Victorian Floodplain Management Strategy*. It was undertaken with reference to ARR 1999 and used best practice approaches to the hydrology and hydraulic modelling at the time. This study is considered to provide the best available flood information for Venus Bay.

5.4 Tarwin Lower Flood Study

5.4.1 Overview

The *Tarwin Lower Flood Study* (Water Technology, 2007) was completed using best practice at the time, however the scope was limited to modelling a single calibration event and a 1% AEP design flood only (riverine and storm surge separately). Flood intelligence was extracted from the modelling for emergency planning and response, and some conceptual flood mitigation opportunities were briefly discussed.

5.4.2 Hydrology

The hydrology for the study was determined using a calibrated RORB rainfall-runoff model and flood frequency analysis of the available streamflow gauge on the Tarwin River at Meeniyan. The RORB model was successfully calibrated to 3 historic flood events (July 1977, September 1993 and August 2001) to the streamflow gauge on the Tarwin River at Meeniyan. Design flood events were run using industry best practice at the time, producing design flood hydrographs using the Bureau of Meteorology Intensity-Frequency-Duration (IFD) rainfall data, and Australian Rainfall and Runoff (1999) temporal patterns. Rainfall-runoff loss parameters were derived by calibrating RORB peak flows to flood frequency analysis (FFA) at the Tarwin River at Meeniyan streamflow gauge. Comparison of RORB modelling and event volume flood frequency analysis revealed that the RORB model produced design hydrographs with less than expected design volume, although the design peak flows compared favourably with the FFA. The adopted design hydrograph used a historic hydrograph which was scaled to the appropriate peak 1% AEP design flow and volume to ensure that the modelled flood conditions at Tarwin Lower and Venus Bay were appropriate for flood risk assessment.

5.4.3 Hydraulics – Flooding

The hydraulic model used MIKE21, an industry standard two-dimensional flood and coastal modelling software package, appropriate for such studies. The topography used as the basis of the model was photogrammetry, with additional field survey. This was the best-available survey at the time and also appropriate for a rural flood study. The model was validated to the August 2001 flood event and the 1% AEP design riverine flood event was simulated.

5.4.4 Hydraulics – Coastal

A 1% AEP storm tide was simulated with a separate MIKE 21 model of Anderson's Inlet. This model adopted boundary conditions that consisted of a spring tide, 1% AEP Bass Strait surge, 1% AEP design wind and 0.2 m of sea level rise. The coastal model was calibrated to measured tidal water levels. This model predicted a peak sea level of 2.75 m AHD near the Tarwin River mouth.

Since this study was undertaken, the approach to sea level rise has been refined and allowance for 0.8 m of SLR is required in accordance with the Victorian Coastal Strategy. A study of sea level rise projections along the Victorian Coast was undertaken by the CSIRO in 2009. This study produced modelled estimates of sea level rise at a number of locations along the Victorian Coast including Venus Bay. This study predicts a peak sea level of 2.78 m AHD under 0.82 m of SLR. This scenario compares favourably with the levels predicted in the Tarwin Lower Flood Study.

5.4.5 Flood Intelligence

Flood intelligence was gathered by interpreting the flood maps for the observed and modelled coastal and riverine design floods as described below.

2001 Modelled Historic Flood

- Inverloch-Venus Bay Rd cut between Tarwin Lower and Inverloch.
- Limited to no flooding in the township.
- Inverloch-Venus Bay Rd between Tarwin Lower and Venus Bay remained open.

1% AEP Riverine Modelled Design Flood

- Flood levels in the river adjacent to Tarwin Lower generally range between 2.7 m AHD at the western end of the township and 2.9 m AHD at the eastern end.
- The levee at the north-western end of the floodplain, adjacent to Anderson Inlet, and other levees within the northern floodplain significantly restrict the propagation of flood flows from the northern floodplain to the inlet.
- Following the point above, the primary control on flooding is the capacity of the Tarwin River channel to convey flood flows from central sections of the floodplain to Anderson Inlet.
- Inundation depths on the northern floodplain are significant, with depths generally greater than 1.0 m predicted, comprising the bulk of the flood conveyance and storage.
- On the southern floodplain, inundation depths are generally shallower, resulting from minor overtopping of levees/roadways.
- Flooding at the western end of Tarwin Lower is caused by overtopping of a very low section of the Inverloch-Venus Bay Road between Tarwin Lower and Venus Bay (approximately 1.8 m AHD).
- The levee/road between Tarwin Lower and Venus Bay on the southern side of the river is generally relatively low, typically 2.4 m AHD.
- With the exception of the Tarwin River itself, flood flow velocities are generally very low (<0.2 m/s).

1% AEP Storm Surge Modelled Design Flood

- Storm surge does not result in significant flooding within the township of Tarwin Lower or Venus Bay.
- Storm surge related flooding of the southern floodplain results from overtopping of the Inverloch-Venus Bay Road between Tarwin Lower and Venus Bay and is more extensive than catchment related flooding.
- The north-west levee adjacent to Anderson Inlet is not overtopped by storm surge. Storm surge related flooding of the northern floodplain results from breaches of levees with lower crest elevation located upstream (e.g. opposite the township of Tarwin Lower).

Due to the limited scope of the *Tarwin Lower Flood Study*, only the August 2001 and 1% AEP design flood model data is available from this study for use in the decision-making process for Amendment C109 to the South Gippsland Planning Scheme. Comparison of the August 2001 peak flow at the Tarwin River at Meeniyan gauge of 230 m^3/s, with the flood frequency analysis at the gauge, indicates that the August 2001 event was between a 10% and a 5% AEP.

5.5 Analysis of Flood Risk

5.5.1 Flood Risk for the Subject Site

The subject site is not subject to flooding from either coastal or riverine processes. Site elevations range from approximately 5 m AHD to 25 m AHD with most of the site above 10 m AHD. This locates the site well above the 1% AEP design flood levels determined from the *Tarwin Lower Flood Study*. Therefore, any development associated with the proposed Amendment will have no adverse flood impact on other properties or the surrounding floodplain. The flood risk at the subject site is considered negligible.

5.5.2 Flood Risk for the Accessway

Access to the site via the Inverloch-Venus Bay Road is flood affected. Flood risk on the Inverloch-Venus Bay Road is discussed below.

The Inverloch-Venus Bay Road north-east of Tarwin Lower, where the road crosses the Tarwin River, is expected to be inundated during floods of around a 10% AEP or greater. While this section of road is impassable in floods similar to the August 2001 flood (10% to 5% AEP), the road between Tarwin Lower and Venus Bay may remain open as flood levels reduce in the downstream direction. Access from Venus Bay to Tarwin Lower then allows access to larger towns like Leongatha via Walkerville Road or Buffalo-Waratah Road. This has been confirmed from discussions with local Venus Bay community members (personal communication between Jacob van der Meulen and the local CFA Captain John Harris, and a phone call between Ben Tate and the owners of the Venus Bay General Store). John Harris has also submitted a written statement that has been included in the Appendix. The local CFA Captain said that, to his knowledge, the road between Tarwin Lower and Venus Bay had not been cut in the past 55 years. An inspection of the streamflow record for the Tarwin River at Meeniyan gauge, Figure 5-6, indicates that over the last 55 years the largest flow recorded at the gauge was in June 2012 at just over 300 m^3/s. Comparing this flow to the flood frequency analysis completed in the *Tarwin Lower Flood Study*, the June 2012 event was approximately equivalent to a 2% AEP design flood. Jacob van der Meulen was operating the Venus Bay Caravan Park during the June 2012 event and confirmed that the road between Tarwin Lower and Venus Bay remained open during that flood. This suggests that the road between Tarwin Lower and Venus Bay has not been flooded by the Tarwin River since records have been kept at the Meeniyan streamflow gauge (1955), and for the Tarwin River to inundate the road and cut off access to Venus Bay, would require an infrequent flood with a chance of being exceeded of less than 2% in any year.

In large infrequent events such as the 1% AEP design flood, sections of the Inverloch-Venus Bay Road between Tarwin Lower and Venus Bay will be inundated and become impassable. Flood velocities across the road are generally expected to be low, with the *Tarwin Lower Flood Study* indicating that velocities are below 0.2 m/s. To assess the inundation depths across the road, a longitudinal section was taken from the roundabout at the intersection of the Inverloch-Venus Bay Road and Walkerville Road through to Venus Bay.

The longitudinal section chainages are displayed over the LiDAR topography in Figure 5-7, with the flood level mapping for the 1% AEP riverine design flood displayed in Figure 5-8. The flood level mapping for the 1% AEP storm surge design flood is displayed in Figure 5-9. The longitudinal section elevations of the road crest, and the 1% AEP design riverine and storm surge floods are shown in Figure 5-10, with the flood depths provided in Figure 5-11.

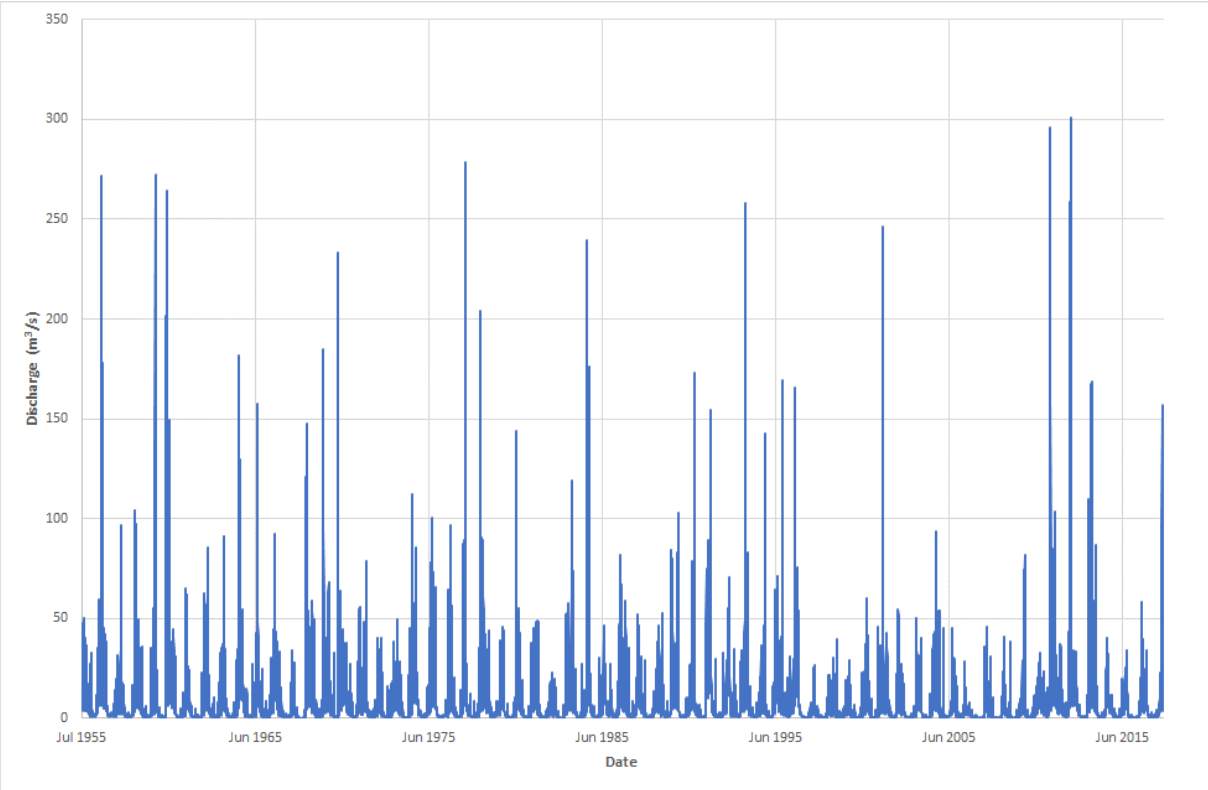

FIGURE 5-6 TARWIN RIVER AT MEENIYAN STREAMFLOW RECORD

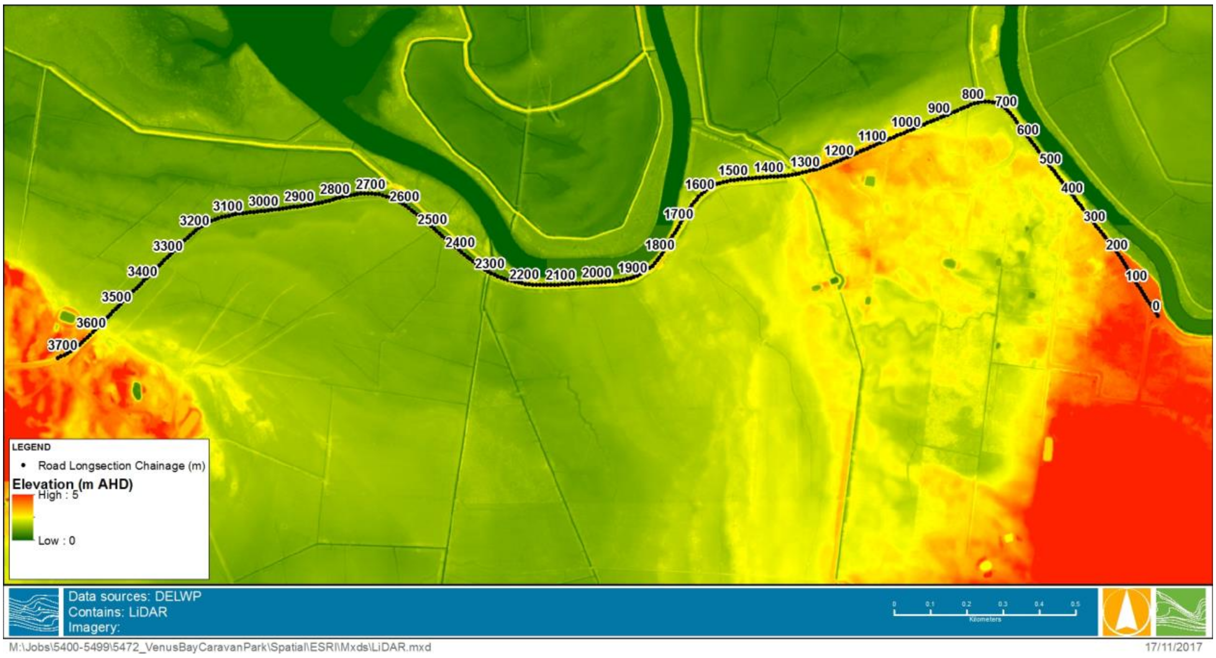

FIGURE 5-7 INVERLOCH-VENUS BAY RD LONGITUDINAL SECTION TOPOGRAPHY

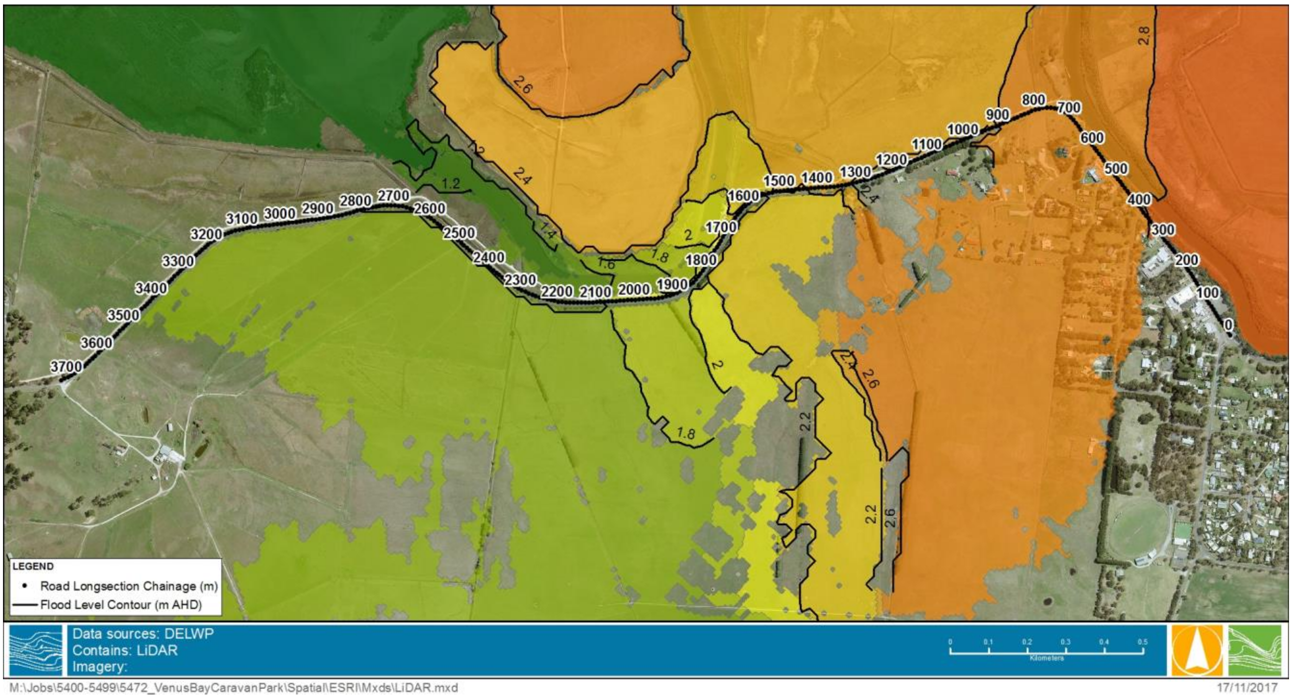

FIGURE 5-8 INVERLOCH-VENUS BAY RD LONGITUDINAL SECTION 1% AEP RIVERINE FLOOD

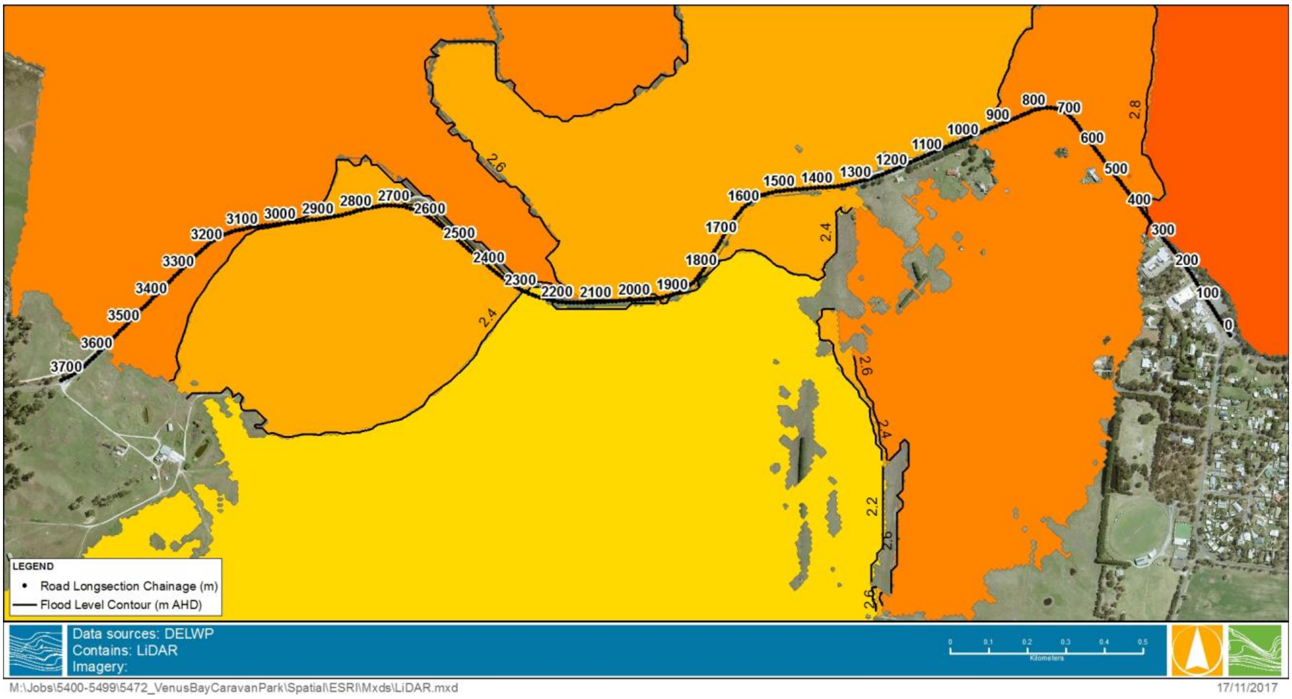

FIGURE 5-9 INVERLOCH-VENUS BAY RD LONGITUDINAL SECTION 1% AEP STORM SURGE FLOOD

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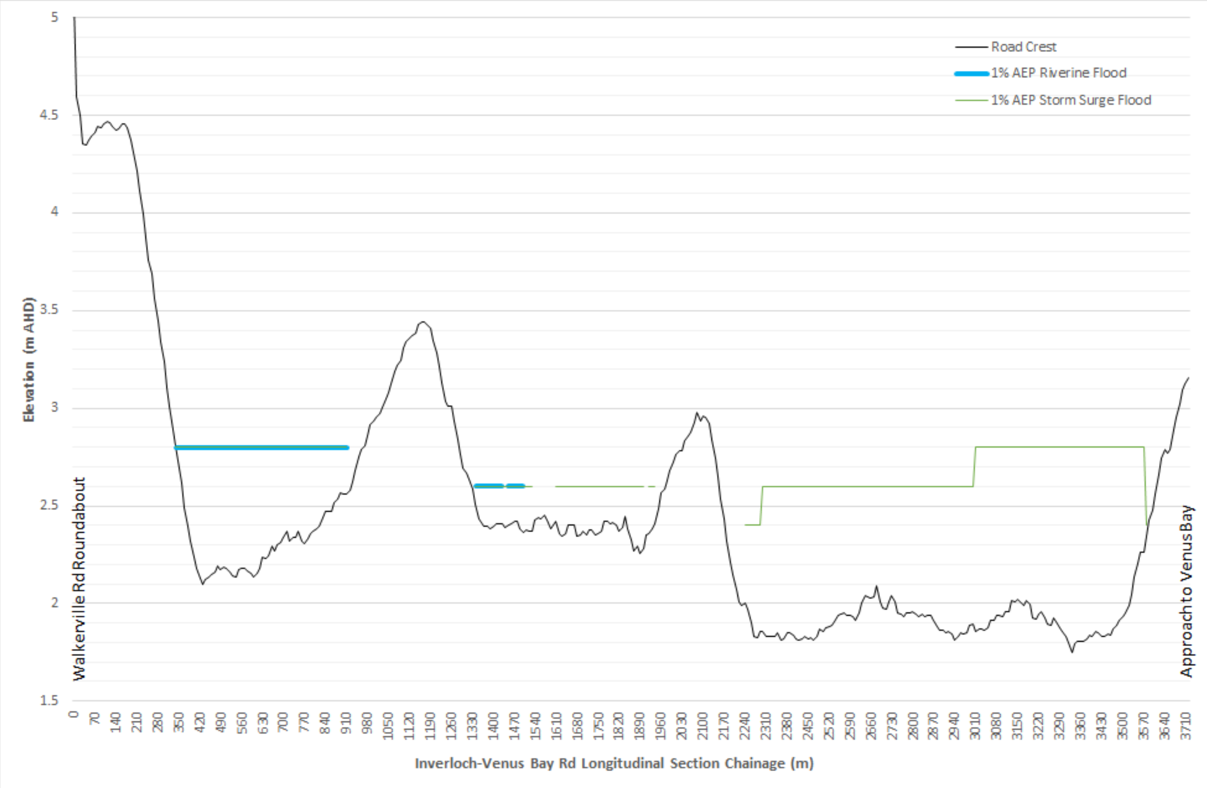

FIGURE 5-10 INVERLOCH-VENUS BAY RD LONGITUDINAL SECTION ELEVATIONS

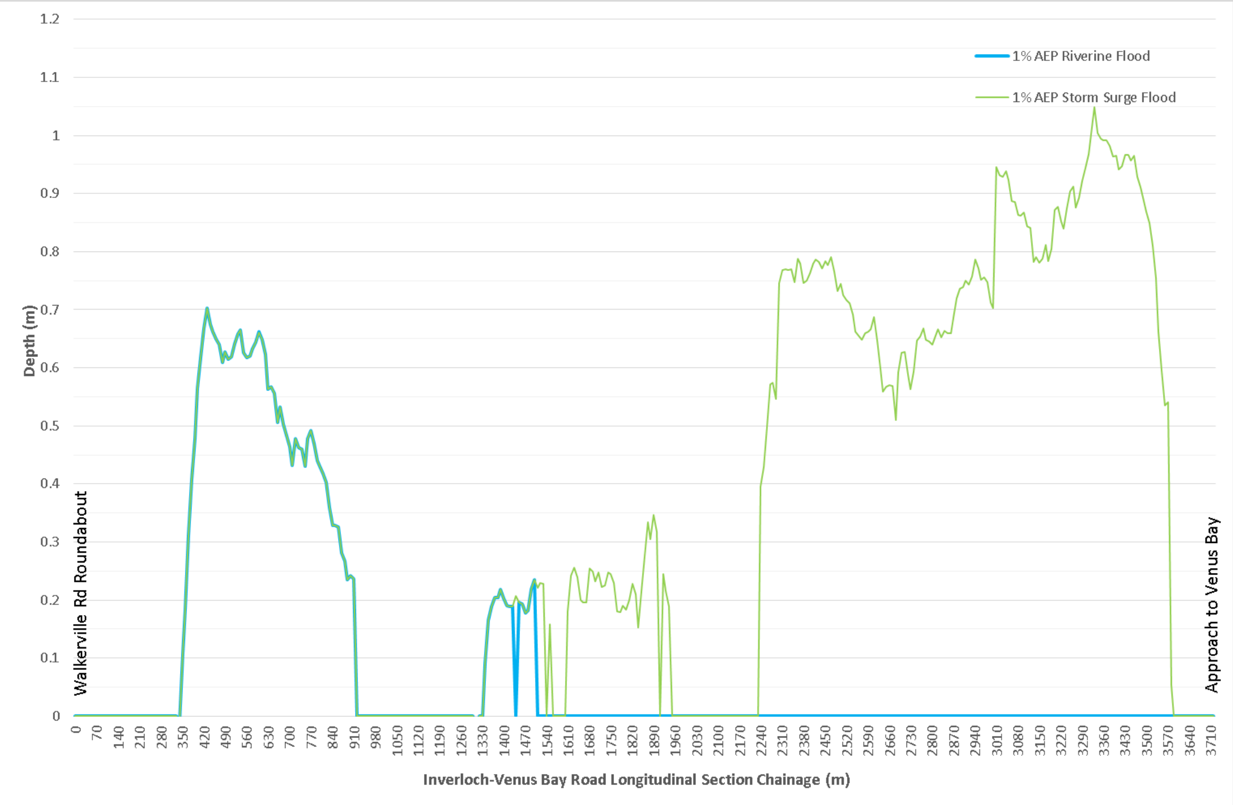

FIGURE 5-11 INVERLOCH-VENUS BAY RD LONGITUDINAL SECTION DEPTHS

Chapter 7 of Book 6 in the latest edition of Australian Rainfall and Runoff provides interim safety criteria for vehicles in variable flood flow conditions. In low velocity flow conditions (less than 1 m/s), a flood depth of 0.3 m is enough to make a small passenger vehicle unstable. A large 4WD such as an emergency vehicle may become unstable in flood depths greater than 0.5 m in low velocity conditions.

In a 1% AEP riverine design flood the road between Tarwin Lower and Venus Bay is predicted to inundate above 300 mm deep over a 500 m section of road from the School Road intersection. Of this section, approximately 280 m is inundated to a depth greater than 0.5 m. Therefore, for a 1% AEP riverine design flood the *Tarwin Lower Flood Study* modelling suggests that the road is inaccessible.

A 1% AEP design storm surge event results in higher flood levels inundating the road closer to Venus Bay, with the *Tarwin Lower Flood Study* modelling indicating that a 1.3 km section of road would potentially be inundated by depths greater than 0.5 m. A 1% AEP design storm surge event renders the road inaccessible.

5.5.3 Flood Warning Time

Considering the 1% AEP design flood depths over the road between Tarwin Lower and Venus Bay are likely to make the road impassable, an understanding of the warning time of a large flood event is significant to defining overall flood risk.

It is understood there are no site-specific flood warnings provided by the Bureau of Meteorology for Tarwin Lower or Venus Bay. The Bureau of Meteorology will issue a severe weather warning for significant storm events, and will issue a Flood Watch for the region to notify the community of the potential flood threat from a developing weather situation. If deemed necessary, VICSES will setup an Incident Control Centre (ICC). The ICC will then coordinate issuing community messaging. Should a large riverine or ocean flood occur on the Tarwin River, it is likely that the community would receive messaging from VICSES with sufficient time to implement their plan to respond to the flood.

The South Gippsland Municipal Flood Emergency Plan (MFEP) suggests that in a typical flood event the lower reaches of the Tarwin River may start to rise 18 to 24 hours after the start of heavy rainfall, with the flood peaking within 30 to 36 hours for big floods. The MFEP also suggests that the travel time between peaks on the Tarwin River between Mirboo and Meeniyan are between 11 to 44 hours.

Gauged rainfall and streamflow data for the June 2012 event, the largest on record for the Tarwin River at Meeniyan gauge, was assessed to develop a timeline of that flood. The timing of flooding at Tarwin Lower has been estimated from modelling and information contained in the MFEP.

TABLE 5-1 INDICATIVE TIMELINE FROM START OF HEAVY RAIN FOR THE JUNE 2012 FLOOD EVENT

Start of heavy rainfall	Rise of river at Meeniyan	Peak of river at Meeniyan	Rise of river at Tarwin Lower	Peak of river at Tarwin Lower	River falls and road access to Venus Bay open again
0 hrs	12 hrs	30 hrs	18 to 24 hrs	42 to 48 hrs	66 to 72 hrs

The community of Venus Bay is likely to receive a Severe Weather Warning and a Flood Watch at least 1.5 to 2 days prior to the initiation of flooding at Tarwin Lower. More definitive messaging will then be issued by the VICSES once it becomes apparent that a flood will impact the lower reaches of the Tarwin River. There are many factors that may influence the timeliness of this messaging, however it is expected that this message is likely to be issued at least 12 hours prior to the road access to Venus Bay being cut. This provides ample time for residents or visitors to decide to evacuate if needed.

5.5.4 Shelter in Place

Based on past experience, it is likely that some people will choose to stay in Venus Bay and not evacuate. Under most circumstances in Victoria there is no compulsion to evacuate. If this is the case, the properties within Venus Bay are well above the 1% AEP flood height, and although the modelling is not available, it is likely that the subject property would be above the probable maximum flood (PMF) level. It is likely that road access from Venus Bay to Tarwin Lower would remain unpassable for a period of 24 to 48 hours. Given that the residents who choose to stay in Venus Bay would have access to the shops on Jupiter Boulevard (including the General Store for essential supplies), and the Community Centre off Canterbury Road; being cut off for 24 to 48 hours is not likely to place people in an unsafe situation with respect to provisions and support. Often a major issue for isolated communities during flood events is a loss of power and water supply. Venus Bay is on tank water, so water supply will not be interrupted. Ben Tate contacted AusNet Services, and their outages team were unaware of any historic power outages in Venus Bay due to flooding. Ben Tate also contacted Geoff Davis of South Gippsland Shire Council, and he did not believe there was any critical infrastructure in Venus Bay (other than the road access), that would be damaged by a flood event. Under these circumstances, being isolated for 24 to 48 hours is not likely to lead to any significant risks.

There is a lot of debate in the floodplain management industry regarding shelter in place strategies in response to floods. There are many cases where sheltering in place and waiting for the flood risk to pass is a much wiser strategy than evacuating and placing people at risk due to unsafe egress routes. One of the largest causes of flood fatalities is people driving through floodwaters. With a shelter in place strategy, driving through flood waters can be avoided. The success of a shelter in place strategy, as with any community strategy, is largely dependent on educating the community at risk, ensuring they understand how to respond prior to and during a flood event. It is considered that at Venus Bay, due to the reasons outlined above, early evacuations should be encouraged, and once the road between Tarwin Lower and Venus Bay becomes inundated, the road should be closed and a shelter in place strategy should apply.

In the case of a critical emergency, where access is required, the MFEP suggests that access to Venus Bay may be achievable through farmland. Alternatively, there are several locations where a helicopter could land safely within Venus Bay. The former local CFA Captain, John Harris has confirmed that a CFA vehicle is permanently stationed in Venus Bay as well as a first medical response unit (CERT).

5.6 Decision Guidelines

There are a range of planning policy documents, strategies and best practice guidelines that relate to development in flood prone areas. They are a consistent and follow the same themes. In relation to Amendment C109 of the South Gippsland Planning Scheme, the key decision-making factors relate to the danger to life, health and safety of people, and increasing the burden on emergency services. As the site itself is not a flood affected area, many of the decision-making factors are not directly relevant.

Planning Practice Note 11 – Applying for a Planning Permit under the Flood Provisions (PPN11) provides a guide for Council's, referral authorities and applicants regarding how to make a permit application for a property subject to flooding, and how to assess the application. Under the section *Making a Decision*, PPN11 suggests that an application should be refused if *"it is likely to result in danger to the life, health and safety of the occupants due to flooding of the site"*, *"it relies on low-level access to and from the site",* and *"it is likely to increase the burden on emergency services and the risk to emergency personal"*.

The site is not flooded affected. The risk to people due to inundation of the accessway can be reduced by employing early evacuation (there is enough warning time to evacuate), and sheltering in place for those who choose to stay, minimising flood risk. With these two strategies the danger to life, health and safety of the occupants is minimised. This strategy is routinely employed for other hazards such as bushfires. Occupants are warned and encouraged to evacuate, but then as the fire approaches and it becomes too dangerous to evacuate, occupants are encouraged to shelter in place. A flood behaves in a much more predictable manner, and it is suggested that this strategy of early evacuations and shelter in place would be very effective in managing flood risk.

PPN11 does not define what low-level access means, but as demonstrated within this report the road between Venus Bay and Tarwin Lower remains open in flood events below a 2% AEP. There are many townships and major roads across Victoria which do not have this level of flood immunity. It takes a very infrequent flood event to close the road. In the largest flood event recorded at the Tarwin River at Meeniyan gauge, the road between Venus Bay and Tarwin Lower has not been closed. This supports the former local CFA Captains claims that to his knowledge the road has not been closed due to flooding in the last 55 years.

It is suggested that, given the current population in Venus Bay, the significant flood magnitude required to render Venus Bay inaccessible, and the ability for occupants to safely shelter in place for 1 to 2 days, there would be no measurable, additional burden placed on emergency services due to this amendment and subdivision.

The *Draft Guidelines for Development in Flood-affected Areas* (August 2017, DELWP), are centred around four development objectives and their associated standards. Objective one *Flood Safety*, relates to protecting human life and health, and provide safety from flood hazard. Standard 1.1 for achieving this objective says, "D*evelopment must ensure that people entering or leaving the site can do so safely".* The document then goes on to say, *"If Standard 1.1 cannot be met for access safety, it will be necessary to demonstrate that safe evacuation is reasonably feasible or that sheltering in place is a viable realistic option".* As discussed above, safe evacuation is possible if it is completed early, and after the road is inundated and access is cut, sheltering in place is a viable realistic option.

5.7 Treatment of Risk

Given there is a residual flood risk for the accessway to Venus Bay, there are a number of treatment strategies that could be employed. These strategies could be appropriately delivered at the township scale, not specifically for the properties of Amendment C109 of the South Gippsland Planning Scheme.

5.7.1 Flood Warning

The South Gippsland MFEP states that *"Council's Flood Management Plan has listed an action to prioritise the installation of flood warning services in South Gippsland Shire"*. With a site specific flood warning service for Tarwin Lower and Venus Bay (provided by the Bureau of Meteorology), residents of Venus Bay would increase their warning time and have a higher accuracy warning service. As this is a listed action of Council's, this should be followed up and implemented. It is noted that the West Gippsland Catchment Management Authority through the Regional Flood Strategy is responsible for reviewing the needs of flood warning systems across its region. Together with Council, they should make a case for a flood warning service for the communities of Tarwin Lower and Venus Bay. The Bureau of Meteorology would develop the service with a cost recovery model, with DELWP covering the capital cost of model development. The Council would need to fund the ongoing maintenance cost for any new gauges required for this service.

5.7.2 Messaging

If an early evacuation and shelter in place strategy is to be employed, clear messaging should be developed so that communication with the community in times of a flood event is clear and elicits a response. Pre-populated messages according to available forecasts and triggers relating to upstream streamflow gauges and storm surge forecasts should be prepared by VICSES in consultation with Bureau of Meteorology (if a flood warning service is developed), Council and Catchment Management Authority.

To complement community messaging, road signage, and in times of flood, road closure due to floods and road barriers should be put in place. Council, with collaboration with VICROADS, would most likely be the lead for this.

5.7.3 Community Awareness

The communities of Tarwin Lower and Venus Bay should be well educated about the risk of flooding, and be encouraged to develop their own flood plan, with advice provided on early evacuation and shelter in place options. It is noted that VICSES engaged with these communities, with the release of the Local Flood Guide in early 2015. Follow-up engagement would ensure that the community is well educated.

5.7.4 Evacuation and Shelter in Place

As discussed previously, a strategy of early evacuation prior to the road being inundated, and then shelter in place once the road is inundated, minimises flood risk. This is the situation currently for residents or visitors to Venus Bay under flood conditions. If this strategy was enhanced, the risk of people entering flood water and risking their safety could be further reduced. This could be implemented by improving warnings, community awareness and messaging. This would not only ensure that the occupants of the land subject to Amendment C109 of the South Gippsland Planning Scheme and the safety of the wider communities of Tarwin Lower and Venus Bay is improved.

5.7.5 Alternative Road Access

An alternative emergency road access to Venus Bay could be established across private land between Tarwin Meadows Road and Venus Bay, for use only in an emergency. This would ensure that Venus Bay remains accessible even in a rare flood. This is obviously a treatment option that would be considered as a response to the isolation of the Venus Bay township as a whole, not specifically the land subject to Amendment C109 of the South Gippsland Planning Scheme. This is a flood risk treatment option that Council could follow up with the relevant land holders but is not necessary for this Amendment.

6 SUMMARY

The property subject to Amendment C109 of the South Gippsland Planning Scheme is not within a directly flood affected area and there are no flood-related overlays the incorporate the site.

The property is located in Venus Bay and the accessway to Venus Bay from Tarwin Lower is likely to be inundated to depths above safe limits for vehicles in a 1% AEP design flood. It does take a very rare flood to cut access to Venus Bay, estimated to have a likelihood of occurrence of less than 2% in any year.

The decision-making guidelines contained within the various planning policies, strategies and best practice guidelines have been reviewed. The site is not directly flood affected and, although access may be limited for a period of up to 48 hours under extreme flood conditions, the options of early evacuation and shelter in place can reduce the risk to an acceptable level.

There is not expected to be any significant additional burden placed on emergency services due to the amendment and subdivision.

There are treatment options that could further reduce flood risk to the wider community of Venus Bay, including the occupants of land related to Amendment C109 of the South Gippsland Planning Scheme. These include improved flood warning, community messaging, and community awareness.

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7 DECLARATION

I have made all the inquires that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel.

Warwick A Bishop

B.E. (Hons), MEngSci

20 November 2017

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8 REFERENCES

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2016, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia.

DELWP (2015), Applying for a Planning Permit under the Flood Provisons, Planning Practice Note 11.

DELWP (2017), Guidelines for Development in Flood-affected Areas, Draft issued August 2017.

South Gippsland Shire Council, VICSES (2013), South Gippsland Shire Flood Emergency Plan, version 1.4 February 2013.

Water Technology (2007), Tarwin Lower Flood Study, Report prepared for Tarwin Property Investments Pty Ltd and West Gippsland CMA.

APPENDIX A – STATEMENT FROM JOHN HARRIS

My name is John Harris, date of birth 17/5/1949 and I have lived in the Tarwin Lower, Venus Bay and Pound Creek area for the past 54 years.

I would like to state the following:

- I have been a member of the different local CFA Brigades for 50 years in different roles, one of which 12 years as Captain of the Venus Bay Tarwin Lower Brigade.
- In all the years living in this area I have never been confronted with any flooding on the road between Tarwin lower and Venus Bay, starting from the roundabout Walkerville Road.
- All the flooding that we encountered was between Tarwin Lower and the intersection towards Meeniyan or Cashin Hill.
- I have been operating the school bus service in the Tarwin Area for more than 40 years and operate a cartage business for 50 years which gives me clear understanding of the local flooding issues and road conditions during these events.
- School bus operation has been affected occasionally by flooding and made detours necessary for the school bus; however we were always in a position to take the children to and from school.
- The CFA in cooperation with the SES have flood warning emergency plans in place for the area mentioned.
- CFA brigade Venus Bay has a vehicle permanently stationed in Venus Bay as well as a first medical response Unit (CERT) stationed in Venus Bay

Sincerely Yours

Signed and endorsed by

John Harris

19 November 2017

Venus Bay

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WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

Melbourne
15 Business Park Drive
Notting Hill VIC 3168
Telephone (03) 8526 0800
Fax (03) 9558 9365

Brisbane
Level 3, 43 Peel Street
South Brisbane QLD 4101
Telephone (07) 3105 1460
Fax (07) 3846 5144

Wangaratta
First Floor, 40 Rowan Street
Wangaratta VIC 3677
Telephone (03) 5721 2650

Perth
PO Box 362
Subiaco WA 6904
Telephone 0407 946 051

Geelong
PO Box 436
Geelong VIC 3220
Telephone 0458 015 664

Gippsland
154 Macleod Street
Bairnsdale VIC 3875
Telephone (03) 5152 5833

Wimmera
PO Box 584
Stawell VIC 3380
Telephone 0438 510 240

www.watertech.com.au

info@watertech.com.au