

## **When Perception and Evidence Based Practice Collide – Floodplain and Waterway Management in the aftermath of the 2016 Floods at St Marys, Tasmania**

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### **Key Points**

- St Marys is a small township near the east coast of Tasmania which suffered three significant flood events during 2016.
- Following the flood events, a range of actions have been suggested by the community to improve flood risk, some of which would have been detrimental to the waterway such as large-scale clearing of in-stream vegetation and excavation of the watercourse with the aim of improving flood risk.
- The St Marys flood risk management study has been completed and involved significant consultation with the community which included education around best practice floodplain and waterway management.
- Good outcomes have been achieved with a much improved understanding of flood risk and waterway management for the community and the development of a flood risk management plan

### **Abstract**

St Marys is a small town near the east coast of Tasmania which experienced three significant flood events in 2016. The largest event occurred in January 2016 and resulted in extensive damage including above floor flooding to numerous dwellings. The flood event has been estimated to be larger than a 0.5% AEP (1 in 200 year ARI) event and also resulted in significant changes to the waterway through the township.

The St Marys Flood Risk Management Study was commissioned in mid-2017 by Break O'Day Council and has since been completed by Water Technology in partnership with Council, the community of St Marys and a number of other key stakeholders. The study commenced in late September 2017 against a backdrop of strong public perception around the cause of flooding at St Marys and how it should be managed. Through extensive consultation, engagement and education the community and study team have come to better understand why and how the town floods, and the sort of flood risk management options that could be implemented which won't adversely impact the town's greatest natural asset – the St Marys Rivulet.

The study has recently concluded, and a number of actions have been identified to improve flood risk that have the support of much of the community. As well as providing sound information for flood risk management, through the study the community has also come to better understand riverine processes in the rivulet and committed to the health of the waterway when managing flood risk.

### **Keywords**

Flood risk, flooding, floodplain management, waterway management, hydrology, hydraulic modelling

### **Introduction**

St Marys is a small rural town located near the eastern coastline of Tasmania. St Marys Rivulet flows through the township as do two small tributaries – Newmans Creek and St Patricks Creek. The catchment upstream of St Marys is predominately farmland and bushland with some areas of rural and low density residential

properties within and around the township. The township was subject to three significant flood events in 2016 with the January 2016 event being the largest and two smaller events occurring in June and November.

## **2016 Flooding at St Marys**

2016 was a wet year across Tasmania with numerous large rainfall and flood events occurring across the state. Three significant flood events occurred at St Marys with the January 2016 event being the largest. The January 2016 flood event was a result of several wet days and then an extreme burst of rainfall in the early hours of 29<sup>th</sup> January which has been determined as approximately a 0.2% AEP rainfall event. The resulting flood event resulted in considerable damage to the town, including above floor flooding at several properties.



**Figure 1. Central St Marys during the January 2016 Flood Event**

## **St Mary Floodplain Risk and Management Study**

### *Objectives and Background*

The St Marys Floodplain Risk and Management Study commenced in September 2017 after Council received funding support through the Natural Disaster Resilience Grants Program (NDRGP). The project was completed under the framework of the Australian Emergency Management Handbook 7 (AEM Handbook 7), with a flood study initially undertaken to understand the current flood risk in the town and then a floodplain management study and plan completed after that to identify management actions to improve flood risk for the township.

The first key objective of the study was to provide flood mapping and flood intelligence for St Marys' major waterways based on best practice modelling and utilising knowledge from recent flood events. Mapping was used to update flood intelligence for emergency response, and to guide future development of the township. The town had never had detailed flood mapping undertaken so the mapping and flood intelligence outputs were a significant improvement on existing knowledge. The second key objective of the study was to assess and determine floodplain management options for St Marys which can be implemented as part of a Flood Risk Management Plan for the town. The management plan ultimately led to a set of recommendations to improve floodplain management for the town. Some of the recommendations were related to structural mitigation works while others were around improved flood response and warning.

### *Community Consultation*

High levels of engagement with the community was a key focus of the study. The initial phase of consultation at the commencement of the study was aimed at informing the community about the study and gathering relevant recent and historic flood data to improve the flood modelling of the town. The second phase of

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consultation in December 2017 allowed draft modelling results to be presented to the community and mitigation options to be discussed. There was a significant turnout at all sessions and the format of the sessions included:

- Community meetings and workshops in the local hall
- A stall at the monthly Saturday market where resident could stop by to discuss how the study was progressing, look at modelling results, ask questions and provide feedback
- A river “walk and talk” was undertaken midway through the project on a Saturday morning with residents and the project team. Residents were able to point out their concerns and talk through their ideas regarding floodplain and waterway management options.



Figure 2. Consultation included a rivulet “walk and talk” (left) and a stall at the weekend market (right)

In addition to the consultation described above, the community engagement process was enhanced through the development of an online flood study portal (Figure 3). The portal allowed key outputs of the study to be shared through a “Google Maps” type environment and allowed community members to leave comments and feedback on the findings as well as submit ideas around flood management and mitigation ideas.

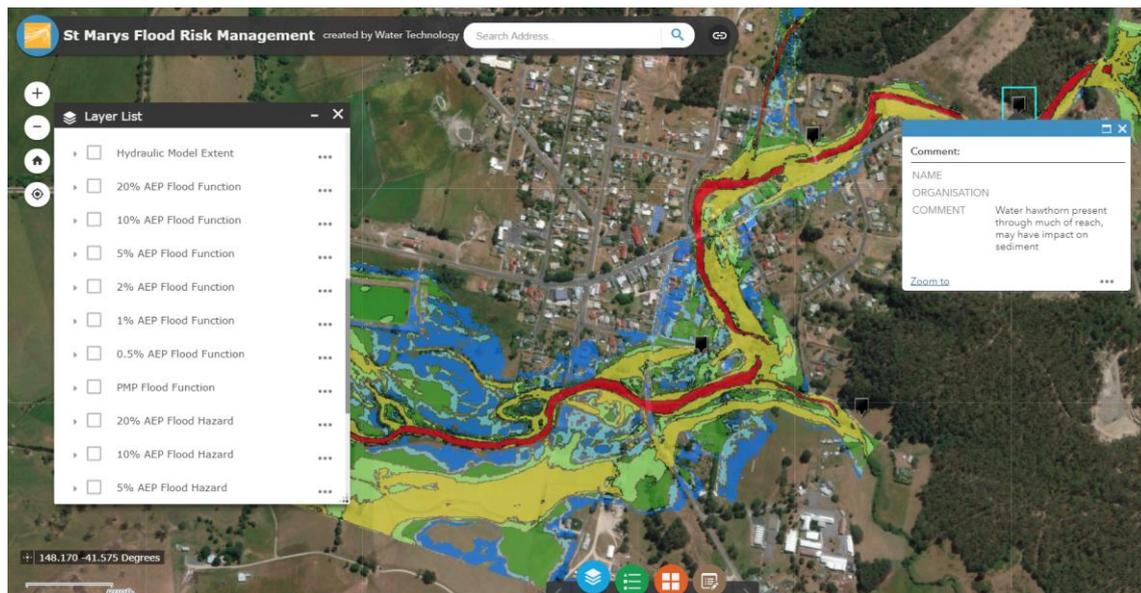


Figure 3. Screenshot from the St Marys Online Mapping Portal

### Hydrology and Hydraulic Modelling

Detailed hydrological and hydraulic modelling was undertaken for the project, which was undertaken in line with Australian Rainfall and Runoff 2016. Hydrologic modelling was completed in RORB, while the hydraulic modelling utilised TUFLOW. RORB is an industry standard rainfall and runoff modelling package used widely throughout Australia and was used to determine flows into St Marys, TUFLOW is also widely used and a benchmarked 1D and 2D hydraulic modelling package. TUFLOW was used to determine flood levels, depths and velocities across the township. The hydraulic model extent and DEM (digital elevation model) is shown in Figure 4.

The hydrologic and hydraulic modelling components were completed in tandem due to the available streamflow and rainfall data being limited and of poor quality. Whilst there was limited recorded streamflow or water level data to calibrate the model, there was significant amounts of anecdotal information and flood photos of the three flood events which occurred in 2016. This information was used to validate the results in the hydraulic model and to inform the hydrologic modelling. This tandem approach is commonly used on ungauged catchments and aims to reduce uncertainty as much as is practical in the modelling results. An example of the model validation for the January 2016 event is shown in Figure 5.

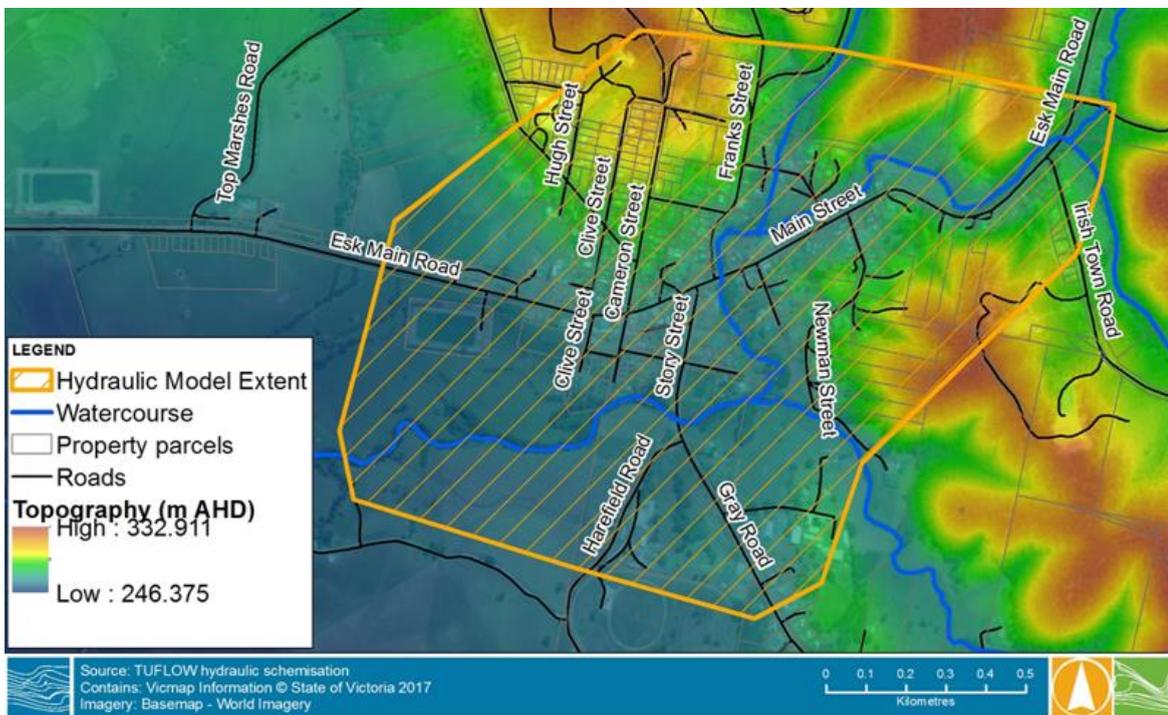


Figure 4. Hydraulic model extent and model DEM (Digital Elevation Model)

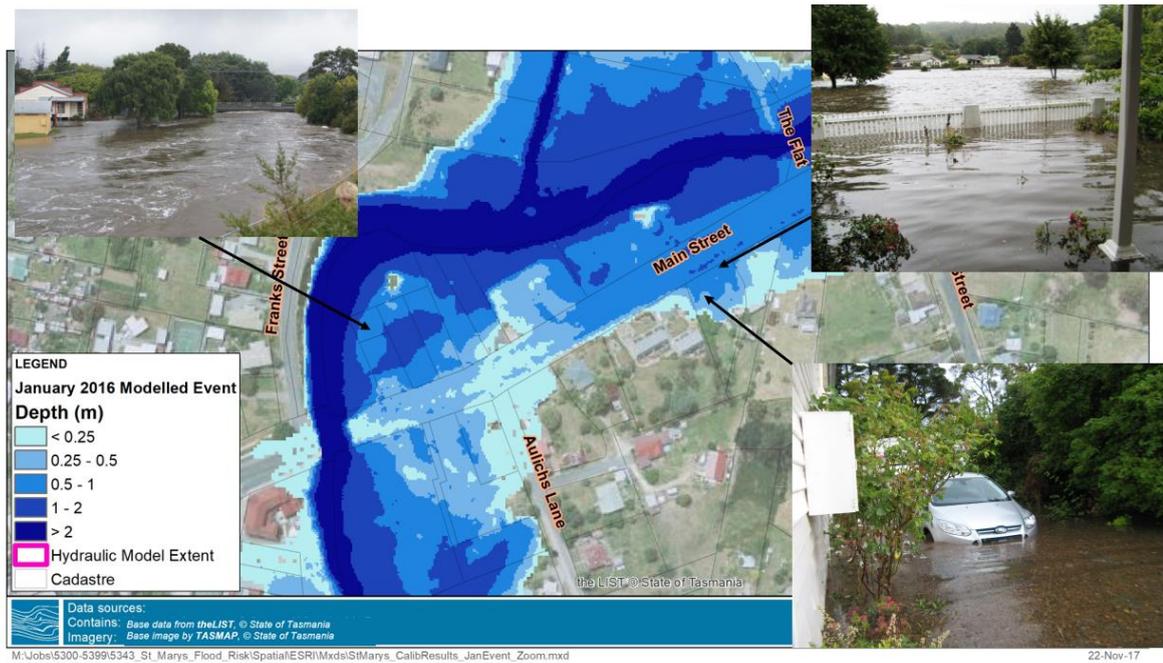


Figure 5. Validating the hydraulic model results to flood photos of the January 2016 event

### Mitigation Modelling

Flood mitigation is aimed at reducing flood risk to a region located on a floodplain. Mitigation options can be in the form of structural options (levees, bridges, culverts, and creek diversion etc.) or non-structural (flood warnings, rezoning, relocating residents, and resilience etc.) processes. A large range of options that had been raised by the community and/or key stakeholders and focused on structural mitigation works were considered for mitigation modelling.

The key focus for the selection of mitigation options was community participation in the process through consultation sessions that were conducted throughout December 2017 and February 2018. There were a number of suggestions raised by the community, and these were refined through reference group meetings and by assessing which adhered to specific criteria, primarily; hydraulic effectiveness, practicality, cost, community support, environmental impacts and that could be tested through modelling.

The key mitigation options which were tested and ultimately recommended as part of the flood management plan included:

- Vegetation reduction in focused areas and replacement with more appropriate, less dense vegetation. The dense vegetation near the confluence of St Marys Rivulet and St Patricks Creek was seen as the highest priority area. This option was modelled and showed modest and local reductions to flood levels. Given the option has no adverse impacts, improves the waterway aesthetics and shows a small benefit with regards to flood risk this option was recommended for the flood risk management plan and has already been implemented by Council
- A low-level levee or bund at the rear of Groom Street, which is the location of a significant breakout during the January 2016 event that inundated several units. The modelling has shown that a well-designed levee or bund would prevent breakout occurring in smaller flood events whilst minimising any adverse impacts of the levee in large flood events.
- Replacement of The Flat road bridge over St Marys Rivulet with a ford structure. The Flat Bridge is located centrally in the town and consists of a thick slab which significantly reduces the capacity of the waterway. The bridge is also noted to capture significant debris loads in large flood events.

Hydraulic modelling demonstrated a ford structure would reduce flood levels in the vicinity of the bridge including down the main street of St Marys and nearby residential properties.



**Figure 6. Some of the focal areas of recommended mitigation works - breakouts near Groom Street (left) and flood debris on The Flat bridge (right) during the January 2016 event**

One of the options raised in the community, sometimes in the local media, was widespread clearing and excavation of the St Marys Rivulet channel. The use of a bulldozer, as had been done decades ago, to clear the waterway channel to increase its capacity was suggested at one point. The perception was that such works would allow flood water to more freely through the town resulting in flood levels and damage being significant reduced.

## **Community Education and Engagement**

Considerable time was spent during the study on discussing flood risk management options, particularly some of the intuitive creek clearing and channel excavation options as discussed above. In these discussions the potential adverse impacts of such works and the limited effect on flooding they would have in a large flood event, such as the January 2016, were explained in the context of stream hydraulics and geomorphic processes. For example the project team at Water Technology and Break O’Day Council used the Flood Study information page on the Break O’Day Council website to explain why some of the actions being suggested would be detrimental to the waterway and likely have limited benefit in terms of flood risk and some other detrimental effects:

*“Why can’t we just ‘clean out’ the rivulet:*

*Cleaning out the rivulet was put forward at the community meeting marking the start of the project in September 2016 as an obvious solution to flooding. Clearing the channel by removing fallen trees, stumps and vegetation and gravel and other sediments would increase in-channel flows through the town to a degree. A bigger, deeper St Marys rivulet channel with less features creating friction for water flows will carry more water away and faster, with less risk of flood waters breaking the bank during in-channel and relatively small flood events. However, it is essential that the broader consequences of such works be considered.*

*For example, typically the faster water flows, the greater the size and amount of sediment the water will carry. Sand, gravel and rocks (and bigger things, such as logs) can all be picked up and carried by the flowing water. The increase in flow energy created by the removal of fallen trees, stumps and vegetation results in the water moving material out of the stream bed and banks that would otherwise have stayed put. As a consequence, it is likely that the St Mary’s Rivulet will erode its streambed and*

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*banks and that erosion that may take many years to re-stabilise. These unintended consequences of removing vegetation and debris have been demonstrated in numerous rivers and catchments across Tasmania and Australia since European settlement.*

*The question of reducing vegetation and debris as a flood mitigation strategy was asked in the 2012 Victorian Parliamentary inquiry into the devastating floods of 2011/2012 in Victoria. The inquiry concluded, based on submissions by numerous experts and scientific studies, that clearing vegetation generally has a very small impact on flood risk. The scientific evidence presented to the inquiry also showed that the impacts of reducing vegetation decreases for larger floods. In big flood events, which fully engage the floodplain, such as that which occurred in St Marys in January 2016, the impact of clearing the creek will have a minimal impact on peak flood levels.*

*Cleaning out the channel of the rivulet is a flood management option that the St Marys Rivulet Flood Management project can test. If the community wants this option considered, then the broader consequences need to also be considered. These considerations include:*

- *Long term channel stability, including:*
  - *The threats to both private and public assets/land adjacent the creek.*
  - *Required erosion control structures to manage long term channel stability.*
  - *The initial and on-going costs associated with the construction and maintenance of the erosion control structures.*
- *The aesthetic changes to the creek. The removal of the removal fallen trees, stumps and vegetation and construction of erosion control structures using materials such as rock, will result in a substantially different looking Rivulet.*
- *The impacts both upstream and downstream of the study area.*
- *The ecological function of the removed material. “*

Another approach to help the community understand what works would achieve with respect to flood risk, such as widespread clearing, was to test such works in the hydraulic model and quantify the impacts they would have on flood levels during large flood events.

Several model scenarios were run with varying levels of vegetation clearing, represented by a reduction in hydraulic roughness within the channel and through riparian areas. An example of a difference plot is shown in Figure 7 which compares current 1% AEP flood levels under conditions to an extreme scenario of widespread vegetation along the full length of the rivulet through the township. The results showed that even with such dramatic vegetation works, the flood extent is largely unchanged. There are some localised reductions in flood levels, but residential areas that suffered the most damage largely do not benefit from the vegetation works. The hydraulic modelling helped the community understand the benefits that could be achieved from such works and thus helped inform their decisions around which options should be recommended as part of the plan. It also alerted them to the potential for works to produce side effects and increase inundation risks in places.

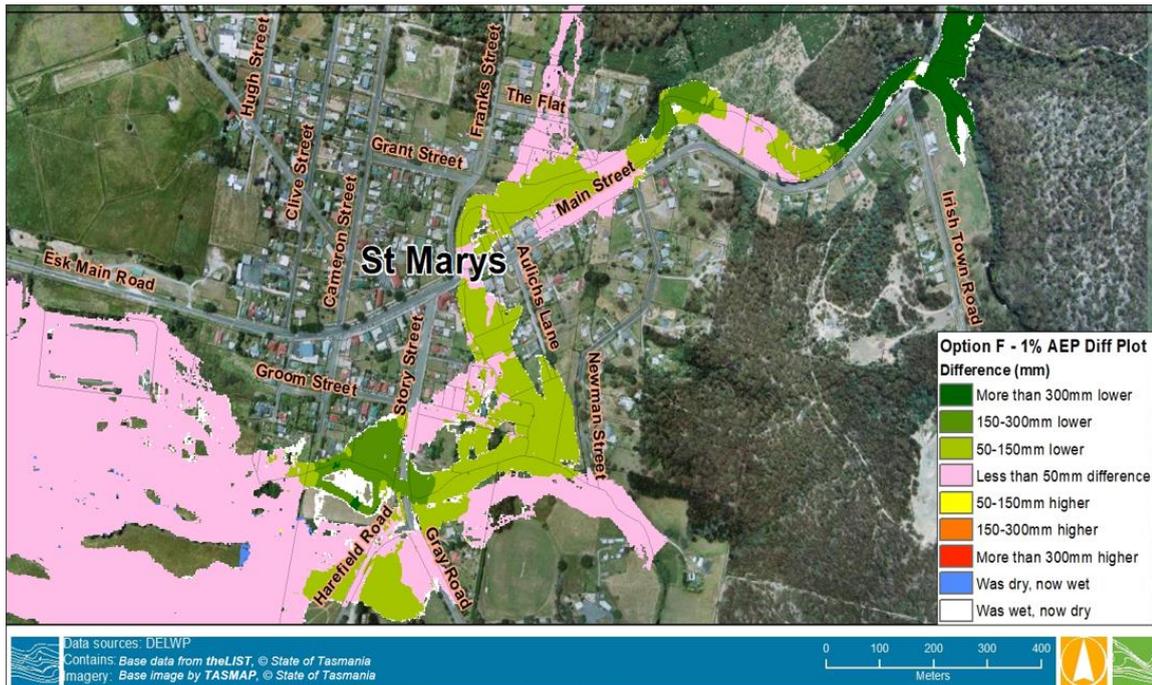


Figure 7. Impact on 1% AEP flood levels with widespread vegetation and debris removal

Over the course of the project appreciation of how streams behave and implications for managing flood risk improved and by the final stages of community consultation in February 2018 widespread creek clearing was no longer being raised as a serious option. Instead, targeted works options for managing the stream and mitigating flood risk were discussed and prioritized by the community to recommend for a flood risk management plan.

## Conclusions

The St Marys Flood Risk Management has resulted in much improved understanding of flood risk at St Marys as well as the development of a floodplain management plan which aims to improve flood risk for the town. The study has involved significant community consultation, using a variety of formats, working with the community to better understand best practice floodplain management for the town and consider the type of mitigation options that may improve flood risk for the town without compromising the quality and integrity of the rivulet and other waterways which flow through the town.

Through the consultation process a set of recommendations have been developed as part of the floodplain plan which have the support of much of the community. The recommendations include structural mitigation works which will reduce flood risk but won't adversely impact the waterways which flow through the township.

## Acknowledgments

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## 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