July 2023

Pacific Motorway (M1) Varsity Lakes to Tugun upgrade

Hydraulics report and addendum following February 2022 flood event

Frequently asked questions

Overview and background

These FAQs are not intended to replace the reports or other key documentation they refer to and instead are simply intended to provide a snapshot of some key issues as concisely and accurately as possible. Please consult the source reports and/or data, where available, if you would like further information or clarification on these matters.

Why did the Queensland Government commission this report?

The flood event of February 2022 was one of the most significant natural disasters to impact Queensland with parts of the Gold Coast encountering some of its heaviest rainfalls on record.

Construction activities were underway at the time as part of the Pacific Motorway (M1) Varsity Lakes to Tugun upgrade (VL2T), including works within Tallebudgera Creek to construct the widened M1 southbound bridge.

In response to community concerns that works on the VL2T upgrade may have contributed to increased flood levels during the extreme rainfall, an independent hydraulics specialist was engaged to undertake a full analysis of the flooding event and the construction works underway at the time.

Who prepared the report?

The independent report was completed by hydraulic experts at SLR Consulting who were appointed based on SLR being a global leader in environmental and advisory solutions.

SLR's report involved conducting a comprehensive analysis of the February and March 2022 flood event, reviewing the causes and any potential impacts on properties in Tallebudgera and Elanora, using the existing and historical flood mapping data available through various state and local government entities.

To help inform the report, RPS Group carried out LiDAR laser scanning and ground surveys. The RPS Group is also a global professional firm that provides market-leading aerial LiDAR and photogrammetry survey technology.

The full report is available at Pacific Motorway M1 Varsity Lakes to Tugun upgrade | Department of Transport and Main Roads (tmr.qld.gov.au).

Is Tallebudgera Creek prone to flooding?

The City of Gold Coast identifies that with 57 kilometres of coastline, 5 rivers, and 260 kilometres of navigable waterways, the Gold Coast has long been susceptible to flooding and, in a submission to the Queensland Flood Commission in 2011, Council noted the Gold Coast has experienced more than 45 floods since 1925 (Section 2.4, p11), with many causing damage to property, roads and natural environments.

According to the Australian Bureau of Meteorology (BoM), the Tallebudgera Creek area has long been recognised as a floodplain, as far back as the 1920's. The area is particularly susceptible to riverine flooding caused by extreme rainfall but can also be impacted by king tides and storm surges.

While Tallebudgera Creek statistics are often generalised within the South Coast river catchments in the majority of the BoM's flooding reports, the following links highlight the number of times that Tallebudgera Creek has been specifically documented.

- March 1927 and February 1928 (Queensland Flood Summary 1920-1929)
- June 1956 (Queensland Flood Summary 1950-1959)
- November 2004 (Heavy Rainfall South East Queensland 6-7 November 2004, figure 2)
- January 2008 (South East Queensland Floods January 2008, pages 2, 10, 25, 30 and 35)
- February 2008 (Report on Queensland Floods February 2008, pages 42 and 59)

Furthermore, table 3.1.1 in the BoM's South East Queensland Floods May 2009 report shows Tallebudgera Creek recording the 4th highest flood level in South East Queensland for that event, with a peak level of 2.39 metres.

The City of Gold Coast's historical flood mapping from 20 years ago (2003) shows areas around Tallebudgera and Elanora that are at risk of flooding (Potential Flood Inundation Overlay Map – OM17). The map shown in this link clearly identifies the Tallebudgera Creek area – including the streets investigated in the hydrology report – as being in a recognised flood zone.

How much rain fell during the February 2022 flood event?

The intense rainfall in February 2022 resulted in South East Queensland's wettest six-day period in recorded history. A natural disaster was declared and emergency supports activated as part of the Commonwealth and State Disaster Recovery Funding Arrangements.

The hydraulics experts reviewed the amount of rainfall and its intensity that fell during this time, finding that over one metre of rain fell at the Australian Bureau of Meteorology's (BoM) Springbrook gauge, with the majority of the downstream catchment receiving between 500 and 700mm of rainfall.

The Elanora Water Treatment Plant is the closest weather observation station to the Tallebudgera Creek construction site. According to the BoM, this observation station (rainfall station position ID 40609) officially recorded the following daily rainfall:

27 February 2022	177.0mm
28 February 2022	260.0mm
1 March 2022	78.4mm
Three-day peak total	**515.4mm**

Data source: BoM daily rainfall station position ID 040609

The flood event that occurred later in the month of March 2022 was also assessed by the independent hydrologists, however the results of that analysis showed substantially lower flood levels, and therefore the primary focus of this report was on the February 2022 event.

How did the February 2022 rain event compare to ex-Tropical Cyclone Debbie in March 2017?

Ex-Tropical Cyclone Debbie produced major flooding in South East Queensland in March 2017, with the Australian Bureau of Meteorology's (BoM) Elanora Water Treatment Plant (rainfall station position ID 40609) receiving 297mm of rain during the first two days of the event.

However, during the February 2022 floods, the same gauge received 437mm of rain over the same first 2-day period – significantly more rainfall than ex-Tropical Cyclone Debbie in this catchment. In fact, multi-day rainfall records were broken during the February 2022 floods.

The following table shows a comparison of total volume of daily rainfall for similar significant wet weather events that were recorded at the Elanora Water Treatment Plant:

Comparative event at Elanora Water Treatment Plant	Day 1 rainfall total	Combined (Days 1 & 2) rainfall total	Combined (Days 1, 2 & 3) rainfall total
2022 – 29 March	**314.0mm**	0	0
2022 – 27 February to 1 March	260.0mm	**437.0mm**	**515.4mm**
2017 – 30 to 31 March	182.0mm	297.0mm	0
2015 – 24 January	291.0mm	0	0
2005 – 29 to 30 June and 1 July	**315.4mm**	**618.4mm**	**687.4mm**
1995 – 15 to 16 February	225.0mm	333.0mm	0
1987 – 5 to 6 March	218.0mm	360.0mm	0
1978 – 17 to 19 March	269.0mm	380.0mm	481.0mm
1976 – 11 February	290.0mm	0	0

Data source: BoM daily rainfall station position ID 040609

The above table shows the volume of rainfall of the two events in 2022 have only been surpassed by the 2005 event on record in the same catchment. Since 1975 – in 47 years of records – the Elanora Water Treatment Plant observation station has recorded only two events of a similar volume of rainfall, one of which is the 2022 event.

Why has the City of Gold Coast (Council) updated the flood mapping for Tallebudgera Creek?

As a result of a better understanding of the ongoing impacts of climate change and increasing extreme wet weather events, many of Queensland's local governments, including the City of Gold Coast, have updated their flood mapping following the unprecedented February 2022 rainfall event.

The City of Gold Coast's new mapping can be viewed at Flood maps | City of Gold Coast.

Why doesn't the report cover the Currumbin Creek catchment?

The focus of the report was on the Tallebudgera Creek catchment, given the nature of construction works happening there at the time and the concerns raised by property owners in that particular area.

The bridge construction works that were underway in Currumbin Creek at the time of the February 2022 severe wet weather event used a different construction methodology, that is floating platforms, smaller rock platforms and large cranes utilised for piling activities. This was not possible at Tallebudgera Creek because the steep northern bank of the creek prevented easy access for construction.

Why weren't different construction methods used in Tallebudgera Creek?

The works underway at the time of the February 2022 rain event included temporary works within Tallebudgera Creek to facilitate construction of the widened M1 southbound bridge as well as culvert extension works.

The independent report confirmed these activities were being carried out in line with industry best practice and determined an appropriate risk assessment was conducted before works started.

Alternative construction methods were considered by TMR and the contractor, however they weren't feasible due to the steep northern bank of the creek, which prevented easy access for construction.

Flood Report – Technical detail

How was the assessment of the flood impacts carried out?

The hydraulics experts set up a detailed computer-based model of the catchment to calculate flood levels and velocities upstream (approximately 200m west of Larch Street) and downstream of the M1 bridge crossing at Tallebudgera Creek. The model contains relevant information about the catchment including various ground levels and surface roughness.

When combined with the flow rates generated from the rainfall data, the model calculated water depth and flow velocity at various points in the catchment for the duration of the February 2022 flood event.

The flood model was then compared to a hydraulic model for pre-project conditions to determine the extent of the M1 temporary construction works that were in place at the time of the February 2022 flood event.

Why weren't all properties surveyed on the ground?

Ground levels were obtained at a number of locations and were then correlated to the accurately measured ground control points at permanent survey markers on Tallebudgera Creek Road.

Mobile Laser Scanning (MLS) was used to gather ground survey data in Larch Street, Daffodil Street, Elm Court, Heather Street and Kentia Court. This type of survey from the street was able to gather data on direct floor levels, tops of doors, garages and eaves as appropriate.

Light Detection and Ranging (LiDAR) aerial laser scanning data from local council was also incorporated to ensure a robust flood model was used in the assessment. LiDAR is a scanning system that allows a large volume of spatial information and level of detail to be gathered relatively easily and quickly compared to ground surveys of individual properties.

Given the positional accuracy of LiDAR, and the further data obtained from the MLS surveys, these survey methods were considered the most acceptable and time-efficient means of gathering the required data.

How was the hydrologic model verified?

A Hydrologic Model Verification was carried out to ensure the flood model developed by the hydraulics experts delivered accurate predictions.

The verification process utilised survey data, flood gauge data, existing flood models and other systems and software to ensure the outputs from the model closely replicated information known at the time the report was prepared.

Was a Flood Risk Assessment carried out for the M1 construction works?

Similar to any risk assessment, a Flood Risk Assessment utilises a 'probability' approach to determine the likelihood and consequences of a flood event.

In the case of the VL2T upgrade, a Flood Risk Assessment of the construction methodology was conducted to determine the most appropriate method that would minimise the consequences of flooding in the situation of a significant rain event.

The independent hydraulics experts confirmed the Flood Risk Assessment for the VL2T upgrade was conducted utilising industry best practice. The Flood Risk Assessment then informed the construction methodology adopted by the construction contractor.

What is meant by afflux and how is it different to flood depth?

Afflux is a hydraulics term that identifies the difference in flood height before and after a development or construction activity.

For example, a predicted storm event may estimate a flood height of 2.0m, but after construction the flood height increases to 2.05m. The afflux is the difference in height, being 0.05m or 5cm.

The flood depth is the depth of flood waters from its peak to the ground surface below. Using the previous example, if the ground level is at 1.5m and the flood reached 2.05m, then the flood depth was 55cm. Of the 55cm of flooding, 5cm of this could be attributed to afflux (an increased flood height due to development or construction activity).

What does Average Exceedance Probability (AEP) mean?

Average Exceedance Probability (AEP) identifies the likelihood of an event being equalled or exceeded in any given year.

For the February 2022 rainfall event, it's been determined to have had an overall AEP of between 2% and 5%. This means, the flood event was an event that is likely to occur between every 20 and 50 years.

It should be noted that the amount and intensity of the rainfall that fell at one location in the area (Coplicks Bridge) recorded rainfall intensities equivalent to a 1% AEP (or a 1 in a 100-year flood event).

Flood Report – Findings and Next Steps

Did the M1 construction works have an impact on the flooding?

While the independent report confirmed that TMR conducted an appropriate Flood Risk Assessment and that industry best practice was followed, the flooding impacts of the heavy rainfall may have been slightly increased in certain areas due to the temporary works within Tallebudgera Creek.

The report found the temporary works are likely to have produced an afflux of between 50mm and 100mm (or up to 10cm), indicating a slight increase to the flood impacts within the Tallebudgera Creek catchment (refer to pg. 25 of the report, paragraph 41).

Has TMR received any additional information as a result of the release of the report?

Since the first SLR report *DTMR M1 Upgrade: flood events of February and March 2022 – impact analysis and risk assessment* dated 7 October 2022 was published the hydraulic model used in the report has been revised using additional data including photographs and videos from members of the public and the Coplicks Bridge gauge.

SLR considers that the revised hydraulic model more accurately estimates flood levels.

Using the revised models, SLR has identified a decrease in afflux associated with the VL2T temporary construction works than previously estimated and has concluded that it is unlikely that the VL2T temporary works caused any property to suffer additional flood damages. That is, the properties which were impacted by flooding in the February 2022 storm event would have suffered over-floor flooding even if no construction works had been underway.

These findings are detailed in the SLR report titled 'DTMR M1 Upgrade: Flood events of February and March 2022 Additional Flooding Analyses Based on New Data', 5 dated April 2023. This report is available to view on the TMR website.

What properties were impacted by flooding as a result of the M1 construction works?

The original independent report found that the temporary works may have impacted 25 properties in Tallebudgera and Elanora.

While many properties in the area did flood during the extreme weather event, the report shows that because of the duration and intensity of the rainfall, and the historical flood mapping that confirms the catchment is a floodplain, these properties would have flooded above the habitable floor level regardless of the temporary construction works in place at the time.

TMR has been in contact with the 25 identified property owners to gather more information on their individual circumstances and to ensure they are aware of any entitlements they may have.

However, as a result of additional information provided by SLR, it has now been determined that the 25 properties which were originally identified in the SLR Hydraulic report dated Oct 2022 would have likely suffered over-floor flooding even if no M1 temporary construction works had been underway.

Will future rain events cause further flooding on the M1 during or after construction is complete?

Rain and storms are common occurrences in Queensland, and while the chance of another event like what occurred in February 2022 statistically should not occur for another 20 to 50 years, it is impossible to predict.

As works progress, the contractor will continue to reduce the amount of temporary works within and adjacent to Tallebudgera Creek. Significant effort has already been made to reduce the temporary works footprint, which will minimise the risk of any future flooding impacts in the unlikely event that another rainfall event of this magnitude should occur.

TMR has, however, designed the permanent works of the M1 upgrade to ensure that in a 1% AEP event, that is an event reoccurrence of every 100 years, there is no predicted afflux to any dwelling within any catchment along the length of the upgrade. This aligns to TMR's commitment that the finished M1 upgrade will have a no-worsening impact to the areas of Tallebudgera, Elanora and Currumbin.

Contract Administrators also conducted a review of the M1 upgrade temporary works and severe weather management compliance, finding that TMR's contractors have complied with all relevant contract conditions and legislative requirements.

Compliance reviews involved checks of conditions imposed by any Waterway Barrier permit or Tidal Works permit and a review of the approved Severe Weather Management Plan.

How was it determined that only 25 properties may have been impacted by the M1 temporary works?

While we acknowledge numerous properties were impacted as a result of the significant rainfall in February 2022, the report identifies just 25 may have been affected because of the temporary works on the M1. This was determined by the hydraulic experts through analysis of the flood modelling and afflux figures. Having said this, the afflux may not have resulted in additional loss.

Due to the additional information provided SLR, it has been found that no properties were affected by the temporary works on the M1.

The Tallebudgera Creek area is a natural floodplain and has been recognised as such for many years. It should be noted that considering the magnitude of the rainfall event that occurred and the location being in a designated Council-mapped flood area, this location would have been susceptible to flooding regardless of what construction activities were happening on the M1.

My property was flooded. What support is available to me?

In response to major flood events in 2021-2022, the Queensland Government announced the Resilient Homes Fund – a $741 million program to help flood impacted homeowners repair, retrofit or raise their homes.

The fund is available to both insured and uninsured homeowners and is not income tested. For more information on eligibility and the application process, visit Resilient Homes Fund | Homes and housing | Queensland Government (www.qld.gov.au).

The *Queensland Strategy for Disaster Resilience 2022-2027* website has also been developed to ensure communities are better equipped to deal with the increasing prevalence of natural disasters.

Those affected are also encouraged to explore their entitlements under any home and contents policies that they held at the time.

How is the government responding to the findings of this report?

The independent SLR report and addendum confirms that TMR conducted an appropriate Flood Risk Assessment, that industry best practice was followed and that TMR and its contractors acted reasonably and appropriately.