Flood Emergency Management Plan

174 – 176 Tygum Road, Waterford West

Blackoak Property Group

Prepared by:

SLR Consulting Australia

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Basis of Report

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Acronyms and Abbreviations

Acronym	Meaning
1% AEP + CC	The 1% Annual Exceedance Probability design flood event, with inclusion of allowance for Climate Change effects including increased rainfall intensity and sea level rise.
AEP	Annual Exceedance Probability – the likelihood of occurrence of a flood of given size or larger occurring in any one year. AEP is expressed as a percentage (%).
AHD	Australian Height Datum – the adopted national height datum that generally relates to height in metres above mean sea level.
ALS	Aerial Laser Survey
ARR	Australian Rainfall and Runoff, 2019
BoM	Bureau of Meteorology
Catchment	The area of land 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.
Climate Change	A change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
DFE	Design flood event – a flood of known magnitude or AEP. In the case of Logan City Council, this is the 1% AEP event with allowance for climate change.
Discharge (Flow)	The rate of flow of water measured in terms of volume (measured in megalitres (ML) or cubic metres (m^3)) over time (measured in days or seconds), i.e., ML/d or m^3/s. 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. (Note 1 m^3/s = 86.4 ML/d).
EAP	Emergency Action Plan
Effective Warning Time	The time available for flood-liable residents to defend their properties, if appropriate, and evacuate themselves and their possessions after having received a warning to do so.
FEMP	Flood Emergency Management Plan
FFL	Finished Floor Level
Flash Flooding	Sudden and unexpected flooding caused by sudden local heavy rainfall or rainfall in another area. Often defined as flooding which occurs within six (6) hours of the rainfall event.
Flood	The temporary inundation of land by expanses of water that overtop the natural or artificial banks of a watercourse i.e., a stream, creek, river, estuary, lake or dam.
Flood Awareness	An appreciation of the likely effects of flooding and knowledge of the relevant flood warning, response and evacuation procedures.
Flood Study	A study to determine and document the nature of flooding for an area. It usually includes a review of history of flooding; and for detailed studies an understanding of flood velocity, depth, frequency and extent.

Acronym	Meaning
Flood Warning	Flood warning involves the timely collection, interpretation and dissemination of flood information before and during a flood event to enable the community to respond effectively to the flood threat. The BoM is responsible for collecting rainfall and stream flow data, operating flood prediction models and preparing and issuing flood warnings to the media, key agencies and other bodies for non-flash flooding situations. Councils are responsible for disseminating flood warnings to the local community, local authorities and other local bodies for flash flooding and non-flash flooding situations.
Floodplain	Area of land adjacent to a creek, river, estuary, lake, dam or artificial channel which is subject to inundation by the Probable Maximum Flood (PMF).
Hydrology	The study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
Likelihood of Flooding	A quantitative or qualitative description of the likelihood that a specified event will occur. The likelihood of occurrence of flooding can be measured in terms of Annual Exceedance Probability (AEP).
Minor, Moderate and Major Flooding	BoM use the following definitions in flood warnings to give a general indication of the type of problems expected with a flood: *Minor Flooding:* causes inconvenience such as closing of minor roads and the submergence of low level bridges. *Moderate Flooding:* low-lying areas are inundated requiring removal of stock and/or evacuation of some houses. Main traffic bridges may be covered. *Major Flooding*: extensive rural areas and/or appreciable urban areas are flooded, with properties and towns isolated.
Mitigation	Any measure intended to reduce the severity of a natural hazard.
Natural Disaster	A natural hazard event that severely disrupts the fabric of a community and requires the intervention of the various levels of government to return the community to normality.
Natural Hazard	A naturally occurring situation or condition with the potential for loss or harm to the community, property or environment. The natural hazards addressed in the State Planning Policy are flood, bushfire and landslide.
Natural Hazard Management Area	An area that has been defined for the management of a natural hazard (flood, bushfire or landslide), but may not reflect the full extent of the area that may be affected by the hazard (e.g., land above the 1% AEP floodplain may flood during a larger flood event).
Nature of the Natural Hazard	The important characteristics of the hazard including the type of hazard and its severity.
Peak Discharge (Flow)	The maximum discharge occurring during a flood event.
Probability	A quantitative measure of the likelihood of occurrence of an event. It normally reflects the relative frequency of or expectation that an event will occur, and is usually expressed as a percentage, e.g., the probability of throwing a given number by rolling a die is 1 in 6, or 16.7%.
PMF	Probable Maximum Flood – the largest flood that could conceivably occur at a particular location. This flood defines the maximum extent of land liable to flooding. The PMF event may form the basis of evacuation planning and the identification of refuge areas.
PMP	Probable Maximum Precipitation

Acronym	Meaning
Recovery	The assisting of people and communities affected by emergencies to achieve a proper and effective level of functioning.
Response	The combating of emergencies and the provision of rescue and immediate relief services.
Risk	The chance of something happening that will have an impact upon objectives. It is measured in terms of consequence and likelihood.
Unacceptable Risk	A situation where people or property are exposed to a predictable hazard event that may result in serious injury, loss of life, failure of community infrastructure, or property damage that would make a dwelling unfit for habitation.
Stormwater Runoff	Inundation by local runoff. Stormwater flooding can be caused by local runoff exceeding the capacity of an urban stormwater drainage system or by the backwater effects of mainstream flooding causing the urban stormwater drainage system to overflow.
Waterway	A river, creek, stream or watercourse that may permanently or sometimes flow throughout the year.

1.0 INTRODUCTION

This Flood Emergency Management Plan (FEMP) has been prepared specifically for the proposed development (referred to as the "site") located at 174 – 176 Tygum Road, Waterford West. The site is described as Lot 46 on RP 106985. The site has an area of 2613 m^2 and is located within the Logan River floodplain. The site location and extent are shown on **Figure 1**.

The site is subject to flooding from the Logan River. Council's City Plan notes that the 1% AEP flood level for the site is 14.3 mAHD. A Flood Emergency Management Plan is required for the site to reduce flood risk in major flood events to an acceptable level. The focus of this Flood Emergency Management Plan is to effectively manage and mitigate the effects of flooding on the residents of the development, before, during and after a flood event.

The overall objective of this FEMP is to maintain the safety of the staff and customers of the proposed development. This plan seeks to minimise the effects of flooding and provide clear guidance on the management activities required to respond to a flood event.

The FEMP was developed in accordance with the following documentation:

- Standards Australia, 2018, Risk Management – Guidelines, AS ISO 31000:2018;
- Australian Institute for Disaster Resilience (AIDR), 2017, Australian Disaster Resilience Handbook Collection Handbook 7: Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia;
- Australian Institute for Disaster Resilience (AIDR), 2015, Australian Disaster Resilience Handbook Collection Handbook 10: National Emergency Risk Assessment Guidelines; and
- Queensland Disaster Management Act 2003.

The FEMP is based on a risk management approach and outlines operations for effective management across all four phases of disaster management:

- Prevention – the taking of preventative measures to reduce the likelihood of an event occurring or, if an event occurs, to reduce the severity of the event.
- Preparedness – the taking of preparatory measures to ensure that, if an event occurs, communities, resources and services are able to cope with the effects of the event.
- Response – the taking of appropriate measures to respond to an event, including action taken and measures planned in anticipation of, during and immediately after an event to ensure that its effects are minimised and that persons affected by the event are given immediate relief and support.
- Recovery – the taking of appropriate measures to recover from an event, including action taken to support disaster-affected communities in the reconstruction of infrastructure, the restoration of emotional, social, economic and physical wellbeing, and the restoration of the environment.

In accordance with the documentation listed above, the Plan includes a risk assessment based on the following tasks:

- Identification of risk;
- Analysis of risk;
- Evaluation of risk; and
- Identification and evaluation of risk amelioration options

Figure 1 Locality Plan

2.0 SITE DESCRIPTION

The site is located in the suburb of Waterford West, within the boundaries of Logan City Council (LCC). The site covers an area of approximately 2613 m^2. It is bounded to the north by Waterford Plaza shopping centre, to the east by Tygum Road and residential dwellings, to the south by residential development and to the west by Tygum Lagoon. The location of the site is shown in **Figure 1**.

The existing site varies in level from 14.9 mAHD, in the north east corner of the site, to 10.4 mAHD on the western boundary of the site. The site generally slopes west to Tygum Lagoon with slopes typically between 5 and 10%. The topography of the area is shown on **Figure 2** and **Figure 3**.

The proposed development will consist of a storage facility, constructed at or above the defined flood level (Logan River 1% AEP with climate change). Access to the site is via Tygum Road.

Figure 2 Topography

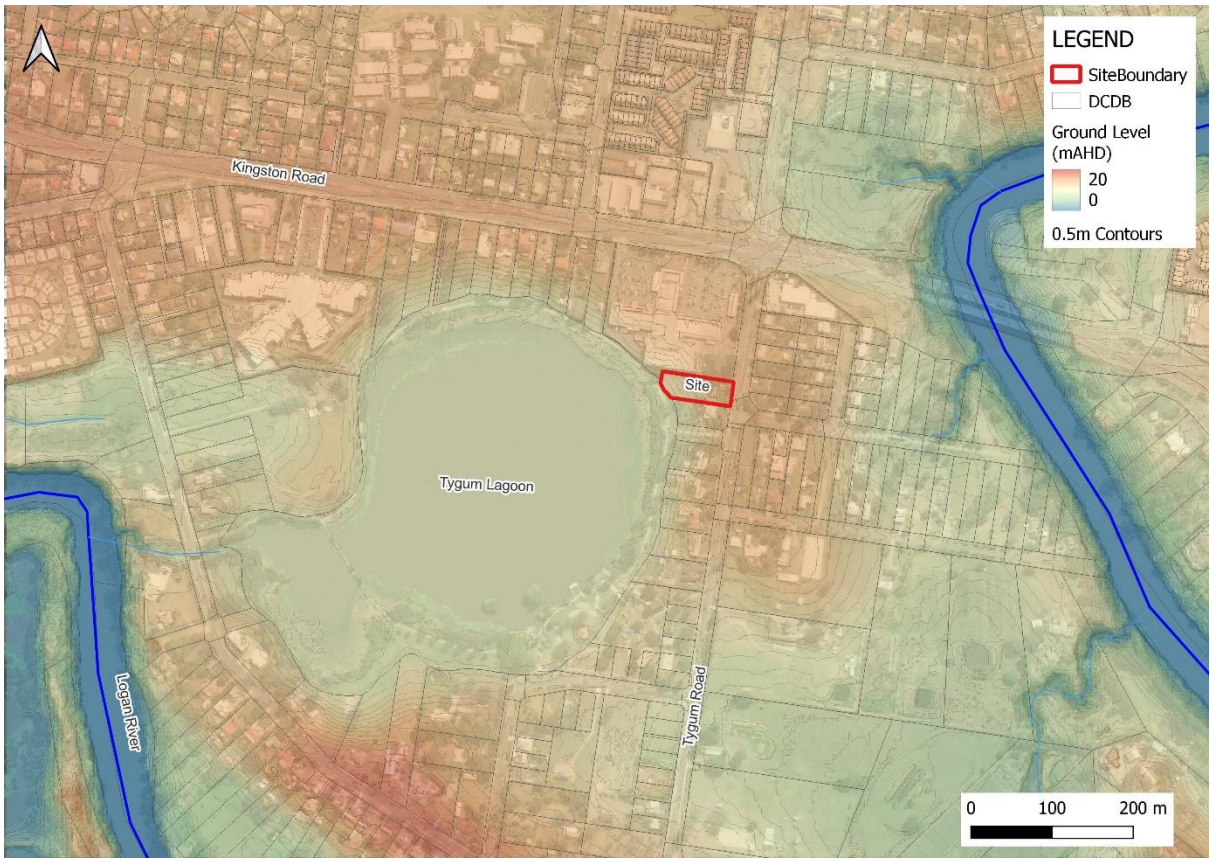
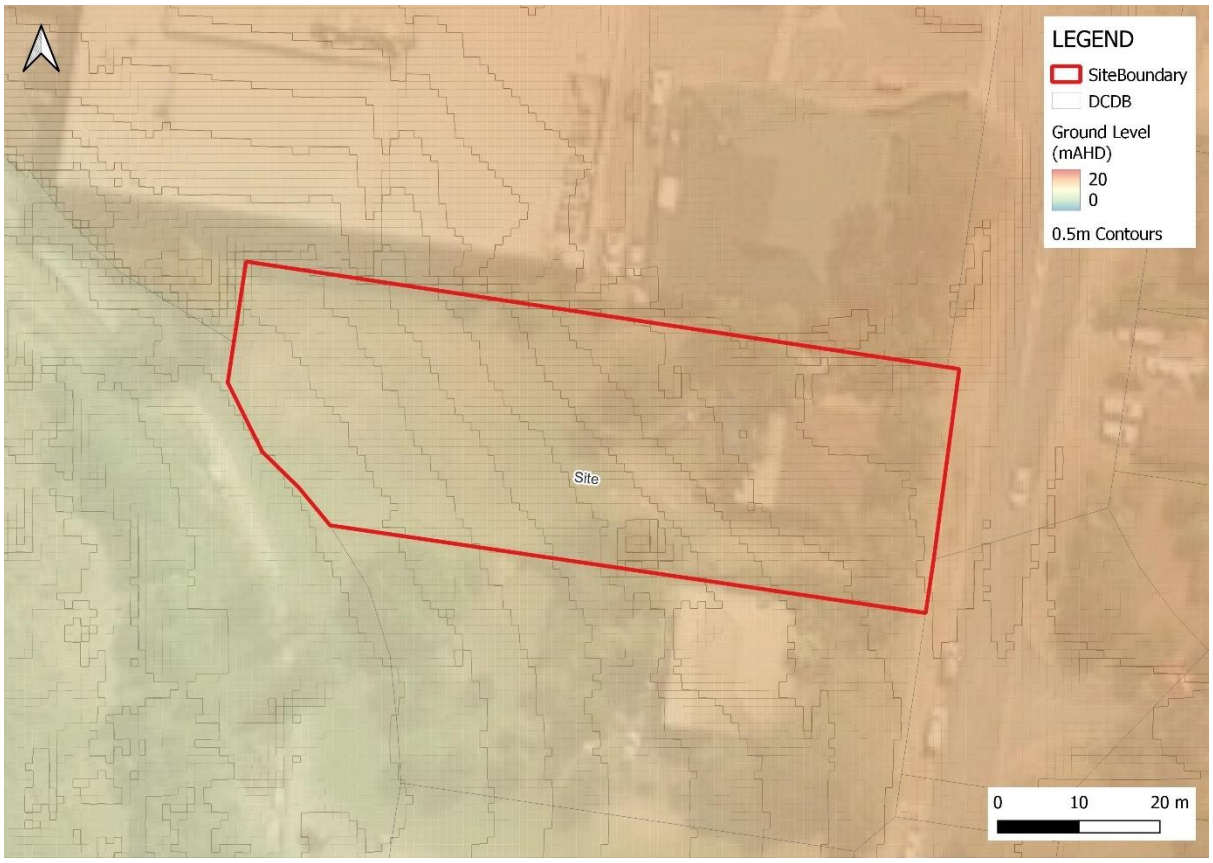


Figure 3 Site Topography



3.0 NATURE OF FLOOD THREAT

3.1 Sources of Flooding

The site is located within the Logan River floodplain and is affected by riverine flooding resulting from heavy rainfalls in the Logan River catchment. The Logan River flows from west to east south of the site. The river has a catchment area of approximately 2,700 km^2 to the site.

The site is not affected by local creek catchment or overland flow flooding. Flood levels at the site from the Logan River are summarised in **Table 1**. These flood levels are extracted from the Logan-Albert Rivers Flood Study completed in 2021 and include climate change for all design events.

The Bureau of Meteorology operates a flood gauge in the Logan River at Waterford (approximately 200 metres east of the site). The peak flood levels at the Waterford gauge due to flooding in the Logan River catchment are also shown in **Table 1**.

Table 1 Logan River Flood Levels at Site

Design Event	Flood Level at site (mAHD)	Flood Level at Waterford Stream Gauge (mAHD)
20%	n/a	7.4
10%	10.7	9.1
5%	12.5	10.6
2%	13.5	12.4
1%	14.3	13.7
0.5%	14.8	14.3
0.2%	15.5	14.9
PMF	19.8	19.3

- Source: Logan-Albert Rivers Flood Study (WRM, August 2021)

The defined flood level provided by Logan City Council for the property is 14.3 mAHD.

It is important to note this behaviour is based on “design events” which statistically represent likely flood events for the catchment. However, as no two floods are the same, changes in rainfall intensity, rainfall location and catchment response may vary these typical results.

3.2 Site Access and Evacuation Route

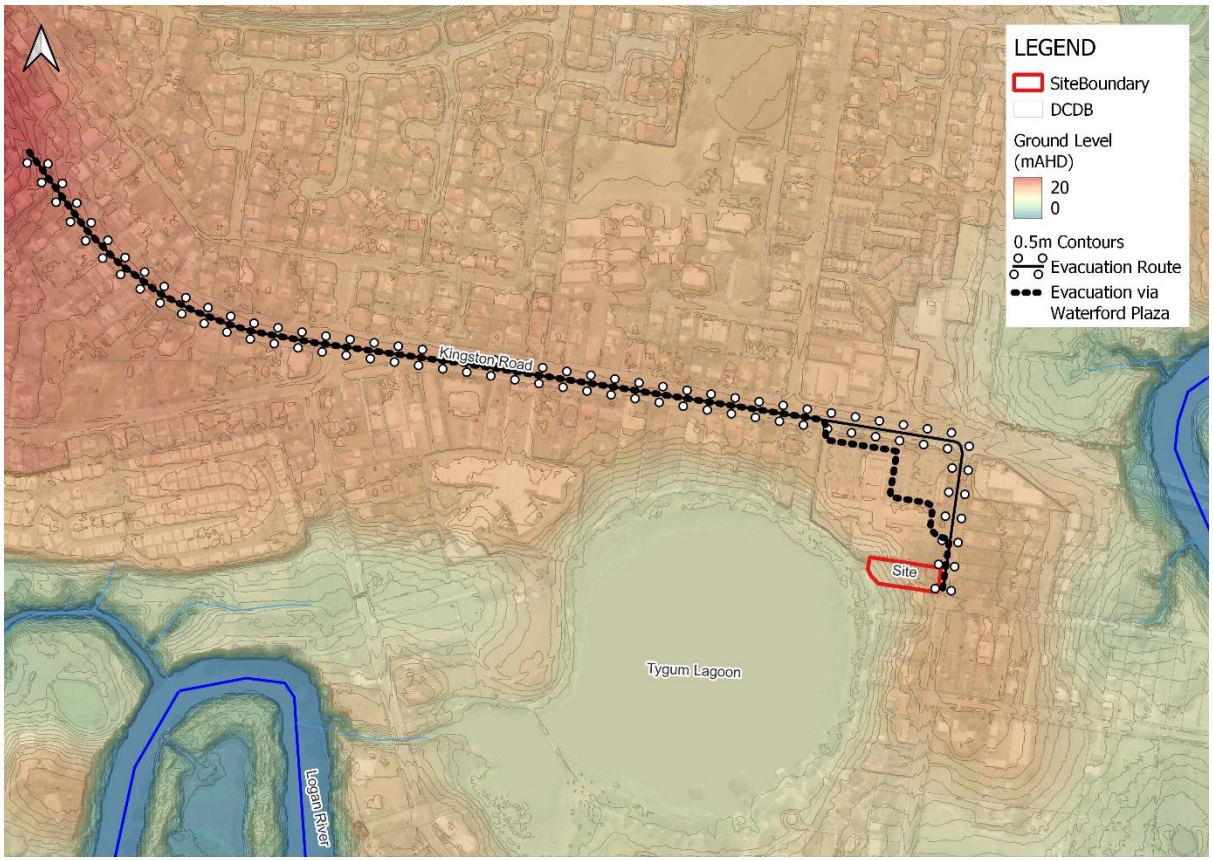
The nearest high ground to the site is to the north west, along Kingston Road. Access to and from the site is via Tygum Road. At the entrance to the site, the elevation on Tygum Road is approximately 14.6 mAHD. However, Tygum Road slopes downwards towards the intersection with Kingston Road, with a minimum level of approximately 12.9 mAHD at the intersection. Kingston Road then rises, reaching a level of 14.3 mAHD (the 1% AEP level including climate change) within 200 metres.

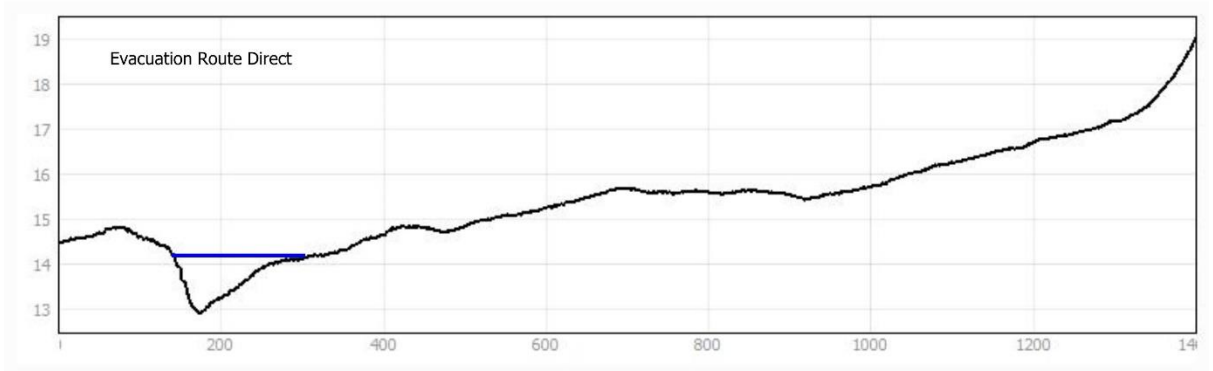
An alternative evacuation route is through the Waterford Plaza car park. This would avoid the low point at the intersection of Tygum Road and Kingston Road. The minimum ground level on this access route is 14.0 mAHD.

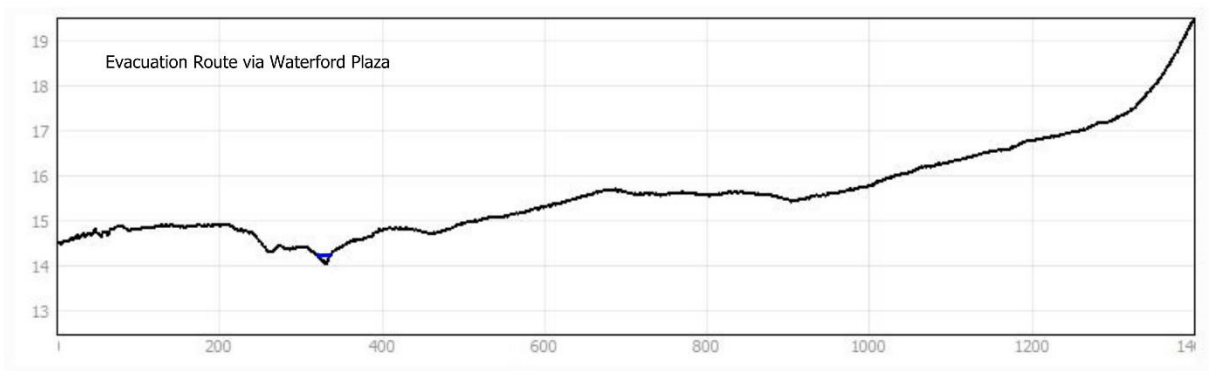
It is noted that for both evacuation routes, inundation occurs directly from the Logan River to the east. The gauge levels at Waterford gauge are therefore directly representative of the flood level. In contrast, flooding of the site occurs from the west, due to overflow from the Logan River, approximately 4 km upstream of the gauge and are therefore higher. There is high ground between the site and the evacuation route.

The evacuation routes and levels are shown on **Figure 4**.

Figure 4 Evacuation Routes







3.3 Evacuation Timeline

In accordance with floodplain best management practice (Handbook 7, Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia, Australian Institute for Disaster Resilience, 2017), it is recommended in this FEMP that evacuation from the site be the principal means of managing flood risk in the event of Logan River flooding.

The New South Wales (NSW) State Emergency Service (SES) Traffic Evacuation Model is used to estimate the time required to safely evacuate a site. The time required is comprised of four components, as follows.

- **Warning Acceptance Factor** – the time taken for people to act following the instruction to evacuate. The NSW SES recommends a value of one hour.
- **Warning Lag Factor** – the time taken by people to prepare to evacuate. The NSW SES recommends a value of one hour.
- **Travel Time** – the time taken for all vehicles to evacuate and pass a point given the capacity of the road. The NSW SES recommends an assumed road capacity of 600 vehicles per hour per lane. Given the number of houses south of the site which would also need to evacuate via Tygum Road, a travel time of one hour is considered appropriate for all vehicles to evacuate.
- **Traffic Safety Factor** – an additional time to allow for possible delays, such as accidents or breakdowns, fallen trees or power lines or water across the road, etc. For a travel time of up to 3 hours, the NSW SES recommends a value of one hour.

The above factors are primarily applicable to residential development. However, whilst a commercial development such as the proposed development will not involve a large number of people requiring evacuation, the FEMP must account for the fact that some people, once hearing of an imminent flood, will travel to the site to ensure the safety of their stored goods. Allowance needs to be made for this type of behaviour. An additional 3 hours has therefore been added to the evacuation time to allow for this.

Therefore, the total time required to completely evacuate the site following the instruction to leave is approximately 7 hours.

The possibility of major flooding in the lower Logan River is typically known several days in advance of the flooding actually occurring. In addition, the Bureau of Meteorology (BoM) Flood Warning Service will issue forecasts of peak flood levels in the Logan River. The warning time provided by the BoM is specified in Service Level Specification for Flood Forecasting and Warning Services for Queensland (Bureau of Meteorology, 2013). For the Logan River at Waterford, the minimum warning lead time for a quantitative flood level forecast is 18 hours.

The warning time available (minimum of 18 hours) is significantly greater than the time required to completely evacuate the site (less than 7 hours).

4.0 SOURCES OF FLOOD DATA

4.1 Flood Model Data

Logan City Council has commissioned flood study reports including flood modelling for all major catchments. This information can be obtained from Council. The following flood study report was obtained from LCC and relied upon in the development of this FEMP:

- '*Logan and Albert Rivers Flood Study*', WRM Water and Environment, August 2021.

As this FEMP was developed based on the information available in the flood study report, any updates to the relevant models may impact the understanding of flood risks. Therefore, this FEMP should be reviewed and, if necessary, updated at such time that the Logan and Albert Rivers flood study reports and/or models are updated.

4.2 Live Data

During an event, there are a number of agencies that provide live flood data which can assist in understanding the severity of the event. These sources are listed in **Table 2**.

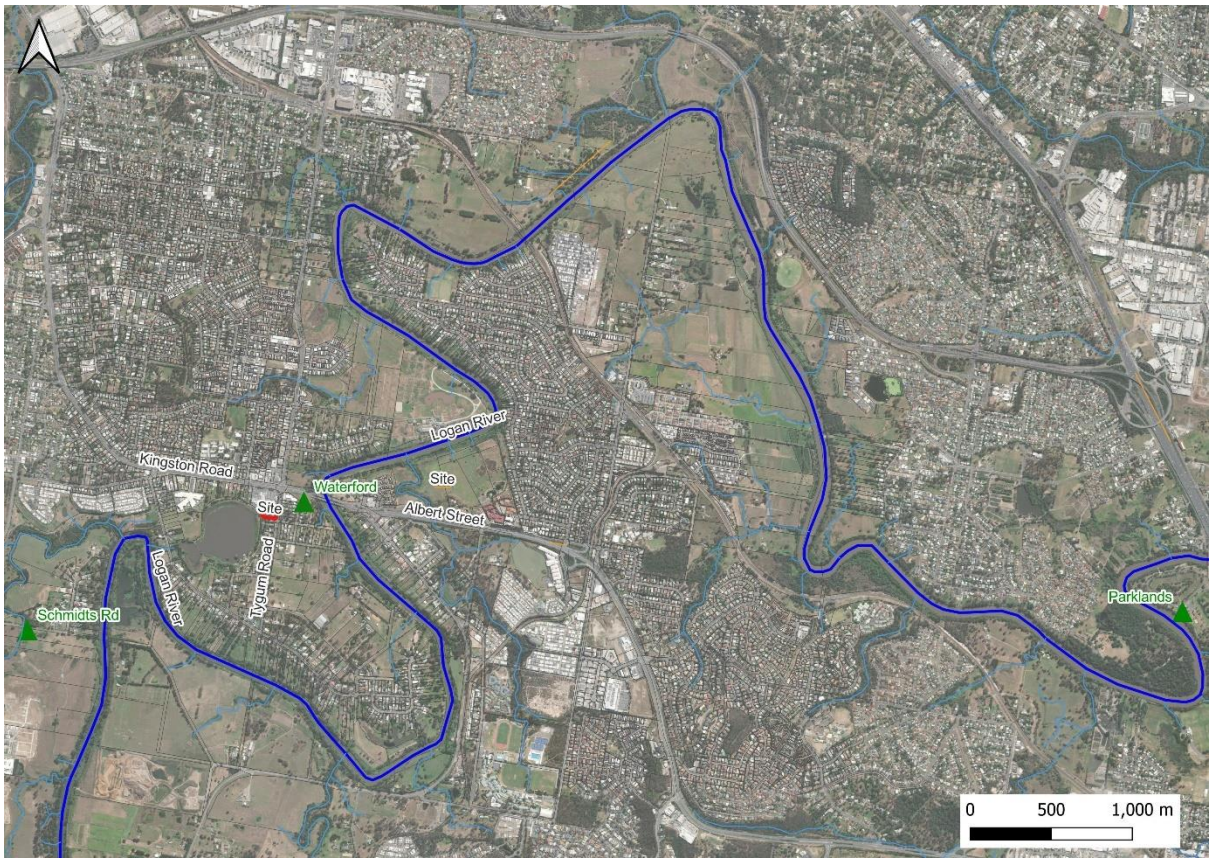
Table 2 Available Flood Data and Resources

Agency/Service	Data type	Contact Details
Bureau of Meteorology (BoM)	Queensland Flood Warning Centre	http://www.bom.gov.au/qld/warnings/
	Stream Gauge – Logan River at Schmidts Road (540675)	http://www.bom.gov.au/fwo/IDQ65388/IDQ65388.540675.plt.shtml
	Stream Gauge – Logan River at Waterford (040878)	http://www.bom.gov.au/fwo/IDQ65388/IDQ65388.040878.plt.shtml
	Stream Gauge – Logan River at Parklands (540645)	http://www.bom.gov.au/fwo/IDQ65388/IDQ65388.540645.plt.shtml
	Recorded Voice Flood Warning System	Main Directory – 1900 955 360 Flood Warnings – 1300 659 219
	General Information	1300 659 219 www.bom.gov.au
	Mt Stapylton Rainfall Radar	http://www.bom.gov.au/products/IDR663.loop.shtml
Logan City Council Disaster Management Centre	Disaster Management Centre Links to various information, including rainfall, river heights, road closures, etc.	https://disaster.logan.qld.gov.au/

The stream gauge in the Logan River at Waterford is a key reporting location. Additional gauges exist upstream and downstream of the Waterford gauge, as detailed in **Table 2**. During flood events, forecasts of peak flood levels are issued for the Waterford stream gauge location. This is the gauge referred to in the emergency action plan.

The location of each gauge relative to the subject site is shown in **Figure 5**.

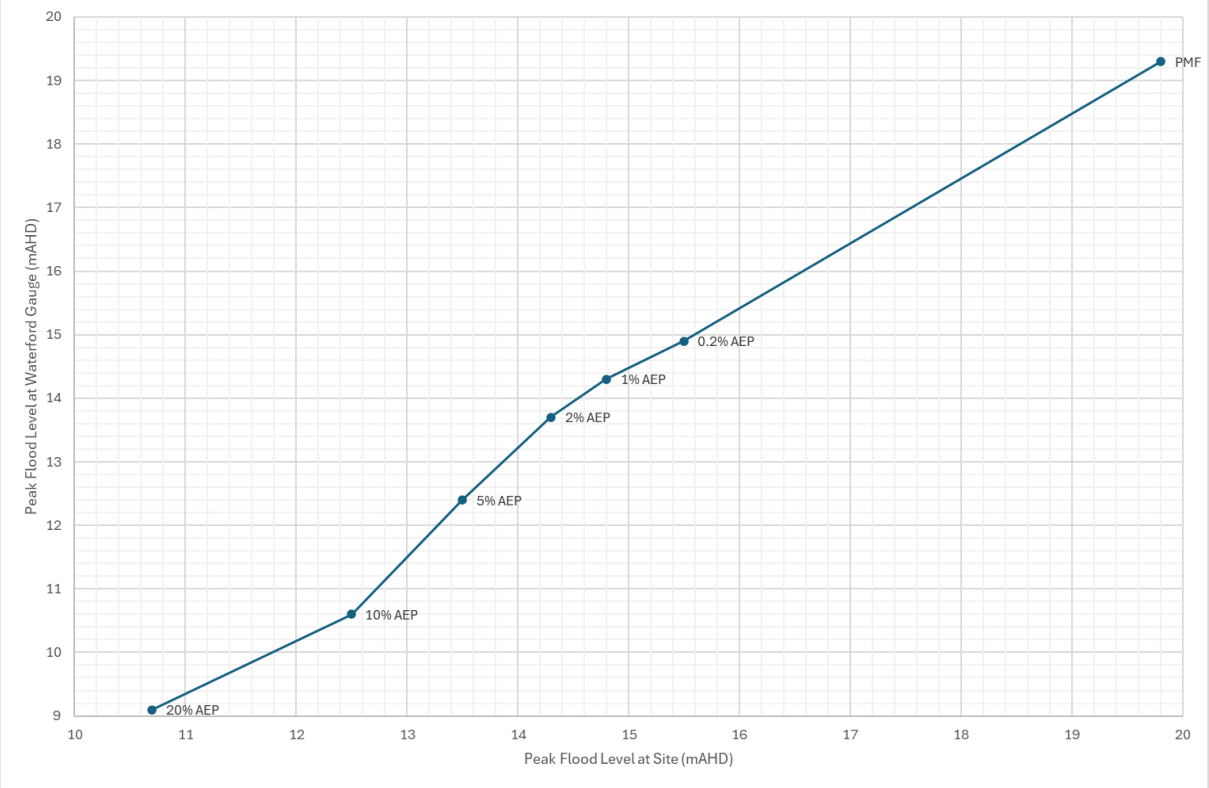
Figure 5 Flood Emergency Details



The Waterford gauge is located within 200 metres of the site. For the larger events, which affect the site, there is a direct relationship between the peak flood level at the Waterford stream gauge and that experienced at the subject site. This relationship is shown in the graph presented in **Figure 6** below. Using this graph, the peak flood level at the subject site (and the evacuation routes) can be estimated based on the forecast peak at Waterford.

The trigger levels listed in **Section 6.0** are based on flood levels at the Waterford stream gauge.

Figure 6 Relationship between Flood Levels at Site and Waterford Gauge



5.0 FLOOD RISK MANAGEMENT

5.1 Overview

The risk management assessment was conducted in accordance with *AS ISO 31000:2018 Risk Management – Guidelines*. This document deals specifically with the steps required in determining the flood risk associated with a particular situation.

The risk assessment was based on the following:

- Risk Identification (refer **Table 6**);
- Risk Analysis (refer **Table 7**);
- Risk Evaluation (refer **Table 8**); and
- Identification and evaluation of treatment options (refer **Table 9**).

Based on the use of the site as a storage facility, the primary risks associated with the site relate to people, vehicles, and damage to infrastructure and stored goods. During a flood event, there is the risk that buildings may be inundated.

Risk management measures suitable for the site include:

- hazard warning signs for customers and staff; and
- an emergency action plan.

The following tables provide further detail on the identification, analysis, evaluation and assessment of the risks associated with the site.

5.2 Methodology

Risk assessment involves considering the sources of risk, their consequence and the likelihood of the defined incident occurring. Likelihood and consequences are combined to determine the level of risk.

Risk criteria were therefore developed to evaluate the risks, by differentiating between the likelihood of the risk and the consequence of the event. The likelihood is defined as a qualitative description of probability and frequency. Consequence is defined as the outcome of the event expressed in terms of death, injury, loss or some form of disadvantage.

The consequence and likelihood levels employed in the risk analysis were drawn from Table 3 and Table 2 respectively of the National Emergency Risk Assessment Guidelines (Emergency Management Australia, October 2010). The adopted consequence and likelihood levels are listed in **Table 3** and **Table 4**. It can be noted that the consequence and likelihood levels nominated for each identified risk relate to conditions without management measures in place.

Table 3 Consequence Levels

Level	Descriptor	Qualitative Description
1	Insignificant	• No injuries • Little disruption to the community • No environmental impact detected
2	Minor	• Small number of injuries • Some displacement of people for a short period of time • Small impact on the environment
3	Moderate	• Medical treatment required • Displacement of people for a short period of time • Short term environmental impact; widespread inconveniences
4	Major	• Extensive injuries and some fatalities • Large number of people displaced • Significant environmental impact at a local scale
5	Catastrophic	• Large number of injuries and fatalities • Widespread displacement of people • Significant environmental impact at a regional scale

Table 4 Qualitative Scale of Likelihood

Level	Descriptor	Qualitative Description
A	Almost Certain	The event is expected to occur at least once a year
B	Likely	The event will probably occur on average once every 10 years
C	Possible	The event may occur on average once per 100 years
D	Unlikely	The event could occur once on average once per 1,000 years
E	Rare	The event could only occur once on average once per 10,000 years

The level of risk depends on the likelihood of the risk occurring, and its consequence. The risk criteria employed for this assessment, which was drawn from the ranking criteria presented in the Safety in Design (Consult Australia, August 2010) (p10) are shown in **Table 5**.

Table 5 Risk Classification Matrix

Likelihood	Consequence				
	1 (Insignificant)	2 (Minor)	3 (Moderate)	4 (Major)	5 (Catastrophic)
A (Almost Certain)	Medium	High	Extreme	Extreme	Extreme
B (Likely)	Medium	Medium	High	Extreme	Extreme
C (Possible)	Low	Medium	Medium	High	Extreme
D (Unlikely)	Low	Low	Medium	Medium	High
E (Rare)	Low	Low	Low	Medium	Medium

5.3 Assessment

Based on this information, the risks were assessed and categorised for the site as detailed in the following tables (Table 6, Table 7 and Table 8).

Table 6 Risk Identification

Vulnerable Element	Risk	Consequence
People	People may try to wade through deep floodwaters.	People may be injured or drowned.
People	People may be trapped in buildings by floodwaters.	People may be injured or drowned.
Vehicles	Inundation and potential loss of vehicles.	Potential for damage to or loss of vehicles.
Access	Subject site may become isolated.	Isolation of people and vehicles.
Buildings	Damage to buildings (including furniture, fittings, stored goods and equipment) for extreme flood events.	Potential for damage of furniture and fittings, damage of goods stored in building. Potential for loss of power and consequent spoilage of refrigerated goods.
Emergency Services	Difficulty in accessing the site and rescuing people if road access becomes significantly inundated. Emergency vehicles cannot access inundated areas if the depth of inundation is more than approximately 500 mm.	Potential inability to reach sick or injured people requiring the attendance of emergency services.

Table 7 Risk Analysis

Vulnerable Element	Risk	Likelihood Rating	Consequence Rating	Risk Rating
People	Residents may try to wade through deep floodwaters.	Unlikely	Minor	Low
People	Residents may be trapped in buildings by floodwaters.	Unlikely	Minor	Low
Vehicles	Inundation and potential loss of vehicles.	Unlikely	Minor	Low
Access	Subject site may become isolated.	Unlikely	Minor	Low
Buildings	Damage to buildings (including furniture, fittings, stored goods and equipment) for extreme flood events.	Unlikely	Minor	Low
Emergency Services	Difficulty in accessing the site and rescuing people if road access becomes significantly inundated. Emergency vehicles cannot access inundated areas if the depth of inundation is more than approximately 500 mm.	Unlikely	Minor	Low

Table 8 Risk Evaluation

Vulnerable Element	Risk	Risk Rating	Risk Evaluation	Risk Priority
People	People may try to wade through deep floodwaters.	Low	Sufficient warning time is available to enable people to leave the site. Access to site would typically be via vehicle. Pedestrian access unlikely.	Low Priority
People	People may be trapped in buildings by floodwaters.	Low	Sufficient warning time is available to enable people to leave the site. People are unlikely to stay in this type of facility during a flood.	Low Priority
Vehicles	Inundation and potential loss of vehicles.	Low	Sufficient warning time is available to enable people to leave the site. Unlikely location to leave a vehicle.	Low Priority
Access	Subject site may become isolated.	Low	Sufficient warning time is available to enable people to leave the site.	Low Priority
Buildings	Damage to buildings (including furniture, fittings, stored goods and equipment) for extreme flood events.	Low	Damage to electrical system could occur in extreme flood events, affecting the recovery time of the buildings.	Low Priority
Emergency Services	Difficulty in accessing the site and rescuing people if road access becomes significantly inundated. Emergency vehicles cannot access inundated areas if the depth of inundation is more than approximately 500 mm.	Low	Sufficient warning time is available to enable people to leave the site. Unlikely location for people to remain.	Low Priority

Table 9 Identification and Evaluation of Treatment Options

Vulnerable Element	Risk	Risk Priority	Treatment Option	Evaluation of Treatment Option
People	People may try to wade through deep floodwaters.	Low Priority	Signage to be displayed throughout the facility to ensure users are aware of how the site is affected by flooding. Preparation of an action plan to be implemented in the event of flooding.	The adoption of an evacuation strategy will minimise the potential for people to be wading through deep water.
People	Residents may be trapped in buildings by floodwaters.	Low Priority	Notification of visitors of potential for flooding and isolation. All residents to be made aware of the recommendation to evacuate site prior to a large flood event. Preparation of an action plan to be implemented in the event of flooding.	The adoption of an evacuation strategy will minimise the potential for people to be trapped in building during a flood event.
Vehicles	Inundation and potential loss of vehicles.	Low Priority	As above.	Sufficient time is available to evacuate via vehicle.
Access	Subject site may become isolated.	Low Priority	As above.	The adoption of an evacuation strategy will minimise the need for people to remain at the site.
Buildings	Damage to buildings (including furniture, fittings, stored goods and equipment) for extreme flood events.	Low Priority	All electrical infrastructure (including meters) will be located above the 0.5% AEP flood level.	Provision of electrical infrastructure above the 0.5% AEP level minimises the risk of electrical infrastructure being damaged and therefore reduces the time for buildings to become operational following an extreme flood event.
Emergency Services	Difficulty in accessing the site and rescuing people if road access becomes significantly inundated.	Low Priority	Notification of potential for flooding and isolation. All residents to be made aware of the recommendation to evacuate site prior to a large flood event. Preparation of an action plan to be implemented in the event of flooding.	The adoption of an evacuation strategy will minimise the need for emergency services to access the site.

6.0 FLOOD EMERGENCY MANAGEMENT

6.1 Flood Gauges

As noted above, there are a number of flood alert gauges operating on the Logan River. The nearest of these gauges are:

- Waterford Alert (040878) – located approximately 800 metres west of the Site, along the Logan River; and
- Schmidt's Creek at Schmidt's Road (540675) – located approximately 2km upstream of the Site on Schmidt's Creek, a tributary of the Logan River.

These gauges form part of the BoM flood warning system. Real time water levels are therefore available through the BoM website. The BoM flood warning system also includes a comprehensive network of rainfall and river height stations located throughout the area, allowing for detailed information regarding flooding and forecasting of flooding.

The Waterford Alert gauge is a flood forecasting gauge. During a flood, the BoM will provide forecast levels at this gauge. These forecasts typically take the form of a predicted flood level at a particular time.

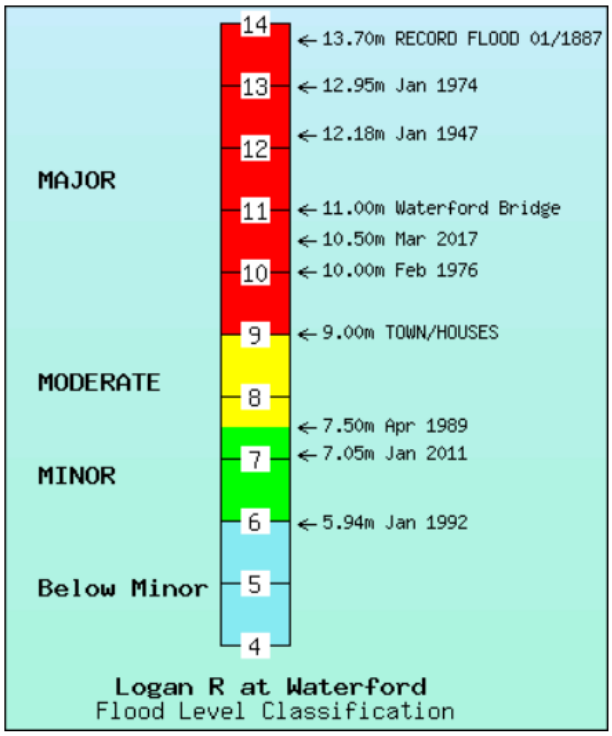
The Schmidt's Creek gauge is located on Schmidt's Creek, a tributary of the Logan River. The gauge is approximately 1km upstream of the junction with the Logan River. The Schmidt's Creek gauge has been included as a backup for the Waterford gauge. As the Waterford Alert gauge is a BoM flood forecasting gauge, it is the preferred gauge.

The Waterford Alert (040878) gauge is recommended for assessing the need for evacuation of properties during an extreme event. This gauge provides excellent and timely information relating to flooding, which is particularly relevant to the site given its proximity. The BoM has defined flood classifications for this gauge, with detailed descriptions relating to each classification. The flood classifications for the Waterford Alert gauge, as detailed by BoM are shown below:

Minor Flooding : Causes inconvenience. Low-lying areas next to watercourses are inundated. Minor roads may be closed and low-level bridges submerged. In urban areas inundation may affect some backyards and buildings below the floor level as well as bicycle and pedestrian paths. In rural areas removal of stock and equipment may be required.

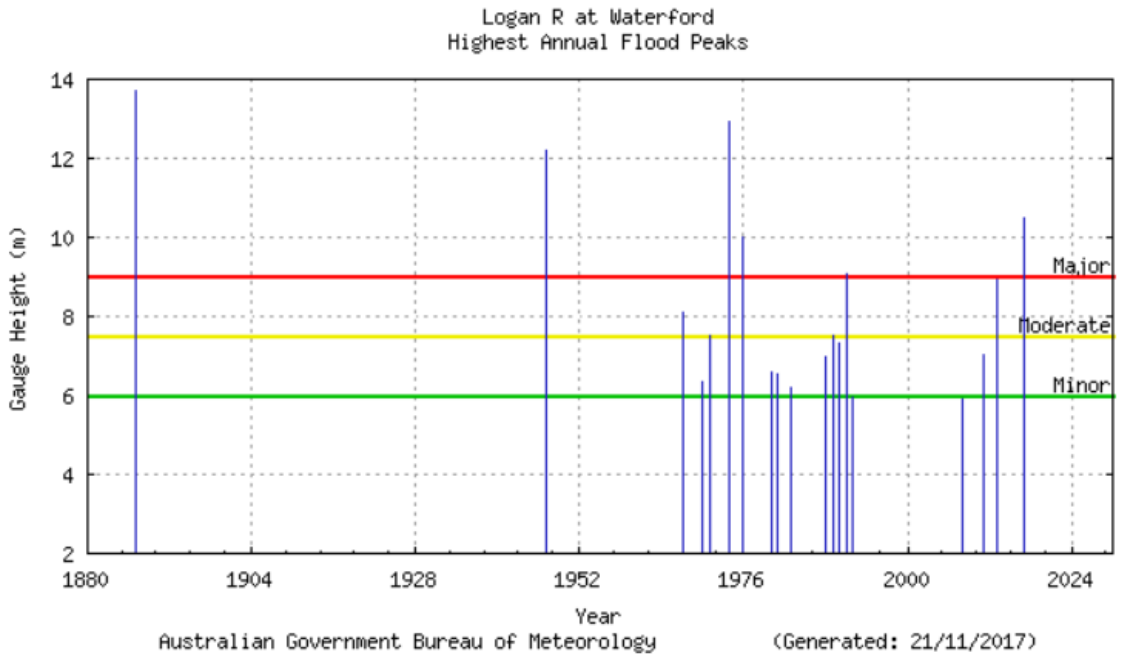
Moderate Flooding : In addition to the above, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood affected areas may be required. In rural areas removal of stock is required.

Major Flooding : In addition to the above, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood affected areas may be required. Utility services may be impacted.



Most specifically, a minor event is classified as being above 6.0 mAHD, a moderate event as being above 7.5 mAHD and a major event as being above 9.0 mAHD. Delineation of a flood as being either minor, moderate or major therefore conveys relevant information as to the peak water level which is predicted to occur.

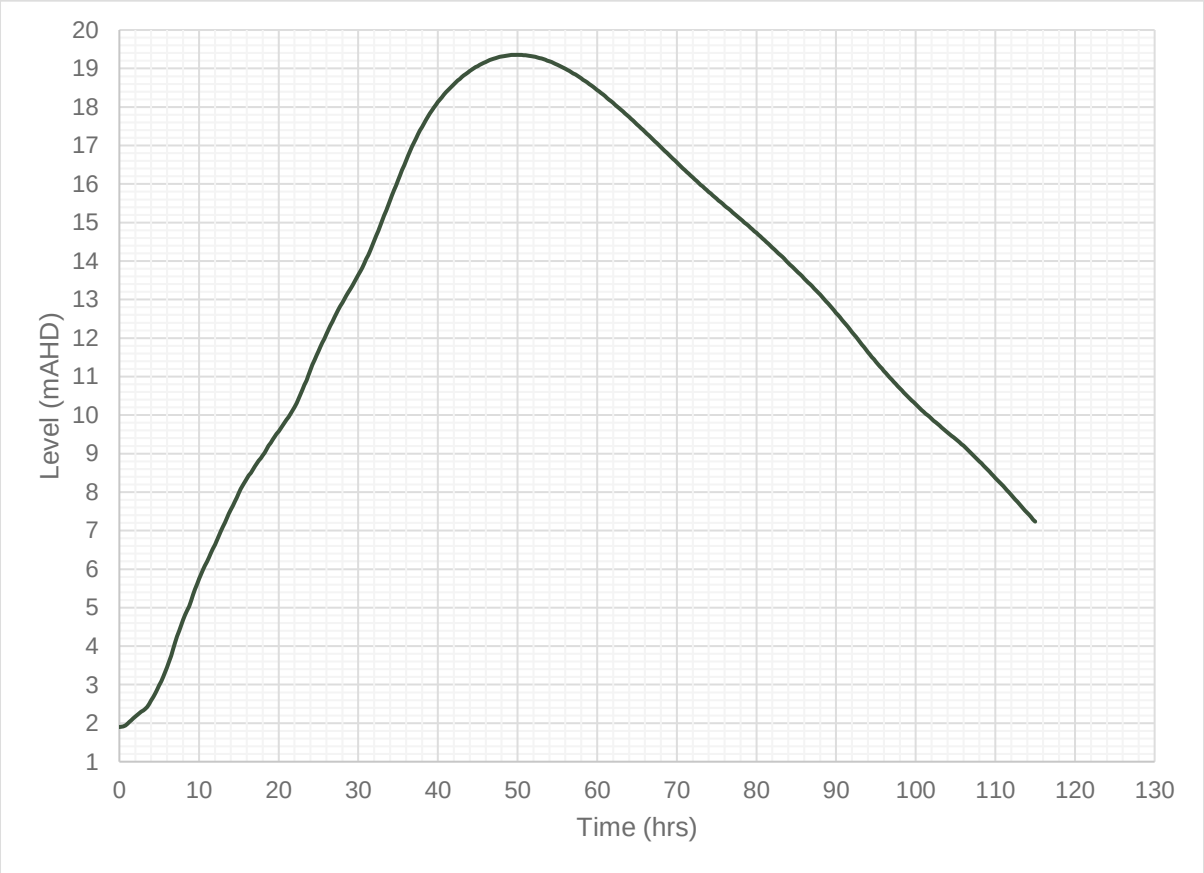
The BoM also provides a graph showing the peak levels for all events that have been recorded, along with the classifications.



As shown on this graph, the largest recorded event at this gauge was in January 1887. Based on the Flood Report for the site, the 1% AEP flood level at the site is 14.3 mAHD, which corresponds toa level of 13.4 mAHD at the gauge.

The *Logan and Albert Rivers Flood Study* provides useful information relating to timing of floods. **Figure 7** below, shows the water levels at the Waterford gauge based on the PMF. The PMF event was chosen as it has the steepest rise in water level, when compared with more frequent events.

Figure 7 Logan River Level Hydrograph, PMF Design Event



As shown on this figure, the minor flood level of 6.0 mAHD at the Waterford gauge is expected to occur 10 hours after the commencement of the flood event, while the moderate flood level of 7.5 mAHD is expected to occur at 14 hours and the major level at 18 hours. Tygum Road, at the intersection with Kingston Road, is expected to become inundated at approximately 27 hours (17 hours after the minor level, 13 hours after the moderate level and 9 hours after the major level). Whilst it is noted that this behaviour is based on “design events” which statistically represent likely flood events for the catchment, it is useful for determining an appropriate trigger level for evacuation of the site. As discussed in Section 3.3, a warning time of at least 7 hours is recommended. This has been taken into account in the trigger levels.

The hydrograph presented in **Figure 7** also shows the duration of inundation. For the PMF event, the site would be isolated for several days.

6.2 Management Approach

6.2.1 Triggers

The site's flood risk has been carefully assessed. As identified above, the site will remain safe for all events up to and including the 1% AEP event. However, access to the site via Tygum Road is lost for events greater than the 2% AEP event. Egress can occur via the Waterford Plaza car park for events greater than the 2% AEP. However, this evacuation route is also cut for events greater than the 1% AEP event.

It is therefore considered appropriate that the site be evacuated, and that customers be advised that the facility is closed if a Major flood event or greater is forecast in the Logan River catchment. Critical flood levels for flood emergencies at the site during Logan River flood events are provided in **Table 10.**

Table 10 Critical Flood Levels

Flood Level (mAHD)		Description
Waterford Gauge	Site	
12.9	13.8	Tygum Road inundation commences. Evacuation via Waterford Plaza car park only above this level.
14.0	14.5	Waterford Plaza car park becomes inundated. Evacuation routes cut.

Safe egress from the site in advance of a flood event is available, as described in **Section 3.2**. Trigger levels for action are shown in **Section 6.3**. The trigger levels are based on the recorded and forecast flood levels at the Waterford stream gauge (refer **Figure 5**).

The flood risk management strategy for the facility will consist of the following.

- The triggers for action as defined in the following sections.
- In the event that BoM warnings are not being issued, the signal for evacuation will be the occurrence of a major flood level (level in excess of 9.0 mAHD) at the Waterford Alert Station. This will allow sufficient time for evacuation should a major event occur and provides a clear warning not requiring interpretation.

6.2.2 Management Structure

It will be the responsibility of the manager of the facility to:

- ensure a copy of the FEMP is available on site and that all staff are aware of its contents.
- Monitor flood forecasts, flood warnings, etc (refer **Table 12**)
- Advise customers on evacuation during a flood event and of closure of the facility (refer **Table 12**)

6.2.3 Signage

It is recommended that signage be installed within the car park of the site advising that the property is subject to flooding and that floodwaters should not be entered. Example wording is : "*This car park is subject to flooding during prolonged periods of excessive rainfall. Do not enter floodwaters.*"

In addition, it is recommended that signage be provided within the site office advising that during a flood, inundation of the intersection of Tygum Road and Kingston Road prevents access to the site during major events.

6.3 Emergency Action Plan

An Emergency Action Plan (EAP) provides a road map of activities based on the risks and consequences of the event. The plan should appropriately balance the need for site operations and prioritising the safety of the residents.

The EAP follows the four levels of action described in the Queensland Disaster Management Arrangements (2018). The levels are listed in **Table 11**.

Table 11 Emergency Action Plan Levels of Activation

Level of Activation	Definition
Alert	A heightened level of vigilance and preparedness due to the possibility of an event in the area of responsibility. Some action may be required and the situation should be monitored by staff capable of assessing and preparing for the potential threat.
Lean Forward	An operational state prior to 'stand up' characterised by a heightened level of situational awareness of a disaster event (either current or impending) and a state of operational readiness. Disaster coordination centres are on stand-by, prepared but not activated.
Stand up	The operational state following 'lean forward' whereby resources are mobilised, personnel are activated and operational activities commenced. Disaster coordination centres are activated.
Stand down	Stand down Transition from responding to an event back to normal core business and/or recovery operations. There is no longer a requirement to respond to the event and the threat is no longer present.

The triggers of emergency action are shown in **Table 12**. It should be noted that the action plan has been based on typical catchment behaviour and response. The plan cannot account for all risks that arise. Situational awareness is required and information provided by authorities should always be prioritised and appropriate action taken.

Table 12 Triggers for Emergency Action

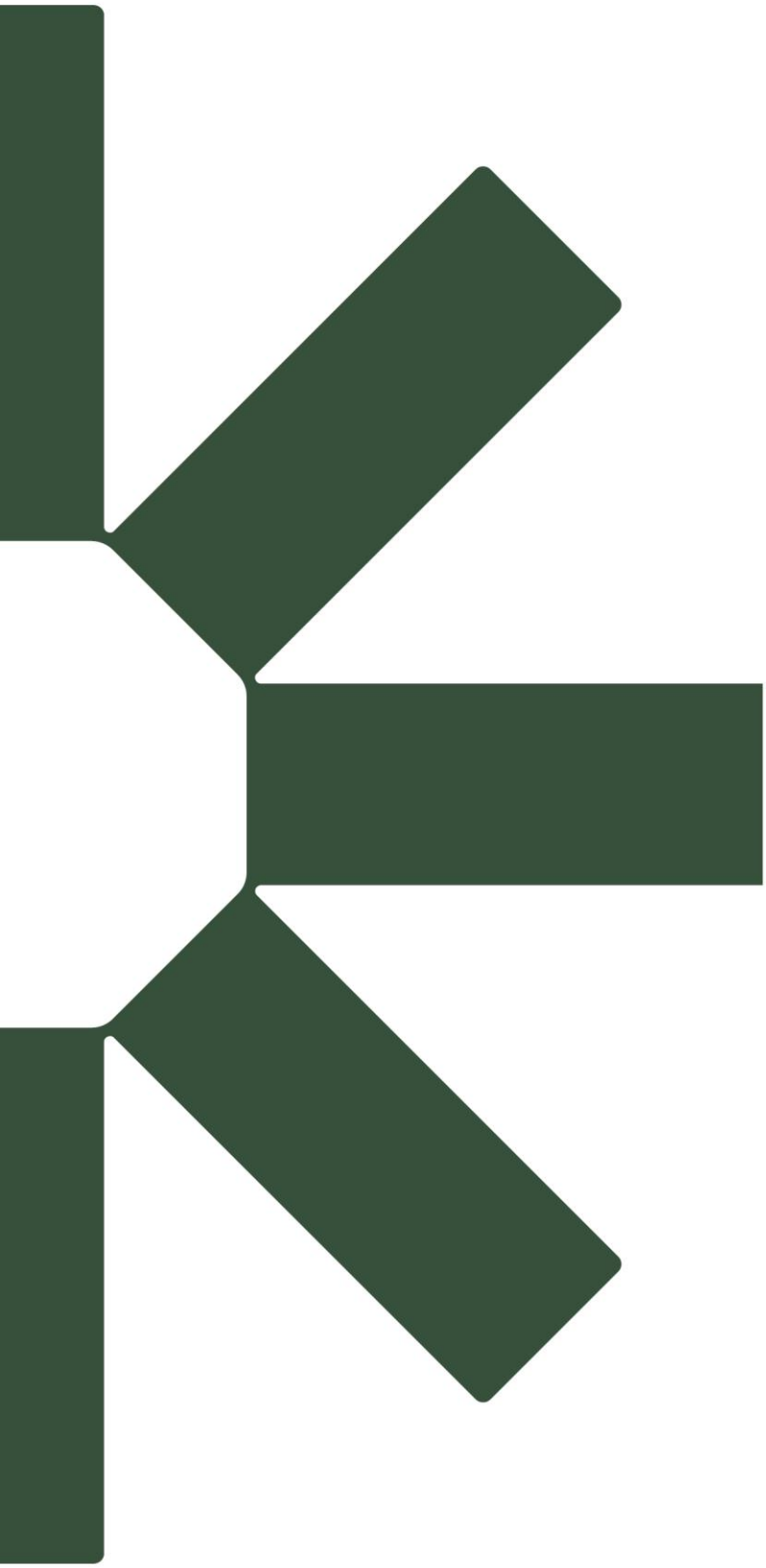
Level of Activation	Trigger	Emergency Classification	Response
Alert	Flood warning issued for the Logan River.	Low Risk	Monitor flood forecasts and warnings issued by BoM and Logan City Council.
Lean Forward	BoM forecast Major flood event in Logan / Albert River	Low Risk	Continue to monitor flood forecasts and warnings issued by BoM. Monitor recorded flood levels at the Waterford stream gauge. Monitoring is to continue for the remainder of the flood emergency. Site manager to advise customers that evacuation/closure of facility may be required.
Stand up	Waterford stream gauge reading reaches 9.0 mAHD.	Low Risk	Prepare to evacuate/close the site if further rises in the Logan River are forecast.
Stand up	Waterford stream gauge reading reaches 9.5 mAHD.	Moderate Risk	Site manager to evacuate the site. Evacuation via Tygum Road can occur until inundation occurs. Evacuation then to occur through Waterford Plaza car park. No vehicles to enter site once Tygum Road is inundated. **If it's flooded, forget it.** Do not return to the site until the flooding has receded and no further flood rises are forecast.
Stand down	Waterford stream gauge reading has fallen below 10.0 mAHD and no further rises are forecast.	Low Risk	Commence recovery operations.

7.0 RECOVERY

Once the flood threat has passed and floodwater receded, it is important that the site is inspected for damage if inundation has occurred. In addition to the expected clean up required to meet Occupation Health and Safety requirements, the following activities should be carried out as a minimum.

- Hazard assessment undertaken by appropriately qualified staff. Report should identify and note mitigating actions to prevent slips, trips, falls, injury from sharp debris, protection from venomous animals and contaminated waste and sediment. Persons undertaking the recovery assessment should be wearing appropriate personal protective equipment (PPE).
- Inspection of all previously inundated areas should be carried out. Remove debris and check for damage to fences, driveways, pipes, vegetation etc.
- Certification by an appropriately qualified electrician that no risk of electrocution is possible.

Following the conclusion of the event, all processes including this plan should be reviewed with key stakeholders and altered where necessary.



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