Paluma Dam

Emergency Action Plan

2024

Approved by the delegate of the Chief Executive, Department of Regional Development, Manufacturing and Water until 1 July 2025.

Emergency Alerts, Notifications

As this Emergency Action Plan and the hazards that it refers too, have a direct impact on downstream residents residing in the Charters Towers Local Government Area, all early warnings, notifications and warning messages are managed directly through early and proactive advice to the Charters Towers Disaster Management Group.

In the event that this EAP is activated, downstream residents are provided with information by the Charters Towers Regional Council (CTRC), as detailed in the Event Alert Tables following.

If the Charters Towers LDMG is not contactable during an Emergency Event or when otherwise required, the Paluma Dam Operator is authorised to make direct contact and advise of emergency event status in accordance with the Australian Warning System detail below.

A copy of the approved (redacted) Paluma Dam EAP is available to the public on the Townsville City Council and DRDMW website.

Emergency Warning Messages

There is limited mobile reception downstream of Paluma Dam. Emergency text messaging will NOT be issued through the Emergency Alert system. All messaging must be issue by phone calls to landlines and email. If the Charters Towers LDMG is not contactable during an Emergency Event or when otherwise required, the Dam Operator is authorised to make direct contact and advise of the emergency event status to downstream residents. The AWS warning titles and call to action is detailed below and should be used when issuing warnings.

Dam Activation Level and Corresponding AWS Warning Levels and Call to Action			
Emergency Event	**Lean Forward**	**Stand Up**	**Stand Up – 0.25m from overtopping wall or Dam in Distress**
Flood	 **Advice (Yellow)** This is a flood advice warning. A dangerous flood is possible in Running River in next 48 hours. PREPARE NOW FOR POSSIBLE FLOODING. Conditions could change very quickly listen to local radio.	 **Watch and Act (Orange)** This is a flood watch and act warning. A dangerous flood is now occurring in Running River. MOVE TO HIGHER GROUND AWAY FROM RUNNING RIVER. Conditions could change quickly. Listen to local radio. If your life is in danger call Triple Zero.	 **Emergency Warning (Red)** This is a flood emergency warning. Paluma dam at risk of overtopping a catastrophic flood is imminent. MOVE TO HIGHER GROUND AWAY FROM RUNNING RIVER or GET UP AS HIGH AS YOU SAFELY CAN. Conditions are changing quickly and very dangerous. Listen to local radio. If your life is in danger call Triple Zero.
Piping	 **Advice (Yellow)** This is a flood advice warning. Piping has been detected in the Paluma Dam wall. A dangerous flood is possible in Running River in next 48 hours. PREPARE NOW FOR POSSIBLE FLOODING. Conditions could change very quickly listen to local radio.	 **Watch and Act (Orange)** This is a flood watch and act warning. Piping has accelerated in the Paluma Dam wall. A dangerous flood is possible in Running River. MOVE TO HIGHER GROUND AWAY FROM RUNNING RIVER. Conditions could change very quickly listen to local radio.	 **Emergency Warning (Red)** This is a flood emergency warning. Paluma dam piping cannot be repaired. Dam failure and a catastrophic flood is imminent. MOVE TO HIGHER GROUND AWAY FROM RUNNING RIVER or GET UP AS HIGH AS YOU SAFELY CAN. Conditions are changing quickly and very dangerous. Listen to local radio. If your life is in danger call Triple Zero.
Earthquake	 **Advice (Yellow)** This is a flood advice warning. A significant earthquake has occurred at Paluma Dam. A dangerous flood is possible in Running River in next 48 hours. PREPARE NOW FOR POSSIBLE FLOODING. Conditions could change very quickly listen to local radio.	 **Watch and Act (Orange)** This is a flood watch and act warning. A significant earthquake has occurred at Paluma Dam and the wall is damaged. A dangerous flood is possible in your area. MOVE TO HIGHER GROUND AWAY FROM RUNNING RIVER. Conditions could change very quickly listen to local radio.	 **Emergency Warning (Red)** This is a flood emergency warning. A significant earthquake has occurred at Paluma Dam. Dam failure and a catastrophic flood is imminent. MOVE TO HIGHER GROUND AWAY FROM RUNNING RIVER or GET UP AS HIGH AS YOU SAFELY CAN. Conditions are changing quickly and very dangerous. Listen to local radio. If your life is in danger call Triple Zero.

Emergency Activation Quick Reference Guide

This EAP Paluma Dam covers four (4) emergency conditions. Use the following table to select the relevant section of the EAP that deals with the emergency condition.

Activation Level	Alert	Lean Forward	Stand Up	Stand down
Activation triggers for emergency conditions relating to dam release hazards				
Flood Event **(Refer to Pg. 20)**	EL893.27 and rising (0.250m above FSL)	EL893.52 and rising (0.500m above FSL)	EL893.77 and rising (0.750m above FSL)	EL893.27 and falling (0.250m above FSL)
Activation triggers for emergency conditions relating to dam failure hazards				
Dam Distress - Seismic Event **(Refer to Pg.23)**	Earthquake in area less than 5MM (Modified Mercalli).	Earthquake in area greater than 5MM (Modified Mercalli).	Evidence of Dam Distress.	No immediate downstream risk.
Dam Distress - Piping and Seepage **(Refer to Pg. 26)**	Increased seepage rate observed.	Increase in seepage rate with cloudy water evident.	Dam distress evident - including an increase in seepage water flow rate, cloudy seepage water, evidence of deformation or erosion, upstream vortex.	Storage stabilised and no immediate downstream risk.
Terrorist Activity/Threat/Hoax **(Refer to Pg. 29)**	Possible terrorist activity noticed or reported	Serious incident that could threaten the integrity of the dam, such as explosion of aircraft strike.	Threat to dam integrity confirmed	Storage stabilised and no immediate downstream risk.

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Revision History

Complete version history information is stored within Paradigm, the Water Services electronic document management system.

Rev No.	Revision Description	Approved for Issue	Date
1.0	Initial Issue		27/05/2020
1.1	PD Emergency Response Structure updated		25/08/2021
1.2	Change to contact details & spill rating curve		30/09/2022
1.3	Included AWS messaging, incorporated new flood maps. Updated PAR and tables to suit 2023 FIA		30/05/2023
1.4	Removed contamination emergency event, corrected AWS symbols and messaging, corrected spelling and formatting errors. Added section 5.6. Corrected alert tables. Added PMF and SDF time and depth graphs and maps. Made other non-substantive changes		30/09/2023
1.5	Update position titles. Updated downstream residents contact details. Correct spelling and grammar errors		25/09/2024

Controlled Document Notice

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1	Director Infrastructure and Operations	Townsville City Council
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4	Principle Dam Safety and Operations	Townsville City Council
5	Team Leader Dams and Catchments	Townsville City Council
6	Paluma Dam Operator (Paluma Dam)	Townsville City Council
7	Paluma Dam Operator (Paluma Village)	Townsville City Council
8	Paluma Dam Operator (Personal)	Townsville City Council
9	Local Disaster Coordinator	Townsville Local Disaster Management Group
10	Executive Officer	Charters Towers Local Disaster Management Group
11	Local Disaster Coordinator	Charters Towers Regional Council
12	Mayor	Charters Towers Regional Council
13	District Disaster Coordinator	Queensland Police Service
14	Executive Director	Queensland Fire and Emergency Service

1. References and Abbreviations

1.1 References

Document title	Reference
PD Personnel Training and Procedural Matters	PD SOP-001
PD Emergency Action and Incident Reporting	PD SOP-002
PD Critical Operating Procedures	PD SOP-003
PD Monitoring and Surveillance	PD SOP-004
PD Maintenance of Dam Log Book	PD SOP-005
PD Detailed Operation and Maintenance Manual	PD DOMM 001
SMEC Paluma Dam Break Assessment	Paradigm
Thrice-Weekly Event Data Collection Check Sheet	QAF0565 PD Thrice-Weekly and Event Data Collection Sheet (WEDCCS)
Routine and Event-Post Event Inspection Report	QAF0564 PD Routine and Event-Post Event Inspection Report (REPEIR)
Record of Communication	QAF0579 PD Record of Communication
Modified Mercalli Scale	www.usgs.gov/natural-hazards/earthquake-hazards/science/modified-mercalli-intensity-scale?qt-science_center_objects=0#qt-science_center_objects
BOM – Queensland Weather Information	www.bom.gov.au
BOM – Hervey Range Radar	www.bom.gov.au/products/IDR733.loop.shtml#skip
BOM – Townsville Area Actual Rainfall	http://www.bom.gov.au/qld/flood/townsville.shtml
Geoscience Australia – Earthquake Monitoring	http://www.ga.gov.au/earthquakes/index.jsp
Australian National Security website	www.nationalsequrity.gov.au/Pages/default.aspxwww.nationalsecurity.gov.au
RACQ Road Conditions	www.racq.com.au/cars-and-driving/safety-on-the-road/road-conditions
Water Supply (Safety and Reliability) Act 2008	www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WaterSupSRA08.pdf
Queensland Dam Safety Management Guidelines 2024	dam-safety-management.pdf (resources.qld.gov.au)
Emergency Action Plan for Referable Dam Guideline 2023	eap-guideline.pdf (resources.qld.gov.au)

1.2 Abbreviations and Acronyms

AHD	Australian Height Datum
BOM	Bureau of Meteorology
CEO	Chief Executive Officer
CTRC	Charters Towers Regional Council
DO	Dam Operator
DRDMW	Department of Regional Development, Manufacturing and Water
DSL	Dead Storage Level
DSR	Dam Safety Regulator
EA	Emergency Alert
EAP	Emergency Action Plan
EER	Emergency Event Report
EL	Elevation
FiR	Failure Impact Rating
FSL	Full Supply Level
GMWS	General Manager Water Services
Km	Kilometre
LDMG	Local Disaster Management Group
ML	Mega litre
MM	Modified Mercalli
PDSO	Principal Dam Safety & Operations
QFCol	Queensland Flood Commission of Inquiry
QFES	Queensland Fire and Emergency Service
QPS	Queensland Police Service
REPEIR	Routine & Event Post Event Inspection Report (QAF0564)
RPEQ	Registered Professional Engineer of Queensland
SDCC	Sate Disaster Coordination Centre
SDMG	State Disaster Management Group
SES	State Emergency Service
SOP	Standard Operating Procedure
TCC	Townsville City Council
TLDC	Team Leader Dams and Catchments
TMDS	Team Manager Water Resources and Dam Safety
WEDCCS	Weekly and Event Data Collection Check Sheet (QAF0565)
WHS	Workplace Health and Safety
WS	Water Services (Trading as Townsville City Council)
WQ	Water Quality
WQO	Water Quality Officer

2. Scope

This EAP covers the situation at Paluma Dam itself and actions to be taken by nominated TCC personnel.

The **Charters Towers Regional Council** local government area is directly downstream of the Dam and as such the Council must be informed of emergency events so they can also implement an appropriate response.

The Charters Towers LDMG will be responsible for:

- Issuing community wide notices alerting of an event in accordance with the Australian Warning System.
- If required closing roads of affected areas.
- Coordinating with local SES, QFES and QPS.

The main population at risk is at or nearby to Hidden Valley, located along the Running River. Refer to Figure 1 for a general locality map.

Figure 1 - General Locality Map

3. Purpose

The main purpose of this emergency action plan for Paluma Dam is to minimise the risk of harm to person or property if a dam hazard event or emergency event for the dam happens by:

- Ensuring compliance with the relevant sections of the *Water Supply (Safety and Reliability) Act 2008.*
- Ensuring adequate activation and deactivation of this EAP.
- Addressing levels of attendance prior to and during and after an emergency event.
- Defining responsibilities, procedures and appropriate remedial actions during flooding and other specific emergency events.
- Providing timely notification to authorities managing downstream local government areas and where necessary, downstream landholders.
- Ensuring the EAP is current and relevant staff are familiar with its implementation.

This EAP identifies emergency scenarios and describes the procedures to be followed by TCC staff to monitor emergency events and provide timely notification to the appropriate authorities.

If required, measures to protect downstream communities and properties will also be implemented.

4. Dam Details

4.1 General Dam Details

Existing Water Infrastructure and Current Operating Arrangements	
Name of infrastructure	**Paluma Dam**
Location of Infrastructure	Stream Name: Swamp Creek, Running River Catchment. General Location: West catchment side of Paluma Range. E415,514.53 N7,901,272.52 (AGD84 Zone 55) Refer to Figure 1 of this document for a map showing the general location of Paluma Dam.
Description of Water Infrastructure	Embankment: Earth core rock embankment approximately 255m long, 5m wide at crest and twenty (20) m high at the embankment toe. A 600mm high wave barrier extends along the upstream side of the embankment crest for its full length. Spillway: Concrete ogee control section with an unlined chute returning to the creek. The spillway is 60.9m in width and has been augmented with mild steel weir plates increasing its level to 893.02m AHD. Saddle Dam 1: Located approximately 200m south east of the main embankment. It comprises a similar cross-section to the main embankment, with a crest length of 130m and a height of 6m. Saddle Dam 2: Located on the right bank approximately 200m north of the spillway. It has a similar cross-section to the main embankment, with a crest length of 120m and a height of approximately eight (8) m. This crest is approximately 2.4m higher than the main embankment (897.10m AHD).
Storage Capacities and Water Levels	Total storage capacity: 11,830ML Dead storage capacity: 80ML Useable storage capacity: 11,750ML Full supply level (FSL): 893.02m AHD Dead storage level (DSL): 880.07m AHD Crest level: 894.70m AHD Catchment area: 8.9km2
Outlet Provisions from Storage other than Spillway	Outlet works: Floating intake raft supporting a submerged 710mm diameter inlet pipe. A trash rack is attached to the intake pipe for primary screening. The inlet pipe is attached to the second of three intakes of the 3.0m diameter reinforced concrete intake tower which is located approximately 50m on the upstream side of the dam wall. Water is delivered from the dam to the Crystal Creek natural channel through a 4.5km long length of MSCL pipe of varying diameter. The discharge point into the Crystal Creek is approximately 13km upstream of the Crystal Creek intake. Outlet works: Located approximately 50m on the left-hand side of the dam spillway. Maximum outlet capacity: 43.2ML/day. Provisions for selective release: Release from the dam into the Crystal Creek catchment is manually controlled using a valve located on the downstream side of the dam wall. Releases supplement supply required by the Crystal Creek intake.
Flow Measurement	Ultrasonic flow metering is used at the outlet works for flows discharging to Crystal Creek.

Existing Water Infrastructure and Current Operating Arrangements (Continued)	
Name of infrastructure	**Paluma Dam**
Pass flows: **1. Environmental provisions** **2. Volume of first flush currently passed through structure** **3. Riparian, stock and domestic flows** **4. Other compensation flows** **5. Flow variations** **6. Maximum allowable release rates**	 Nil Nil Nil Nil Min – 0 L/sec Avg – Varies Max – @500 L/sec Note: The dam is operated to maintain a required weir level at the Crystal Creek Intake. Hence flows vary depending on the natural flow in Crystal Creek. 43.2 ML/day
Operational constraints: **1. Minimum operating level/capacity of storage** **2. Operation of fabri-dams or gates** **3. Flood mitigation arrangements**	 880.07m AHD Nil Nil
Management of storage and/or release water quality	Regular raw water testing program and floating intake level adjustment as required.
Referable Dam category	Category 1 (high)
Population at risk	Sunny Day Failure PAR = 6 Flood Failure Total PAR = 23
Spillway adequacy	Current spillway capacity is 309m³/s with the steel flashboards in place and utilising the sharp-crested weir formula.

4.2 Spillway Adequacy – Acceptable Flood Capacity

The Failure Impact assessment completed by SMEC in 2023, using the DNRME "Guidelines for Failure Impact Assessment of Water Dams 2018" determined that the spillway has the capacity to discharge the probable maximum precipitation – (PMP-F) of AEP 1 in 10,000,000 without overtopping the dam wall.

5. Preparation

5.1 EAP Review

In accordance with the *Act*, the *Guidelines*, and SOP-002 Register of Emergency Contacts:

- The EAP shall be reviewed by October 1st each year to ensure its currency and effectiveness in consultation with the relevant LDMG's, the EAP shall be consistent with the Disaster Management Plans for the relevant Disaster Management Group/s;
- Those involved in the implementation of the EAP shall be adequately trained and familiar with their responsibilities under the EAP;
- An updated version of the EAP (or the affected pages) shall be distributed to all persons on the distribution list in a controlled and timely manner.

5.2 Personnel

A 24hr rolling roster shall be developed and distributed prior to November 1st each year.

For safety reasons during the activation of an EAP, the DO shall be supported by an assistant whenever possible. If shifts are required, as would be the case during 24hr surveillance, a second shift of suitably qualified and trained personnel shall be provided for the duration of the event.

5.3 Fatigue Management

When working on the rolling roster during EAP activation the DO and assistant shall comply with WS fatigue Management Procedure (WS-PRO-002 version 1.1).

5.4 Training

Refresher training specific to the operation of Paluma Dam and the implementation of this EAP is conducted annually in October for all relevant operational staff.

In addition, all operational personnel are required to successfully complete formal Dam Safety Awareness training.

Records of all training are maintained on TCC's training database.

5.5 Maintaining food and water supplies

Due to situations where personnel may be required to attend the Dam, and could be cut off due to road conditions, the DO shall maintain suitable supplies of food, water and other essentials at the Dam, sufficient for a minimum period of fourteen (14) days for two (2) people.

5.6 Public Awareness and Community Information

A copy of the Paluma Dam approved EAP is available to the public on the Townville City Council website.

A copy of the EAP is emailed to all impacted downstream residents once available.

6. Emergency Activation and Deactivation

6.1 Dam Emergency Organisation

The Paluma Dam emergency management framework utilises the Townsville City Council (TCC) management hierarchy in liaison with the Local Disaster Coordinator (LDMG) and other specialised dam safety expert input as illustrated in Figure 2 below.

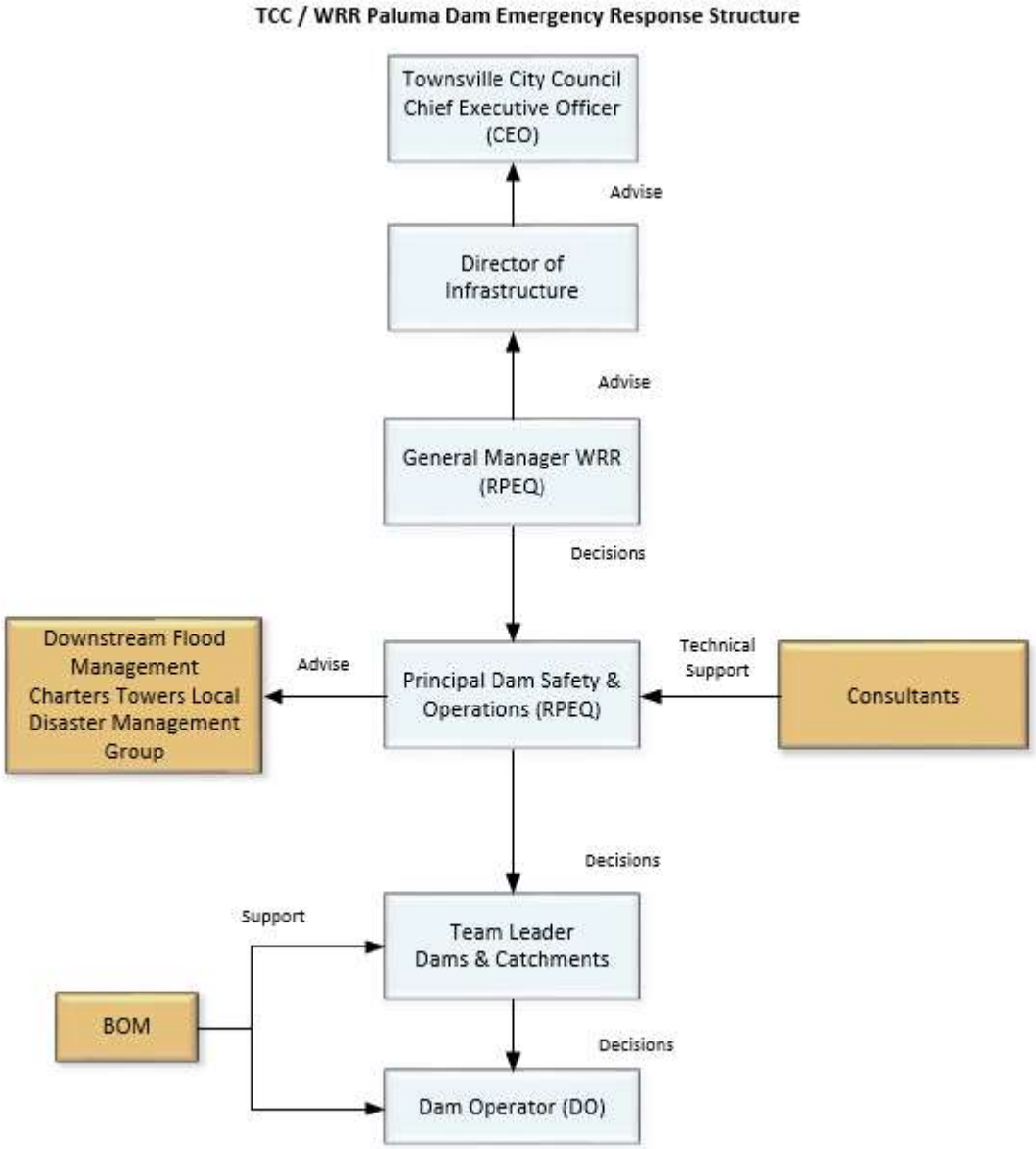

Figure 2 - TCC Emergency Response Organisation

6.2 Overview

Only those employees within WS who are familiar with Paluma Dam and have delegation, are authorised to activate the EAP. These includes:

- DO and Assistant (Only in situations if there is no communication from the Dam to the Team Leader, Principle or General Manager)

- Team Leader Dams and Catchments
- Principle Dam Safety & Operations
- General Manager Water Services

The DO will regularly assess the Dam's emergency status. The EAP should be activated when any of the following emergency conditions are triggered:

- Flood Event
- Dam Distress (Seismic Event)
- Embankment Piping and Seepage
- Terrorist Threat/Hoax/Other Event

Note: Two (2) or more emergency conditions may be triggered simultaneously.

6.3 Escalation Levels

In accordance with the *Guidelines*, the level of EAP escalation should be consistent with those applied by the relevant Disaster Management Group, hence this EAP is activated using an escalation model based on the following levels:

Alert	• A heightened level of vigilance due to the possibility of an event occurring. It will tend to require increased monitoring with the frequency of monitoring being dependent upon the rate of development of the potential failure condition. • During the ALERT level of EAP activation the need for, and the frequency of situational reports should be discussed with the relevant Disaster Management Group. • No further action may be required; however, the situation may need to be monitored by someone capable of assessing the potential of the threat.
Lean Forward	• An operational state characterised by a heightened level of situational awareness and a state of operational readiness. The disaster management group and dam operational staff are placed in a state of operational readiness to move to the "Stand-Up" level of activation in the event of an emergency event occurring or to mitigate the consequences of such an event. • It will require increased monitoring with the frequency of monitoring being dependent upon the rate of development of the emergency condition. Situational reports to the relevant DMG should continue as previously arranged or otherwise requested. Personnel at the Dam should be on standby, ready to move to the Stand-Up level of activation in the event of an emergency event occurring or to mitigate the consequences of such an event.
Stand up	• An operational state where resources are mobilised, personnel are activated, and operational activities are commenced as part of the EAP activation in response to an emergency event occurring or the need to mitigate the consequences of such an event occurring. • Any works that may become necessary at the dam site to minimise the risk of dam failure or minimise the consequences of failure should be undertaken. • Situational reports should be provided to the relevant DMG and Dam Safety Regulator (DSR) according to agreed timelines. Activation of this level of response will trigger the requirement to develop and Emergency Event Report (EER) in accordance with the provisions of the Act.
Stand down	• Transition from responding to event back to normal core business and/or continuance of emergency recovery operations. • The movement through these levels of activation is not necessarily sequential and should be applied with flexibility and adaptability and be tailored to the location and event. • Triggering of one of these levels of activation may not necessarily mean a similar activation of relevant DMG's however the provision of information to relevant group members regarding the risks associated with a pending hazard impact should still occur.

	• There is no longer a requirement to respond to the event and the threat is decreasing.

6.4 Mobilisation

The DO and Assistants are required to mobilise and attend the dam on a daily basis or for longer durations as directed by the TLDC or PDSOO. If required, a second team may be placed on stand-by once an initial assessment is carried out by the DO.

It is recognised that early mobilisation for Emergency Condition – Flood Event is paramount to the effective activation of the EAP due to the site's remote location and access issues resulting from sustained rainfall and adverse weather.

Mobilisation is required under the following situations:

- Any spillway discharges above + 0.250m
- Any other event that is likely to result in the triggering of the EAP.

In addition, the TLDC or PDSO may direct the DO to mobilise earlier if required.

In some circumstances the DO may elect to self-mobilise. To assist in making the decision to self-mobilise the DO shall monitor regional weather patterns, news and radio bulletins and relevant websites such as Bureau of Meteorology, Department of Transport and Main Roads. Geoscience Australia or US Geological Survey.

7. Emergency Communication

The DO has the following communication resources:

Paluma Dam:

- Radio telephone
- Satellite internet
- Dedicated UHF network (TCC channel 6)
- Standalone power (micro-hydro, solar array, battery storage and backup generator)

Paluma Village:

- Landline
- Dedicated UHF Network (TCC channel 8)
- Broadband Internet
- Standby generator power

Paluma Vehicles:

- Fixed and handheld UHF
- Satellite telephone (DO vehicle only)

Note: There is currently no reliable mobile telephone communications on the Mount Spec Forestry Road, Paluma Dam or downstream areas. Telstra mobile service is available in the Paluma Village.

Each of the abovementioned communication resources are checked at least monthly by the DO.

7.1 Communication Confirmation

Immediately following ANY communication initiated by ANY person that will result in the DO triggering the EAP, the DO shall immediately call back and confirm the message received. This is to prevent triggering the EAP based on unauthorised or fraudulent calls.

7.2 Loss of Communications

Dam Operator or Ranger:

This person will have the best understanding of the situation and is authorised to take immediate and appropriate local actions. In the event of loss of communication at the Dam and/or Paluma Township during or leading up to an event the Paluma Dam Operator may:

- Attempt to mitigate impacts on downstream communities by directly communicating to the Charters Towers LDMG and/or Hidden Valley Cabins where a UHF radio is currently based that communicates with local residents.
- Preserve Dam infrastructure integrity.
- Prevent significant contamination from reaching Crystal Creek intake.

Team Leader Dams and Catchments or Principal Dam Safety & Operations:

In the situation where there is a loss of communications, the TLDC or PDSO shall judge the seriousness of the situation and may:

- Inform CTRC of a potential emergency
- Arrange attendance to the Dam by various means within the timeframe commensurate with the situation.

8. Emergency Condition – Flood Event

8.1 Overview

The emergency actions described in this section relates to a condition where natural catchment inflows fill Paluma Dam and the rate of inflow exceeds the capacity of the outlet works. The spillway will then discharge water downstream into Running River.

During flood events, the Dam will be monitored by the DO in accordance with QAF0565 Weekly and Event Data Collection Check Sheet (WEDCCS) and collected information will be forwarded to the TLDC.

It should be noted that the Paluma Dam catchment area is very small in relation to the immediate downstream catchment of Running River. As a result, minor spillway discharges (<+0.250m) pose minimal risk and do not constitute a downstream release hazard.

Refer to Appendix A for maps of the areas likely to be affected by a spillway release.

8.2 Monitoring and Notification - Event Alert Table - Flood Event

Activation Level	Alert (Water Level Rising)	Lean Forward	Stand Up	Stand Down (Water Level Falling)
Storage Level Ref FSL	+0.250m	+0.500m	+0.750m	+0.250m
Storage level EL	893.270m AHD	893.520m AHD	893.770m AHD	893.270m AHD
ARI	1 in 3 years	1 in 35 years	1 in 500 years	1 in 3 years
Discharge m3/s	<15	45	85	<15
Flood Alert Notes	Minor flow event. Little downstream flood risk.	Event Increasing. Downstream flood risk developing depending upon regional rainfall.	Almost certainly significant rainfall in the Running River Catchment downstream of Paluma Dam which may lead to inundation of some low-lying properties.	Minor flow event. Little downstream flood risk.
Actions DO	Mobilise to site. (24 Hr. in 2x12 Hr.) . (Day Shift, 8.5 Hrs.) Daily monitoring as per Paluma Dam SOP4 6.1.1: Complete Event Data Collection Check Sheet (WEDCCS Parts A & B) (QAF0565) • Rainfall • Lake level • Catchment conditions • Forecasts Notify: • TLDC • If communication with TLDC, PDSO or alternate is unavailable, notify Charters Towers LDMG.	4-Hourly monitoring as per Paluma Dam SOP4 6.1.1: Complete Event Data Collection Check Sheet (WEDCCS Parts A & B) (QAF0565) • Rainfall • Lake level • Catchment conditions • Forecasts Record all communications on log sheet. Forward twice-daily reports to TLDC. Notify: • TLDC • If communication with TLDC, PDSO or alternate is not available, notify Charters Towers LDMG.	4-Hourly monitoring as per Paluma Dam SOP4 6.1.1: Complete Event Data Collection Check Sheet (WEDCCS Parts A & B) (QAF0565) • Rainfall • Lake level • Catchment conditions • Forecasts • Record all communications on log sheet. Forward twice-daily reports to TLDC. Notify: • TLDC • If communication with TLDC, PDSO or alternate is not available, notify Charters Towers LDMG and downstream landholders.	Prepare information for EER and provide to TLDC. Notify: • TLDC If communication with TLDC, PDSO or alternate is not available, notify Charters Towers LDMG.

Activation Level	Alert (Water Level Rising)	Lean Forward	Stand Up	Stand Down (Water Level Falling)
Actions TLDC	Gather technical advice from Dam Safety Technical Advisor as required. Notify: • PDSO	If significant rainfall forecast: • If required seek advice from Dam Safety Technical Advisor • Mobilise additional assistants • Provide twice-daily reports to PDSO	If significant rainfall forecast: • Seek advice from Dam Safety Technical Advisor • Mobilise additional assistants • Provide twice-daily reports to PDSO	Gather technical advice from Dam Safety Technical Advisor for EER. Notify: • PDSO
Actions PDSO	Gather technical advice from Dam Safety Technical Advisor as required. Notify: • GMWS • Dam Safety Regulator • Charters Towers LDMG IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway. Provide SitRep updates to TCC LDMG as required.	Notify in order: • GMWS • Dam Safety Regulator • Charters Towers LDMG IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway. Provide SitRep updates to TCC LDMG as required.	If dam in distress mobilisation engineers and contractors to complete works that may become necessary at the dam site to minimise the risk of dam failure Notify: • GMWS • Dam Safety Regulator • Charters Towers LDMG IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway. Provide SitRep updates to TCC LDMG as required.	Notify: • GMWS • Dam Safety Regulator • Charters Towers LDMG IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway.
Actions GMWS	Consult with PDSO	Consult with PDSO Advise Director and CEO	Consult with PDSO Advise Director and CEO	Advise PDSO Advise Director and CEO

9. Emergency Condition – Dam Distress - Seismic Event

9.1 Overview

The emergency action described in this section relates to a potential dam failure hazard due to a seismic event causing damage to the dam embankment (main dam), saddle dams, foundations or dam abutment. Indications of damage might include:

- Increased seepage
- Change in seepage turbidity
- Cracking of embankment or spillway
- Slumping of embankment
- Embankment deformation
- Land slips

Seismic events above 5MM (see below) may result in dam distress. If damage occurs due to a seismic event a dam failure may result.

Magnitude (Mw)	Modified Mercalli Scale (MM)	Seismic Event Effects
<4.9Mw	< 5MM	May be felt indoors and outdoors. Windows may rattle. Standing motor vehicles may rock.
4.9Mw+	5MM+	Felt by everyone. Dishes and windows break. Unstable objects overturned.

During seismic events the Dam will be monitored by the DO in accordance with the Event Data Check Sheet and SOP-004 Data Reporting and collected information will be forwarded to the TLDC.

Refer to Appendix A for maps of the areas likely to be affected by a dam way failure.

9.2 Monitoring and notification - Event Alert Table - Seismic Event

Activation Level	Alert	Lean Forward	Stand Up	Stand Down
Activation Trigger	Earthquake reported or felt in the area, less than 5MM	Earthquake reported or felt in the area, greater than 5MM on the Modified Mercalli Scale.	Earthquake reported or felt in the area and dam distress is evident.	No immediate downstream risk identified.
Actions DO	Immediately record piezo and seepage readings. Complete Event Data Collection Check Sheet (WEDCCS form Parts A & B) (QAF0565) as required by Paluma Dam SOP004. Undertake surveillance inspections of embankments, spillway and abutments. Check for leaks, deformation, erosion and concrete damage using REPEIR form (QAF0564) Immediately report results to TLDC. Record all communications. Complete event log. Notify: • TLDC	Immediately record piezo and seepage readings. Complete Event Data Collection Check Sheet (WEDCCS form Parts A & B) (QAF0565) as required by Paluma Dam SOP004. Undertake surveillance inspections of embankments, spillway and abutments. Check for leaks, deformation, erosion and concrete damage using REPEIR form (QAF0564) Immediately report results to TLDC. Record all communications. Complete event log. **If dam distress is evident immediately move to STAND UP.** Notify: • TLDC. • If communication with TLDC, PDSO or alternate is not possible notify Charters Towers LDMG.	Notify TLDC immediately. Lower storage level if safe to do so. Confirm with TLDC that Charters Towers LDMG and Landholders have been notified. Photograph damage from safe point. Record all communications. Complete event log. Notify: • TLDC • If communication with TLDC, PDSO or alternate is not possible notify Charters Towers LDMG and downstream landholders.	Prepare information for emergency event report and supply to PDSOO. Notify: • TLDC

Activation Level	Alert	Lean Forward	Stand Up	Stand Down
Actions TLDC	Based on inspection and instrument readings, increase the frequency of recordings as per PD SOP004. Gather technical advice from Dam Safety Technical Advisor if required. **NOTE:** If an alert is received from a seismic monitoring organisation, immediately notify the DO and arrange an inspection of the dam to assess condition. Notify: • PDSO	Based on inspection and instrument readings, increase the frequency of recordings as per Paluma Dam SOP004. Gather technical advice from Dam Safety Technical Advisor if required. **If dam distress is evident immediately move to STAND UP.** Notify: • PDSO	Mobilise additional assistants to site. Gather technical advice from Dam Safety Technical Advisor. Provide twice daily reports to PDSOO. Notify: • PDSO	Gather technical advice from the Dam Safety Technical Advisor for Emergency Event Report. Notify: • PDSO
Actions PDSO	Notify: • GMWS • Dam Safety Regulator SitRep updates to TCC LDMG as required	Notify in order: • GMWS • Dam Safety Regulator • Charters Towers LDMG IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway. SitRep updates to TCC LDMG as required	If dam in distress mobilisation engineers and contractors to complete works that may become necessary at the dam site to minimise the risk of dam failure Notify: • GMWS • Dam Safety Regulator • Charters Towers LDMG IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway. SitRep updates to Townsville LDMG as required.	Notify: • GMWS • Dam Safety Regulator • Charters Towers LDMG. IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway.
Actions GMWS	Consult with PDSO	Consult with PDSO Advise Director and CEO	Consult with PDSO Advise Director and CEO	Advise Director and CEO

10. Emergency Condition – Embankment Piping and Seepage

10.1 Overview

The emergency action described in this section relates to a potential dam failure hazard due to a piping condition through the embankment, foundations or dam abutments.

Early indications of a piping condition may include:

- Increased seepage
- New areas of seepage
- Change in the colour or clarity of seepage

If a piping condition occurs and/or continues a dam failure may result.

Remedial measures to mitigate the risk of a dam failure due to piping should occur as soon as the piping is noticed. These measures should be directed by an appropriately qualified Dam Safety Technical Advisor.

Refer to Appendix A for maps of the areas likely to be affected by a dam wall failure.

10.2 Monitoring and Notification - Event Alert Table - Embankment Piping and Seepage

Activation Level	Alert	Lean Forward	Stand Up	Stand Down
Activation Trigger	Increased seepage rate observed.	Increased seepage rated observed with increased turbidity.	**Dam Distress evident.** Increased seepage rate with increased turbidity. Evidence of deformation or erosion. Upstream vortex identified.	Storage stabilised and no immediate downstream risk.
Actions DO	Monitor piezo and seepage readings for observable trends. Undertake surveillance inspections of embankments, spillway and abutments. Complete Event Data Collection Check Sheet (WEDCCS form Parts A & B) (QAF0565) as required by Paluma Dam SOP004. Record all communications. Complete Logbook entries. Notify: • TLDC	Immediately record piezo and seepage readings. Undertake surveillance inspections of embankments, spillway and abutments. Complete Event Data Collection Check Sheet (WEDCCS form Parts A & B) (QAF0565) as required by Paluma Dam SOP004. Photograph where possible. Record all communications. Complete logbook entries. ***If piping condition is established or dam distress is evident immediately move to STAND UP.*** Notify: • TLDC • If communication with TLDC, PDSO or alternate is unavailable notify Charters Towers LDMG.	Notify TLDC immediately. Lower storage level if safe to do so. Confirm with TLDC that Charters Towers LDMG and landholders have been notified. Photograph event from safe point. Record all communications. Complete logbook entries. Notify: • TLDC • If communication with TLDC, PDSO or alternate is unavailable notify Charters Towers LDMG.	Prepare information for Emergency Event Report and supply to TLDC.

Activation Level	Alert	Lean Forward	Stand Up	Stand Down
Actions TLDC	Based on inspection and instrument readings, instruct DO to increase the frequency of recordings as per SOP004. Arrange inspection by Dam Safety Technical Advisor. Notify: • PDSO	Based on inspection and instrument readings, instruct DO to increase the frequency of recordings as per SOP004. Arrange inspection by Dam Safety Technical Advisor. Notify: • PDSO	Mobilise additional assistants to site. Gather technical advice from the Dam Safety Technical Advisor. Provide twice-daily reports to PDSO. Notify: • PDSO	Gather technical advice from the Dam Safety Technical Advisor for emergency event report. Notify: • PDSO
Actions PDSO	Notify: • GMWS • Dam Safety Regulator • Charters Towers LDMG SitRep updates to TCC LDMG as required	Notify in order: • GMWS • Dam Safety Regulator • Charters Towers LDMG IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway. SitRep updates to TCC LDMG as required	If dam in distress mobilisation engineers and contractors to complete works that may become necessary at the dam site to minimise the risk of dam failure Notify: • GMWS • Dam Safety Regulator • Charters Towers LDMG IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway. SitRep updates to TCC LDMG as required.	Notify: • GMWS • Dam Safety Regulator • Charters Towers LDMG IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway.
Actions GMWS	Consult with PDSO	Consult with PDSO Advise Director and CEO	Consult with PDSO Advise Director and CEO	Advise PDSO Advise Director and CEO

11. Emergency Condition -Terrorist Activity/Threat/Hoax/High-Energy Impact

11.1 Overview

The emergency condition described in this section relates to a potential dam failure hazard due to terrorist activity, threat or a hoax. It is also applicable to a high energy impact on the Dam.

This may include:

- Aircraft crash
- Meteorite impact
- Bomb or related explosion.

Refer to Appendix A for maps of the areas likely to be affected by a dam wall failure.

11.2 Monitoring and Notification - Emergency Event Alert Table - Terrorist Activity/Threat/Hoax/High-Energy Impact

If there is a chemical contamination threat associated with this emergency condition, Activate 10. Emergency Condition – Significant Contamination immediately.

Activation Level	Alert	Lean Forward	Stand Up	Stand Down
Activation Trigger	Possible terrorist activity noticed, reported or threatened.	Serious incident that could threaten the integrity of the dam such as an explosion or aircraft strike.	Threat to dam integrity confirmed.	Storage stabilised and no immediate downstream risk.
Actions DO	Follow bomb threat checklist (WHS384 available in ECM and can be searched for on TCC intranet SERVE). Record all conversations and observations. Inspect/observe if safe to do so, identify possible threat and evacuate immediate area if necessary. Record all communications. Complete Logbook entries. Notify: • TLDC • Police 000 • National Security Hotline (1800 123 400)	Immediately notify Police/Emergency Services (000). Inspect if safe to do so. Immediately report results to TLDC Based on risk, close recreation area. Notify: • TLDC	Notify TLDC immediately. Lower storage level if safe to do so. Confirm with TLDC that Charters Towers LDMG and landholders have been notified. Undertake surveillance inspections of embankments, spillway and abutments. Check for leaks, deformation, erosion and concrete damage using REPEIR form (QAF0564) Photograph damage from safe point. Record all communications. Complete event log. Notify: • TLDC • If communication with TLDC, PDSO or alternate is not possible, notify Charters Towers LDMG and downstream landholders	Prepare information for Emergency Event Report and supply to TLDC

Activation Level	Alert	Lean Forward	Stand Up	Stand Down
Actions TLDC	Provide technical information to authorities as requested. Notify: • PDSO	Based on inspection and instrument readings, instruct DO to increase the frequency of recordings as per SOP004. Arrange inspection by Dam Safety Technical Advisor. Notify: • PDSO	Mobilise additional assistants to site. Gather technical advice from the Dam Safety Technical Advisor. Provide twice-daily reports to PDSOO. Notify: • PDSO	Gather technical advice from the Dam Safety Technical Advisor for emergency event report. Notify: • PDSO
Actions PDSO	Notify: • GMWS • Dam Safety Regulator • Charters Towers LDMG SitRep updates to TCC LDMG as required	Notify in order: • GMWS • Dam Safety Regulator • Charters Towers LDMG IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway. SitRep updates to TCC LDMG as required.	If dam in distress mobilisation engineers and contractors to complete works that may become necessary at the dam site to minimise the risk of dam failure Notify: • GMWS • Dam Safety Regulator • Charters Towers LDMG IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway. SitRep updates to TCC LDMG as required.	Notify: • GMWS • Dam Safety Regulator • Charters Towers LDMG IF Charters Towers LDMG is unavailable, downstream landholders (PAR) will be contacted by email (messages pg 3) then phone sequentially as listed in Table 14 (pg 33) priority will be based on residences distance from the spillway.
Actions GMWS	Consult with PDSO	Consult with PDSO Advise Director and CEO	Consult with PDSO Advise Director and CEO	Advise Director and CEO

Section 12 and Section 13 have been redacted

14. Normal and Emergency Access Routes

14.1 Emergency Road Access

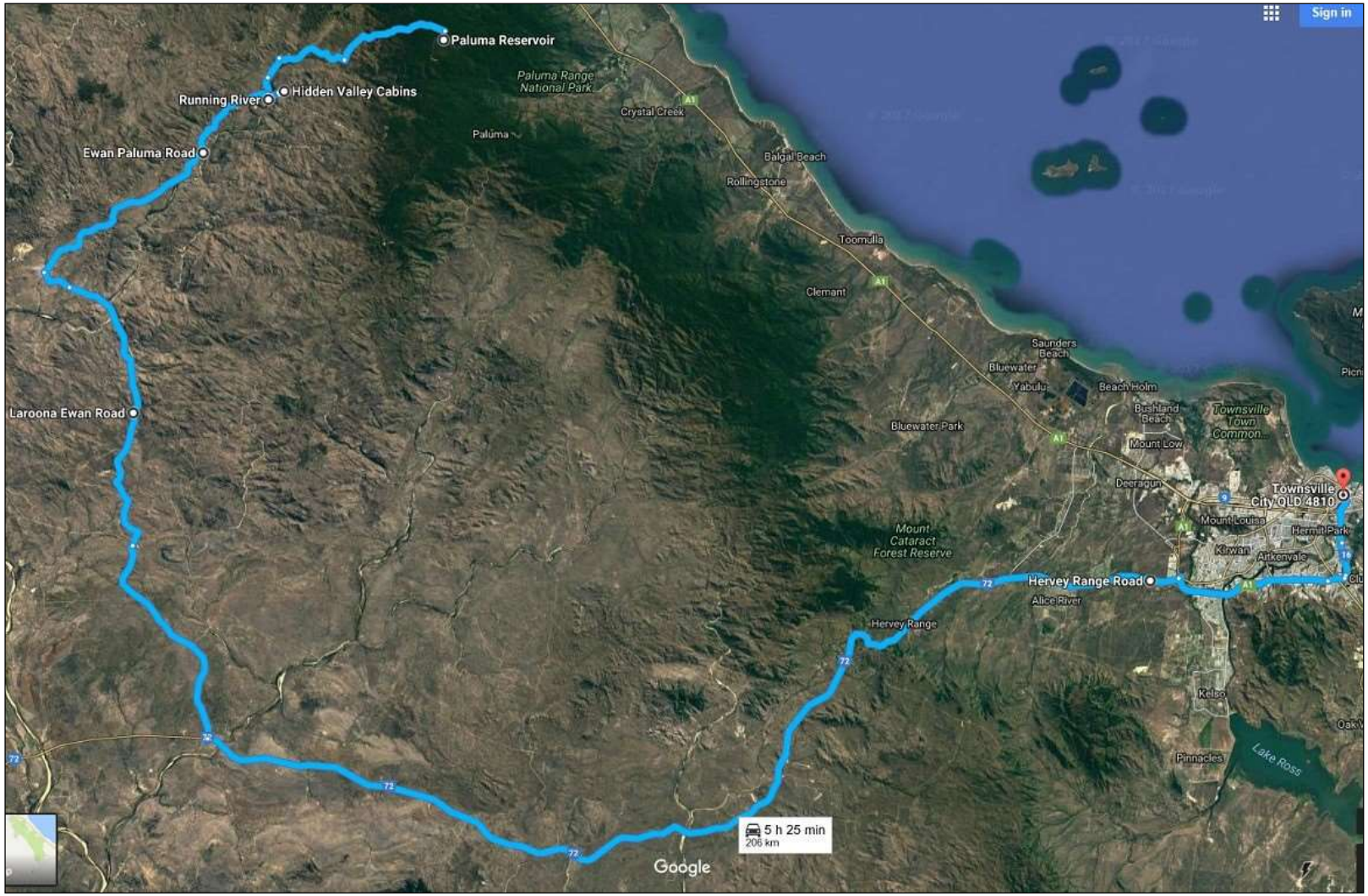

Figure 3 - Emergency Road Access Route

14.2 Normal Access Route

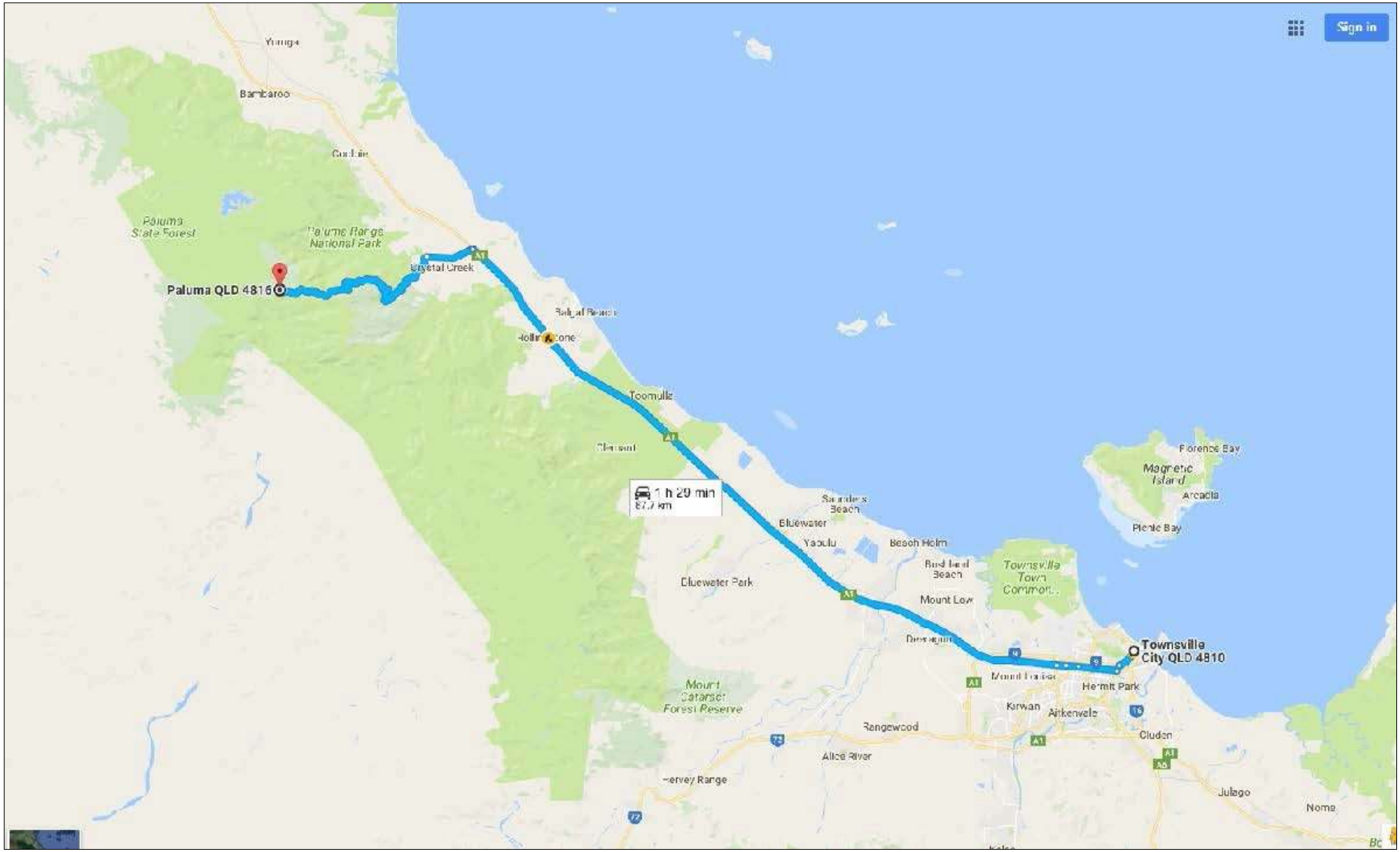

Figure 4 - Normal Access Route

14.3 Secondary Access

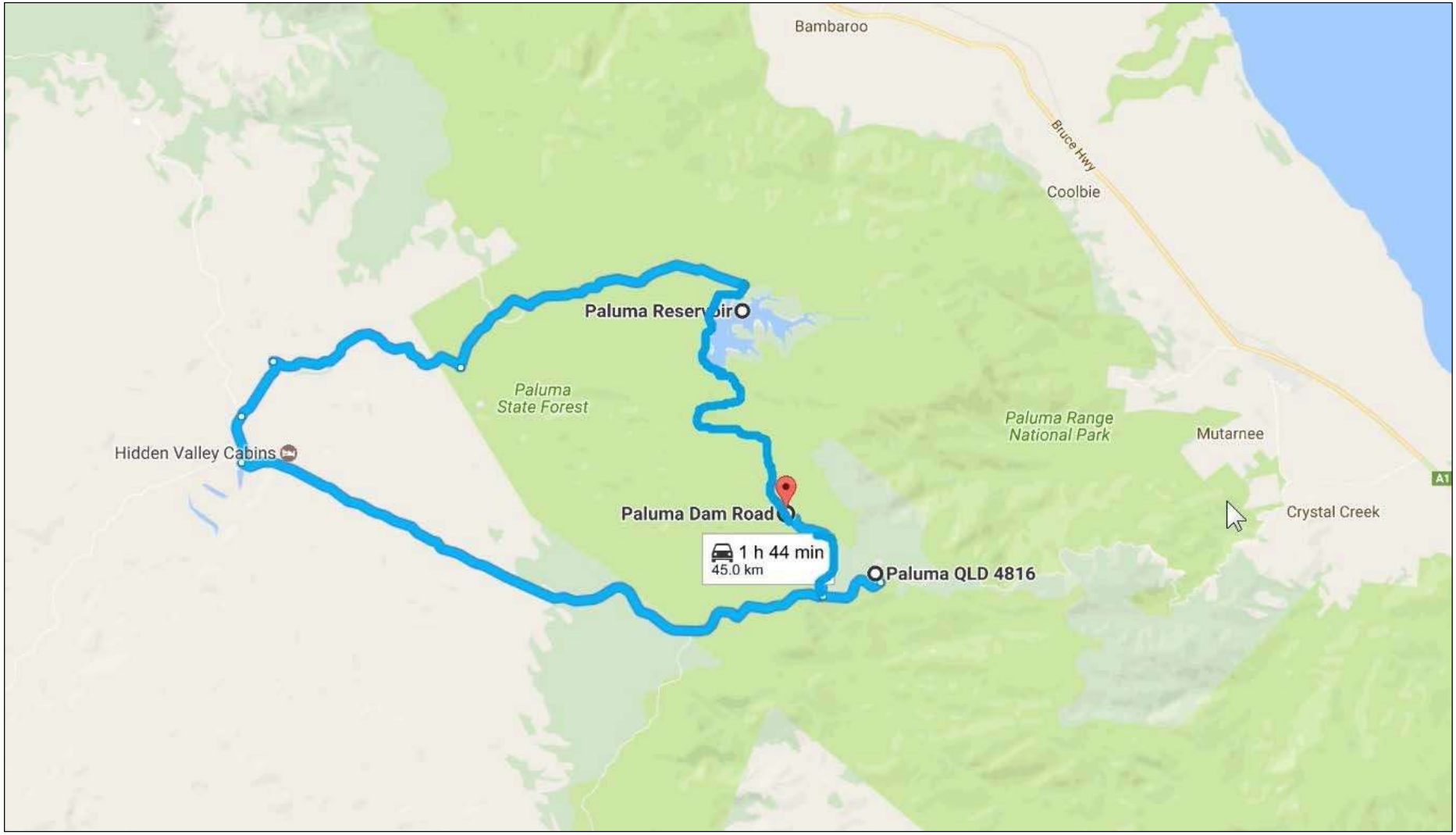

Figure 5 - Emergency Road Access Route

15. Paluma Dam Storage, Rainfall and Storage Curve

15.1 Flood Frequency Probability

AEP (1 in X)	Peak Inflow (m^3/s)	Peak Outflow (m^3/s)	Critical Duration (h) ^	Peak Reservoir Level (m AHD)	Head over Weir (m)
2	29.7	9.9	18	893.20	0.18
5	52.8	20.4	18	893.32	0.30
10	62.0	28.3	18	893.40	0.38
20	78.0	36.3	18	893.47	0.45
50	95.7	54.4	18	893.60	0.58
100	112	66.0	18	893.68	0.66
1,000	185	104	12	893.89	0.87
2,000	205	117	12	893.96	0.94
10,000	257	151	18	894.12	1.10
100,000	340	204	18	894.33	1.31
1,000,000	425	256	18	894.52	1.50
10,000,000 (PMP-F, Rank 6)	511	306	18	894.69	1.67
10,000,000 (PMF, Rank 10)	623	390	18	894.94 *	1.92

^ Critical duration with respect to peak outflow/reservoir level

* Water level by spillway discharge only (no consideration given to weir flow over dam wall)

Figure 6 - Flood Frequency Probability

15.2 Paluma Dam Storage Curve

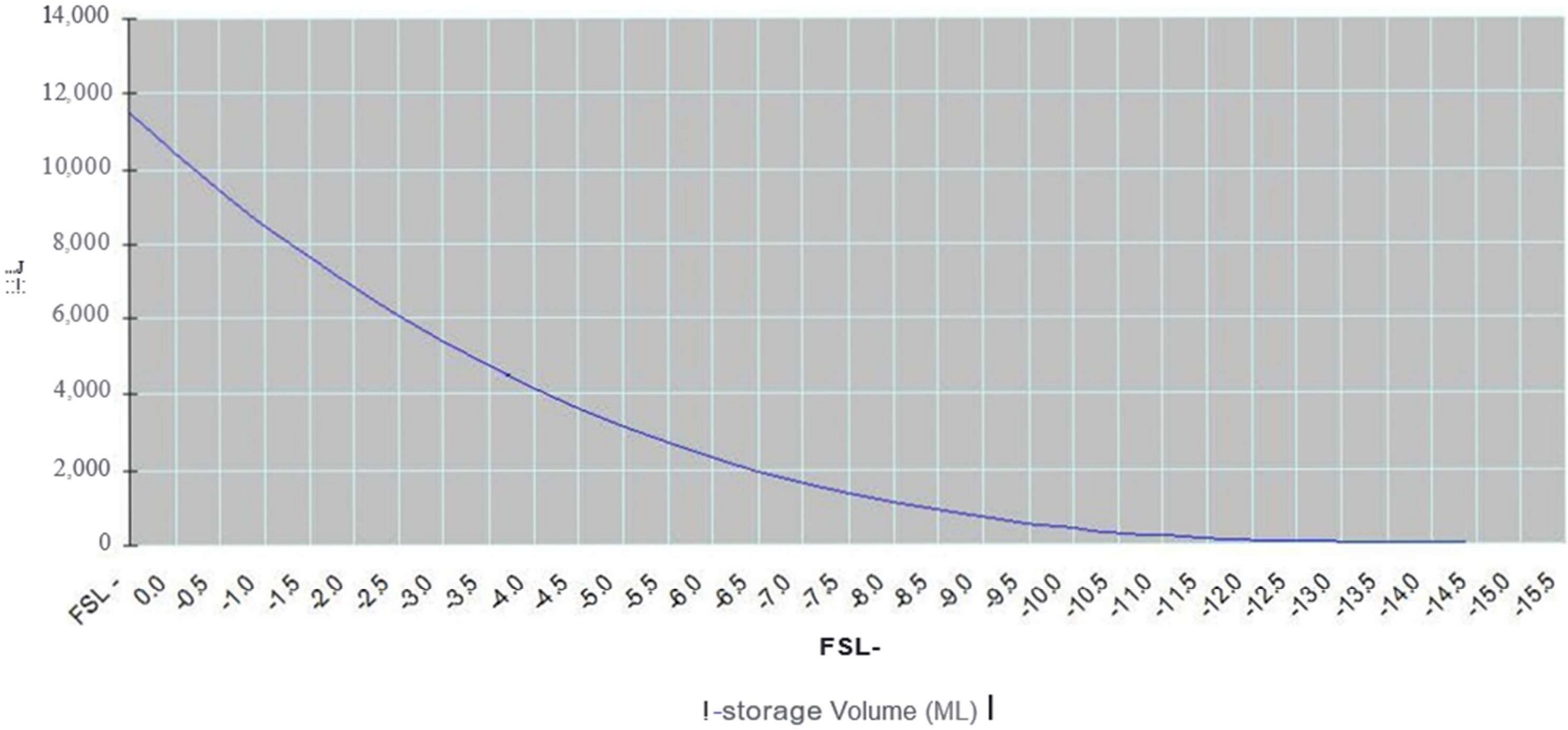

Figure 7 – Paluma Dam Storage Curve

15.3 Rainfall Enveloped Curve

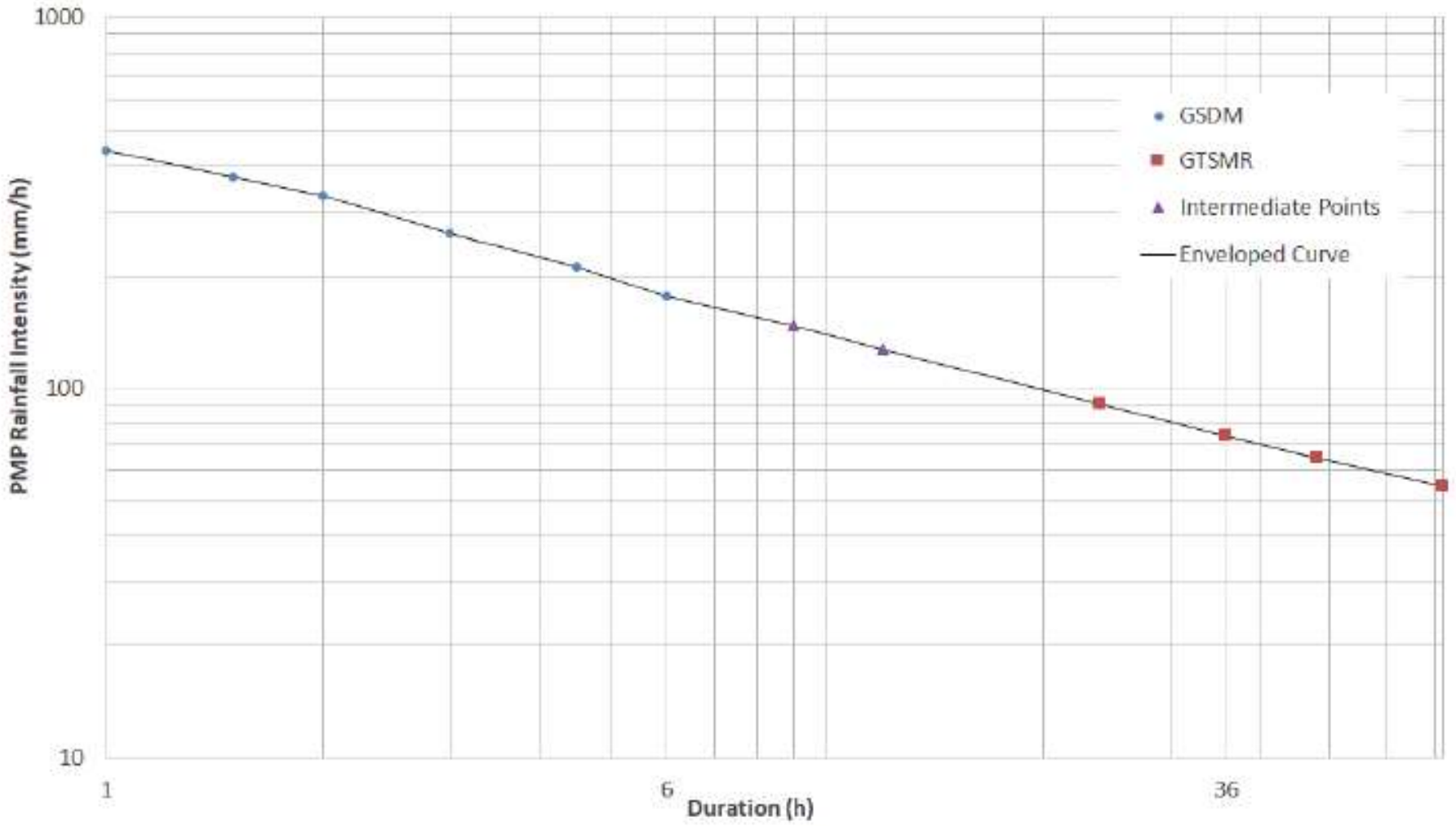

Figure 8 – Rainfall Enveloped Curve

15.4 Spillway Rating Curve

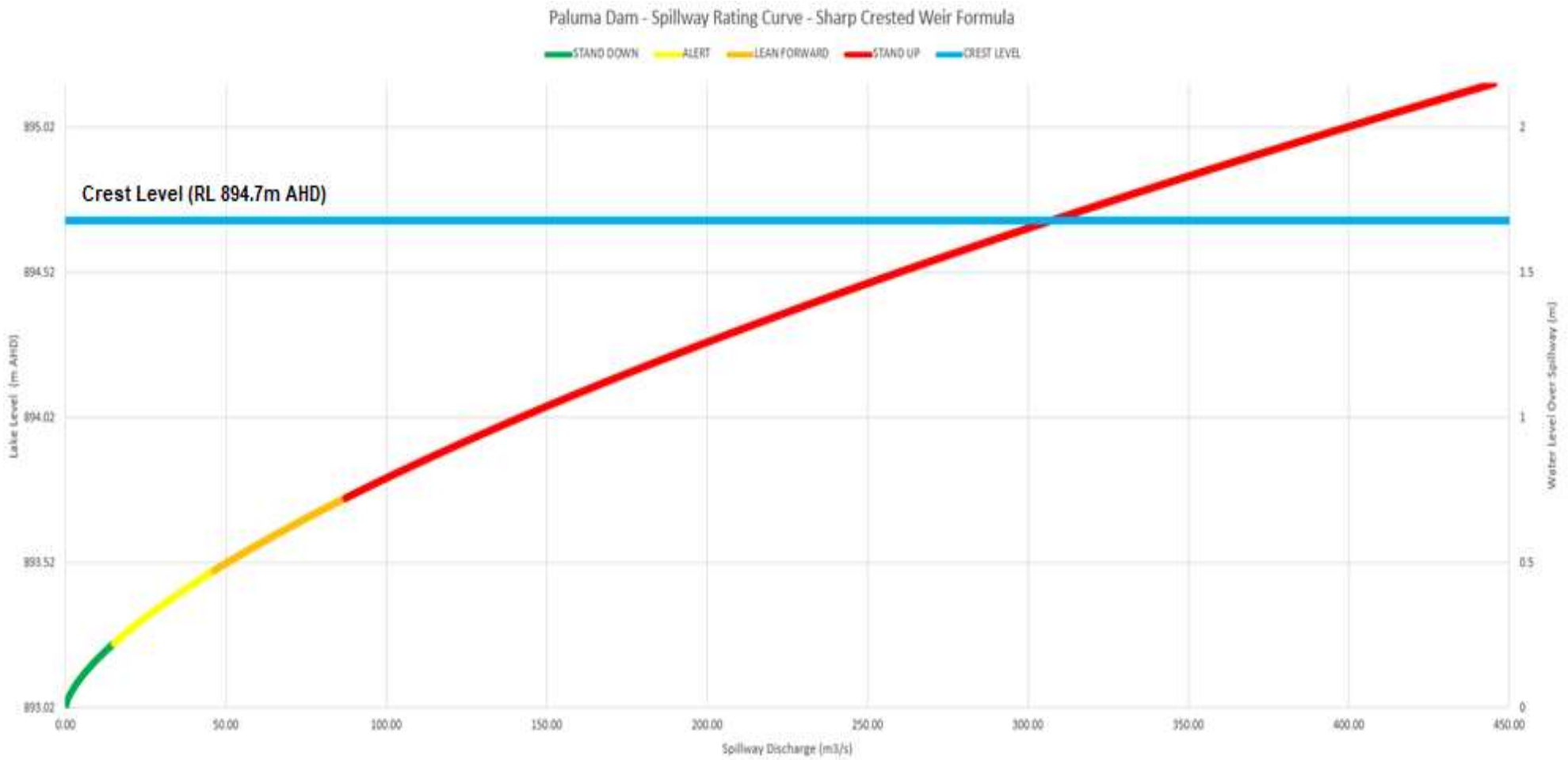

Figure 9 – Spillway Rating Curve

16. Flood Travel Times

16.1 Flood Level Profile

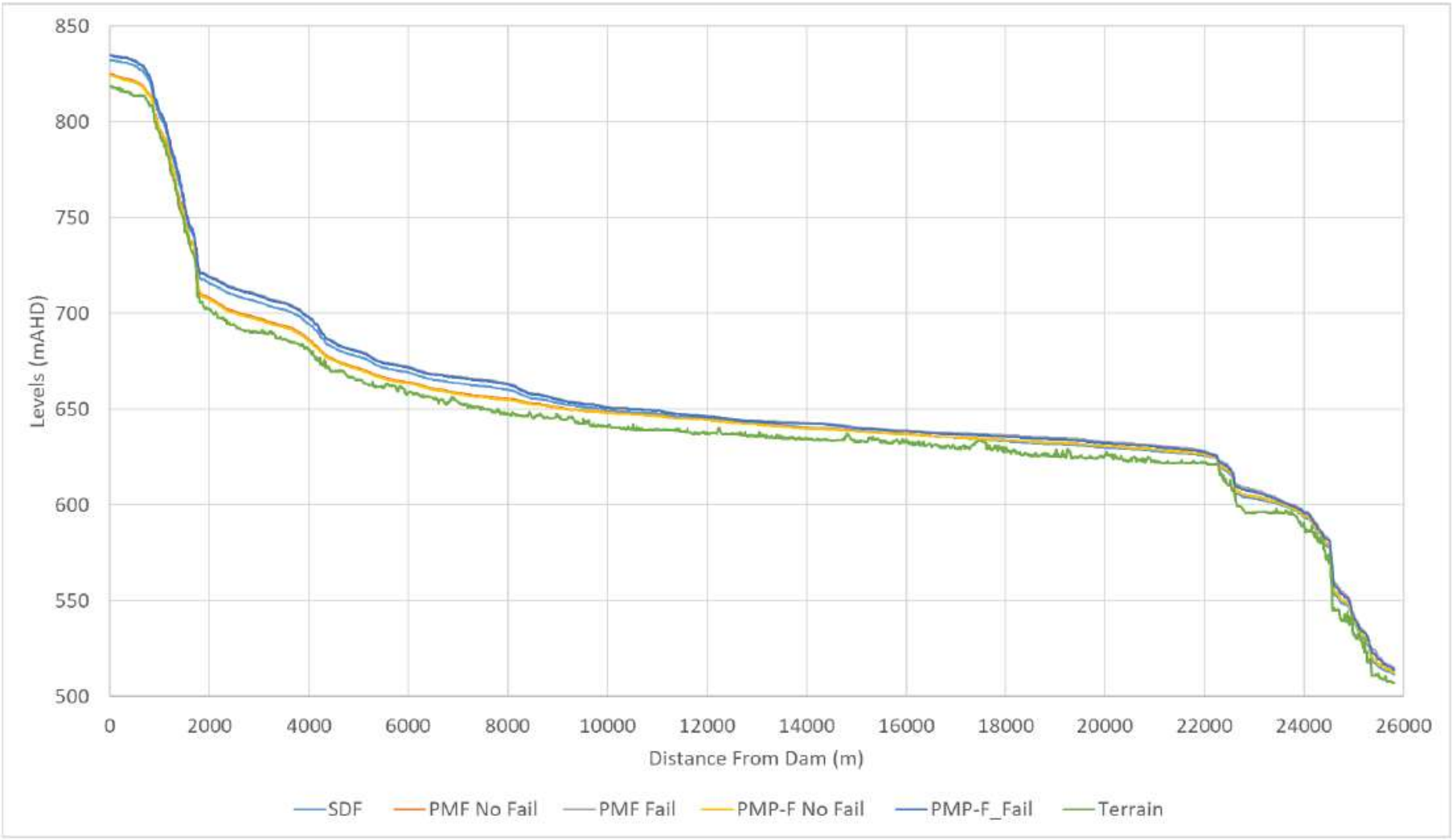

Figure 10 – Flood Level Profile

16.2 Flood Travel Time – Probably Maximum Flood Failure

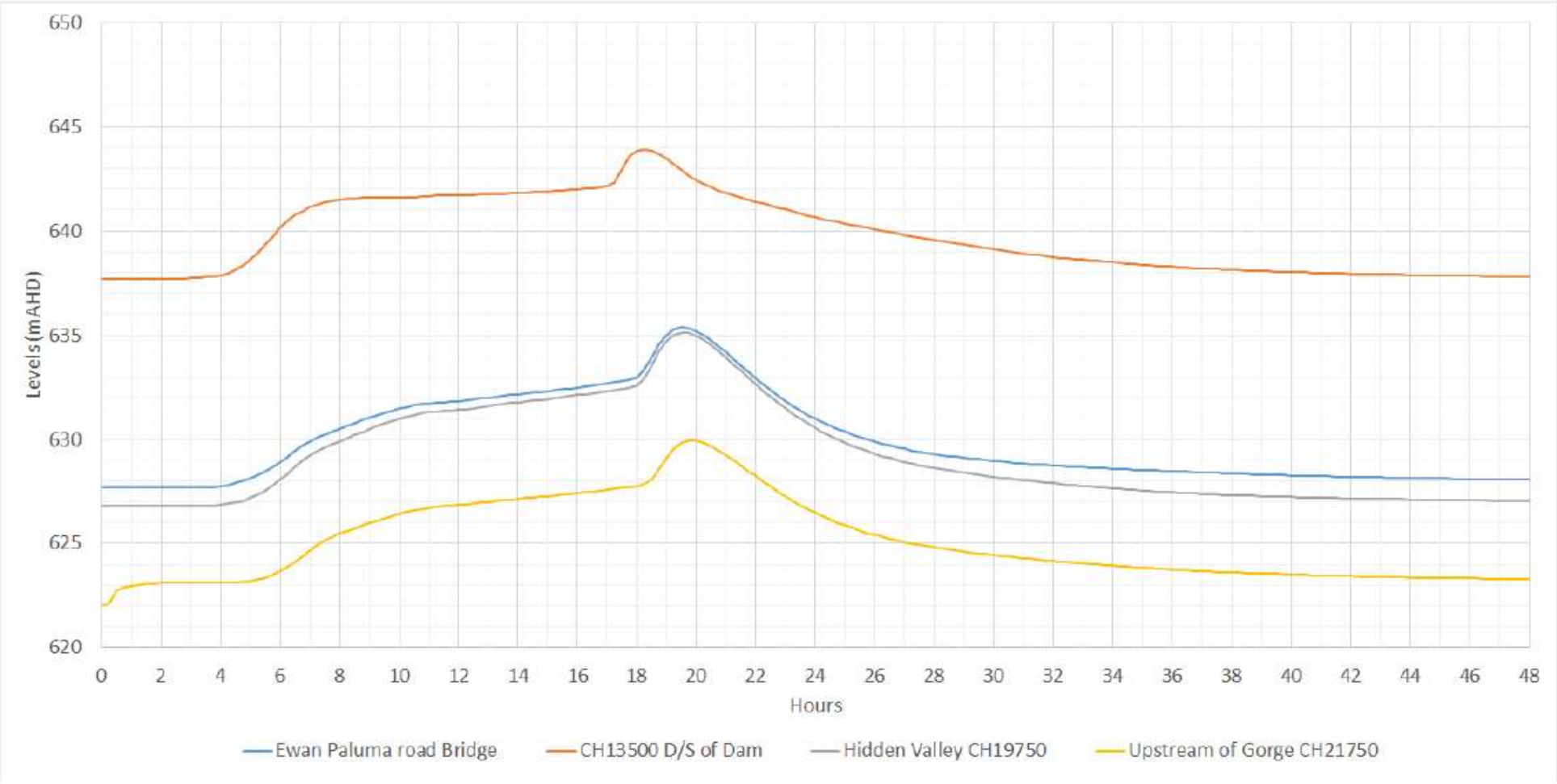

Figure 11 – Flood Travel Time – PMF Failure

16.3 Flood Travel Time – Sunny Day Failure

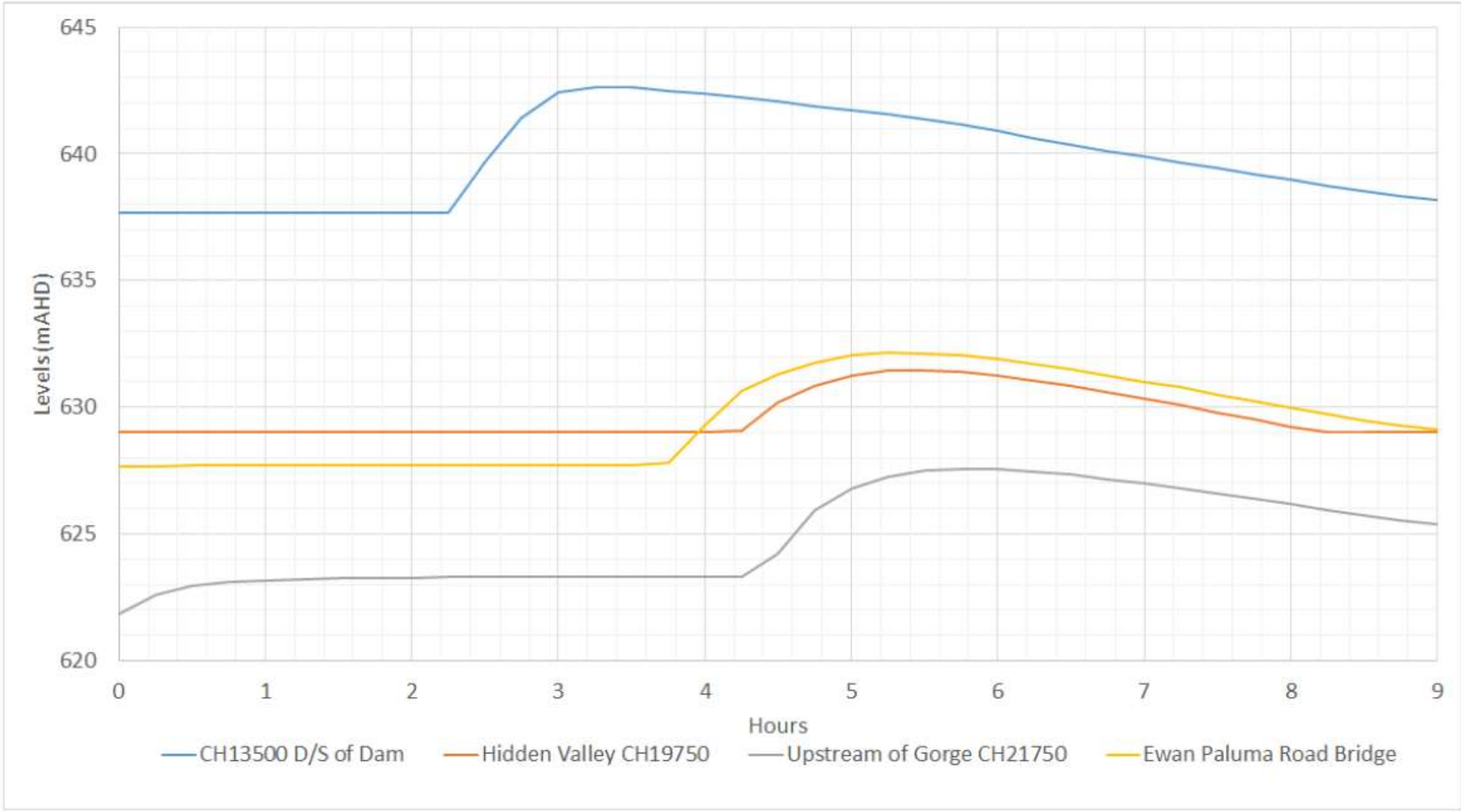

Figure 12 – Flood Travel Time – SDF Failure