Prepared by **TOOWOOMBA REGIONAL COUNCIL**

# QP-M-087 EMERGENCY ACTION PLAN – CRESSBROOK DAM
# QP-M-087 EMERGENCY ACTION PLAN – PERSEVERANCE DAM

**Issue: 19** **Date: September 2023**

**Project: Cressbrook and Perseverance Dams EAP** **File No: DM#9538221-v2A**

**Rural No.**
**Cressbrook: Lot 58 on Plan CHS2241, Parish of Deongwar, County of Cavendish, Shire of Esk**
**Perseverance: Toowoomba Region (Formerly Crow's Nest Shire) Cavendish, Shire of Crow's Nest**

**Cressbrook: Location: Lat. 27° 15' 30" S** **Longitude: 152° 11' 28" E**
**Perseverance: Location: Lat. 27° 18' 05" S** **Longitude: 152° 07' 15" E**

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

## Emergency activation quick reference

The Emergency Action Plan (EAP) for Cressbrook Dam covers five dam hazards evaluated within Toowoomba Regional Council's Dam Safety Management Program. Use the following table to select the relevant section of the EAP that deals with the dam hazard. **The General Manager, Water and Waste Services (GM, W&WS) is responsible for the decision to activate the EAP. Should the GM be unavailable, the Actg. GM is responsible for the decision.**

**Table 1:Emergency activation quick reference**

| Dam Hazards and section numbers | Activation Levels | | | |
|---|---|---|---|---|
| | **Alert** | **Lean Forward** | **Stand Up** | **Stand Down** |
| | • Locally managed (DO, PEC & Inhouse staff) | • Locally managed (DO, PEC and Manager, WIS) | • Locally managed (DO, PEC, Manager, WIS) with advice from Central Plaza Leveel1 Command Centre | • Locally managed (DO, PEC, Manager, WIS) with advice from Central Plaza Level 1 Command Centre |
| | **Activation triggers for dam hazards** | | | |
| **Flood operations** See S***ection 5*** ***Cressbrook dam*** | • **RL279.50m and rising (0.5m below FSL)** When storage level is at RL 279.50 to RL 280.50 and daily rate of rise greater than 250mm and daily weather forecast indicates expected further rainfall over the catchment. | • **Storage above FSL 280.50m and rising** When storage is RL 280.50, +0.50m above FSL and rising to RL 284.0, +4.0m above FSL. | • **Storage above EL 284.0m** When storage is RL 284.0, +4.0 m above FSL and rising to RL 284.9, +4.9m above FSL | • **Storage level EL 280.5m and falling, no more rain observed in previous 12 hours** |
| **Flood operations** See S***ection 5*** ***Perseverance dam*** | • **RL445.58m and rising (0.5m below FSL)** When storage level is at RL445.58 to RL446.58m and daily rate of rise greater than 250mm and daily weather forecast indicates expected further rainfall over the catchment. | • **Storage above RL446.58 and rising** When storage is RL 446.58, +0.50m above FSL and rising to RL449.08, +3.0m above FSL. **Jan 2011 flood peak +3.03m RL449.11** | • **Storage above EL 449.08m** When storage is RL 449.08, +3.0 m above FSL and rising to RL 450.08, 4.0m above FSL **Max. spillway design** | • **Storage level EL 446.58m and falling, no more rain observed in previous 12 hours** |
| **Piping: embankment, foundation, or abutments** | • Increasing leakage through an embankment, the foundations, or abutments | • Increasing leakage through an embankment, the foundations, or abutments with cloudy water | • Piping condition has been established | • Risk assessment has determined that failure risk has reduced |

| | | | | |
|---|---|---|---|---|
| See ***Section 7*** | | | | |
| **Earthquake**<br>See ***Section 8*** | • Earthquake reported or felt in the area, AND<br>• Intensity less than 5 Modified Mercalli (MM) | • Earthquake reported or felt in the area, AND<br>• Intensity greater than or equal to 5MM, OR<br>• Intensity less than 5MM and change detected during surveillance inspection | • Earthquake reported or felt in the area, AND<br>• A possible failure path has been identified | • Risk assessment has determined that failure risk has reduced |
| **Terrorist threat/ activity or high energy impact**<br>See ***Section 9*** | • Not applicable | • Not applicable | • Possible terrorist activity noticed at dam or threat received<br>• Large explosion heard/observed at dam (e.g., bomb explosion, aircraft hit)<br>• Failure in progress or likely due to impact or explosion<br>• Sufficient water in storage to create a dam hazard | • Risk assessment has determined that failure risk has reduced |

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**Document Control Sheet**

CONTROLLED COPY NUMBER:

AUTHORISATION:

**Approved by:** **Date: 22 September 2021**

This Emergency Action Plan has been reviewed pursuant to section 352 of the Water Supply (Safety and Reliability) Act 2008 (the Act.) by Water and Waste Services Group of Toowoomba Regional Council. This has been done in accordance with the Notice approving EAP and the Schedule of EAP matters issued by the Department of Regional Development, Manufacturing and Water (DRDMW) during 2020.

**Document Revision History**

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| 0 | Draft | | 14 August 1997 |
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| 10 | Issue 11 Revision | Complete | August 2015 July 2016 |
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| 14 | Issue 15 | Complete | February 2020 |
| 15 | Updated Property contact details in Cressbrook Gorge | 1 Table 1.2 | 3 March 2020 |
| 16 | Issue 17 - Annual Review -Updated contact details and non-substantial editions highlighted in Schedule of matters except items 15,16&17). | Tables 1.1 -1.3 & 1.6.2 | September 2020 |
| 17 | Review as per Guidelines | Complete | August 2021 |
| 18 | Issue 18 | QA review | September 2021 |
| 19 | Issue 19 | Review | September 2023 |

## Controlled Document Distribution List

| Copy Number | Location | Position |
|---|---|---|
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| 5. | External – Qld Police Service -Electronic copy | 5.1. QPS - Officer in charge - Toowoomba – PO Box 144 Toowoomba Qld 4350<br>5.2. QPS - Officer in charge - Esk - Highland Street Esk Qld 4312<br>5.3. QPS - Officer in Charge - Toogoolawah - Gardner Street Toogoolawah Qld 4313<br>5.4. QPS – Crow's Nest – – 34 Albert Street Crow's Nest Qld 4355 |
| 6. | External – State Emergency Services (SES) and State Disaster Management Group – Uncontrolled – Electronic copies | 6.1. State Emergency Services, Somerset Region SES Unit - C/- Somerset Regional Council PO Box 117 Esk Qld 4312<br>6.2. Regional Director, SES –<br>6.3. Toowoomba District Disaster Coordinator – 52 Neil Street, Toowoomba Qld 4350<br>6.4. Local Disaster Coordinator, LDMG Somerset Regional council PO Box 117 ESK Qld 4312<br>6.5. Executive Officer Ipswich DDMG – Yamanto Police Complex PO Box 382 Ipswich Qld 4305 |

## 1. References, abbreviations and definitions

### 1.1 References/Associated Documents

| Ref | Document Title | Reference /location |
|---|---|---|
| 1 | Emergency action plan for referable dam guideline (DRDMW 2021) | https://www.dews.qld.gov.au/__data/assets/pdf_file/0018/84015/eap-guideline.pdf |
| 2 | Water Supply (Safety and Reliability) Act 2008 | https://www.legislation.qld.gov.au/view/pdf/2017-07-03/act-2008-034 |
| 3 | Water Act 2000 | https://www.legislation.qld.gov.au/view/pdf/2017-07-03/act-2000-034 |
| 4 | Queensland Dam Safety Management Guidelines (DEWS 2002) | https://www.dews.qld.gov.au/__data/assets/pdf_file/0007/78838/qnrm02013.pdf |
| 5 | Queensland Disaster Management Guidelines | http://www.disaster.qld.gov.au |
| 6 | Local Government Act | https://www.legislation.qld.gov.au/view/html/inforce/current/act-2009-017# |
| 7 | Bureau of Meteorology | http://www.bom.gov.au/ |
| 8 | Cressbrook and Perseverance dams Operation and Maintenance Manual | DM#3214638 QP-M-085 Operations and Maintenance Manual |
| 9 | Cressbrook and Perseverance dams Safety Condition Schedules | DM#2898328 QP-MAN-029 Standard Operating Procedures |
| 10 | Cressbrook Dam – Review of Acceptable Flood capacity Assessment – December 2011 | DM#4936279 |

### 1.2 Definitions

| | |
|---|---|
| Concurrent Flooding | Flood flows downstream of a dam that are not a result of dam outflows, for instance those from adjacent catchments and which occur in the same period as downstream releases or flooding from the dam. |
| Downstream Releases | Downstream releases are outflows from the dam made through appurtenant structures such as spillways or outlet works that are in accordance with the design of the dam. |

## 1.3 Abbreviations and acronyms

| | | | |
|---|---|---|---|
| AEP | Annual Exceedance Probability | O&M | Operation & Maintenance |
| AHD | Australian Height Datum | OB | Observation Bore |
| AMTD | Adopted Mean Thread Distance | OC | Operations Co-Ordinator |
| ANCOLD | Australian National Committee on Large Dams | PAR | Population at Risk |
| BOM | Bureau of Meteorology | PFRM | Predictive Flood Routing Model |
| CEO | Chief Executive Officer | PMF | Probable Maximum Flood |
| CRA | Comprehensive Risk Assessment | PMP | Probable Maximum Precipitation |
| D/S | Downstream | PMPDF | Probable Maximum Precipitation Design Flood |
| DCF | Dam Crest Flood | PEC | Principal Engineer, Civil |
| DCL | Dam Crest Level | PEE&M | Principal Engineer, E&M |
| DDC | District Disaster Coordinator | QDMC | Queensland Disaster Management Committee |
| DDMG | District Disaster Management Group | QFES | Queensland Fire & Emergency Services |
| DO /DDO | Dam Operator /Dam Duty Officer | RB | Right Bank |
| DDS | Director Dam Safety | RCC | Roller Compacted Concrete |
| RDMW | Department of Regional Development, Manufacturing and Water | RPEQ | Registered Professional Engineer of Queensland |
| | | RSL | Reduced Supply Level |
| DSR | Dam Safety Regulator | SCE | Senior Civil Engineer |
| EAP | Emergency Action Plan | SDCC | State Disaster Coordination Centre |
| EA | Emergency Alert | SDF | Sunny Day Failure |
| EER | Emergency Event Report | SES | State Emergency Service |
| EL | Elevation Level | SHD | State Height Datum |
| FSL | Full Supply Level | SMS | Short Message Service |
| GM(W&WSG) | General Manager (W&WSG) | SO | Standby Operator |
| IGEM | Inspector-General Emergency Management | SOP | Standard Operating Procedure |
| CP1 | Central Plaza Level 1 Command Post | SWL | Storage Water Level |
| LDC | Local Disaster Coordinator | TRC | Toowoomba Regional Council |
| LDMG | Local Disaster Management Group | U/S | Upstream |
| LEC | Local Event Coordinator | WHS | Workplace Health & Safety |
| MOL | Maximum Operating Level | | |
| MM | Modified Mercalli | | |

## 2.Introduction

### 2.1 Context

Under the Water Supply (Safety and Reliability) Act 2008 (the Act), the owner of a referable dam must have an approved EAP for the dam. In accordance with the Queensland guidelines, a Referable dam is 'A dam if a failure impact assessment demonstrates there would be 2 or more people at risk if the dam was to fail.

The local government area that may be affected by a dam hazard for Cressbrook Dam has been determined as Somerset Regional Council. As Toowoomba Regional Council is the owner of the Cressbrook and Perseverance dams, consultation has been ongoing with Somerset Regional Council prior to submission of the EAP for their review.

This EAP has been prepared in accordance with Chapter 4 of the Act. The content requirements for EAPs are contained in section 352H of the Act.

***Summary of legal requirements – Section 352H***

*Section 352H(1) of the Act requires that the EAP must identify each dam hazard for the dam; and for each of these dam hazard types (e.g., flood operations, or chemical spill/toxic conditions):*

1. *identify the area likely to be affected by a dam hazard event or emergency event arising from the dam hazard; and*
2. *identify each circumstance that indicates a material increase in the likelihood of the dam hazard event or emergency event happening; and*
3. *state when and how the owner of the dam plans to warn persons who may be harmed, or whose property may be harmed by an event caused by the dam hazard, if one happens, and/or there is a material increase in the likelihood of an occurrence, including the order of priority in which the persons or categories of persons are to be warned; and*
4. *state when and how the owner plans to notify the relevant entities for the dam, if a dam hazard event or emergency event happens or, there is a material increase in the likelihood of such an occurrence, including the order of priority in which the relevant entities are to be notified; and*
5. *state the actions the owner of the dam plans to take in response to a dam hazard event or emergency event.*

In accordance with section 352H(2) of the Act, the EAP may provide for the dam owner to make arrangements with a relevant entity for warnings to be given by the relevant entity on behalf of the dam owner in appropriate circumstances. Section 352HA of the Act states that before giving the chief executive an EAP, the owner of the dam must give a copy of the plan to each local government whose area may be affected by a dam hazard identified in the plan; and each district group for the plan. Section 352HB of the Act states that the local government must assess the EAP for consistency with its disaster management plan. In its assessment, the local government must consult with the local district group for the plan.

Within 30 business days of receiving the EAP, the local government must give the owner of the dam a notice, which states whether it considers the plan is consistent with its disaster management plan; and if not, give reason why it considers the EAP is not consistent. The EAP must include any such notices, provided to the owner of the dam by a local government (or district group); and any responses which the owner gives to these notices. Section 352H(1) further stipulates that an EAP must include any other relevant matter prescribed by regulation.

### 2.2 Purpose

***The both, Perseverance and Cressbrook dams Emergency action plans combined into a one document by considering following factors.***

- *Perseverance dam locates in an upstream tributary of Cressbrook dam, hence they are in the same catchment.*
- *Perseverance dam only has PAR in a cascade failure scenario, which is downstream of the Cressbrook dam. There is no PAR between the section of the Perseverance dam to the Cressbrook dam.*
- *It is considered very important to assess both dams EAPs scenarios together upon activation of the EAP due to the interconnectivity of the possible failure modes.*

Toowoomba Regional Council (TRC) is committed to maintaining a comprehensive dam safety management program aimed at ensuring the continued safe and reliable operation of its three dams. However, as the consequences of a dam failure event are high, this Emergency Action Plan (EAP) has also been prepared as required by the Water Supply, Safety and Reliability Act.

The purpose of this EAP is:

- To allow TRC to respond quickly to potential dam hazard events as soon as they are identified and to undertake targeted and effective intervention actions to prevent the situation developing into a hazard.
- If emergency dam hazard event develops that could endanger the integrity of the Perseverance Dam or Cressbrook Dam, this EAP describes procedures and actions which should be followed by Toowoomba Regional Council (TRC) staff in the event of such an emergency.
- A primary focus of these actions is to provide timely warning to appropriate emergency response and management agencies (for example the Somerset Local Disaster Management Group and Local Disaster Co-ordination Centre), allowing them to implement protective measures to minimise the risk of harm to the downstream communities as well as properties.

It is possible for more than one dam hazard to exist at Perseverance or Cressbrook dams, given that they are cascaded dams at the same time. In such a circumstance, it may be necessary to act on the procedures within separate sections simultaneously.

The focus of this EAP is the management of dam hazards at Perseverance and Cressbrook dams by the Water and Waste Services Group of Toowoomba Regional Council (owner of the dam) and the communication and notification of dam hazards to the Toowoomba LDMGs, DDMGs and broader community. However, the EAP sits within the broader emergency response framework. This EAP has been assessed and considered to be consistent with the Toowoomba and Somerset Local Disaster Management Plans.

## 2.3 Scope

The Cressbrook and Perseverance dams EAP covers:

- Dam hazards evaluated by Toowoomba Regional Council Dam Safety Management Program
- Details about the dam that are relevant to a dam hazard
- Identification of circumstances that indicates a material increase in the likelihood of a dam hazard event and/or emergency event happening
- triggers for activation of a tiered response to dam hazard event and/or emergency event
- Roles and responsibilities in responding to a dam hazard event and/or emergency event
- Notification, warning, and communication protocols
- Inspection, monitoring, and reporting protocols during emergencies
- Other relevant information that may assist with identifying the area affected by a dam hazard event and/or emergency event, and the management of such.

The Emergency Action Plan is supported by the associated TRC Dam Safety Documentation and Procedures established for maintaining structural safety of TRC dams. These are in accordance with the Dam Safety Condition Schedule issued by the Dam Safety Regulator and are listed below:

- Internal Dam Safety Routine Inspections and Surveillance Programs in accordance with Dams Operation and Maintenance Manuals and Standard Operating Procedures.
- Annual and Comprehensive inspections (1 year and 5 year) by External Dam Safety Engineers. These inspections are carried out in accordance with QLD Dam Safety Management Guidelines.
- Dam Instrumentation monitoring and dam control surveys as per Standarding Operating Procedures.

## 2.4 TRC Training

Toowoomba Regional Council employs in-house experienced dam safety inspection and monitoring staff. TRC provides regular ongoing dam safety training, on a five-yearly basis for its staff through accredited dam safety training providers. Further, they

receive on the job training through participation in every 3 months dam safety inspections with in-house engineering staff as well as participating in the annual and comprehensive dam inspections performed by an external dam safety engineer /Group.

Emergency Action Plans are reviewed, updated and submitted for the Dam Safety Regulator's approval as per the regulatory requirement. All dam safety staff are involved in providing comments during the review process. The TRC and Somerset Local Disaster Management Groups are involved during the EAP review process and once the draft report is compiled, it is submitted to the TRC and Somerset LDMG's for final comment. Once the review process is complete, the Perseverance and Cressbrook Dam EAP is submitted to the Dam Safety Regulator (DSR) for approval.

An internal stake holder meeting /training is organized to explain the contents of the EAP including amendments. Approved copies (hard and electronic versions) are distributed to relevant stakeholders as listed in the "Controlled Copy Distribution List".

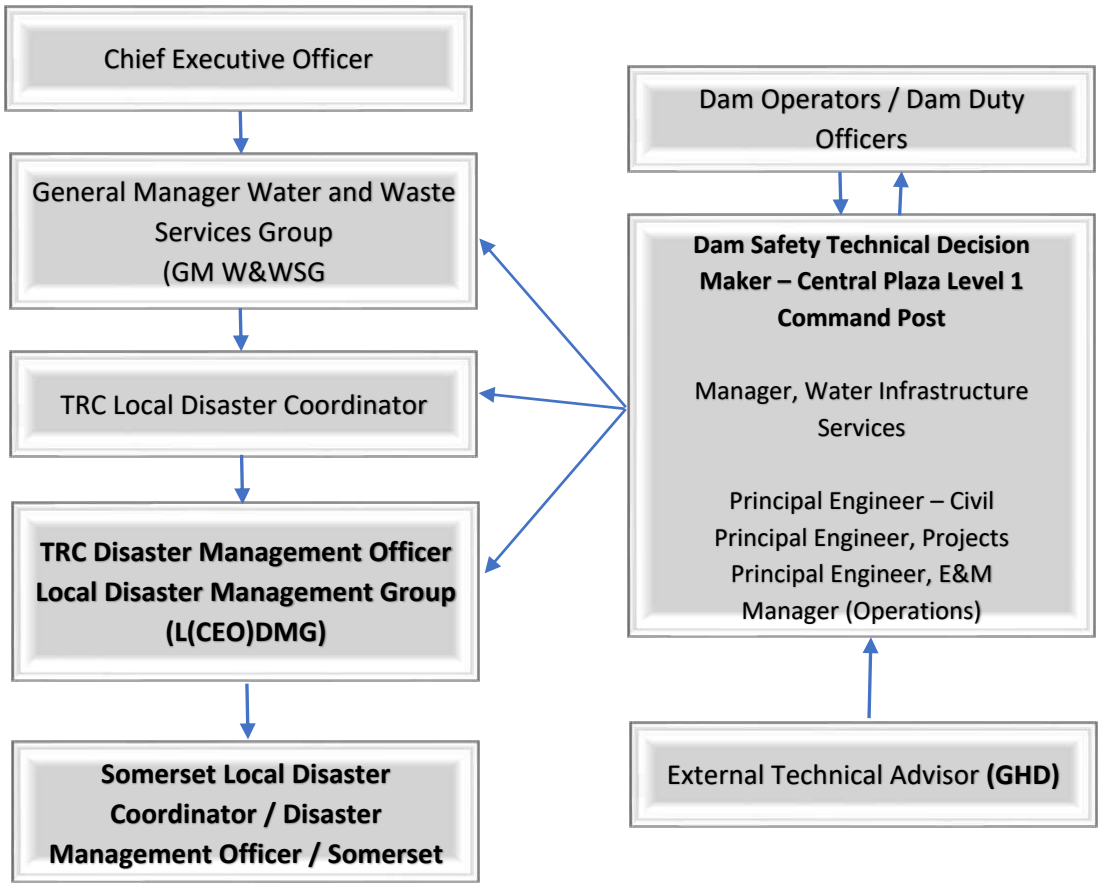
Further, the Perseverance and Cressbrook Dam Emergency Action Plan has been exercised in recent times during 2011 and 2013 floods events. After these events, EAP debrief exercises were organized to allow involved dam safety staff to make comments and suggestions for follow up actions. All suggestions have been reviewed and where appropriate, incorporated during EAP revisions. Emergency contacts lists and in-house dam safety emergency staff rosters are updated on a regular basis to ensure preparedness. Regular EAP training and exercises will be undertaken with all stakeholders involved.

During April 2017, there was a preparation exercise carried out for TRC Operational staff prior to the recent Cyclone Debbie. There was a meeting held with Somerset Regional Council during April 2017 to discuss the matters in the approved EAP and future improvements.

## 2.5 Dam Emergency organization within TRC

The Toowoomba Regional Council emergency management framework generally utilizes the organization's hierarchy and in-house experts as illustrated in Figure 1 below.

**Figure 2.1: TRC Emergency Response organization**



**Key aspects of the dam's emergency management framework are:**

- The General Manager, Water and Waste Services Group (GM, W&WSG) will maintain the overall responsibility for managing dam hazard.
- The GM, W&WSG is responsible for the decision to activate the EAP. Should the GM, W&WSG be unavailable, his delegate followed by the Manager, WIS is responsible for the decision. If GM, W&WSG or his delegate loses all communications during a dam hazard, then as a fail-safe position Manager, WIS or his delegate followed by the PEC will assume the duties and responsibility of the GM, W&WSG.
- Toowoomba Regional Council in-house engineering and technical staff will provide technical advice to the GM, W&WSG and Manager, WIS on and as needs basis. PEC and TRC technical staff will provide flood and dam engineering advice respectively during a dam hazard. Such advice will be provided within an established framework of Standing Operating Procedures (SOPs), models, standards and manuals.
- If unusual circumstances develop during a dam hazard, it will be necessary to escalate to the attention of higher management.

## 2.6 Community information

- TRC with the assistance of the TRC Disaster Management Group and the Somerset Disaster Management Group will ensure community education around messaging and impacts of the EAP and its related events is undertaken. Further, continuous improvement of the EAP will be done via actions on lessons learnt workshops /training and EAP review processes.
- TRC currently provides information externally to customers, downstream residents and the community via various channels including LDMG member groups. Individuals can access information through Facebook, Twitter, TRC website and TRC Customer Service Centers.
- Immediate downstream residents of Cressbrook dam are also provided information with follow up phone calls prior to spilling the Cressbrook dam and activation of the EAP as a priority one basis.
- At present, all downstream inundation maps are available on the TRC Disaster Management Dash Board for Community Information as outlined in the SMS/ALERT messages. Further, Council is in the process of issuing an information booklet to the community notifying that the Toowoomba Regional Council may issue emergency warnings on behalf of Somerset LDMG, in conjunction with Somerset LDC.
- In the event of an emergency event or when otherwise required, the TRC also have the use of the National Emergency Alert System to send a voice message and SMS. This service is provided by Telstra and managed by the State Disaster Coordination Centre. The process TRC follows is documented in Appendix A.
- Copies of all TRC approved EAPs are available to the public on the Business Queensland website: https://www.business.qld.gov.au/industries/mining-energy-water/water/industry-infrastructure/dams/emergency-action-plans/map

## 2.7 Lessons Learnt

- As part of its post event management, TRC organized Lessons Learnt workshops to cover each event to allow all involved dam safety staff to make comments and suggestions for follow up actions.
- All suggestions have been reviewed and where appropriate, incorporated into the EAPs during next revisions.
- Emergency contacts lists and in-house dam safety emergency staff rosters are updated on a regular basis to ensure preparedness.
- Further, the Perseverance and Cressbrook Dam Emergency Action Plan has been exercised in recent times during 2011 and 2013 floods events. After these events, EAP debrief exercises were organized to gather lessons learned and actioned off.
- Regular EAP training and exercises will be undertaken with all stakeholders involved. During April 2017, there was a preparation exercise carried out for TRC Operational staff prior to the recent Cyclone Debbie. There was a meeting held with Somerset Regional Council during April 2017 to discuss the matters in the approved EAP and propose further improvements. Most recently during 2020, internal TRC staff conducted an exercise which included SRC to test the effectiveness of the EAP.

## 2.8 Downstream notification lists

- Refer Appendix A for TRC Notification Lists immediate downstream of the Cressbrook Gauge up to the Kippers Creek Road.
- TRC and Somerset Local Disaster Management plans are prepared to meet disaster management standards in line with PPR Guidelines and Emergency Management Assurance Frame work.

| Document Description |
| --- |
| Somerset RC and TRC Local Disaster Management Plans |
| Somerset RC and TRC LDCC Standing operating procedures |
| Electronic File – Property Inundation details for each event in the Somerset LGA |

**Downstream Notification**

***Priority 1:*** The General Manager,WWSG should notify the Cressbrook downstream gorge property Owners if EAP is activated.

***Second Priority:*** The General Manager, WWSG should Contact TRC Local Disaster Management Coordinator, [redacted] or TRC Disaster Management Officer, [redacted] immediately. TRC LDC will issue Emergency Alert after consultation with Somerset LDC/DMO to areas downstream of Cressbrook Dam.

If TRC LDC is not contactable, contact Somerset Local Disaster Coordinator [redacted] or Somerset Regional Council Disaster Management Officer, [redacted]
There are EA Alerts registered in SDCC Portal with pre-formatted message and polygon held on DMPortal which can be requested to release.

In case of a terrorist threat, immediately call "**National Security Hot Line 1800 123 400"; Email: hotline@nationalsecurity.gov.au**

## 2.9 Comprehensive Risk Assessments

- Comprehensive Risk Assessments are carried on all TRC dams as a requirement to satisfy the Dam Safety Condition Schedule. These are technical reports that are prepared by external qualified consultants engaged by TRC.

## 3.Dam Details

### 3.1 General dam Information

Toowoomba Regional Council owns and operates three dams and reservoirs namely: Cooby, Cressbrook and Perseverance for the purpose of water supply to the Toowoomba region. **Cressbrook and Perseverance Dams** are located in the same catchment while the Cooby Dam is located in Cooby Creek catchment.

Perseverance Dam is located on Perseverance Creek, an upper tributary of the Cressbrook Creek and approximately 15 km upstream of the Cressbrook Dam and 35 km north-east of Toowoomba. Cressbrook Dam is located on Cressbrook Creek an upper tributary of the Brisbane River and 43km north-east of Toowoomba. Cressbrook Creek flows into the Brisbane River downstream of Toogoolawah. Refer Annexure 3.1: *Location Map of Cooby, Cressbrook and Perseverance Dams* for details.

Perseverance Dam is located close to the town of Crow's Nest, which is 7 km to north-northwest of Perseverance Dam and 15 km to the west of Cressbrook Dam. Toowoomba City is located 35 km to south-west of Perseverance Dam and 43 km to south-west of Cressbrook Dam. Perseverance Dam can be accessed by travelling north from Toowoomba on the New England Highway, turning right at Pechey where signposted to the Perseverance Dam (approximately 31km to turn-off from Mt Kynoch). These access roads are sealed and all-weather roads. Approximate travel time is about 45 minutes from Toowoomba city.

Access to the Cressbrook Dam is generally from the New England Highway at Crow's Nest, approximately 36 km north of Toowoomba. The dam is approximately 15 km from Crow's Nest via Albert Street, Three Mile Road and Sebastapool Road. There is all weather access from Toowoomba to about 5 km east of Crow's Nest. The remaining 10 km is unsealed 2WD dry weather or 4WD access. Access to the Cressbrook dam is also possible by boat from the Lake Cressbrook Recreation Area. Approximate travel time by road is around 90 minutes during dry weather period from Toowoomba.

The Lake Cressbrook Recreation Area is reached by travelling north from Toowoomba on the New England Highway, turning right at Pechey where signposted to Perseverance Dam (approximately 31km to turn-off from Mt Kynoch) and turning left where signposted to Lake Cressbrook. Approximate travel time is about 60 minutes. Refer Table 3.1: for design and construction details of Cressbrook and Perseverance dams and Annexure 3.2: Road Access Map for Cressbrook and Perseverance dams for details.

***Table 3.1: Design and Construction details of Cressbrook and Perseverance Dams***

| Details | Cressbrook Dam | Perseverance Dam |
|---|---|---|
| Designer (Date) | Farr and Evrat Consulting Engineers (early 1970s through to 1980) | Toowoomba City Council (1955-1961) |
| Construction Authority Supervisor – | Farr and Evrat Consulting Engineers and Toowoomba City Council | Farr and Evrat Consulting Engineers and Toowoomba City Council |
| Construction Contractor | Abigano | Eric Newham Pty Ltd constructed the dam and Hornibrooks constructed the concrete works under assignment from C.R. Keath Earthmoving Co Pty Ltd |
| Construction period | Completed in 1983 | 1962-1965 |
| Safety review dates | 1996, 2011 | 1996, 2011 |

### *3.2: Technical Details of Cressbrook and Perseverance Dams*

| Details | Cressbrook Dam | Perseverance Dam |
|---|---|---|
| Dam Type | Zoned earth fill embankment with central clay core | Zoned earth and rock fill with an upstream sloping core |
| Purpose | Water supply | Water Supply |
| Dam Height (above lowest toe) | 59 m | 56m |
| Dam Length | 363 m | 208m |
| Storage at FSL | 81,800 ML | 31,000ML |
| Dam Crest Elevation | RL 290 m | RL 452.6m |
| Elevation of Foundation | RL 221 m | RL 396m (15pprox..) |
| Wall Length | 363 m | 208.0m |
| Wall Description (dimensions and zone arrangements) | 7 m crest width<br>2.25H:1V upstream face<br>2.25H:1V (average) downstream face (1.45H:1V between 4m wide berms at 5 m vertical intervals)<br>Central clay core (Zone 1) with both faces sloped at 0.18H:1V<br>Filter (Zone 2) and chimney drain (Zone 4), both 1 m wide, on downstream side of core | 9.1m wide crest<br>Upstream sloping core (Zone 3) with slopes of 1.5H:1V (upstream side) and 1.38H:1V (downstream side), both in the upstream direction.<br><br>Upstream rockfill (Zone 4) with a slope of 1.38H:1V above RL442M, 2.3H:1V between the 6m wide toe berm at RL 413m and RL 442 m and 1.33H:1V below the toe berm.<br><br>Downstream rockfill (Zone 1) with a slope of 1.38H:1V above RL 439m and 1.356H:1V above RL 439m and 1.356H:1V below RL 439m.<br><br>Upstream and Downstream filters (Zones 2A, 2B, 2C, 2D and 2E) between the core and the rockfill zones. |
| Spillway Type | Uncontrolled crest with open channel chute and flip bucket on the left abutment (see below for further details) | Uncontrolled crest with open channel chute and flip bucket through the saddle on the right abutment of the dam (see below for further details) |
| Outlet Description | Cast iron pipe through diversion culvert (see below for further details) | Single low-level outlet for riparian releases |
| Spillway Description | Un-gated overflow spillway controlled by an ogee crest with open channel chute and flip bucket. | Un-gated ogee-controlled spillway with a tapered concrete lined chute leading to a flip bucket and unlined discharge channel. |
| Spillway Crest | RL 280m | RL 446.08m |
| Spillway Width | 20.3m | 53.6 m (3 x 17.88m bays) tapering to approximately 36m wide at the flip bucket. |
| Energy Dissipation Method | Flip bucket and plunge pool | 6.1m radius flip bucket $40^0$ exit angle and discharge channel. |
| Design Head | 6m | 4.8m |
| Control Description | Uncontrolled ogee crest | Uncontrolled ogee crest |
| | | |
| **Storage characteristics** | | |
| Full supply level (FSL) | **RL 280 m** | **RL 446.08 m** |
| Storage capacity at FSL | 81,800 ML | 31,000 ML |
| Surface area | 517 ha (15pprox..) | 216 ha |
| Spillway capacity at FSL | FSL is at spillway crest – zero discharge | FSL is at spillway crest – zero discharge |
| Outlet capacity at FSL | 1 $m^3/s$ (15pprox..) | 1 $m^3/s$ (15pprox..) |
| Dam crest level (DCL) | **RL 290 m** | **RL 452.6 m** |
| Storage capacity at DCL | 134,000 ML | 46,000 ML |
| Spillway capacity at DCL | 1,490 $m^3/s$ | 1,982 $m^3/s$ |
| Minimum operating level(MOL) | **RL 250m (15pprox..)** | |

| | | |
|---|---|---|
| Storage capacity at MOL | 3,100 ML (16pprox..) | |
| Outlet capacity at MOL | 0.6 $m^3/s$ (16pprox..) | 1.1 $m^3/s$ Outlet capacity at DCL |
| **Catchments description** | | |
| Catchment area | 326 $km^2$ | 110$Km^2$ |
| Catchment description | Incorporating Perseverance Dam and its catchment. Moderately undulating country varying from patches of rain forest to lightly-timbered with some land originally cleared around Ravensbourne for dairy farming. | Moderately undulating country varying from patches of rain forest to lightly-timbered with some land originally cleared around Ravensbourne for dairy farming. |
| **Design Rainfall Review** | | |
| Methods | The hydrology was reviewed by GHD for the spillway upgrade options study (GHD, 2005) using AR&R 1999, GTSM-R PMP data from BOM and CRC-FORGE data from DRDMW. | ARR (1999), CRC-FORGE (2005), GTSMR 2003 PMP data for long duration events, GSDM 2003 PMP data for short duration events. |
| **Original Spillway Design Flood** | | |
| Maximum Reservoir Level | RL 286 m | RL 450.8 m |
| Flood volume | Unknown | |
| Peak Discharge | 640 $m^3/s$ | 1,260 $m^3/s$ |
| AEP of Flood 1 | in 300 (16pprox..) based on hydrology reported in GHD (2005) | < 1 in 100,000 (16pprox..) estimated from data based on methods described above |
| Freeboard | 4 m | Zero |
| **Spillway Design Flood (Acceptable Flood Capacity)** | | |
| ***Current Spillway Peak Discharge Capacity*** | ***1476 $m^3/s$ (35% of Acceptable Flood Capacity)*** | ***1910 $m^3/s$ (65% of Acceptable Flood Capacity)*** |
| Maximum Reservoir Level | RL 293.7 m (flow through spillway and over dam crest); or RL 299.6 m (flow through spillway only – assumes dam upgraded by raising dam wall) | RL 452.6 m (dam crest level) |
| Flood Volume | Unknown | |
| Future Spillway Peak Discharge Capacity | 6,643 $m^3/s$ (flow through spillway and over dam crest); or 4,091 $m^3/s$ (flow through spillway only – assumes raised dam wall to RL 299.6 m) | 1,950 $m^3/s$ |
| AEP of Flood | 3.3 x 10-7 or 1 in 3,000,000 (PMP Design Flood) | 1 in 2,000,000 (as defined by risk assessment method in GHD (2010)) |
| Freeboard | Nil – embankment overtops by 3.7 m in its current configuration | Zero |
| **Description of Spillway** | | |
| Spillway Description | Un-gated overflow spillway controlled by an ogee crest with open channel chute and flip bucket. | Un-gated ogee-controlled spillway with a tapered concrete lined chute leading to a flip bucket and unlined discharge channel. |
| Spillway Crest | RL 280m | RL 446.08m |
| Spillway Width | 20.3m | 53.6 m (3 x 17.88m bays) tapering to approximately 36m wide at the flip bucket. |
| Energy Dissipation Method | Flip bucket and plunge pool | 6.1m radius flip bucket $40^0$ exit angle and discharge channel. |
| Design Head | 6m | 4.8m |
| Control Description | Uncontrolled ogee crest | Uncontrolled ogee crest |
| **Description of Outlet Works** | | |
| Reservoir Outlet Description | Riparian outlet works were installed in the diversion conduit through the dam at the end of construction. The current outlet works consist of a 500mm diameter cast iron pipe installed through a concrete plug in the diversion conduit. The reservoir outlet works has two outlets: a low-flow and a high-flow: each outlet has its own regulating valve and a knife gate isolation valve.<br>The lower outlet works also connected to the Wivenhoe pipeline inlet to the reservoir and this is a pumping main from Wivenhoe reservoir to Cressbrook reservoir. | Single low-level outlet for riparian releases. |

| | | |
|---|---|---|
| | The water supply off-take is via 51m high intake tower with multiple-level draw –off.<br>The tower is located to the west of the dam site on the point between the Cressbrook Creek and Little Oaky Creek arms of the reservoir. The water supply off-take is not included in the dam safety inspection. | |
| Conduit Description | 500 mm diameter cast iron pipe. | Single 600mm diameter cement lined steel pipe trenched into rock and encased in concrete over its full length. |
| Regulator Description | One 350mm diameter needle valve and one 150mm diameter cone valve protected upstream by two 500mm diameter gate valves (one immediately downstream of the concrete plug and the second immediately upstream of the regulating valves in the Terminal House. Isolating valve were installed immediately upstream of the control valves to prevent damage of the control valves during operation of the Wivenhoe-Cressbrook pipeline. | One 305mm diameter control valve protected upstream by a 610mm diameter guard valve. |
| Outlet – Offtake Description | Low-level releases through a submerged tower 18 approx.. 15m high with downstream control only. | Uncontrolled offtake through a single concrete chamber at pipe level protected by a galvanised mild steel screen. |
| Capacity at FSL | 1 $m^3/s$ (18 approx..) | |
| **PMP Design Flood (PMPDF)** | | |
| Maximum Reservoir Level | RL 293.7 m (flow through spillway and over dam crest) RL 299.6 m (flow through spillway only – assumes dam upgraded by raising dam wall) | RL 452.6 m (Dam Crest Level) |
| Critical Storm Duration | 24 hours | |
| Peak Inflow | 7,223 $m^3/s$ | |
| Peak Discharge | 6,643 $m^3/s$ (flow through spillway and over dam crest) 4,091 $m^3/s$ (flow through spillway only – assumes raised dam wall) | 1,950 $m^3/s$ |
| AEP of flood | 3.3 x 10-7 or 1 in 3,000,000 | 1 in 2,000,000 (as defined by risk assessment method in GHD (2010) |
| Outflow Volume | Unknown | Unknown |
| Freeboard | Nil – embankment overtops by 3.7 m in its current configuration | Zero |

## 3.2 Population at Risk

| Hazard Rating | Cressbrook | Perseverance |
|---|---|---|
| Failure Impact Rating | A Failure Impact Assessment was undertaken in 2007 in accordance with the NRM guidelines which assigned a Category 2 failure impact rating to the dam. | A failure impact assessment was undertaken in 2007 (GHD, 2007). This found that the incremental population at risk resulting from a cascade failure of Cressbrook Dam during the PMP-DF was greater than 100. The dam was therefore assigned a Category 2 failure impact rating. |

**Table 3.2: Cressbrook Dam Summary of population at Risk for Flood and Dam Break scenarios (2011 AFC Assessment)**

| Event | Population at risk | |
|---|---|---|
| | Total | Incremental |
| | Night (worst case scenario) | Night (worst case scenario) |
| Sunny Day Failure | 266 | 266 |
| 1 in 100AEP Event | 39 | - |
| 1 in 100AEP Event flood piping breach | 266 | 227 |
| Dam Crest Flood Failure | 133 | - |
| DCF Piping Breach | 377 | 244 |
| DCF Overtopping Breach | 377 | 244 |
| PMP design flood failure | 199 | - |
| PMP design flood overtopping breach | 507 | 308 |

## 3.3 Spillway Adequacy

As part of risk assessment conducted during 2007, it was assigned the Cressbrook dam as a Category 2 for failure impact rating. This triggers Cressbrook dam Spillway upgrading. The requirement is that Cressbrook be upgraded to pass 65% of the AFC by 2025 and 100% of the AFC by 2025.

## 3.4 General Arrangement

Refer Appendices B2 and B3 for details of Cressbrook and Perseverance dams respectively. Cressbrook and Perseverance dams are located in the same catchment while Perseverance dam is located on Perseverance Creek, an upper tributary of the Cressbrook Creek. Distance between the two dams is approximately 15 km.

There are **NO** spillway outlet control gates installed in either, Perseverance or Cressbrook dams. Therefore, during a normal flood event, all spillway flows are natural flood flows.

## 3.5 Emergency inspections and monitoring

Frequency of dam inspections is provided below as per Dam Safety Standing Operating Procedures (QP-M-029 – Appendix 1).

***Table 3.3: Frequency of Dam Inspections and Reporting***

| **Frequency of Dam Inspections (Rising Levels) and Reporting** | | |
|---|---|---|
| **Dam Level** | **Cressbrook Dam** | **Perseverance Dam** |
| Rising by >1m in a single event | Inspect and Report Daily for one week and then return to previous inspection and reporting levels. | Inspect and Report Daily for one week and then return to previous inspection and reporting levels. |
| Rising by >2m<3m in a single event | Inspect and Report Daily for one fortnight week and then return to previous inspection and reporting levels. | Inspect and Report Daily for one fortnight week and then return to previous inspection and reporting levels. |
| Rising by >3m<5m in a single event | Inspect and Report Daily for three weeks and then return to previous inspection and reporting levels. | Inspect and Report Daily for three weeks and then return to previous inspection and reporting levels. |
| Greater than 5m rise in a single event<br><br>Flood ALERT 1 up to STANDUP Procedures | As listed below inspect and report:<br>Alert 1 & 2 – Daily or 250mm rise<br>Event Stages 1, 2 & 3 – 6 hourly or 250mm rise<br>Event Stages 4 and above – 2 hourly or 100mm rise. | As listed below inspect and report:<br>Alert 1 & 2 – Daily or 250mm rise<br>Event Stages 1 & 2 – 6 hourly or 250mm rise<br>Event Stages 3 and above – 2 hourly or 100mm rise. |
| **Frequency of Dam Inspections (Falling Levels) and Reporting** | | |
| **Dam storage %** | **Cressbrook Dam** | **Perseverance Dam** |
| 100% - 70% | Daily inspections and reporting | Daily inspections and reporting |
| 60% -40% | Tri-weekly inspections and reporting | Tri-weekly inspections and reporting |
| 30% -10% | Twice weekly inspections and reporting | Twice weekly inspections and reporting |
| Flood and Non-flood Events | As per procedures listed in this EAP. Section 4.0 and 5.0 inspections and reporting | As per procedures listed in this EAP. Section 4.0 and 5.0 inspections and reporting |

There are no instrumentations installed at Perseverance Dam except seepage monitoring while Cressbrook has 24 numbers of hydraulic piezometers and 6 numbers of vibrating wire piezometers along with seepage monitoring. Cressbrook dam instrumentation monitoring is scheduled as per SOP 10. Dam control survey monitoring program is in place for both dams on an annual basis.

***Table 3.4: Frequency of Dam Instrumentation Monitoring***

**SOP10: Frequency of Instrumentation Monitoring:**

| **Dam Level (%)** | **Cressbrook Dam** |
|---|---|
| >25% of FSL | Weekly |
| <25% FSL | Monthly |
| >1 m dam level rise in a single event | Weekly for one month |
| Flood and Non-flood Events | As per Sections 4.0 and 5.0 |

## 4.Roles and responsibilities

Specific Roles and responsibilities in line with the Toowoomba Regional Council Emergency Response Organization (Ref Figure 2.1) are listed below in Table 4.1.

***Table 4.1: Roles and Responsibilities***

| Roles and responsibilities | Position holder |
|---|---|
| **Toowoomba Regional Council**<br>• Notify the Mayor and Liaise with the Councillors and Media<br>• Activate TRC Strategic Response and Business Continuity Plans, if required.<br>• Ensure necessary resources are available to manage the event | **Chief Executive Officer, Toowoomba Regional council**<br>(CEO) |
| **Toowoomba Regional Council**<br>• Activation and deactivation of the Perseverance and Cressbrook Dams Emergency Action Plan (EAP) Notify the Chief Executive Officer and TRC LDC<br>• Notify the Dam Regulator and the dam safety Group of RDMW<br>• Submit update information regarding the event including Emergency Event Report<br>• Ensure necessary resources are available to manage the event<br>• Activate TRC Water Services Strategic Response and Business Continuity Plans, if required.<br>• Authorize Manager, WIS to issue warnings for Cressbrook downstream property owners up to Kippers Creek Road | **General Manager (Water and Waste Services Group) of TRC or his delegate**<br>(GM W&WSG) |
| **Toowoomba Regional Council**<br>• Take appropriate actions in relation to the activation and deactivation of the Perseverance and Cressbrook Dams Emergency Action Plan (EAP)<br>• Notify Cressbrook downstream property owners up to Kippers Creek Road<br>• Advise Manager (Operations), Manager (Capital delivery), Manager (Parks and Gardens)<br>• Authorize the issuing of EAPs, SOPs and O&M Manuals and Amendments.<br>• Facilitate Dam Safety Training Courses for relevant staff as appropriate and ensure that staff required to undertake Dam Safety work are trained and accredited.<br>• Ensure all Dam Safety Condition schedule requirements are met.<br>• Ensure all communications and records are maintained for reporting including EER | **Manager, WIS or delegate** |
| **Toowoomba Regional Council** | **Manager, Operations/ Coordinator (Operations) and Operations Team** |

| | |
|---|---|
| • Ensure all communications and records are maintained.<br>• Maintain all communication logs and records.<br>• Facilitate dam operators /trained staff allocation on emergency works. | |
| **Toowoomba Regional Council**<br><br>• Ensure it has a disaster response capability<br>• Approve its Local Disaster Management Plan<br>• Ensure information about an event or a disaster in its area is promptly given to the District Disaster Coordinator for the disaster district in which area it is situated.<br>• Perform other functions given to the local government under the Act<br>• Must assess (in consultation with its LDMG) the EAP for consistency with the Local Disaster Management Plan.<br>• Notify the Somerset LDC/DMO<br>• TRC LDC will notify the Somerset LDC/DMO when activating the Perseverance and Cressbrook Dams Emergency Action Plan (EAP). | **Toowoomba LDMG**<br>TRC Local Disaster Coordinator /Principal Disaster Management Officer |
| **Somerset Local Disaster Management Group**<br><br>• Ensure it has a disaster response capability<br>• Approve its Local Disaster Management Plan<br>• Ensure information about an event or a disaster in its area is promptly given to the District Disaster Coordinator for the disaster district in which area it is situated.<br>• Perform other functions given to the local government under the Act<br>• Must assess (in consultation with its LDMG) the EAP for consistency with the Local Disaster Management Plan. | **Somerset LDC/DMO**<br>**Somerset LDMG**<br><br>**DDMGs (Toowoomba and Ipswich)** |
| **Toowoomba Regional Council**<br><br>• Review the information and provide technical advises for Civil Infrastructure.<br>• Coordinate with Dam Operator /Dam Duty Officer and issue technical advises as required.<br>• Ensure all communications and records are maintained.<br>• Ensure the EAP is implemented appropriately and carry out the DDO role as required.<br>• Ensure Dam inspections and reporting as listed. | **Principal Engineer, Civil or Delegate** |
| **Toowoomba Regional Council**<br><br>• Review the information and provide technical advises on E&M infrastructure.<br>• Ensure all communications and records are maintained.<br>• Asist to implement EAP appropriately and carry out the DDO role as required.<br>• Ensure Dam inspections and reporting as listed. | **Principal Engineer, E&M or Delegate** |

| | |
|---|---|
| **Toowoomba Regional Council**<br><br>• Complete accreditation (Dam Safety Training) to operate and maintain relevant storage.<br>• Ensure the EAP is implemented appropriately and carry out the DDO role as required.<br>• Ensure Dam inspections and reporting as listed.<br>• Ensure all communications and records are maintained.<br>• Ensure to coordinate close off the Perseverance Dams Roads at Lean Forward. | **Dam Operators /Various staff as per the Dam Safety Roster** |

Functional responsibilities of Dam Safety Management Group are listed in Appendix E1

## 5. Dam Hazard – Flood Operations

### 5.1 Overview

The emergency action described in this section (dam hazard – Flood Operations) relates to:

- Cressbrook and Perseverance dams are located in the same catchment while Perseverance dam is located on Perseverance Creek, an upper tributary of the Cressbrook Creek. Distance between the two dams is approximately 15 km.
- A dam hazard where natural catchment inflows fill Perseverance dam (FSL 446.08) and Cressbrook dam (FSL 280.0) exceeds the capacity of the reservoirs.
- There are **NO** spillway outlet control gates installed in either, Perseverance or Cressbrook dams. Therefore, during a flood event, all spillway flows are natural inflows from the dam catchment.
- Once the Perseverance reservoir reaches its FSL, then Perseverance spillway naturally discharges into the Perseverance Creek which is in upstream of the Cressbrook dam.
- Once Cressbrook reservoir reaches its FSL, it discharges in to the Cressbrook creek.

Note:

- The greater the rate of inflow, the higher the both storages will rise.
- The higher the storage level rises, the greater the loads on the dam structures.
- Although unlikely, the greater the loading, the higher the likelihood of a dam failure.
- Typically, the level of surveillance is increased during flood event.
- This Emergency Action Plan (EAP) identifies flood related dam hazard events that could endanger the integrity of Perseverance and/or Cressbrook dams and describes specific procedures which should be followed by TRC Dam Safety Management Group in the event of such an emergency.

The area likely to be affected by this emergency event is described as:

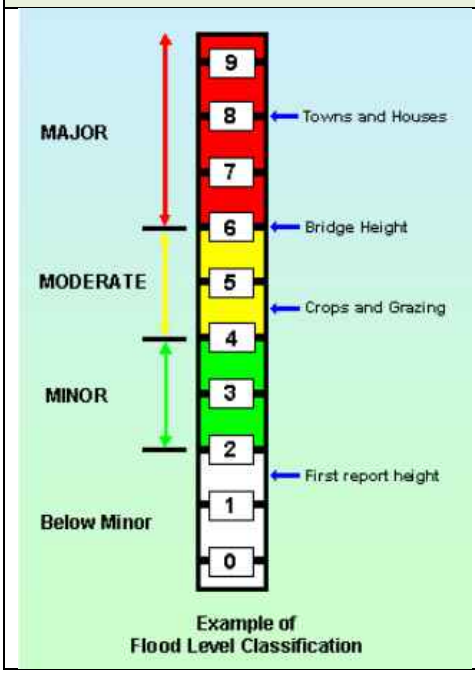
- As the rate of Cressbrook spillway discharge increases, there will be an impact on low-level road crossings of the Cressbrook creek – downstream of the Cressbrook gorge and other infrastructure in the creek such as pump sites.
- When the storage height exceeds minor flood level (0.5m over the spillway) EL 280.5 m low-lying areas next to water courses are inundated including minor road crossings over creek may be inundated.
- Further, there will be road closures for dam access roads. Details are attached in the Appendix B4: Road Closure Maps for Cressbrook and Perseverance dams.
- 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.
- When the storage height exceeds major flood level (3.0m over the spillway) EL 283.0 m, in addition to the above, extensive rural areas and/or urban areas are inundated. Some 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.
- Frequency of dam inspections is provided below as per Dam Safety Standing Operating Procedures (QP-M-029 – Appendix 1).

The following table shows historical floods experienced at Perseverance and Cressbrook dams.

**Table 5.1: Historical Flood Figures and Key Storage Levels at Perseverance and Cressbrook Dams**

| Summary of key levels | | |
|---|---|---|
| **Description** | **Perseverance Dam** | **Cressbrook Dam** |
| Full Supply Level (FSL) | RL 446.08 | RL 280.0 |
| Spillway Design Flood Level | RL 450.80 | RL 286.0 over 6.0m spillway - **Q ($m^3/s$) =637** |
| Dam Crest | RL 452.60 | RL 290 – Clay core at RL 285.0 |
| Freeboard at Design Flood Level | RL 450.80 -1.8m to Crest Level | RL 286.0 – 4.0m to Crest Level |
| **2011 maximum recorded flood level** | **RL 449.11 – 3.03 m over spill level** | **RL 284.2 - +4.2 m over spill level** |

**Table 5.2: Flood Classification Triggers**

| BOM Flood Classification triggers | Flood Classification level | Depth over Spillway (m) | Storage Elevation (m AHD) |
|---|---|---|---|
|  | Major | Cressbrook - 3.0<br>Perseverance -3.0 | RL 283.00<br>RL 449.08 |
| | Moderate | Cressbrook - 2.0<br>Perseverance - 2.0 | RL 282.0<br>RL 448.08 |
| | Minor | Cressbrook - 0.5<br>Perseverance -1.0 | RL 280.50<br>RL 447.08 |

*Source: Bureau of Meteorology*

**Table 5.3: Frequency of Dam Inspections (Rising Levels) and Reporting**

| Dam Level | Cressbrook Dam | Perseverance Dam |
|---|---|---|
| Rising by >1m in a single event | Inspect and Report Daily for one week and then return to previous inspection and reporting levels. | Inspect and Report Daily for one week and then return to previous inspection and reporting levels. |
| Rising by >2m<3m in a single event | Inspect and Report Daily for one fortnight week and then return to previous inspection and reporting levels. | Inspect and Report Daily for one fortnight week and then return to previous inspection and reporting levels. |
| Rising by >3m<5m in a single event | Inspect and Report Daily for three weeks and then return to previous inspection and reporting levels. | Inspect and Report Daily for three weeks and then return to previous inspection and reporting levels. |
| Greater than 5m rise in a single event<br><br>Flood ALERT up to STANDUP Procedures<br>Stand up greater than flood of records, standby officers will be stationed at dam sites. | As listed below inspect and report:<br><br>Alert – Daily or 250mm rise<br>Lean Foreword – 6 hourly or 250mm rise<br>Stand Up Events and above – 2 hourly or 100mm rise. | As listed below inspect and report:<br><br>Alert – Daily or 250mm rise<br>Lean Foreword – 6 hourly or 250mm rise<br>Stand Up Events and above – 2 hourly or 100mm rise. |
| **Frequency of Dam Inspections (Falling Levels) and Reporting** | | |
| **Dam storage %** | **Cressbrook Dam** | **Perseverance Dam** |
| 100% - 70% | Daily inspections and reporting | Daily inspections and reporting |
| 60% -40% | Tri-weekly inspections and reporting | Tri-weekly inspections and reporting |
| 30% -10% | Twice weekly inspections and reporting | Twice weekly inspections and reporting |
| Flood and Non-flood Events | As per procedures listed in this EAP. | As per procedures listed in this EAP. |

There are no instrumentations installed at Perseverance Dam except seepage monitoring while Cressbrook has 24 numbers of hydraulic piezometers and 6 numbers of vibrating wire piezometers along with seepage monitoring. Cressbrook dam instrumentation monitoring is scheduled as per SOP 10. Dam control survey monitoring program is in place for both dams on an annual basis.

**Table 5.4: Frequency of Dam Instrumentation Monitoring (SOP 10)**

| Dam Level (%) | Cressbrook Dam |
|---|---|
| >25% of FSL | Weekly |
| <25% FSL | Monthly |
| >1 m dam level rise in a single event | Weekly for one month |
| Flood and Non-flood Events | As per Sections 4.0 and 5.0 |

## 5.2 Emergency Actions

Regarding the emergency action tables in this section; each level of activation includes both its own actions and the actions of any lower level, unless those lower levels are superseded.

### 5.2.1 Activation triggers

**Table 5.5: Flood emergency activation trigger summary**

| Activation trigger | Cressbrook dam | Perseverance dam |
|---|---|---|
| **Alert** | Storage above EL 278.50m and rising (0.5m below FSL) | Elevation at RL 445.58 and rising<br>-0.5m below to +0.5m above spillway (RL 446.08) |
| **Lean Forward** | Storage above EL 280.50m to RL 284.0 and rising<br>+0.5m to +4.0m above spillway | Storage above RL 447.08 to RL 449.08<br>+1.0m to +3.0m above spillway |
| **Stand Up-greater than flood of record** | **Storage above RL 284.0 to RL284.9 (+4.9m over FSL)**<br>**2011 Flood peak RL284.20 – 4.20m over spillway** | **Storage above RL 449.08, +3.0m over FSL) and rising**<br>**2011 Flood peak 3.03m over spillway** |
| **Stand Up-2** | Storage above RL 284.9, +4.9m above FSL and rising to RL 286.5, +6.5m above FSL. | Storage RL 450.08, +4.0m to >+6.52m above spillway –RL 450.08m Crest Overtopping |
| **Stand Up-3** | Storage is RL 289.00, +9.0m above FSL and rising to Top of Embankment Level – Depth of Water over Spillway 10 m and Overtopping the Dam Crest | ***If Perseverance at Stand up 2 and Cressbrook at Stand Up 2 the dam may be subject to failure due to cascade event should Perseverance breach. Confirm evacuation order for all Cressbrook downstream residents.*** |
| **Stand Down** | Storage level falls below RL280.5 and no more rain observed or is forecast. | Storage level falls below RL447.08 and no more rain is forecast.<br>(+1.0 m above spillway) |

- Water and Waste Services Group of TRC is responsible for issuing appropriate notification for the property owners immediately downstream of the Cressbrook dam (Cressbrook Gorge, down to Kipper Creek Road) in case of Flood or Non-Flood related dam hazard events on a Priority 1 basis.
- TRC LDC will issue Emergency Alerts /notification via SDCC to downstream residents on a Priority 2 basis with consultation of Somerset LDC/DMO.

### 5.2.2 Assessment of circumstances that indicate an increase in the likelihood of flood operations triggers

The Central Plaza Level 1 Command Centre (CP1) will assess the weather and flood warnings daily in accordance with the Dam Operator /Duty Officers reports. The CP1 will escalate to the TRC Disaster Coordinator or Incident Coordinator any warnings that have the potential to generate an inflow event in the catchment in the following 24 hours.
The on-call Dam Operator /Duty Officer will escalate to the CP1 any local intelligence on catchment conditions that could increase the probability of inflows to the dam.
The CP1will determine whether it is reasonably likely that the dam could reach EL 280.5m within the subsequent 24 hours.

### 5.2.3 Emergency action roles

Table 5.5 to Table 5.8 specify emergency actions for the following roles:

- Dam Operators /Dam Duty Officer
- Principal Engineer, Civil or delegate
- Manager, WIS
- Manager, Operations
- General Manager, W&WSG
- Local Disaster Coordinator /Principal Disaster Management Officer, TRC

| Table5.6: Flood Operations – Dam Operators /Duty Officers emergency actions - Cressbrook FSL - RL 280.0 and Perseverance FSL – RL 446.08 | | | | | | |
|---|---|---|---|---|---|---|
| **Activation Level** | **Alert** | **Lean Foreword** | **Stand Up-Grater than flood of record** | **Stand Up-2** | **Stand Up-3** | **Stand Down** |
| **Activation trigger – Cressbrook Dam** | **Elevation at RL 279.50 and rising -0.5m below to +0.5m above spillway** | **Storage above RL 280.50 +0.5m to +4.0m above spillway** | **Storage above RL 284.0 to RL284.9 (+4.9m over FSL)**<br><br>***2011 Flood peak RL284.20 – 4.20m over spillway*** | **Storage above RL 284.9, +4.9m above FSL and rising to RL 286.5, +6.5m above FSL.** | **storage is RL 289.00, +9.0m above FSL and rising to Top of Embankment Level – Depth of Water over Spillway 10 m and Overtopping the Dam Crest** | **Storage level falls below RL280.5 and no more rain is forecast.**<br><br>**(+0.5m above spillway)** |
| **Activation trigger – Perseverance Dam** | **Elevation at RL 445.58 and rising -0.5m below to +0.5m above spillway (RL 446.08)** | **Storage above RL 447.08 to RL 449.08 +1.0m to +3.0m above spillway** | **Storage above RL 449.08 to RL 449.11 (+2.0 -+3.0m over FSL)**<br>***2011 Flood peak 3.03m over spillway*** | **+4.0m to >+6.52m above spillway –RL 450.08m Crest Overtopping** | **If Perseverance at Stand up 2 and Cressbrook at Stand Up 2 the dam may be subject to failure due to cascade event should Perseverance breach. Confirm evacuation order for all Cressbrook downstream residents.** | **Storage level falls below RL447.08 and no more rain is forecast.**<br><br>**(+1.0 m above spillway)** |
| **Actions** | • Inspect the dam daily (or as instructed by PEC) and photograph/video and record using the approved forms in Appendix D and send to PEC.<br>• Undertake site preparations including not limited to:<br>  ○ Check communications systems,<br>  ○ Check fuel, vehicles and other resources.<br>  ○ Organize a generator<br>  ○ Liaise with Parks for road closures and monitor catchment.<br>• Record storage level, rainfall, communication and dam log books and ring or radio to the PEC.<br><br>Frequency of dam inspections and reporting as listed in **the Table 5.3** in this EAP.<br>**Note:** If structural damage to the dam is identified, refer to procedures under relevant sections. However, monitoring frequencies should be in accordance with the Flood events. | Inspect as per previous activation AND<br>Inspect the dam as per Table 5.3 (or as instructed by PEC) and photograph/video and record using the approved forms and send to PEC.<br>Inspect the dams, downstream of the dams, spillway and associated structures as per SOPs.<br>Monitor and record piezometer readings at the piezometer hut and report. Observe tail water level. Review reservoir level of the Perseverance dam.<br>Organize dam access road closures as appropriate. | Inspect as per previous activation AND<br>Increase inspection of the dam and downstream.<br>Inspect /photograph spillway flow and tail water.<br>Maintain communication with Central Plaza Level 1 Command Post every half an hour.<br>**Note:**<br>At RL 285.0 the top of the clay core is reached. There is an increased risk of piping failure above this level. At RL 286.0 the reservoir is at the Spillway Design Flood height. | Inspect as per previous activation | Inspect as per previous activation AND<br><br>All personnel to conduct observations without going on the Dam. Monitor and record water levels in the dam every 50mm rises or 1 hour.<br><br>Maintain communication with Central Plaza Level 1 Command Post every half an hour. | Return to routine surveillance activities and frequencies and inspect the dam for any damage identified.<br><br>Foreward EER information to PEC<br><br>Update Dam Log Books as per SOP |
| **Internal notifications** | 1. Principal Engineer, Civil<br>2. Co-Ordinator (water operations) | As per previous activation level | As per previous activation level | As per previous activation level | As per previous activation level | As per previous activation level |

| | | | | | | |
|---|---|---|---|---|---|---|
| External Notifications | As required. | As required. | As required. | As required. | As required. | As required. |

ALL ACTION MUST BE TAKEN WHEN IT IS SAFE TO DO SO
Dam Inspections, Photo Graphs /Video, Instrumentation Readings etc., ALL PHOTOS MUST BE DATE STAMPED.

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**Table 5.7: Flood Operations – Principal Engineer, Civil or Delegate**

| **Activation Level** | **Alert** | **Lean Foreword** | **Stand Up-Grater than flood of record** | **Stand Up-2** | **Stand Up-3** | **Stand Down** |
|---|---|---|---|---|---|---|
| **Activation trigger – Cressbrook Dam** | **Elevation at RL 279.50 and rising -0.5m below to +0.5m above spillway** | **Storage above RL 280.50 +0.5m to +4.0m above spillway** | **Storage above RL 284.0 to RL284.9 (+4.9m over FSL)**<br><br>***2011 Flood peak RL284.20 – 4.20m over spillway*** | **Storage above RL 284.9, +4.9m above FSL and rising to RL 286.5, +6.5m above FSL.** | ***storage is RL 289.00, +9.0m above FSL and rising to Top of Embankment Level – Depth of Water over Spillway 10 m and Overtopping the Dam Crest*** | **Storage level falls below RL280.5 and no more rain is forecast.**<br><br>**(+0.5m above spillway)** |
| **Activation trigger – Perseverance Dam** | **Elevation at RL 445.58 and rising -0.5m below to +0.5m above spillway (RL 446.08)** | **Storage above RL 447.08 to RL 449.08 +1.0m to +3.0m above spillway** | **Storage above RL 449.08 to RL 449.11 (+2.0 -+3.0m over FSL)**<br><br>***2011 Flood peak 3.03m over spillway*** | **+4.0m to >+6.52m above spillway –RL 450.08m Crest Overtopping** | ***If Perseverance at Stand up 2 and Cressbrook at Stand Up 2 the dam may be subject to failure due to cascade event should Perseverance breach. Confirm evacuation order for all Cressbrook downstream residents.*** | **Storage level falls below RL447.08 and no more rain is forecast.**<br><br>**(+1.0 m above spillway)** |
| **Actions** | • Review information provide by the dam operator and monitor levels through SCADA.<br>• Communicate with Managers, WIS and water Operations as per Table 5.3.<br>• Alert dam Safety staff.<br>• Prepare Command Post at Cressbrook Site Office | • Trigger Perseverance Stand up -2 or Cressbrook AV and above - Maintain a command post at Cressbrook Rangers Office and report as per Table 5.3 | • Trigger at Cressbrook Stand Up -1 - Ensure that the top 5.5m of the embankment is monitored, as this sector will be experiencing its first water loading condition, which is critical for dam safety. The top of the filters and core is at RL 285. Communicate with Manager (Table 5.3). | | | Trigger at Perseverance Stand Up-2- If storage level is less than RL 447.08of Perseverance and no more rain is forecast advise |
| Internal notifications | Manager, WIS<br>Manager, Water Operations<br>Dam Safety Staff | Manager, WIS<br>Manager, Water Operations<br>Dam Safety Staff | Manager, WIS<br>Manager, Water Operations<br>Dam Safety Staff | Manager, WIS<br>Manager, Water Operations | Manager, WIS<br>Manager, Water Operations | Manager, WIS<br>Manager, Water Operations |
| External Notifications | As required. | As required. | As required. | As required. | As required. | As required. |

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Dam Inspections, Photo Graphs /Video, Instrumentation Readings etc., ALL PHOTOS MUST BE DATE STAMPED.

| Table 5.8: Flood Operations – Manager, WIS or Delegate | | | | | | |
|---|---|---|---|---|---|---|
| **Activation Level** | **Alert** | **Lean Foreword** | **Stand Up-Grater than flood of record** | **Stand Up-2** | **Stand Up-3** | **Stand Down** |
| **Activation trigger – Cressbrook Dam** | **Elevation at RL 279.50 and rising -0.5m below to +0.5m above spillway** | **Storage above RL 280.50 +0.5m to +4.0m above spillway** | **Storage above RL 284.0 to RL284.9 (+4.9m over FSL)**<br><br>***2011 Flood peak RL284.20 – 4.20m over spillway*** | **Storage above RL 284.9, +4.9m above FSL and rising to RL 286.5, +6.5m above FSL.** | ***storage is RL 289.00, +9.0m above FSL and rising to Top of Embankment Level – Depth of Water over Spillway 10 m and Overtopping the Dam Crest*** | **Storage level falls below RL280.5 and no more rain is forecast.**<br><br>**(+0.5m above spillway)** |
| **Activation trigger – Perseverance Dam** | **Elevation at RL 445.58 and rising -0.5m below to +0.5m above spillway (RL 446.08)** | **Storage above RL 447.08 to RL 449.08 +1.0m to +3.0m above spillway** | **Storage above RL 449.08 to RL 449.11 (+2.0 -+3.0m over FSL)**<br>***2011 Flood peak 3.03m over spillway*** | **+4.0m to >+6.52m above spillway –RL 450.08m Crest Overtopping** | ***If Perseverance at Stand up 2 and Cressbrook at Stand Up 2 the dam may be subject to failure due to cascade event should Perseverance breach. Confirm evacuation order for all Cressbrook downstream residents.*** | **Storage level falls below RL447.08 and no more rain is forecast.**<br><br>**(+1.0 m above spillway)** |
| Actions | • Ensure the bulkhead door and floor plates in Cressbrook #1 pump station are closed and made watertight.<br>• Close Cressbrook dam Gorge to vehicular traffic at RL280.10. RL280.10 (+100mm) Advise Manager Parks & Recreation to close Cressbrook dam to all water based recreational activities. RL280.25 (+250mm) Advise Manager Parks & Recreation to close Cressbrook dam to all public and non-essential personnel.<br>• Notify all property owners within the area between Cressbrook dam and Kipper Creek Road at Property ID 34CA31688 when spillway discharge exceeds RL 280.10 due to water over creek crossings on GM W&WSG's permission.<br>• Cressbrook: Activate the Water and Waste Services Dam Event Management Room in the | • Organize resources to cover the event | • Arrange for Principal Engineer, E&M to de energise Cressbrook #1 pump station at RL 281.40 (0.1 m below pump floor).<br>• Recommend to the GM W&WSG at RL284.0 to advsie TRC LDC to contact Somerset RC to consider preparation to evacuate Toogoolawah and Cressbrook creek area downstream of dam. | • Confirm evacuation of downstream residents including Toogoolawah. | • At Cressbrook Stand Up-3, seek reconfirmation on evacuation status of all downstream properties. Use the RDMW website to monitor water levels in Cressbrook Creek downstream of the dam at Rosentreters Crossing gauging station. Station additional crews at each dam when either Cressbrook = >RL 285.00 and or Perseverance Dam = >RL 450.08. Consider further evacuation advice to GM W&WSG after reviewing information. Refer Flood Trigger Levels | • Follow stand down procedures when storage level drops to next activation level.<br>• If reservoir level falls and no more rain is forecast deactivate or downgrade the EAP to the below Stage. Advise GM W&WSG. Carry out Safety Inspection of the reservoir with Rangers to determine when safe to re-open dam to recreational activities. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Central Plaza Level 1 Centre. Provide flood updates to all property owners within the area between Cressbrook dam and Kipper Creek Road on GM W&WSG's permission. | | | | and inundation maps in Appendix C | |
| Internal notifications | Manager, Water Operations<br>Manager, Parks and Gardens<br>Manager, Capital Delivery | Manager, Water Operations<br>Manager, Parks and Gardens<br>Manager, Capital Delivery | Manager, Water Operations<br>Manager, Parks and Gardens<br>Manager, Capital Delivery | Manager, Water Operations<br>Manager, Parks and Gardens<br>Manager, Capital Delivery | Manager, Water Operations<br>Manager, Parks and Gardens<br>Manager, Capital Delivery | Manager, Water Operations<br>Manager, Parks and Gardens<br>Manager, Capital Delivery |
| External Notifications | As required. | As required. | As required. | As required. | As required. | As required. |

ALL ACTION MUST BE TAKEN WHEN IT IS SAFE TO DO SO
Dam Inspections, Photo Graphs /Video, Instrumentation Readings etc., ALL PHOTOS MUST BE DATE STAMPED.

| Table 5.9: Flood Operations – General Manager, W&WSG or Delegate | | | | | | |
|---|---|---|---|---|---|---|
| **Activation Level** | **Alert** | **Lean Foreword** | **Stand Up-Grater than flood of record** | **Stand Up-2** | **Stand Up-3** | **Stand Down** |
| **Activation trigger – Cressbrook Dam** | **Elevation at RL 279.50 and rising -0.5m below to +0.5m above spillway** | **Storage above RL 280.50 +0.5m to +4.0m above spillway** | **Storage above RL 284.0 to RL284.9 (+4.9m over FSL)**<br><br>***2011 Flood peak RL284.20 – 4.20m over spillway*** | **Storage above RL 284.9, +4.9m above FSL and rising to RL 286.5, +6.5m above FSL.** | ***storage is RL 289.00, +9.0m above FSL and rising to Top of Embankment Level – Depth of Water over Spillway 10 m and Overtopping the Dam Crest*** | **Storage level falls below RL280.5 and no more rain is forecast.**<br><br>**(+0.5m above spillway)** |
| **Activation trigger – Perseverance Dam** | **Elevation at RL 445.58 and rising -0.5m below to +0.5m above spillway (RL 446.08)** | **Storage above RL 447.08 to RL 449.08 +1.0m to +3.0m above spillway** | **Storage above RL 449.08 to RL 449.11 (+2.0 - +3.0m over FSL)**<br><br>***2011 Flood peak 3.03m over spillway*** | **+4.0m to >+6.52m above spillway –RL 450.08m Crest Overtopping** | ***If Perseverance at Stand up 2 and Cressbrook at Stand Up 2 the dam may be subject to failure due to cascade event should Perseverance breach. Confirm evacuation order for all Cressbrook downstream residents.*** | **Storage level falls below RL447.08 and no more rain is forecast.**<br><br>**(+1.0 m above spillway)** |
| Actions | - **A**uthorise MWIS to issue flood warnings for property owners downstream of Cressbrook Gorge | - **A**uthorise MWIS to issue flood warnings for property owners downstream of Cressbrook Gorge<br>- | -Advise the TRC LDC to consider the evacuation preparation of downstream residents and advsie Somerset LDC to consider evacuation downstream of Cressbrook residents. | -Confirm that LDC to issue notification advice to consider evacuation downstream of Cressbrook including Somerset LDC. | -Reconfirm with the LDC that the Somerset LDMG has taken steps to evacuate downstream residents. | -Deactivate or downgrade the EAP.<br>***Submit the EER to the Dam Safety Group of DRDMW and TRC, once the Event is closed.*** |
| Internal notifications | CEO, TRC<br>TRC LDC /Incident Management Co-ordinator | CEO, TRC<br>TRC LDC /Incident Management Co-ordinator | CEO, TRC<br>TRC LDC /Incident Management Co-ordinator | CEO, TRC<br>TRC LDC /Incident Management Co-ordinator | CEO, TRC<br>TRC LDC /Incident Management Co-ordinator | CEO, TRC<br>Manager, WIS<br>TRC LDC /Incident Management Co-ordinator |
| External Notifications | Director /Dam Safety Group of RDMW, Somerset LDC if TRC LDCC or Emergency Services is not activated.<br><br>E mail alert Seqwater | Director /Dam Safety Group of RDMW Somerset LDC if TRC LDCC or Emergency Services is not activated.<br><br>E mail alert Seqwater | Director /Dam Safety Group of RDMW<br><br>Notify Seqwater | Director /Dam Safety Group of RDMW<br><br>Notify Seqwater | Director /Dam Safety Group of RDMW<br><br>Notify Seqwater | Director /Dam Safety Group of DRDMW<br><br>Notify Seqwater |

| Table 5.10: Flood Operations – Local Disaster Coordinator /Principal Disaster Management Officer, TRC | | | | | | |
|---|---|---|---|---|---|---|
| **Activation Level** | **Alert** | **Lean Foreword** | **Stand Up-Grater than flood of record** | **Stand Up-2** | **Stand Up-3** | **Stand Down** |
| **Activation trigger – Cressbrook Dam** | **Elevation at RL 279.50 and rising -0.5m below to +0.5m above spillway** | **Storage above RL 280.50 +0.5m to +4.0m above spillway** | **Storage above RL 284.0 to RL284.9 (+4.9m over FSL)**<br><br>***2011 Flood peak RL284.20 – 4.20m over spillway*** | **Storage above RL 284.9, +4.9m above FSL and rising to RL 286.5, +6.5m above FSL.** | ***storage is RL 289.00, +9.0m above FSL and rising to Top of Embankment Level – Depth of Water over Spillway 10 m and Overtopping the Dam Crest*** | **Storage level falls below RL280.5 and no more rain is forecast.**<br><br>**(+0.5m above spillway)** |
| **Activation trigger – Perseverance Dam** | **Elevation at RL 445.58 and rising -0.5m below to +0.5m above spillway (RL 446.08)** | **Storage above RL 447.08 to RL 449.08 +1.0m to +3.0m above spillway** | **Storage above RL 449.08 to RL 449.11 (+2.0 -+3.0m over FSL)**<br><br>***2011 Flood peak 3.03m over spillway*** | **+4.0m to >+6.52m above spillway –RL 450.08m Crest Overtopping** | ***If Perseverance at Stand up 2 and Cressbrook at Stand Up 2 the dam may be subject to failure due to cascade event should Perseverance breach. Confirm evacuation order for all Cressbrook downstream residents.*** | **Storage level falls below RL447.08 and no more rain is forecast.**<br><br>**(+1.0 m above spillway)** |
| Actions | - Liaise with Water Services for updates<br>- Contact LDMGs TRC and Somerset LDC to organize notifications as per Table 5.11 | - As per previous activation level AND Warnings as per Table 5.11 | -Issue notification to Somerset LDC to consider evacuation downstream of Cressbrook dam including Toogoolawah. | -Confirm evacuation notification with Somerset LDC to issue notification advice downstream of Cressbrook including Somerset RC area. | -Reconfirm with the LDC that the Somerset LDC has taken steps to evacuate downstream residents. | - Liaise with Water Services regarding deactivation of EAP<br><br>- Issue notification to LDMGs TRC & Somerset<br><br>- Return to normal routine |
| Internal notifications | LDMGs /TRC /Somerset<br>CEO and Mayor, TRC | CEO, TRC<br>TRC LDC /Incident Management Co-ordinator | CEO, TRC<br>TRC LDC /Incident Management Co-ordinator | CEO, TRC<br>TRC LDC /Incident Management Co-ordinator | CEO, TRC<br>TRC LDC /Incident Management Co-ordinator | Advise previously contacted staff /personnel |
| External Notifications | Somerset LDC and as required | TRC to send EA (via SDCC) to downstream residents and notify Somerset LDC | As per previous Activation Level | As per previous Activation Level | As per previous Activation Level | Advise previously contacted personnel |

**Table 5.11: Flood Operations – Local Disaster Coordinator /Principal Disaster Management Officer, TRC – Communication Plan**

| Activation level | Trigger for communications | Group to contact | Method | Message Text |
|---|---|---|---|---|
| **Alert**<br>(>0m above Cressbrook spillway) | **Cressbrook Dam Only Elevation at RL 279.50 and rising -0.5m below to +0.5m above spillway** | • **LDMG (TRC/Somerset)** | • E mail /Phone/Guardian | Describe current situation with dam—What is the event? (Dam Safety Risk due to floods, Issue -Unconfirmed) What is the status?<br>**Advise** of current storage level<br>**SMS messages only** |
| | | • **D/S Residents** | • Phone /SMS<br>• E mail | Liaise with Somerset LDC to send SMS: **WATCH AND ACT**<br>Flood watch & Act message on behalf of Somerset Local Disaster Management Group Cressbrook Dam spilling, flooding at x hours-warn others-prepare to leave-visit TRC website listen to radio for more info |
| **Lean Forward** | **Cressbrook Storage above RL 280.50 +0.5m to +4.0m above spillway** | • **LDMG (TRC /Somerset)** | • Phone | Describe current situation with dam—What is the event? (Dam Safety Risk due to floods — Unconfirmed) What is the status?<br>**Advise** of current storage level and discuss potential downstream floods due to spilling. |
| | | • **D/S Residents** | • SMS (Phone for those without mobiles) | Liaise with Somerset LDC to send SMS: **WARNING**<br>*Flood warning on behalf of Somerset Local Disaster Management Group for Toogoolawah and downstream area Cressbrook Dam. flooding at xx hours-warn others-leave area NOW or seek higher ground-visit TRC website listen to radio* |
| **Stand Up-Grater than flood of record** | **Storage above RL 284.0 to RL284.9 (+4.9m over FSL)**<br>***2011 Flood peak RL284.20 – 4.20m over spillway*** | • **LDMG (TRC /Somerset)**<br>• **DDMG** | • Phone & E mail /Guardian<br>• | Describe current situation with dam—What is the event? (Dam Safety Risk due to floods — Unconfirmed) What is the status?<br>**Advise** of current storage level and discuss potential downstream flood impacts due to spilling.<br>**Activate Emergency Alert Response**. **Prepare for possible Evacuation**<br>Liaise with Somerset LDC to send the SMS |
| | | • **SDCC Watch Desk** | • Phone & E mail /Guardian | Complete Emergency Alert Request Form as per instructions and e mail to SDCC Watch Desk to send.<br>SMS Text as follows:<br>File Name:<br>***Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen to abc radio*** |
| | | • **D/S residents – Cressbrook and Toogoolawah** | • SMS (Phone those without mobiles) | Liaise with LDMG of Toowoomba and Somerset to send the SMS.<br>***Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen to ABC radio*** |

| | | | | |
|---|---|---|---|---|
| **Stand Up-2** | **Storage above RL 284.9, +4.9m above FSL and rising to RL 286.5, +6.5m above FSL.** | • **LDMG (TRC /Somerset)**<br>• **DDMG** | • Phone & E mail /Guardian | Complete Emergency Alert Request Form as per instructions and e mail to SDCC Watch Desk to send.<br>SMS Text as follows:<br>File Name:<br>***Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen ABC radio*** |
| | | • **SDCC Watch Desk** | • Phone & E mail /Guardian<br>• SMS (Phone those without mobiles) | TRC LDC request Emergency Alerts via SDCC in consultation with Somerset LDC |
| | | • **D/S residents – Cressbrook and Toogoolawah** | • SMS (Phone those without mobiles) | ***Emergency Emergency This is a dam breach warning on behalf of Somerset LDMG to evacuate. Areas downstream of Cressbrook Dam and Toogoolawah are likely to experience rapidly rising water levels and flash flooding and property inundation over the next 2 hours, posing an immediate danger to residents. You should warn neighbours, secure your belongings and move to higher ground now. For more information listen to ABC radio or visit w w w dot t r dot q l d dot g o v dot a u. For flood assistance contact State Emergency service on 1 3 2 500*** |
| **Stand Up-3** | ***Cressbrook storage is RL 289.00, +9.0m above FSL and rising to Top of Embankment Level – Depth of Water over Spillway 10 m and Overtopping the Dam Crest OR*** | • **LDMG (TRC /Somerset)**<br>• **DDMG** | • Phone | TRC LDC request EA via SDCC in consultation with Somerset LDC.<br>Describe current situation with dam—What is the event? (Dam Safety Risk due to floods — What is the status? **IMMINENT FAILURE**<br>**Advise** of current storage level and discuss potential downstream flood impacts due to spilling. |
| | ***If Perseverance at Stand up 2 and Cressbrook at Stand Up 2 the dam may be subject to failure due to cascade event should Perseverance breach. Confirm evacuation order for all Cressbrook downstream residents.*** | • **SDCC Watch Desk** | • Phone and E mail | ***Emergency Emergency This is a dam breach warning on behalf of Somerset LDMG to evacuate. Areas downstream of Cressbrook Dam and Toogoolawah are likely to experience rapidly rising water levels and flash flooding and property inundation over the next 2 hours, posing an immediate danger to residents. You should warn neighbours, secure your belongings and move to higher ground now. For more information listen to ABC radio or visit w w w dot t r dot q l d dot g o v dot a u. For flood assistance contact State Emergency service on 1 3 2 500*** |
| **Stand Down** | **Storage level falls below RL280.5 and no more rain is forecast.**<br><br>**(+0.5m above spillway)** | • LDMGs (TRC /Somerset) | • Phone & E mail /Guardian<br>• SMS (Phone those without mobiles) | Describe current situation with dam—What is the event? (Dam Safety Risk due to floods)<br>What is the status?<br>Advise risk assessment has been determined that flood failure risk has reduced and that EAP has been deactivated. |
| | | • D/S residents – Cressbrook and Toogoolawah | • SMS (Phone those without mobiles) | Liaise with LDMG to send SMS: TRC Emergency Notification for Cressbrook dam.<br>Appendix A3 & A4 for detailed messages. Refer TRC website for details |

# 6.Dam Hazard – piping, embankment, foundation, or abutments

## 6.1 Overview

The emergency action described in this section relates to a potential dam hazard due to a piping condition through the embankment (main dam), foundations or abutments. An early indicator of a piping condition can be an increase in seepage or a new area of seepage. If the seepage water is cloudy or has become cloudy, it may indicate that the material is being transported and piping has been established.

If a pipe is established and progresses, then a dam failure may result. If a potential pie is detected early, remedial repairs may be possible if safe to do so.

The inundation maps in Appendix C are there to provide indicative outlines of the maximum potentially affected area of a dam hazard caused by piping. The use of flood inundation maps is prescribed below:

- Use the Sunny Day Failure (SDF) at FSL inundation map when a dam failure is in progress or likely due to piping and no concurrent flooding or downstream spillway releases are occurring or expected to occur, or
- Use the Probable Maximum Flood (PMF) inundation map when a dam failure is in progress or likely due to piping and concurrent flooding or downstream spillway releases are occurring or expected to occur

### 6.1.1 Assessment of circumstances that indicate an increase in the likelihood of piping

An increase in seepage or a new area of seepage is a circumstance that could indicate an increase likelihood of piping. This circumstance is the trigger for the alert status for piping.

Seepage flow is increasing, and the suspended solids is evident in the seepage water and the seepage flow cannot be controlled is the trigger for lean forward status for piping. Cressbrook dam and Perseverance dam piping failure mechanisms are to be considered separately in line with storage volumes.

## 6.2 Emergency action roles

Table 6.1 to Table 6.8 specify emergency actions for the following roles:

- Dam Operators /Dam Duty Officer
- Principal Engineer, Civil or delegate
- Manager, WIS
- General Manager, W&WSG
- Chief Executive Officer, TRC
- Local Disaster Coordinator /Principal Disaster Management Officer, TRC

**Table 6.1: Dam Hazard Incident Level Assessment – piping, embankment, foundation, or abutments failures**

| Trigger Condition | Dam Hazard Trigger Level |
|---|---|
| Significant new or increased seepage areas identified at the dam or seepage areas containing earth material identified at the dam. (Either Perseverance or Cressbrook dam). If seepage flow is increasing over the time, escalate to Alert Stage 2. Implement control measures /preventive actions and monitoring. | ALERT STAGE<br><br>(Increase On-Site monitoring) |
| Seepage flow is increasing, and the suspended solids is evident in the seepage water and the seepage flow cannot be controlled. | LEAN FORWARD (EVENT STAGE 1)<br><br>(Continuous On-site Monitoring) |
| Cressbrook Dam failure is considered possible via an identified failure mechanism (Failure mechanism has to be considered separately for Perseverance and Cressbrook dams).<br><br>Advice TRC LDC to advise Somerset to consider evacuation of downstream properties. | STANDUP<br><br>(Commence Public Warning /Evacuations) |
| Evidence of Dam Hazard event is confirmed and the impacts on downstream residents and properties are possible considering the reservoir RL. Confirm evacuation.<br><br>Confirmation on Dam Hazard Failure Event. | STANDUP - EVENT STAGE 2<br><br>(Confirm Evacuation) |
| Seepage through the dam is controlled. No indicators of potential Dam failure are present. | STAND DOWN |

**Figure 6.1: piping: embankment, foundation, or abutments failure flowchart**

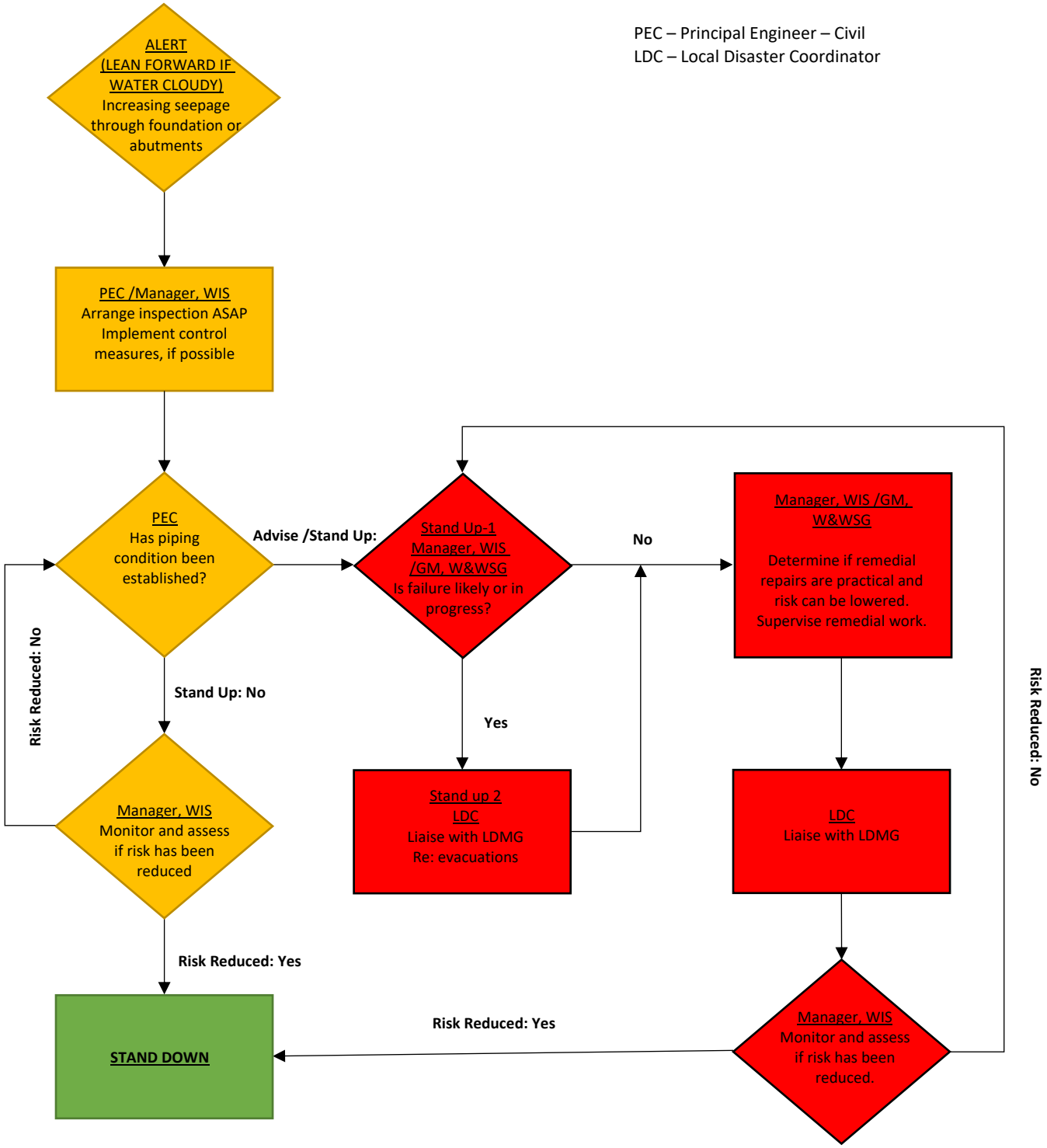

**Table 6.2: Piping: embankment, foundation or abutments – Dam operator emergency action**

**Note:** Trigger level is to be assessed based on Piping condition /situation. Based on the field investigation, the initial activation level is to be decided.

| Activation level | Alert | Lean Forward | Stand Up-1 | Stand Up -2 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Increasing leakage through the embankment, the foundations, or abutments**<br>• **Refer Tables 6.1 for identification of Dam Hazards Levels.** | • **Increasing leakage through the embankment, the foundations, or abutments with cloudy water (particles)** | • **Piping condition has been established** | • **Failure in progress or likely due to piping, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that piping risk has reduced.** |
| **Actions** | • Report to the Principal Engineer, Civil and Co-Ordinator or delegate and monitor as instructed.<br>• Increase frequency of inspections to daily until further advises.<br>• Photograph /Video from a safe point and send to the PEC.<br>• Update dam Log book<br>• Record all communication | • As per previous activation level<br>• Erect warning signs<br>• Organize Road closures for public access | • As per previous activation level, AND<br>• Support /supervise remedial works as required.<br>• Lower the storage levels if directed.<br>• Organize to close the impacted roads<br>• Maintain surveillance of area immediately downstream of dam and around, if safe to do so.<br>• Advise Parks and Gardens staff to isolate the recreational areas. | • As per previous activation level, AND<br>• Vacate the immediate vicinity of the piping condition.<br>• Update Dam Log Book | • Forward information to the PEC<br>• Update Dam Log Bok<br>• Record in Dams Inspection sheets<br>• Return to routine activities. |
| **Internal notifications** | 1. Coordinator, Operations<br>2. Principal Engineer, Civil | • As per previous activation level | • As per previous activation level | • As per previous activation level | • Advise previously contacted staff |
| **External notifications** | • As required | • As required | • As required | • As required | • Advise previously contacted external parties |

ALL ACTION MUST BE TAKEN WHEN IT IS SAFE TO DO SO
Dam Inspections, Photos /Video, Instrumentation Readings etc., ALL PHOTOS MUST BE DATE STAMPED.

**Table 6.3: Piping: embankment, foundation or abutments – Principal Engineer, Civil emergency action**

| Activation level | Alert | Lean Forward | Stand Up-1 | Stand Up -2 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Increasing leakage through the embankment, the foundations, or abutments** | • **Increasing leakage through the embankment, the foundations, or abutments with cloudy water (particles)** | • **Piping condition has been established** | • **Failure in progress or likely due to piping, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that piping risk has reduced.** |
| **Actions** | • Report to the Manager, WIS and assess the situation based on the information provided by the Dam Operator.<br>• Record all communication and review information from the dam Operator. | • As per previous activation level AND<br>• Inspect the dam if possible<br>• Liaise with the Manager, WIS regarding the situation. | • As per previous activation level, AND<br>• Organize remedial works as required.<br>• Liaise with DO and DDO regarding the situation.<br>• Provide updated information to the Manager, WIS<br>• Advise DO /DDO to maintain surveillance of area immediately downstream of dam and around, if safe to do so.<br>• Check Parks and Gardens staff that public has been evacuated from the recreational areas. | • As per previous activation level, AND<br>• Advise DO /DDO to vacate the immediate vicinity of the piping condition.<br>• Update records. | • Forward information to the Manager, WIS<br>• Return to routine activities. |
| **Internal notifications** | 1. Manager, WIS<br>2. Dam Safety Staff | • As per previous activation level | • As per previous activation level | • As per previous activation level | • Advise previously contacted staff |
| **External notifications** | • As required | • As required | • As required | • As required | • Advise previously contacted external parties |

ALL ACTION MUST BE TAKEN WHEN IT IS SAFE TO DO SO
Dam Inspections, Photos /Video, Instrumentation Readings etc., ALL PHOTOS MUST BE DATE STAMPED.

**Table 6.4: Piping: embankment, foundation or abutments – Manager, WIS emergency action**

| Activation level | Alert | Lean Forward | Stand Up-1 | Stand Up -2 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Increasing leakage through the embankment, the foundations, or abutments** | • **Increasing leakage through the embankment, the foundations, or abutments with cloudy water (particles)** | • **Piping condition has been established** | • **Failure in progress or likely due to piping, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that piping risk has reduced.** |
| **Actions** | • Report to the General Manager, W&WSG and assess the situation based on the information provided by the Dam Operator.<br>• Issue Alert notification for Cressbook Gauge Property Owners on GM's permission.<br>• Record all communication | • As per previous activation level AND<br>• Liaise with the GM W&WSG regarding the situation.<br>• Seek permission from GM, W&WSG to issue notification of Cressbrook d/S gauge property owners.<br>• Issue notification for Cressbrook downstream property owners. | • As per previous activation level, AND<br>• Organize remedial works as required.<br>• Provide updated information to the GM W&WSG.<br>• Advise PEC to inspect the dam, if safe to do so. | • As per previous activation level, AND<br>• Advise PEC to vacate the immediate vicinity of the piping condition.<br>• Update records. | • Forward information to the GM W&WSG<br>• Return to routine activities. |
| **Internal notifications** | 1. Manager, Operations<br>2. Internal Staff | • As per previous activation level | • As per previous activation level | • As per previous activation level | • Advise previously contacted staff |
| **External notifications** | • As required | • As required | • As required | • As required | • Advise previously contacted external parties |

ALL ACTION MUST BE TAKEN WHEN IT IS SAFE TO DO SO
Dam Inspections, Photos /Video, Instrumentation Readings etc., ALL PHOTOS MUST BE DATE STAMPED.

**Table 6.5: Piping: embankment, foundation or abutments – General Manager, W&WSG emergency action**

| Activation level | Alert | Lean Forward | Stand Up-1 | Stand Up -2 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Increasing leakage through the embankment, the foundations, or abutments** | • **Increasing leakage through the embankment, the foundations, or abutments with cloudy water (particles)** | • **Piping condition has been established** | • **Failure in progress or likely due to piping, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that piping risk has reduced.** |
| **Actions** | • Activate EAP and Advise LDC /DMO, TRC to contact Somerset LDC for Alert notification.<br>• Advise Manager, WIS to organize onsite inspection and further monitoring.<br>• Issue Manager, WIS permission to issue Alert notification for Cressbook Gauge Property Owners.<br>• Notify the Dam Safety Group of DRDMW and the Chief Executive Officer, TRC and the LDC.<br>• Organize external expert advice and consider impact mitigation options.<br>• Support remedial works as required.<br>• Record all communication | • As per previous activation level AND<br>• Advise TRC LDC to notify Somerset LDMG to evacuate residents downstream of the Cressbrook Dam.<br>• Arrange for additional steps to take as required to mitigate the effects of any damage.<br>• Provide updates to LDC and the CEO. | • As per previous activation level, AND<br>• Provide updated information to the CEO, LDC and the Dam Safety Group of RDMW<br>• Advise LDC to issue Evacuation Notification<br>• Update records | • As per previous activation level, AND<br>• Update records. | • Deactivate EAP<br>• Advice LDC, CEO and the Dam Safety Group<br>• Advise Managers, WIS and Operations<br>• Update Log Book as per SOP<br>• Return to routine activities. |
| **Internal notifications** | 1. CEO, TRC<br>2. LDC /DMO, TRC | • As per previous activation level | • As per previous activation level | • As per previous activation level | • Advise previously contacted staff |
| **External notifications** | • Dam Safety Regulator<br>• E mail alert Seqwater | • As per previous activation level<br>• E mail alert Seqwater | • As per previous activation level<br>• Notify Seqwater | • As per previous activation level<br>• Notify Seqwater | • As per previous activation level<br>• Notify Seqwater |

**Table 6.6: Piping: embankment, foundation or abutments failure – Local Disaster Coordinator /Principal Disaster Management Officer emergency action**

| Activation level | Alert | Lean Forward | Stand Up-1 | Stand Up -2 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Increasing leakage through the embankment, the foundations, or abutments** | • **Increasing leakage through the embankment, the foundations, or abutments with cloudy water (particles)** | • **Piping condition has been established** | • **Failure in progress or likely due to piping, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that piping risk has reduced.** |
| **Actions** | • Liaise with Water Services for updates<br>• Liase with Somerset LDC prior to issue notification as per Table 6.7 | • As per previous activation level AND<br>• Warnings as per Table 6.7 | • As per previous activation level, AND | • As per previous activation level, AND<br>• Update records. | • Liaise with Water Services regarding deactivation of EAP<br>• Issue notification with consultation of Somerset LDC<br>• Return to normal routine |
| **Internal notifications** | • LDMGs (TRC /Somerset)<br>• CEO and Mayor, TRC | • As per previous activation level | • As per previous activation level | • As per previous activation level | • Advise previously contacted staff |
| **External notifications** | • As required | • As required | • SDCC to send EA and DS Residents | • SDCC to send EA and DS Residents | • Advise previously contacted external parties |

**Table 6.7: Piping: embankment, foundation or abutments – Local Disaster Coordinator /Principal Disaster Management Officer Communication Plan**

| Activation level | Trigger for communications | Group to contact | Method | Message Text |
|---|---|---|---|---|
| **Alert** | • **Increasing leakage through the embankment, the foundations, or abutments** | • **Send TRC Incident and Near Miss Alert**<br>• **LDC, TRC** | • Phone<br>• E mail | Describe current situation with dam—What is the event? (Dam Safety Risk—Possible piping Issue -Unconfirmed) What is the status? (Under investigation) Advise of current storage level **Advise** EAP has been activated Stand by for further information |
| **Lean Forward** | • **Increasing leakage through the embankment, the foundations, or abutments with cloudy water (particles)** | • **LDMG (TRC /Somerset)** | • Phone | Describe current situation with dam—What is the event? (Dam Safety Risk—Unconfirmed Piping Risk) What is the status? (Under investigation) Advise of current storage level **Advise** EAP has been activated Stand by for further information |
| | Send TRC Incident Report | | | EAP Alert Notification – Perseverance and Cressbrook dams |
| **Stand Up-1** | • **Piping condition has been established** | • **LDMG (TRC /Somerset)**<br>• **DDMG** | • Phone & E mail /Guardian<br>• | Describe current situation with dam and the event? (Dam Safety Risk—Confirmed Piping Risk) What is the status? Dam Failure in progress – Advise current storage level. Discuss d/s impacts **Activate Emergency Alert Response**. **Prepare for possible Evacuation**<br>Liaise with Somerset LDC and TRC LDC to send the EA |
| | | • **SDCC Watch Desk** | • Phone & E mail /Guardian | Complete Emergency Alert Request Form as per instructions and e mail to SDCC Watch Desk to send.<br>SMS Text as follows:<br>File Name:<br>***Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen to ABC radio*** |
| | | • **D/S residents – Cressbrook and Toogoolawah**<br>• **Manager, WIS will notify Cresbrook residents** | • SMS (Phone those without mobiles) | Liaise with Toowoomba LDC with Somerset LDC before sending the EA.<br>***Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen to ABC radio*** |
| **Stand Up-2** | • **Failure in progress or likely due to piping, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **LDMG (TRC /Somerset)**<br>• **DDMG** | • Phone & E mail /Guardian | Complete Emergency Alert Request Form as per instructions and e mail to SDCC Watch Desk to send.<br>SMS Text as follows:<br>File Name:<br>***Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen to ABC radio*** |

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | • **SDCC Watch Desk** | • Phone & E mail /Guardian<br>• SMS (Phone those without mobiles) | Toowoomba LDC to liaise with Somerset LDC before to sending the EA. |
| | | • **D/S residents – Cressbrook and Toogoolawah** | • SMS (Phone those without mobiles) | ***Emergency Emergency This is a dam breach warning on behalf of Somerset LDMG to evacuate. Areas downstream of Cressbrook Dam and Toogoolawah are likely to experience rapidly rising water levels and flash flooding and property inundation over the next 2 hours, posing an immediate danger to residents. You should warn neighbours, secure your belongings and move to higher ground now. For more information listen to ABC radio or visit w w w dot t r dot q l d dot g o v dot a u. For flood assistance contact State Emergency service on 1 3 2 500*** |
| **Stand Down** | • **Risk assessment has determined that failure risk has reduced.** | • LDMG(TRC & Somerset) | • Phone & E mail /Guardian<br>• SMS (Phone those without mobiles) | Describe current situation with dam—What is the event? (Dam Safety Risk—Piping damage)<br>What is the status? Dam Hazard Stood Down<br>Advise risk assessment has been determined that failure risk has reduced and that EAP has been deactivated. |
| | | • D/S residents – Cressbrook and Toogoolawah | • SMS (Phone those without mobiles) | Liaise with LDMG to send SMS: TRC Emergency Notification for Cressbrook dam.<br>Appendix A3 & A4 for detailed messages. Refer TRC website for details |

## 7.Dam Hazard – Earth Quake

### 7.1 Overview

The emergency action described in this section relates to a potential dam hazard due to an earthquake causing damage to the dam embankment, foundations, outlet structures, spillway or dam abutment. Damage could take the form of cracking or slumping of the embankment, deformation or land slip, or increased seepage.

There are many potential indicators of structural damages as results of an earth quake. The significance of these will depend on the intensity of the earthquake and the circumstances at the dam. Refer Appendix D9 - Modified Mercalli Intensity Scale for earthquake intensities.

If damage does occur, then a dam failure may result. If damage is detected early, remedial repairs may be possible depending on the nature of the damage. If new instances of any of the dam hazard indicators are discovered at either Perseverance or Cressbrook dams, the actions listed below should be followed.

The flood outlines in Appendix C are there to provide indicative outlines of the maximum potentially affected area of a dam hazard caused by earthquake damage. The use of these flood outlines is prescribed below:

- Use the Sunny Day Failure (SDF) Inundation Map for Cressbrook when a dam failure is in progress or likely due to earthquake damage and no concurrent flooding or spillway flows are occurring or expected to occur, or
- Use the Probable Maximum Flood (PMF) Inundation Map when a dam failure is in progress or likely due to earthquake damage and concurrent flooding or spillway flows are occurring or expected to occur.

**Note:** Definitions for Concurrent Flooding and Downstream Releases are provided in Section 1.2

### 7.2 Emergency action roles

Table 7.2 to Table 7.7 specify emergency actions for the following roles:

- Dam Operator or delegate (rostered trained staff)
- Principal Engineer, Civil
- Manager, WIS
- General Manager, W&WSG
- Local Disaster Coordinator /Principal Disaster Management Officer, TRC

**Figure 7.1: Earthquake flowchart**

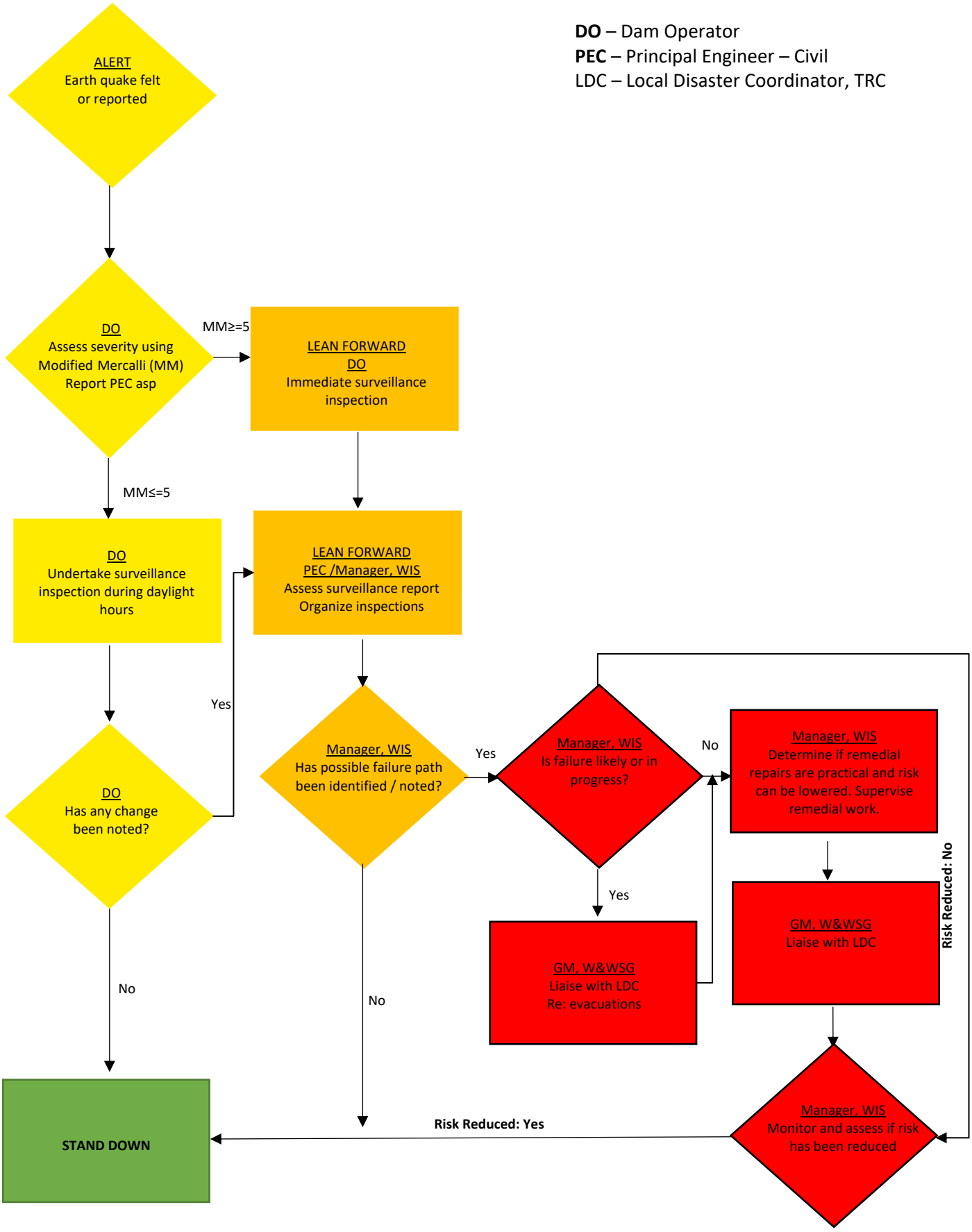

**Table 7.1: Earthquake – Dam Operator emergency action**

| Activation level | Alert | Lean Forward | Stand Up-1 | Stand Up -2 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Earthquake reported or felt in the area AND**<br>• **Intensity less than 5MM***<br><br>***Note: 'Reported' is defined as an alert received from Geoscience Australia or other source that advises an Earthquake >2.5ML (Richter Scale) has occurred within a 100 Km radius of the dam. An e mail notification registered in Geo Science, Australia.*** | • **Earthquake reported or felt in the area, AND**<br>• **Intensity greater than or equal to 5MM*, OR**<br>• **Intensity less than 5MM and change detected during surveillance inspection** | • **Earthquake reported or felt in the area, AND**<br>• **A possible failure path has been identified** | • **Failure in progress or likely due to earthquake, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that failure risk has reduced.** |
| **Actions** | • Inspect the dam, abutments, spillway and associated structures in daylight hours (if safe to do so) and report to the PEC, Coordinator (Operations) immediately.<br>• Photograph/video and record using the approved forms in Appendix and send to PEC asp.<br>• Check for leaks, deformation, erosion and concrete damage<br>• Update Log book as per SOP<br>• Record all communication (ref Appendix D) | • As per previous activation level AND<br>• Repeat the inspection as directed.<br>• Liaise with PEC as required.<br>• Organize C&M, North for road closures to prevent public access for both dams. | • As per previous activation level, AND<br>• Lower the storage level if directed.<br>• Coordinate road closures with Road Operations, North<br>• Maintain surveillance of dam (if safe to do so) and advise rangers to move on any members of the public.<br>• Support remedial works as required.<br>• Provide updated information to the management.<br>• Check Parks and Gardens staff that public has been evacuated from the recreational areas. | • As per previous activation level, AND<br>• Update records. | • Forward information to the Manager, WIS<br>• Update Log Book as per SOP<br>• Return to routine activities. |
| **Internal notifications** | 1. PEC, WIS<br>2. Coordinator, Operations<br>3. Manager, WIS | • As per previous activation level | • As per previous activation level | • As per previous activation level | • As per previous activation level |
| **External notifications** | • As required | • As required | • As required | • As required | • As per previous activation level |

* Earth Quake magnitude (MM Scale) at dam location are to be assessed.

ALL ACTION MUST BE TAKEN WHEN IT IS SAFE TO DO SO
Dam Inspections, Photos /Video, Instrumentation Readings etc., ALL PHOTOS MUST BE DATE STAMPED.

**Table 7.2: Earthquake – Principal Engineer (Civil) emergency action**

| Activation level | Alert | Lean Forward | Stand Up-1 | Stand Up -2 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger**<br><br>***An e mail notification registered in Geo Science, Australia.*** | • **Earthquake reported or felt in the area AND**<br>• **Intensity less than 5MM***<br>***Note: 'Reported' is defined as an alert received from Geoscience Australia or other source that advises an Earthquake >2.5ML (Richter Scale) has occurred within a 100 Km radius of the dam.*** | • **Earthquake reported or felt in the area, AND**<br>• **Intensity greater than or equal to 5MM*, OR**<br>• **Intensity less than 5MM and change detected during surveillance inspection** | • **Earthquake reported or felt in the area, AND**<br>• **A possible failure path has been identified** | • **Failure in progress or likely due to earthquake, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that failure risk has reduced.** |
| **Actions** | • Advise Manager, WIS and Manager Operations about the situation and assess the field information<br>• Organize /Inspect the dam, abutments, spillway and associated structures in daylight hours (if safe to do so) and provide updates to the Manager, WIS<br>• Assess the situation based on the information provided by the Dam Operator/public and determine the Hazard Triger Level<br>• Record all communication | • As per previous activation level AND<br>• Assess the situation with updated information and report.<br>• Notify the Manager and seek permission to advise property owners downstream of the Cressbrook dam section d/s gauge)<br>• After the event immediately, submit records and reports to the MWIS for review. | • As per previous activation level, AND<br>• Follow the directions from the management.<br>• Organize surveillance of dam (if safe to do so) and move on any members of the public.<br>• Support remedial works as required.<br>• Provide updated information to the management.<br>• Check Parks and Gardens staff that public has been evacuated from the recreational areas. | • As per previous activation level, AND<br>• Update records. | • Forward information to the Manager, WIS<br>• Update Log Book as per SOP<br>• Return to routine activities. |
| **Internal notifications** | 1. Manager, WIS<br>2. Manager, Operations<br>3. Principal Engineer, E&M | • As per previous activation level | • As per previous activation level | • As per previous activation level | • As per previous activation level |
| **External notifications** | • As required | • Not applicable | • As required | • As required | • As per previous activation level |

ALL ACTION MUST BE TAKEN WHEN IT IS SAFE TO DO SO
Dam Inspections, Photos /Video, Instrumentation Readings etc., ALL PHOTOS MUST BE DATE STAMPED.

**Table 7.3: Earthquake – Manager, WIS emergency action**

| Activation level | Alert | Lean Forward | Stand Up-1 | Stand Up -2 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Earthquake reported or felt in the area AND**<br>• **Intensity less than 5MM***<br>***Note: 'Reported' is defined as an alert received from Geoscience Australia or other source that advises an Earthquake >2.5ML (Richter Scale) has occurred within a 100 Km radius of the dam.*** | • **Earthquake reported or felt in the area, AND**<br>• **Intensity greater than or equal to 5MM*, OR**<br>• **Intensity less than 5MM and change detected during surveillance inspection** | • **Earthquake reported or felt in the area, AND**<br>• **A possible failure path has been identified** | • **Failure in progress or likely due to earthquake, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that failure risk has reduced.** |
| **Actions** | • Inform the GM W&WSG of the status of Dam Hazard Incident Level. On receipt of damage report, carry out field inspection. If necessary, obtain specialist technical advice from a Dam Consultant for further actions.<br>• Photograph/video and record using the approved forms in Appendix and send to PEC asp.<br>• Check for leaks, deformation, erosion and concrete damage<br>• Organize to alert Cressbrook d/s gorge Residents on GM's permission<br>• Update Log book as per SOP<br>• Record all communication | • As per previous activation level AND<br>• Arrange for a command post to be set up and manned at Central Plaza Level 1.<br>• Advise PEC-WIS to issue notification to residents within the 5km zone if dam failure likely.<br>• Recommend GM W&WSG to activate the EAP and advise LDC.<br>• Advice Manager (Parks & Recreation) to evacuate the public in reservoir area.<br>• Organize PEC to advsise Cressbrook downstream gorge residents. | • As per previous activation level, AND<br>• Coordinate with the specialist team and PEC.<br>• Maintain surveillance of dam (if safe to do so) and move on any members of the public.<br>• Organize remedial works as required.<br>• Provide updated information to the management. | • As per previous activation level, AND<br>• Update records. | • Forward information to the General Manager, W&WSG<br>• Update Log Book as per SOP<br>• Return to routine activities. |
| **Internal notifications** | 1. General Manager, W&WSG<br>2. Manager, Operations and Capital Delivery<br>3. Manager, Parks & Recreation | • As per previous activation level | • As per previous activation level | • As per previous activation level | • As per previous activation level |
| **External notifications** | • As required | • Not applicable | • As required | • As required | • As per previous activation level |

*****Review records and reports produced following the event and compile an Emergency Event Report to GM W&WSG for review.***

**Table 7.4: Earthquake – General Manager, W&WSG emergency action**

| Activation level | Alert | Lean Forward | Stand Up-1 | Stand Up -2 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Earthquake reported or felt in the area AND**<br>• **Intensity less than 5MM***<br>***Note: 'Reported' is defined as an alert received from Geoscience Australia or other source that advises an Earthquake >2.5ML (Richter Scale) has occurred within a 100 Km radius of the dam.*** | • **Earthquake reported or felt in the area, AND**<br>• **Intensity greater than or equal to 5MM*, OR**<br>• **Intensity less than 5MM and change detected during surveillance inspection** | • **Earthquake reported or felt in the area, AND**<br>• **A possible failure path has been identified** | • **Failure in progress or likely due to earthquake, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that failure risk has reduced.** |
| **Actions** | • Activate EAP and Advise LDC /DMO, TRC to contact Somerset LDC for Alert notification.<br>• Advise Manager (WIS) to organize onsite inspection and further monitoring and issue Alerts to d/s Cressbrook Gauge property owners.<br>• Notify the Dam Safety Group of DRDMW and the Chief Executive Officer, TRC and the LDC.<br>• Organize external expert advice and consider impact mitigation options.<br>• Support remedial works as required.<br>• Record all communication | • As per previous activation level AND<br>• Advise TRC LDC to notify Somerset LDC to evacuate residents downstream of the Cressbrook Dam.<br>• Arrange for additional steps to take as required to mitigate the effects of any damage.<br>• Provide updates to LDC and the CEO. | • As per previous activation level, AND<br>• Provide updated information to the CEO, LDC and the Dam Safety Group of RDMW<br>• Advise LDC to issue Evacuation Notification<br>• Update records | • As per previous activation level, AND<br>• Update records. | • Deactivate EAP<br>• Advice LDC, CEO and the Dam Safety Group<br>• Advise Managers, WIS and Operations<br>• Update Log Book as per SOP<br>• Return to routine activities. |
| **Internal notifications** | 1. CEO, TRC<br>2. LDC /DMO, TRC | • As per previous activation level | • As per previous activation level | • As per previous activation level | • As per previous activation level |
| **External notifications** | • Dam Safety Group of RDMW<br>• E mail alert Seqwater | • Dam Safety Group of RDMW<br>• E mail alert Seqwater | • Dam Safety Group of RDMW<br>• Notify Seqwater | • Dam Safety Group of RDMW<br>• Notify Seqwater | • Dam Safety Group of RDMW<br>• Notify Seqwater |

*****Submit the Emergency Event Report to the Dam Safety Group of RDMW and TRC, once the Event is closed.**

**Table 7.5: Earthquake – Local Disaster Coordinator /Disaster Management Officer (TRC) emergency action**

| Activation level | Alert | Lean Forward | Stand Up-1 | Stand Up -2 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Earthquake reported or felt in the area AND**<br>• **Intensity less than 5MM***<br><br>***Note: 'Reported' is defined as an alert received from Geoscience Australia or other source that advises an Earthquake >2.5ML (Richter Scale) has occurred within a 100 Km radius of the dam.*** | • **Earthquake reported or felt in the area, AND**<br>• **Intensity greater than or equal to 5MM*, OR**<br>• **Intensity less than 5MM and change detected during surveillance inspection** | • **Earthquake reported or felt in the area, AND**<br>• **A possible failure path has been identified** | • **Failure in progress or likely due to earthquake, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that failure risk has reduced.** |
| **Actions** | • Liaise with Water Services for updates<br>• Contact LDMGs TRC and Somerset LDC to organize notifications as per Table 7.7 | • As per previous activation level AND<br>• Warnings as per Table 7.7 | • As per previous activation level, AND | • As per previous activation level, AND<br>• Update records. | • Liaise with Water Services regarding deactivation of EAP<br>• Issue notification to LDMGs TRC & Somerset<br>• Return to normal routine |
| **Internal notifications** | • **LDMG (TRC /Somerset)**<br>• **CEO and Mayor, TRC** | • As per previous activation level | • As per previous activation level | • As per previous activation level | • As per previous activation level |
| **External notifications** | • As required | • Not applicable | • As required | • As required | • As per previous activation level |

**Table 7.7: Earthquake – Local Disaster Coordinator /Principal Disaster Management Officer (TRC) communication plan**

| Activation level | Trigger for communications | Group to contact | Method | Message Text |
|---|---|---|---|---|
| **Alert** | • **Earthquake reported or felt in the area, AND**<br>• **Intensity less than 5MM** | • **LDMG (TRC /Somerset)** | • Phone | Describe current situation with dam—What is the event? (Dam Safety Risk—Earthquake damage) What is the status? (Under investigation) Advise of current storage level<br>**Advise** EAP has been activated Stand by for further information |
| **Lean Forward** | • **Earthquake reported or felt in the area, AND**<br>• **Intensity greater than or equal to 5MM, OR**<br>• **Intensity less than 5MM and change detected during surveillance inspection** | • **LDMG (TRC /Somerset)** | • Phone | Describe current situation with dam—What is the event? (Dam Safety Risk—Earthquake damage) What is the status? (Under investigation) Advise of current storage level<br>**Advise** EAP has been activated Stand by for further information |
| | Send TRC Incident Report | | | EAP Alert Notification – Perseverance and Cressbrook dams |
| **Stand Up-1** | • **Earthquake reported or felt in the area, AND**<br>• **A possible failure path has been identified.** | • **LDMG (TRC /Somerset)DDMG** | • Phone & E mail /Guardian<br>• | Describe current situation with dam and the event? (Dam Safety Risk—Earthquake damage) What is the status? Dam Failure in progress – Advise current storage level. Discuss d/s impacts<br>**Activate Emergency response**.<br>Liaise with Somerset LDC prior to send the EA by TRC LDC |
| | | • **SDCC Watch Desk** | • Phone & E mail /Guardian | Complete Emergency Alert Request Form as per instructions and e mail to SDCC Watch Desk to send.<br>SMS Text as follows:<br>File Name:<br>***Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen to ABC radio*** |
| | | • **D/S residents – Cressbrook and Toogoolawah** | • SMS (Phone those without mobiles) | Liaise with LDMG of Toowoomba and Somerset to send the SMS.<br>***Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen to ABC radio*** |
| **Stand Up-2** | • **Dam failure in progress** | • **LDMG (TRC /Somerset)**<br>• **DDMG** | • Phone & E mail /Guardian | Complete Emergency Alert Request Form as per instructions and e mail to SDCC Watch Desk to send.<br>SMS Text as follows:<br>File Name:<br>***Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen to ABC radio*** |

| | | | | |
|---|---|---|---|---|
| | | • **SDCC Watch Desk** | • Phone & E mail /Guardian<br>• SMS (Phone those without mobiles) | Liaise with Somerset LDC before sending the EA. |
| | | • **D/S residents – Cressbrook and Toogoolawah** | • SMS (Phone those without mobiles) | ***Emergency Emergency This is a dam breach warning on behalf of Somerset LDMG to evacuate. Areas downstream of Cressbrook Dam and Toogoolawah are likely to experience rapidly rising water levels and flash flooding and property inundation over the next 2 hours, posing an immediate danger to residents. You should warn neighbours, secure your belongings and move to higher ground now. For more information listen to ABC radio or visit w w w dot t r dot q l d dot g o v dot a u. For flood assistance contact State Emergency service on 1 3 2 500*** |
| **Stand Down** | • **Risk assessment has determined that failure risk has reduced.** | • **LDMG (TRC /Somerset)** | • Phone & E mail /Guardian<br>• SMS (Phone those without mobiles) | Describe current situation with dam—What is the event? (Dam Safety Risk—Earthquake damage)<br>What is the status? Dam Hazard Stood Down<br>Advise risk assessment has been determined that failure risk has reduced and that EAP has been deactivated. |
| | | • D/S residents – Cressbrook and Toogoolawah | • SMS (Phone those without mobiles) | Liaise with LDMG to send SMS: TRC Emergency Notification for Cressbrook dam.<br>Appendix A3 & A4 for detailed messages. Refer TRC website for details |

## 8. Dam Hazard – Terrorist threat /activity or high energy impact

### 8.1 Overview

The emergency action described in this section relates to a potential dam hazard due to a terrorist threat or activity or a high energy impact on the dam such as a plane crash or meteorite.

The risk of terrorist attacks either on Perseverance or Cressbrook dams are low.

The downstream Inundation maps outlined in Appendix C is to provide the potential maximum impacted area of a dam hazard caused by a terrorist attack or a high impact energy impact. The use of these Inundation maps is prescribed below:

- Use the Sunny day failure Cressbrook dam Inundation map when the Cressbrook dam failure is in progress or likely due to a terrorist attack or a high energy impact and no concurrent flooding or downstream releases are occurring or expected to occur.
  or
- Use the Probable Maximum Flood (PMF) outline when a dam failure is in progress or likely due to a terrorist attack or a high energy impact and concurrent flooding or downstream releases are occurring or expected to occur.
- Use the Cascade failure maps if Cressbrook dam fails as a result of failing Perseverance Dam for both situations (no concurrent flooding and concurrent flooding).

#### 8.1.1 Assessment of circumstances that indicate an increase in the likelihood of terrorist activity or high energy impact

Advice from authorities of a specific risk to water infrastructure is a circumstance that could indicate increased risk of likelihood a terrorist threat. If this were specific enough to name a dam, this circumstance would trigger Stand Up-1 activation level.

### 8.2 Emergency action roles

Table 8.1 to Table 8.6 specify emergency actions for the following roles:

- Dam Operator or delegate (rostered trained staff)
- Principal Engineer, Civil
- Manager, WIS
- General Manager, W&WSG
- Local Disaster Coordinator /Principal Disaster Management Officer, TRC

**Figure 8.1: Terrorist threat / activity or high energy impact flowchart**

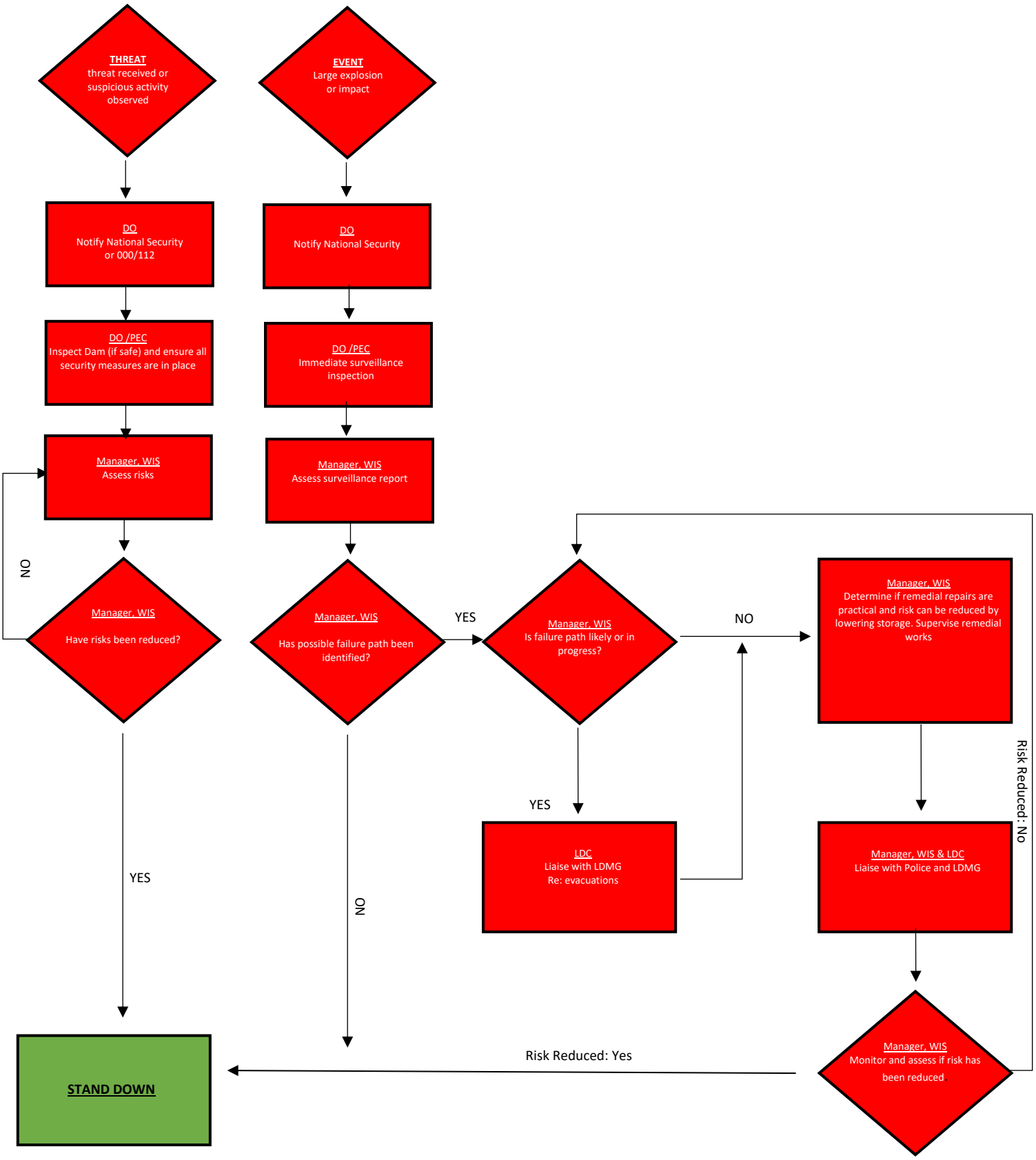

**Table 8.1: Terrorist threat / activity or high energy impact – Dam Operator**

| Activation level | Alert | Stand Up -1 | Stand Up-2 | Stand Up -3 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Not applicable.** | **THREAT**<br>• **Possible terrorist activity /suspicious behaviors noticed at the dam, OR**<br>• **Threat received** | **EVENT**<br>• **Large Explosion heard/observed at dam (e.g. Bomb explosions, Aircraft hit)** | **RESPONSE**<br>• **Failure in progress or likely due to impact or explosion, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that piping risk has reduced.** |
| **Actions** | • Not applicable | • If any suspicious behavior noticed, contact PEC for advice. If instructed by PEC or management, complete the following:<br>• Notify National Security or 000/112<br>• Inspect dam (if safe) and ensure all security measures are in place (locked gates, etc.)<br>• Photograph/video the damage from a safe point and record using the approved forms in Appendix D and send to PEC and Managers, WIS & Operations<br>• Close any affected roads, if not already closed by others<br>• Update Dam Log Book as per SOP<br>• If Police appoint incident manager support and follow instructions<br>• Record all communication | • As per previous activation level, AND<br>• Undertake surveillance inspection if safe to do so with PEC.<br>• Vacate the immediate vicinity of the affected area<br>• Advise Parks and Gardens staff to isolate the recreational areas. | • As per previous activation level, AND<br>• Take actions as directed.<br>• Update Dam Log Book | • Forward information to the PEC<br>• Update Dam Log Book<br>• Record in Dams Inspection sheets<br>• Return to routine activities. |
| **Internal notifications** | • Not applicable | 1. PEC<br>2. Manager /Coordinator, Operations<br>3. Managers, WIS | • As per previous activation level | • As per previous activation level | • As per previously contacted |
| **External notifications** | • Not applicable | • Notify immediately the National Security Line or 000/112 "National Security Hot Line 1800 123 400"; Email: hotline@nationalsecurity.gov.au | • As required | • As required | • As per previously contacted |

ALL ACTION MUST BE TAKEN WHEN IT IS SAFE TO DO SO
Dam Inspections, Photos /Video, Instrumentation Readings etc., ALL PHOTOS MUST BE DATE STAMPED.

**Table 8.2: Terrorist threat / activity or high energy impact – Principal Engineer (Civil)**

| Activation level | Alert | Stand Up -1 | Stand Up-2 | Stand Up -3 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Not applicable.** | **THREAT**<br>• **Possible terrorist activity /suspicious behaviors noticed at the dam, OR**<br>• **Threat received** | **EVENT**<br>• **Large Explosion heard/observed at dam (e.g. Bomb explosions, Aircraft hit)** | **RESPONSE**<br>• **Failure in progress or likely due to impact or explosion, AND**<br>• **Volume of water in the storage to create a dam hazard** | • **Risk assessment has determined that piping risk has reduced.** |
| **Actions** | • Not applicable. | • Liaise with DO, and Manager, WIS regarding the situation.<br>• Inspect the dam infrastructure with DO.<br>• Liaise with the management regarding the situation.<br>• Record all communication. | • As per previous activation level, | • As per previous activation level, AND<br>• Liaise with Manager, WIS and LDC re: potential for evacuations<br>• Update records. | • Forward information to the Manager, WIS<br>• Return to routine activities. |
| **Internal notifications** | • Not applicable. | • Manager, WIS & Operations<br>• Dam Safety Staff | • As per previous activation level | • As per previous activation level | • As per previously contacted |
| **External notifications** | • Not applicable. | • As required | • As advised by the management | • | • As per previously contacted |

ALL ACTION MUST BE TAKEN WHEN IT IS SAFE TO DO SO
Dam Inspections, Photos /Videos, Instrumentation Readings etc., ALL PHOTOS MUST BE DATE STAMPED.

**Table 8.3: Terrorist threat / activity or high energy impact – Manager Water Infrastructure**

| Activation level | Alert | Stand Up -1 | Stand Up-2 | Stand Up -3 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Not applicable.** | **THREAT**<br>• **Possible terrorist activity /suspicious behaviors noticed at the dam, OR**<br>• **Threat received** | **EVENT**<br>• **Large Explosion heard/observed at dam (e.g. Bomb explosions, Aircraft hit)** | **RESPONSE**<br>• **Failure in progress or likely due to impact or explosion, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that piping risk has reduced.** |
| **Actions** | • Not applicable. | • Liaise with the GM, W&WSG and Manager, Operations regarding the situation regarding the situation.<br>• Complete Situation report, unless otherwise directed.<br>• If Police appoint incident manager, support and follow instructions<br>• Monitor situation and assess risk<br>• Record all communication | • As per previous activation level, AND<br>• Arrange an inspection of the dam and assess its condition as soon as possible, when safe to do so<br>• Assess risk and determine if failure likely or in progress<br>• Determine if remedial repairs are practical<br>• Determine if risks can be reduced by lowering storage<br>• Supervise remedial repairs (if applicable)<br>• Monitor situation and assess risks | • As per previous activation level, AND<br>• Mobilize resources to undertake remedial measures if directed by GM, W&WSG<br>• Update records. | • Advise GM to deactivate EAP Event<br>• Compile EER and deliver to DSR if required<br>• Complete Incident Report (final)<br>• Return to routine activities. |
| **Internal notifications** | • Not applicable. | • GM, W&WSG, Dam Safety staff<br>• LDC TRC Local Disaster Management Coordinator, on [redacted] or Principal Disaster Management Officer on [redacted] immediately.<br>• Set up Command Post at CP1. | • As per previous activation level | • As per previous activation level | • As per previously contacted |
| **External notifications** | • Not applicable | • National Security Hotline (If not completed by DO)<br>• National Security Line or 000/112 "National Security Hot Line 1800 123 400"; Email: hotline@nationalsecurity.gov.au<br>• Cressbrook Gorge property owners | • As required AND<br>• Issue Alerts to Cressbrook Gorge property owners D/S Residents in Cressbrook Gorge | • Notify Cressbrook Gorge property owners | • As per previously contacted |

**Table 8.4: Terrorist threat / activity or high energy impact – General Manager W&WSG**

| Activation level | Alert | Stand Up -1 | Stand Up-2 | Stand Up -3 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Not applicable.** | **THREAT**<br>• **Possible terrorist activity /suspicious behaviors noticed at the dam, OR**<br>• **Threat received** | **EVENT**<br>• **Large Explosion heard/observed at dam (e.g. Bomb explosions, Aircraft hit)** | **RESPONSE**<br>• **Failure in progress or likely due to impact or explosion, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that piping risk has reduced.** |
| **Actions** | • Not applicable. | • Activate EAP<br>• Follow up inspection outcomes | • Activate EAP<br>• Follow up inspection outcomes | • As per previous activation level, AND<br>• Update records. | • Deactivate EAP<br>• Advice LDC, CEO and the Dam Safety Group<br>• Advise Managers, WIS and Operations<br>• Update Log Book as per SOP<br>• Return to routine activities. |
| **Internal notifications** | • Not applicable. | • As per previous activation level | • As per previous activation level | • As per previous activation level | • As per previous activation level |
| **External notifications** | • Not applicable. | • If TRC LDC is not contactable, contact Somerset Local Disaster Coordinator [redacted] or Somerset Regional Council Disaster Management Officer, [redacted]<br>• DSR -Dam Safety Regulator<br>• Notify Seqwater | • DSR -Dam Safety Regulator<br>• Notify Seqwater | • DSR -Dam Safety Regulator<br>• Notify Seqwater | • DSR -Dam Safety Regulator<br>• Notify Seqwater |

**Table 8.6: Terrorist threat / activity or high energy impact – Local Disaster Coordinator /Principal Disaster Management Officer (TRC) Emergency Action**

| Activation level | Alert | Stand Up -1 | Stand Up-2 | Stand Up -3 | Stand Down |
|---|---|---|---|---|---|
| **Activation trigger** | • **Not applicable.** | **THREAT**<br>• **Possible terrorist activity /suspicious behaviors noticed at the dam, OR**<br>• **Threat received** | **EVENT**<br>• **Large Explosion heard/observed at dam (e.g. Bomb explosions, Aircraft hit)** | **RESPONSE**<br>• **Failure in progress or likely due to impact or explosion, AND**<br>• **Sufficient water in the storage to create a dam hazard** | • **Risk assessment has determined that piping risk has reduced.** |
| **Actions** | • Liaise with Water Services for updates<br>• Contact LDMGs TRC and Somerset LDC to organize notifications as per Table 8.7 | • As per previous activation level AND<br>• Warnings as per Table 8.7 | • As per previous activation level, AND | • As per previous activation level, AND<br>• Update records. | • Liaise with Water Services regarding deactivation of EAP<br>• Issue notification to LDMGs TRC & Somerset<br>• Return to normal routine |
| **Internal notifications** | • LDMGs /TRC /Somerset<br>• CEO and Mayor, TRC | • As per previous activation level | • As per previous activation level | • As per previous activation level | • As per previous activation level |
| **External notifications** | • As required | • As required | • SDCC to send EA and DS Residents | • SDCC to send EA and DS Residents | • As per previous activation level |

**Table 8.7: Terrorist threat / activity or high energy impact – Local Disaster Coordinator /Principal Disaster Management Officer (TRC) Communication plan**

| Activation level | Trigger for communications | Group to contact | Method | Message Text |
|---|---|---|---|---|
| **Alert** | • **Not applicable.** | • **LDMG (TRC /Somerset)** | • Phone | Describe current situation with dam—What is the event? (Dam Safety Risk— Terrorist threat / activity or high energy impact) What is the status? (Under investigation) Advise of current storage level<br>**Advise** EAP has been activated Stand by for further information |
| **Stand Up-1** | **THREAT**<br>• **Possible terrorist activity /suspicious behaviors noticed at the dam, OR**<br>• **Threat received** | • **LDMG (TRC /Somerset)** | • Phone | Describe current situation with dam—What is the event? (Dam Safety Risk— Terrorist threat / activity or high energy impact) What is the status? (Under investigation) Advise of current storage level<br>**Advise** EAP has been activated Stand by for further information |
| | Send TRC Incident Report | | | EAP Alert Notification – Perseverance and Cressbrook dams |
| **Stand Up-2** | **EVENT**<br>• **Large Explosion heard/observed at dam (e.g. Bomb explosions, Aircraft hit)** | • **LDMG (TRC /Somerset, DDMG** | • Phone & E mail /Guardian<br>• | Describe current situation with dam and the event? (Dam Safety Risk— Terrorist threat / activity or high energy impact)<br>What is the status? Dam Failure in progress – Advise current storage level. Discuss d/s impacts<br>**Activate Emergency response**.<br>Liaise with Somerset LDC before send EA by TRC LDC |
| | | • **SDCC Watch Desk** | • SMS & E mail /Guardian | Complete Emergency Alert Request Form as per instructions and e mail to SDCC Watch Desk to send.<br>SMS Text as follows:<br>File Name:<br>***Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen to abc radio*** |
| | | • **D/S residents – Cressbrook and Toogoolawah** | • **Voice** (Phone those without mobiles) | Liaise with Somerset LDC before send EA by TRC LDC ***Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen to ABC radio*** |

| | | | | |
|---|---|---|---|---|
| **Stand Up-3** | | • **LDMG (TRC /Somerset)**<br>• **DDMG** | • SMS & E mail /Guardian | Complete Emergency Alert Request Form as per instructions and e mail to SDCC Watch Desk to send.<br>SMS Text as follows:<br>File Name:<br>***Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen to abc radio*** |
| | **RESPONSE**<br>• **Failure in progress or likely due to impact or explosion, AND**<br>**Sufficient water in the storage to create a dam hazard** | • **SDCC Watch Desk** | • Phone & E mail /Guardian<br>• SMS (Phone those without mobiles) | Liaise with Somerset LDC before send EA by TRC LDC |
| | | • **D/S residents – Cressbrook and Toogoolawah** | • **Voice** (Phone those without mobiles) | ***Emergency Emergency This is a dam breach warning on behalf of Somerset LDMG to evacuate. Areas downstream of Cressbrook Dam and Toogoolawah are likely to experience rapidly rising water levels and flash flooding and property inundation over the next 2 hours, posing an immediate danger to residents. You should warn neighbours, secure your belongings and move to higher ground now. For more information listen to ABC radio or visit w w w dot t r dot q l d dot g o v dot a u. For flood assistance contact State Emergency service on 1 3 2 500*** |
| **Stand Down** | • **Risk assessment has determined that failure risk has reduced.** | • **LDMG (TRC /Somerset)** | • Phone & E mail /Guardian<br>• SMS (Phone those without mobiles) | Describe current situation with dam—What is the event? (Dam Safety Risk—Earthquake damage)<br>What is the status? Dam Hazard Stood Down<br>Advise risk assessment has been determined that failure risk has reduced and that EAP has been deactivated. |
| | | • D/S residents – Cressbrook and Toogoolawah | • SMS (Phone those without mobiles) | Liaise with Somerset LDC before send EA by TRC LDC: TRC Emergency Notification for Cressbrook dam.<br>Appendix A3 & A4 for detailed messages. Refer TRC website for details. |

## Appendix A Notification and communication lists /interaction with Somerset Regional Council

Appendix A-1: Notification for properties in Cressbrook Gorge – Up to Kipper Creek Road
Appendix A-2: Property Details in Cressbrook Gorge – Up to Kipper Creek Road
Appendix A-3: Property Notification by TRC LDCC on behalf of Somerset LDCC – Stand up process
Appendix A-4: Optional Stand Down Messages by TRC LDC on behalf of Somerset LDCC – Stand down process
Appendix A-5: Form of Communication
Appendix A-6: TRC Internal Emergency Contact Details
Appendix A-7: External Stakeholder Emergency Contact Details by TRC LDCC
Appendix A-8: Somerset Regional Council Emergency Contact Details
Appendix A-9: Seqwater Contact Details
Appendix A-10: Department Of Meteorology Emergency Contact Details
Appendix A-11: Emergency Alert Polygons registered in SDCC Portal

### Appendix A-1: Notification for properties in Cressbrook Gorge – Up to Kipper Creek Road - Notification by TRC Water Services – *Priority 1*

| EVENT | SEVERITY | MESSAGE TO OWNERS | METHODOLOGY /SDCC REFERENCE |
|---|---|---|---|
| Alert 1 | Advice | Water Services to explain situation to property owners over the phone. | Over the phone by Water Services for properties in the Cressbrook downstream gorge.<br>Ref. Annexure 4.2 for location map and details in Table 1.2. |
| Alert 2 & Event 1 | Watch and Act | As Above | Provide updates of spillway flows |
| Event 2 | Emergency evacuation | As Above | Over the phone by TRC Water Services for properties in the Cressbrook downstream gorge. |
| Sunny Day Failure | Emergency evacuation | Water Services to explain situation to property owners over the phone. | Over the phone by TRC Water Services for properties in the Cressbrook downstream gorge.<br>Ref. Annexure 4.2 for location map and details in Table 1.2. |

### Appendix A-2: Property Details in Cressbrook Gorge – Up to Kipper Creek Road - Notification by TRC Water Services

***Priority 1 Notification***

| PROPERTY DESCRIPTION (LOT & RP) | OWNERS NAME/S | PRIMARY CONTACT AND SECONDARY CONTACT |
|---|---|---|
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Appendix A-3: Property Notification by TRC LDCC [on behalf of Somerset LDCC] – Stand up Process

| EVENT | SEVERITY | VOICE MESSAGE | SMS MESSAGE | Methodology /SDCC Reference |
|---|---|---|---|---|
| **ALERT 2 /EVENT 1**<br><br>**(>0m above spillway)** | WATCH AND ACT | *This is a flood watch and act message on behalf of Somerset LDMG. Cressbrook Dam has begun to spill affecting Toogoolawah and downstream of Cressbrook Creek with possible flooding in xx hours. Properties in this area may experience some flooding causing property inundation. You should warn neighbours, secure property and belongings and prepare to move to higher ground.*<br><br>*For more information listen to ABC radio or visit w w w dot t r dot q l d dot g o v dot a u. For flood assistance call state emergency services on 1 3 2 500* | *Flood watch & Act message on behalf of Somerset Local Disaster Management Group Cressbrook Dam spilling flooding at x hours-warn others-prepare to leave-visit TRC website listen to radio for more info* | ***Emergency Alert SDCC Ref:***<br><br>***File Name:*** |
| **EVENT 2**<br><br>**>+1.5m over the spillway** | **WARNING** | *This is a flood warning on behalf of Somerset Disaster Management Group. Cressbrook dam is spilling affecting Toogoolawah and downstream area with flooding in xx hours. Properties in this area may experience flooding causing property inundation. You should warn neighbours, secure property and belongings and move to higher ground. For more information listen to ABC radio or visit w w w dot t r dot q l d dot g o v dot a u. For flood assistance call state emergency services on 1 3 2 500* | *Flood warning on behalf of Somerset Local Disaster Management Group for Toogoolawah and downstream area Cressbrook Dam spilling flooding at xx hours-warn others-leave area NOW or seek higher ground-visit TRC website listen to radio* | ***Emergency Alert SDCC Ref:***<br><br>***File Name:*** |
| **EVENT 3+ or Dam failure at any time** | **WARNING** Emergency Evacuation - Dam at Risk of Failure - Evacuation | *Emergency Emergency This is a flash flood warning on behalf of Somerset Disaster Management Group. to evacuate. Areas downstream of Cressbrook Dam and Cressbrook Creek and Toogoolawah are likely to experience rapidly rising water levels and flash flooding and property inundation, posing an immediate danger to remaining residents. You should warn neighbours, secure your belongings and move* | *Dam Breach Warning to evacuate now- on behalf of Somerset Local Disaster Management Group for downstream of Cressbrook dam and Toogoolawah. Immediate threat to life/property warn others* | ***Emergency Alert SDCC Ref:***<br><br>***Folder Name:*** |

| | | | | |
|---|---|---|---|---|
| | | *to higher ground now. For more information listen to ABC radio or visit w w w dot t r dot q l d dot g o v dot a u. For flood assistance contact State Emergency service on 1 3 2 500* | *leave area/prepare now or seek higher ground listen to abc radio* | |
| **SUNNY DAY FAILURE** | **WARNING** - Dam at Risk of Failure - Evacuation | *Emergency Emergency This is a dam breach warning on behalf of Somerset LDMG to evacuate. Areas downstream of Cressbrook Dam and Toogoolawah are likely to experience rapidly rising water levels and flash flooding and property inundation over the next 2 hours, posing an immediate danger to residents. You should warn neighbours, secure your belongings and move to higher ground now. For more information listen to ABC radio or visit w w w dot t r dot q l d dot g o v dot a u. For flood assistance contact State Emergency service on 1 3 2 500* | *Dam Breach Warning to evacuate on behalf of Somerset Local Disaster Management Group for Downstream of Cressbrook dam and Toogoolawah immediate threat to life/property warn others leave area/prepare now or seek higher ground listen to abc radio* | ***Emergency Alert SDCC Ref:*** [redacted]<br><br>***File Name:*** [redacted] |

Appendix A-4: Optional Stand Down Messages by TRC LDC [on behalf of Somerset LDCC] – Stand down Process

| *Event* | *Severity* | *SMS Message* |
|---|---|---|
| *Event 3* | *Down grade to Event 2* | *ADVICE on behalf of Somerset Local Disaster Management Group*<br>*The flood waters are receding.*<br>*For more information listen to ABC radio or contact Somerset LDMG on* [redacted] *or visit Council website.* |
| *Event 2 /Alert 2* | *Downgrade to Alert 2* | *ADVICE on behalf of Somerset Local Disaster Management Group*<br>*The flood waters are continuing to recede.*<br>*For more information listen to ABC radio or contact Somerset LDMG on* [redacted] *or visit Council website.* |
| *Alert 1* | *Cancel Alerts* | *ADVICE on behalf of Somerset Local Disaster Management Group*<br>*The Cressbrook dam is no longer spilling. No threat to the downstream properties of Cressbrook Dam.*<br>*For more information listen to ABC radio or contact Somerset LDMG on* [redacted] *or visit Council website.* |
| *Sunny Day Failure* | *Cancel Alerts* | *ADVICE on behalf of Somerset Local Disaster Management Group*<br>*The flood waters are receding.*<br>*For more information listen to ABC radio or contact Somerset LDMG on* [redacted] *or visit Council website.* |

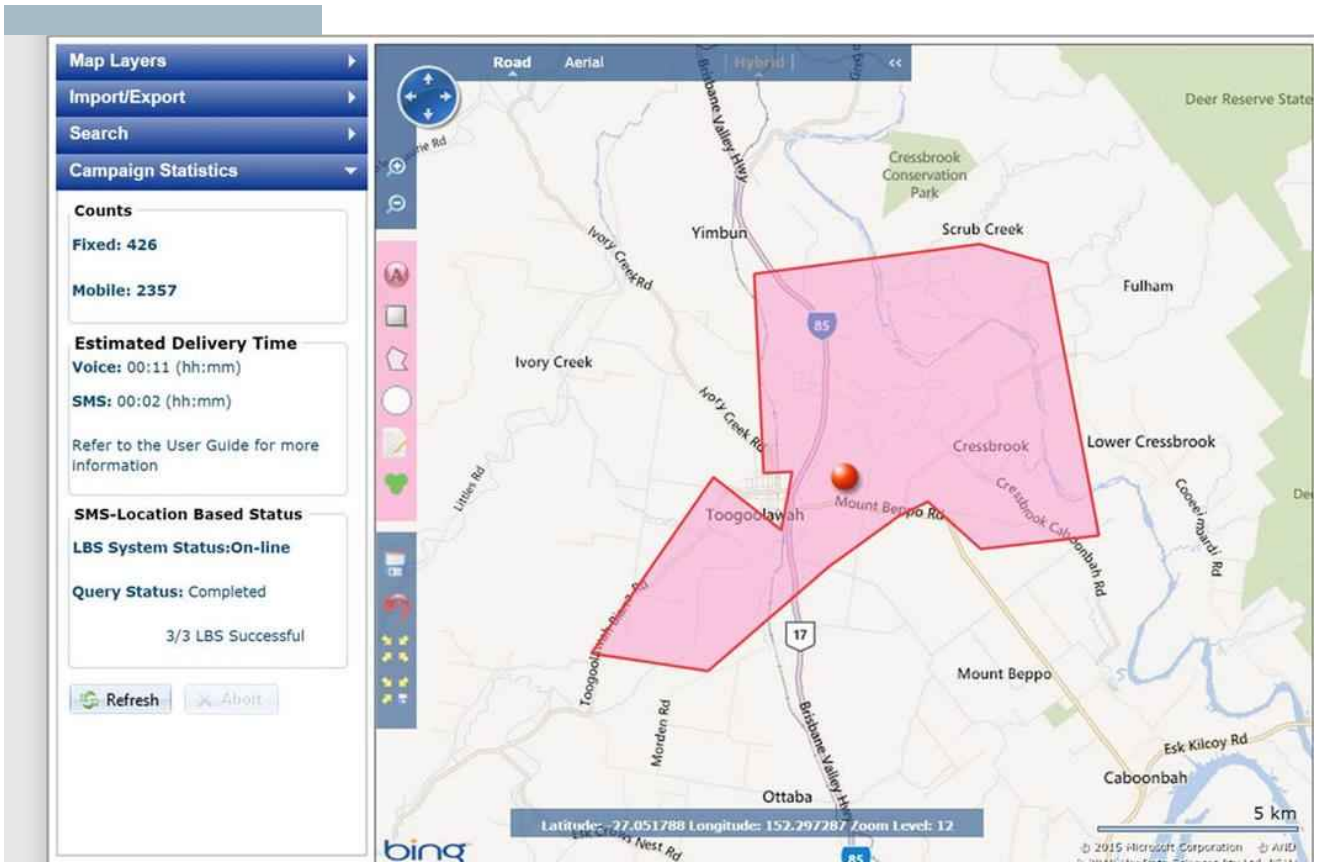
Appendix A-5: Form of Communication

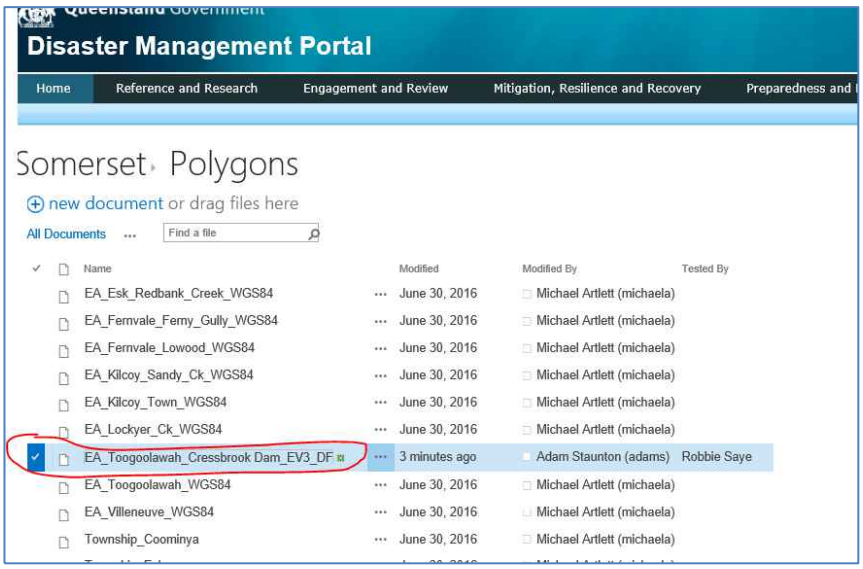
| **Group** | **Communication Forms** | **Comments** |
|---|---|---|
| **TRC – Internal Communication** | By mobile phones /Land Phones /E mails/SMS. | Until Central Plaza Level 1 Command Post Setup |
| **Central Plaza Level 1 Command Post** | In house radio System /SCADA Access /TRC Internal / Server management System | Alternative Options – Phones |
| **External to TRC** | | |
| **Properties downstream of Cressbrook – Up to Kipper Creek Road** | Using telephone numbers as per the Appendix A-2 | Initial warning prior to Cressbrook dam spill over. |
| **Downstream Properties by Somerset LDMG** | Flood Warning System, Emergency Alert System, Media /<br>Media, TRC internet<br>Public Address system<br>Doorknocking if safe to do so | Somerset LDC/LDMG<br>Refer to Appendix A3 for SMS and Pre-recorded sound messages/polygons for emergency alert system by TRC LDCC on behalf of Somerset LDCC. |



Appendix A6 to Appendix A10 have been redacted

Appendix A-11: Emergency Alert Polygons registered in SDCC Portal




Queensland Government
Disaster Management Portal
Home
Reference and Research
Engagement and Review
Mitigation, Resilience and Recovery
Preparedness and
Somerset › Polygons
new document or drag files here
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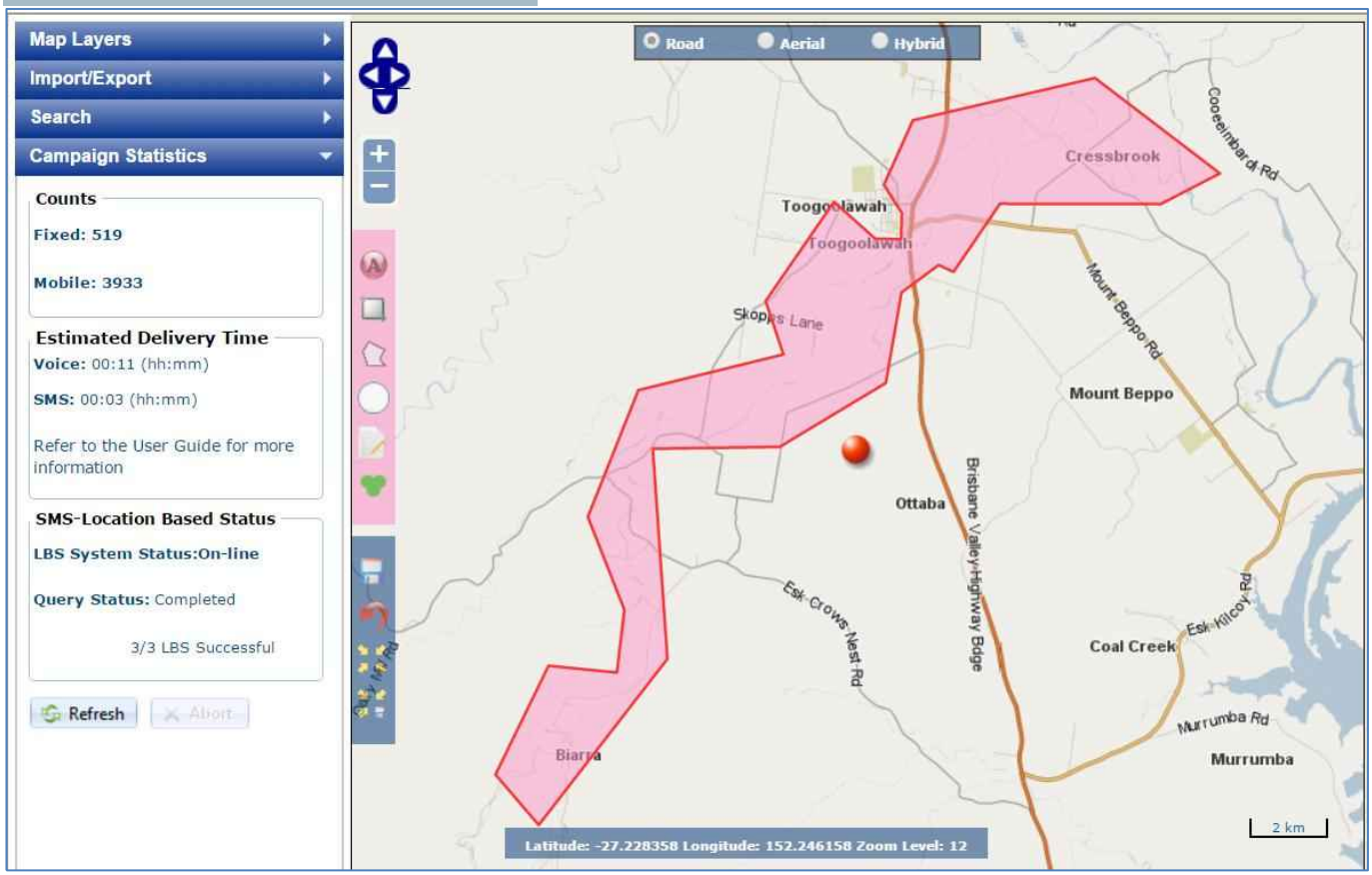
EA_Esk_Redbank_Creek_WGS84 June 30, 2016 Michael Artlett (michaela)
EA_Fernvale_Ferny_Gully_WGS84 June 30, 2016 Michael Artlett (michaela)
EA_Fernvale_Lowood_WGS84 June 30, 2016 Michael Artlett (michaela)
EA_Kilcoy_Sandy_Ck_WGS84 June 30, 2016 Michael Artlett (michaela)
EA_Kilcoy_Town_WGS84 June 30, 2016 Michael Artlett (michaela)
EA_Lockyer_Ck_WGS84 June 30, 2016 Michael Artlett (michaela)
EA_Toogoolawah_Cressbrook Dam_EV3_DF 3 minutes ago Adam Staunton (adams) Robbie Saye
EA_Toogoolawah_WGS84 June 30, 2016 Michael Artlett (michaela)
EA_Villeneuve_WGS84 June 30, 2016 Michael Artlett (michaela)
Township_Coominya June 30, 2016 Michael Artlett (michaela)


Map Layers
Import/Export
Search
Campaign Statistics
Counts
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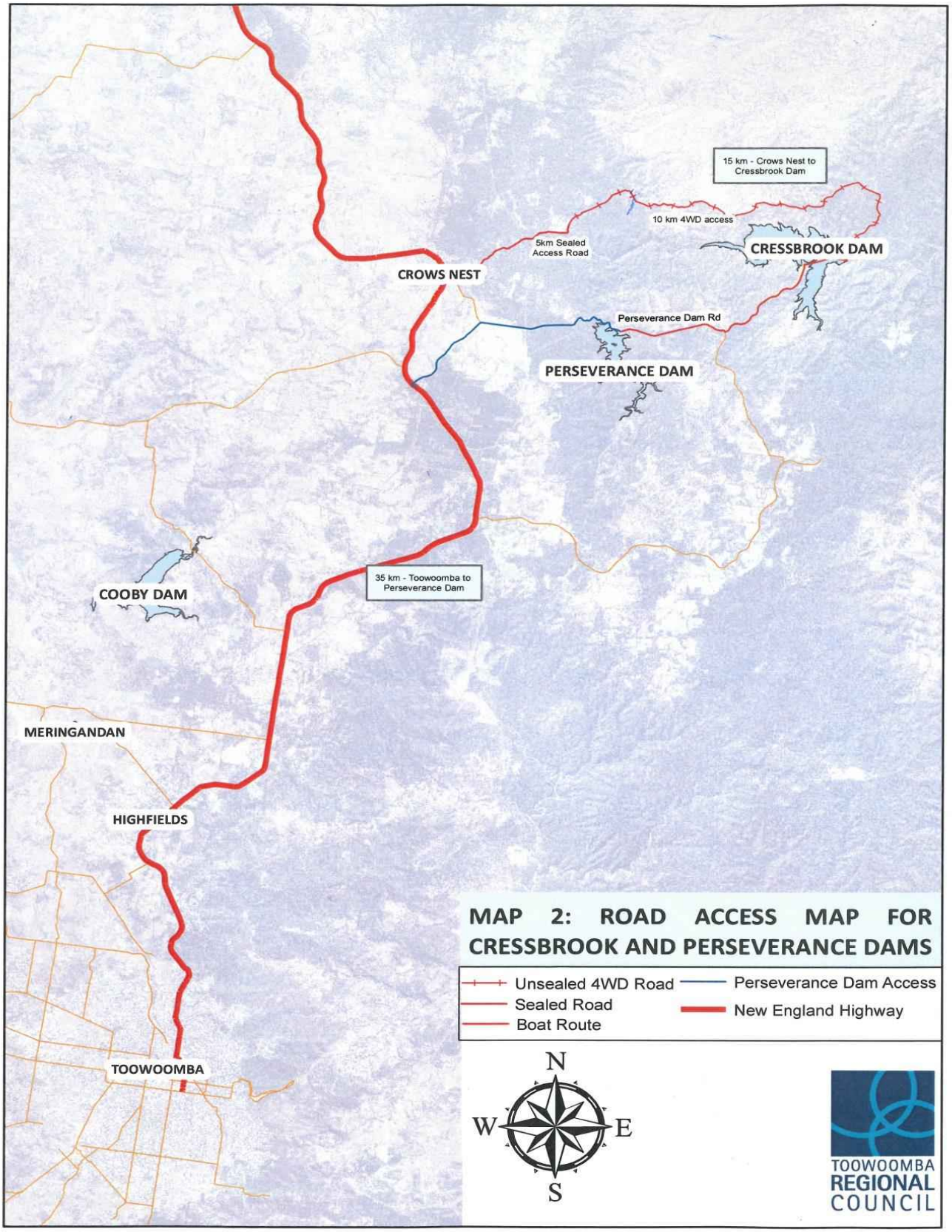
Estimated Delivery Time
Voice: 00:11 (hh:mm)
SMS: 00:03 (hh:mm)
Refer to the User Guide for more information
SMS-Location Based Status
LBS System Status:On-line
Query Status: Completed
3/3 LBS Successful
Refresh
Abort
Road
Aerial
Hybrid
Cressbrook
Toogoolawah
Mount Beppo Rd
Mount Beppo
Ottaba
Brisbane Valley Highway Edge
Esk Crows Nest Rd
Coal Creek
Esk Kilcoy Rd
Murrumba Rd
Murrumba
2 km
Latitude: -27.228358 Longitude: 152.246158 Zoom Level: 12

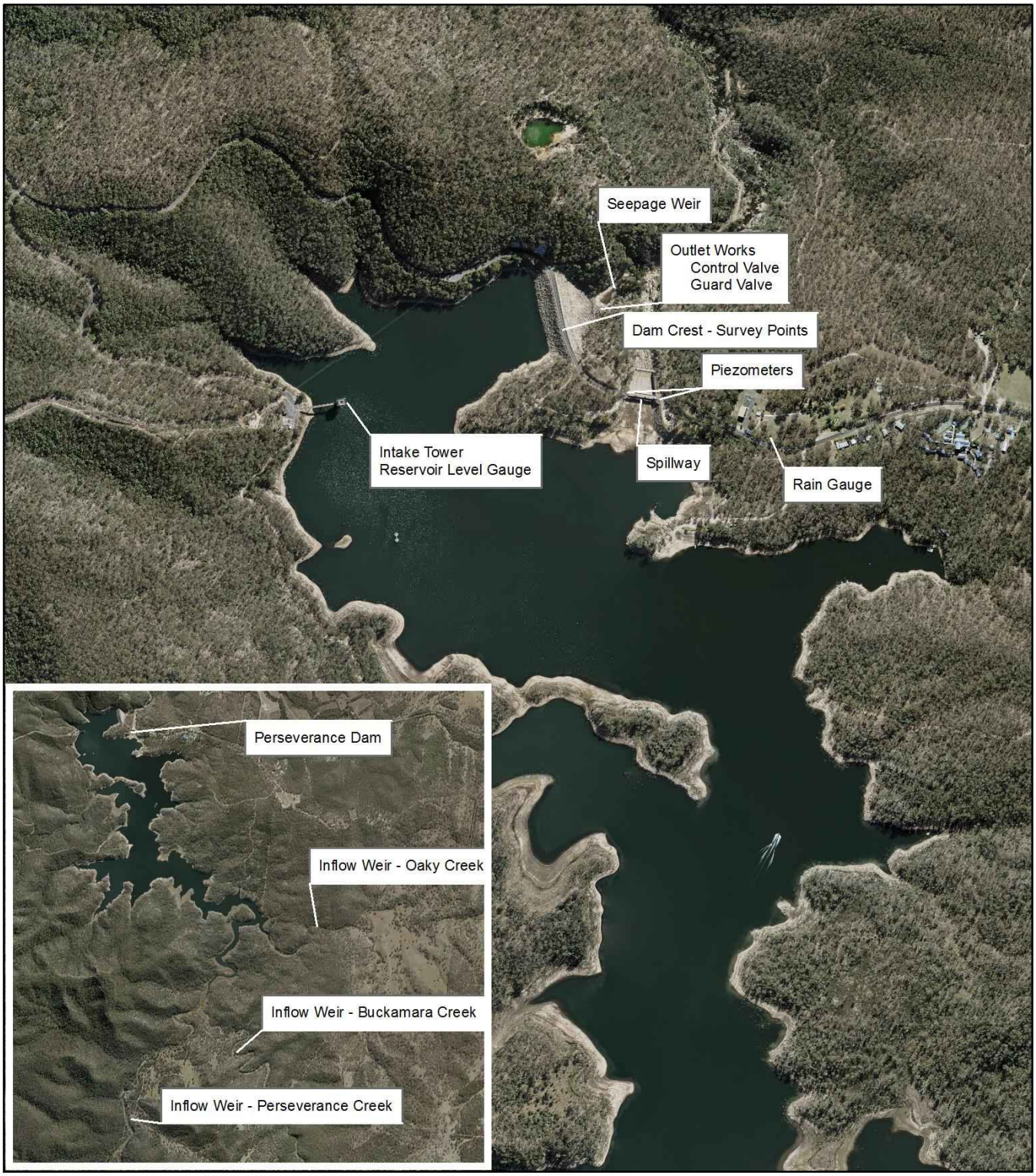
## Appendix B Detailed maps of Dams and Cressbrook Gorge Property locations

Appendix B1: Location map of Cressbrook and Perseverance dams
Appendix B2: Location of Instrumentations at Perseverance dam
Appendix B3: Location of Instrumentations at Cressbrook dam
Appendix B4: Cressbrook and Perseverance dams road closure maps
Appendix B5: Cressbrook gorge identified property locations

Appendix B1 Location Map of Cressbrook and Perseverance Dams

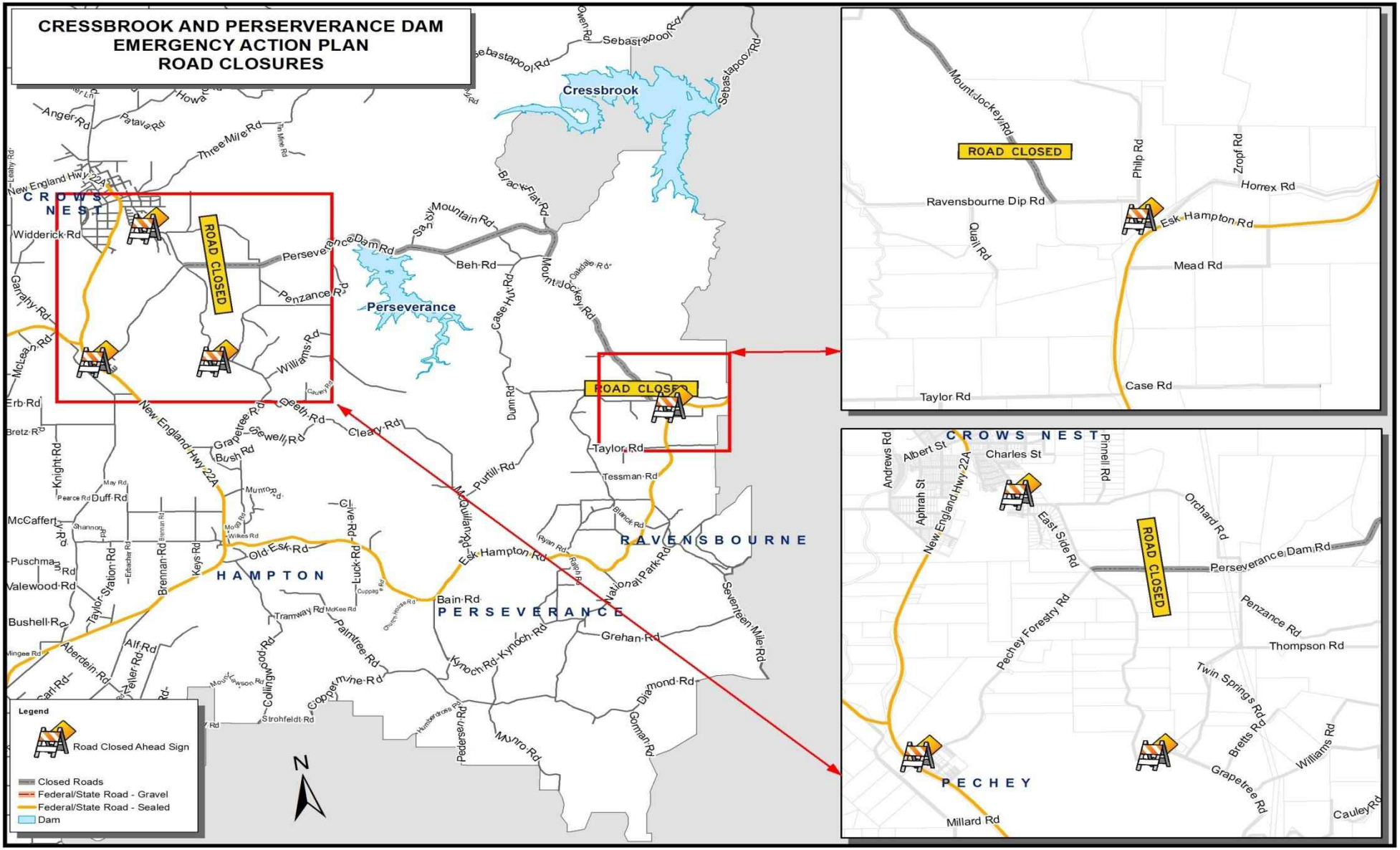


Appendix B2 Location of Instrumentations at Perseverance Dam

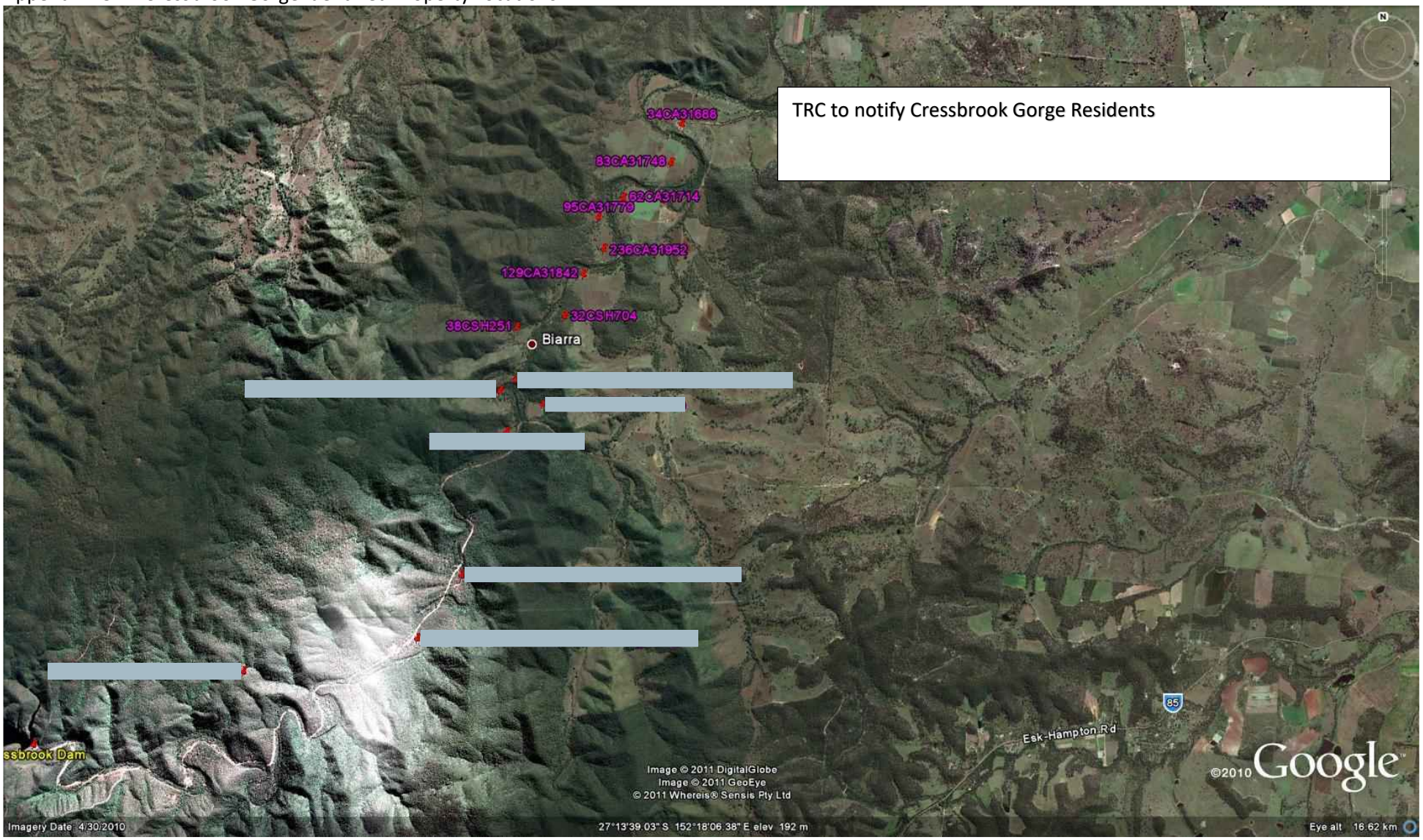


Appendix B3 Location of Instrumentations at Cressbrook Dam

Appendix B4 Cressbrook and Perseverance Dams Road Closure Maps



Appendix B5 Cressbrook Gorge Identified Property Locations



## Appendix C: Inundation Maps

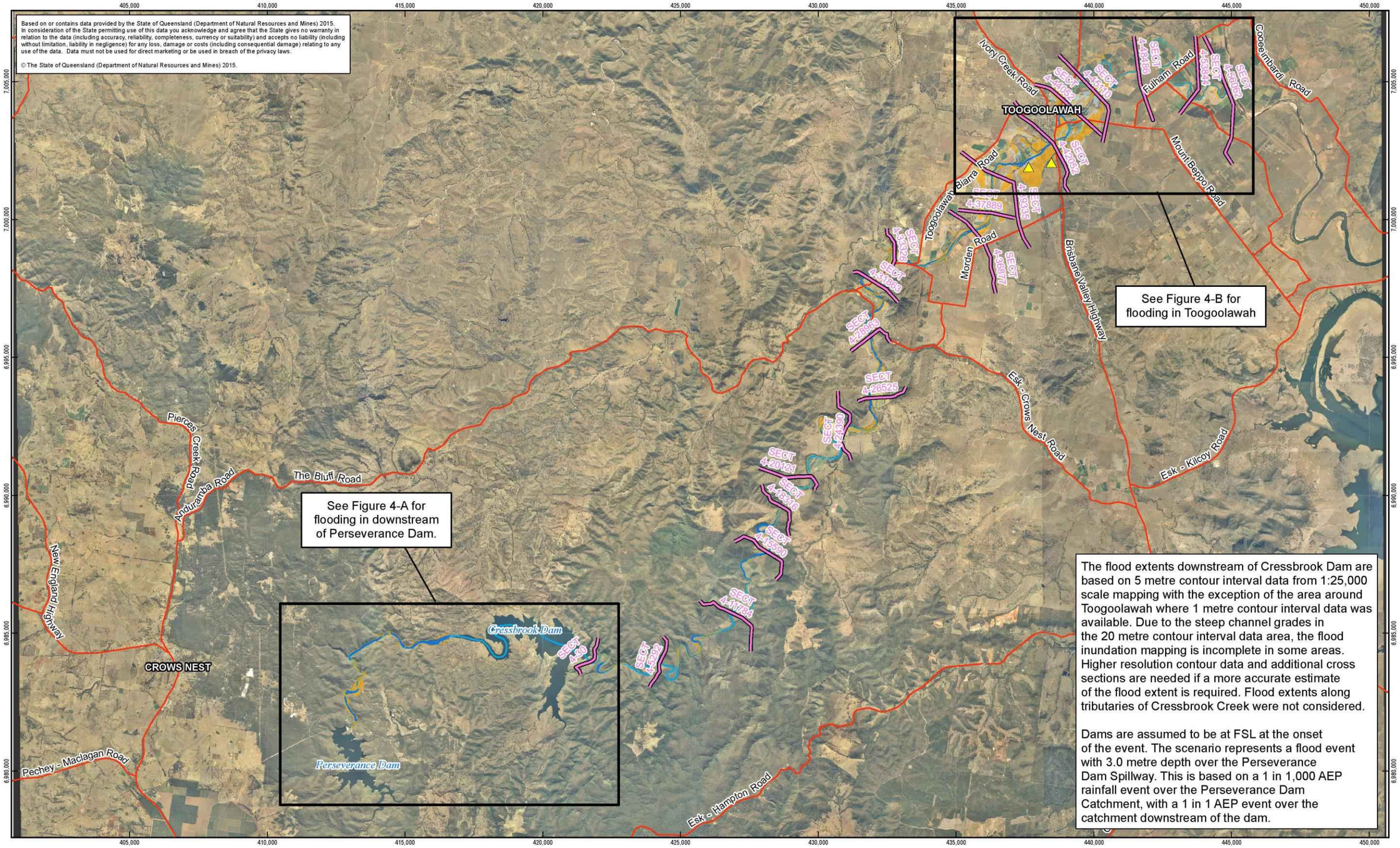
### Appendix C1: Perseverance dam inundation maps

Cressbrook and Perseverance dams downstream flood modelling is considered flows associated with the Perseverance and Cressbrook dam catchments **ONLY**. Downstream tributaries may have inflows during flood events upstream of Cressbrook. Perseverance dam Inundation maps consists of two sections: Section between Perseverance dam to Cressbrook Dam (Map Series A -No PAR) and Downstream of Cressbrook dam (Map Series B).

Some of selected inundation maps downstream of Cressbrook dam (Map Series B) is listed below.

| Event | Reservoir Level -Perseverance dam | Map |
|---|---|---|
| Lean Forward and Dam Failure -Close to flood of record | +3.0m over spillway<br>(AEP 1 in 1,000 Event) | Figure 4 and Figure 4-B |
| Stand Up – Greater than flood of record | +4.0m over spillway<br>(AEP 1 in 10,000 Event) | Figure 5 and Figure 5-B |
| Stand Up 2 -Flood Event Stage 5 and Dam Failure | +6.52m over spillway<br>(AEP 1 in 2,000,000 Event) | Figure 6 and Figure 6-B |
| Stand Up 3 and Dam Failure | +6.52m over spillway – Cascade Failure<br>(AEP 1 in 2,000,000 Event) | Figure 8 and Figure 8-B |
| PMP -DF | +8.12m over spillway | Figure 9 and Figure 9-B |
| Sunny Day Failure | At Full supply level | Figure 10 and Figure 10-B |
| Cascade Failure at PMP -DF | +8.12m over spillway | Figure 11 and Figure 11-B |

**Note:** All flood inundation mapping of Perseverance dam is assuming that the Cressbrook dam is at full supply level at the onset of the event. Digital Excel files (DM#7456109) for lot plan details and all inundation maps (DM#7456192) have provided for Somerset LDMG use.




1:125,000 @ A3

0 1 2 3 4 5
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

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Perseverance Dam EAP Flood Mapping

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## Event Stage 3 - Water Level +3.0m Over Spillway Estimated Flood Inundation (AEP 1 in 1,000)

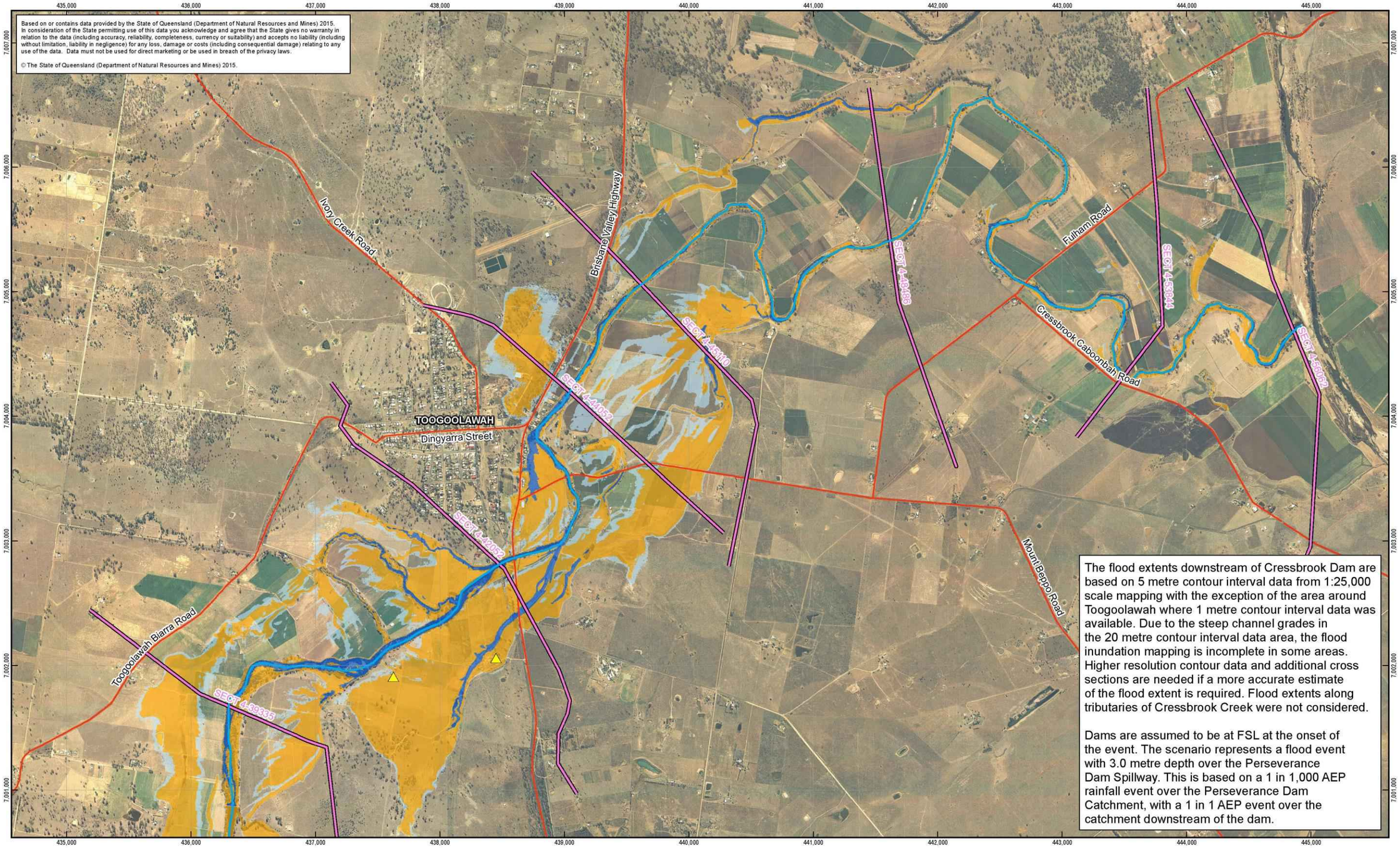
Figure 4

G:\41\28851\GIS\Maps\41_28851_16.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




1:25,000 @ A3
0 250 500 750 1,000
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND
- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

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## Event Stage 3 - Water Level +3.0m Over Spillway
## Estimated Flood Inundation (AEP 1 in 1,000)

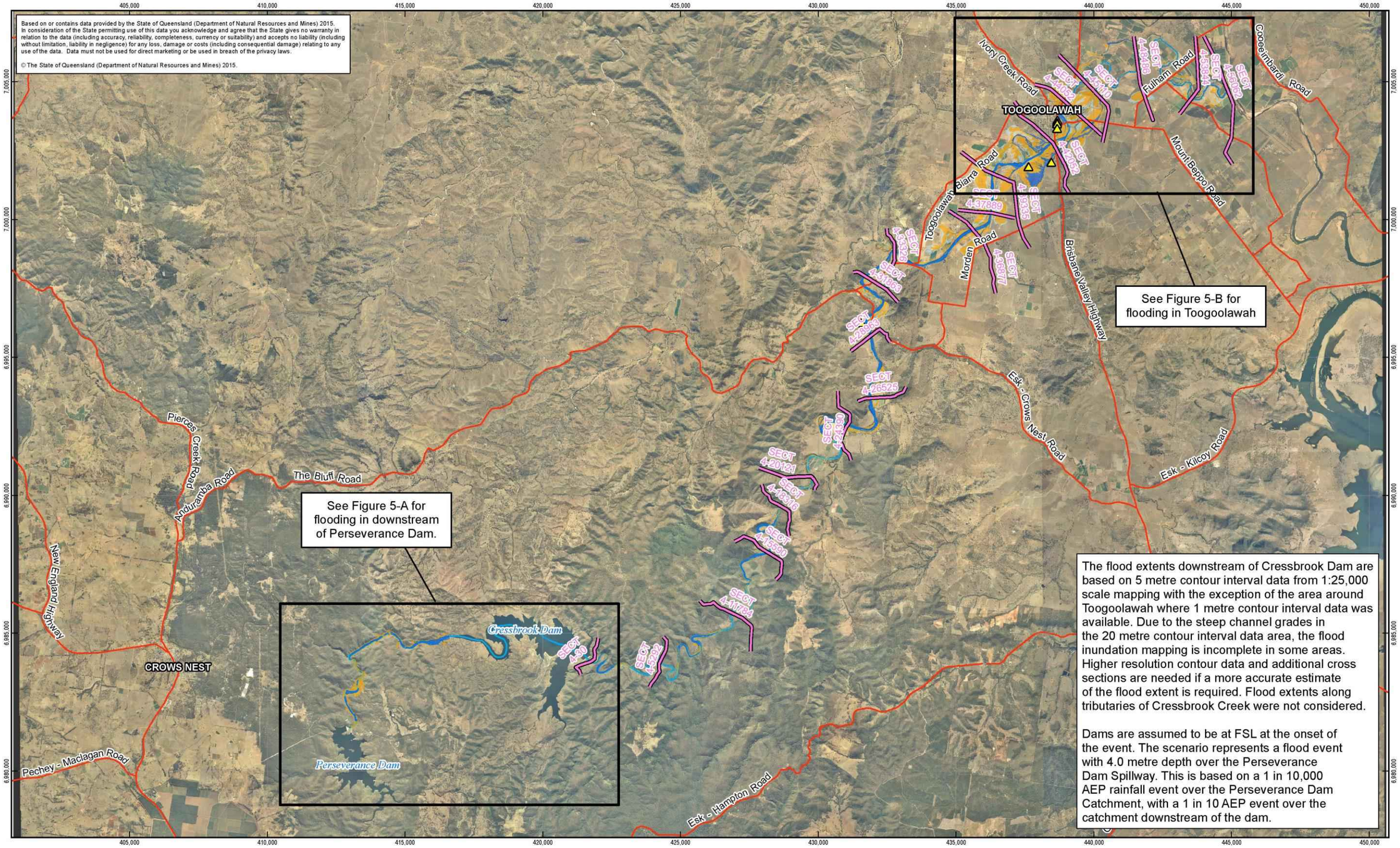
**Figure 4-B**

G:\41\28851\GIS\Maps\41_28851_22.mxd



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com




1:125,000 @ A3

0 1 2 3 4 5
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

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## Event Stage 4 - Water Level +4.0m Over Spillway Estimated Flood Inundation (AEP 1 in 10,000)

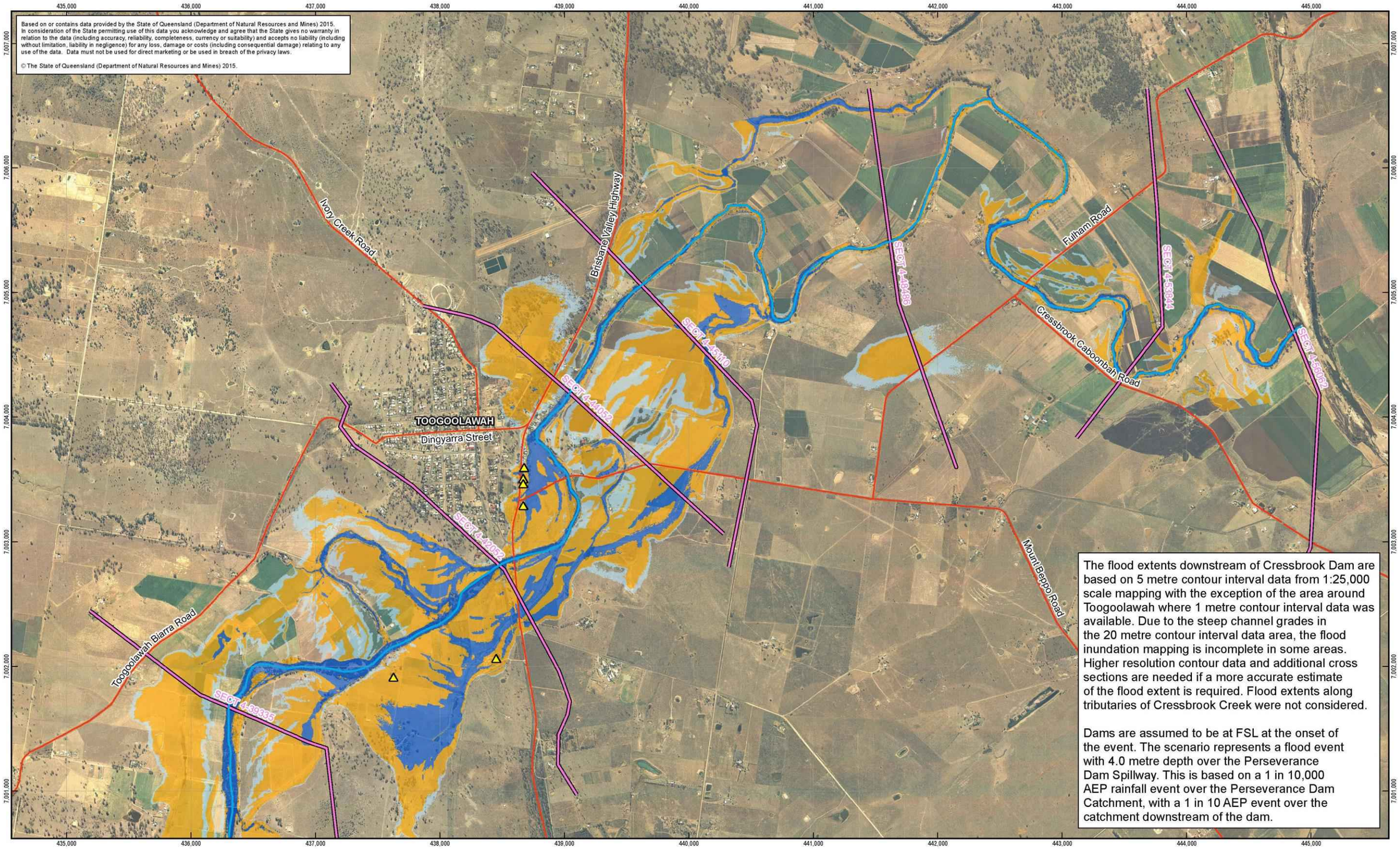
Figure 5

G:\41\28851\GIS\Maps\41_28851_17.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




The flood extents downstream of Cressbrook Dam are based on 5 metre contour interval data from 1:25,000 scale mapping with the exception of the area around Toogoolawah where 1 metre contour interval data was available. Due to the steep channel grades in the 20 metre contour interval data area, the flood inundation mapping is incomplete in some areas. Higher resolution contour data and additional cross sections are needed if a more accurate estimate of the flood extent is required. Flood extents along tributaries of Cressbrook Creek were not considered.

Dams are assumed to be at FSL at the onset of the event. The scenario represents a flood event with 4.0 metre depth over the Perseverance Dam Spillway. This is based on a 1 in 10,000 AEP rainfall event over the Perseverance Dam Catchment, with a 1 in 10 AEP event over the catchment downstream of the dam.

1:25,000 @ A3

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
Perseverance Dam EAP Flood Mapping

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## Event Stage 4 - Water Level +4.0m Over Spillway Estimated Flood Inundation (AEP 1 in 10,000)

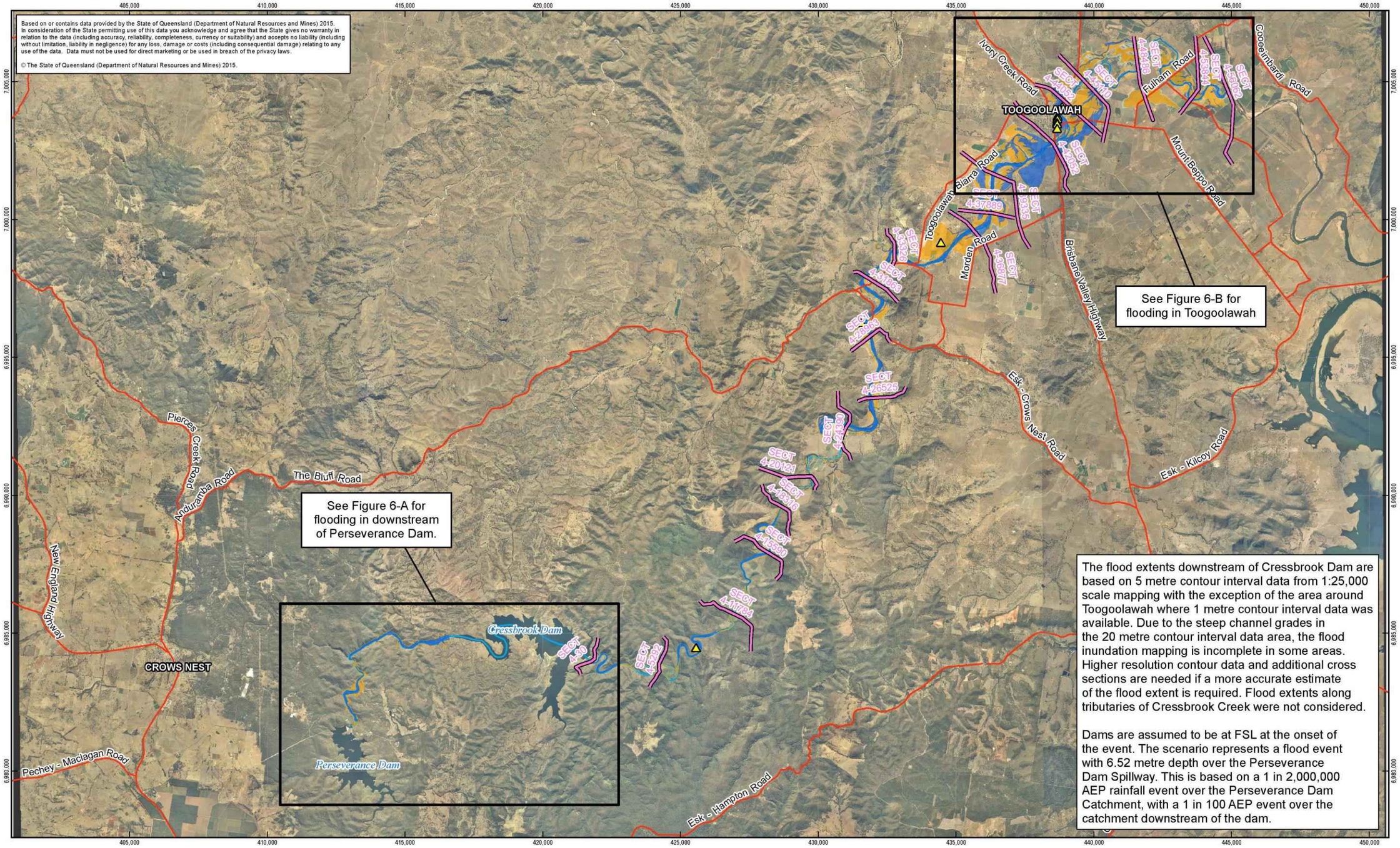
Figure 5-B

G:\41\28851\GIS\Maps\41_28851_23.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




1:125,000 @ A3

0 1 2 3 4 5
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
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## Event Stage 5 - Water Level +6.52m Over Spillway Estimated Flood Inundation (AEP 1 in 2,000,000)

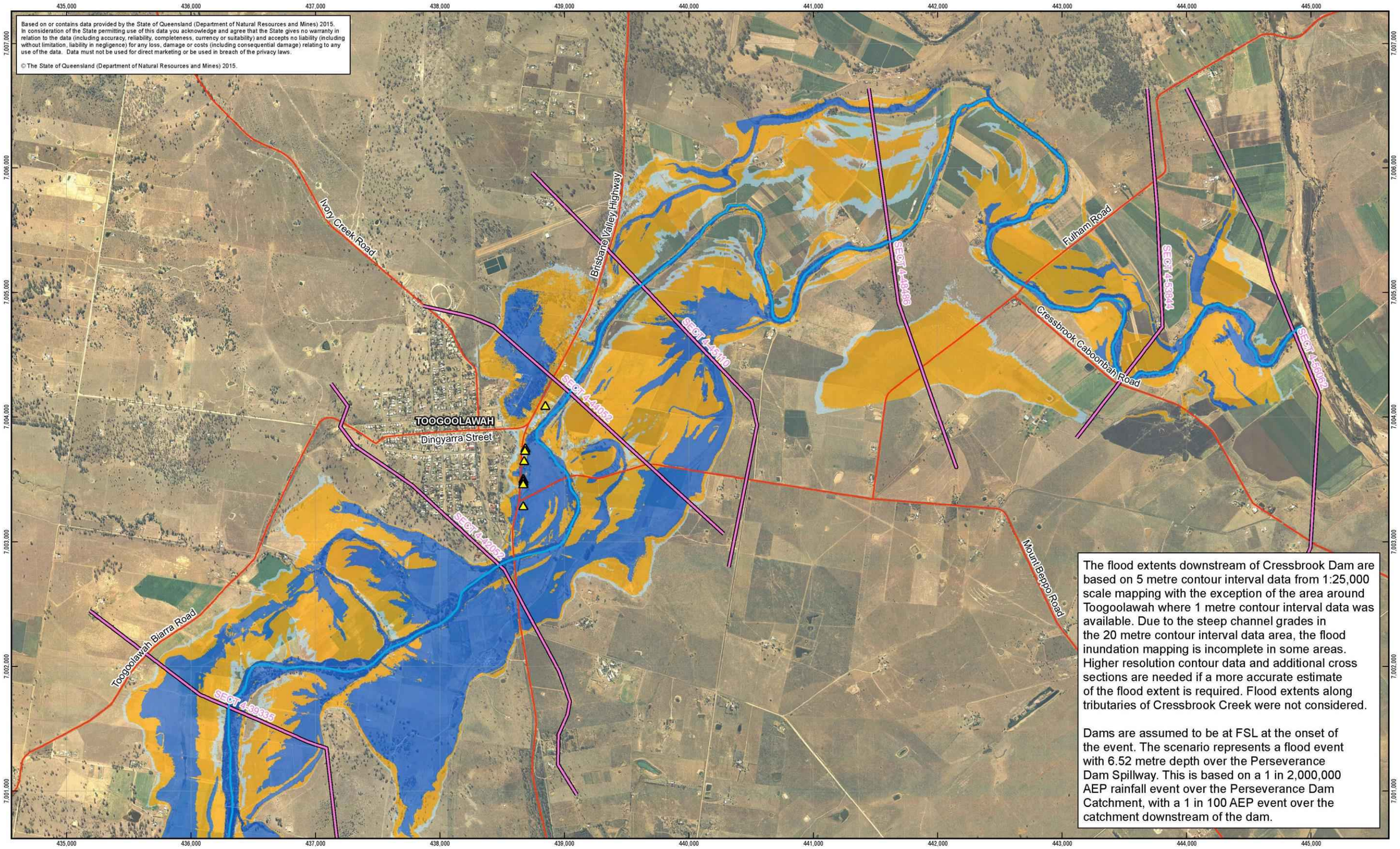
Figure 6

G:\41\28851\GIS\Maps\41_28851_18.mxd



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com




The flood extents downstream of Cressbrook Dam are based on 5 metre contour interval data from 1:25,000 scale mapping with the exception of the area around Toogoolawah where 1 metre contour interval data was available. Due to the steep channel grades in the 20 metre contour interval data area, the flood inundation mapping is incomplete in some areas. Higher resolution contour data and additional cross sections are needed if a more accurate estimate of the flood extent is required. Flood extents along tributaries of Cressbrook Creek were not considered.

Dams are assumed to be at FSL at the onset of the event. The scenario represents a flood event with 6.52 metre depth over the Perseverance Dam Spillway. This is based on a 1 in 2,000,000 AEP rainfall event over the Perseverance Dam Catchment, with a 1 in 100 AEP event over the catchment downstream of the dam.

1:25,000 @ A3

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cressbrook Creek
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

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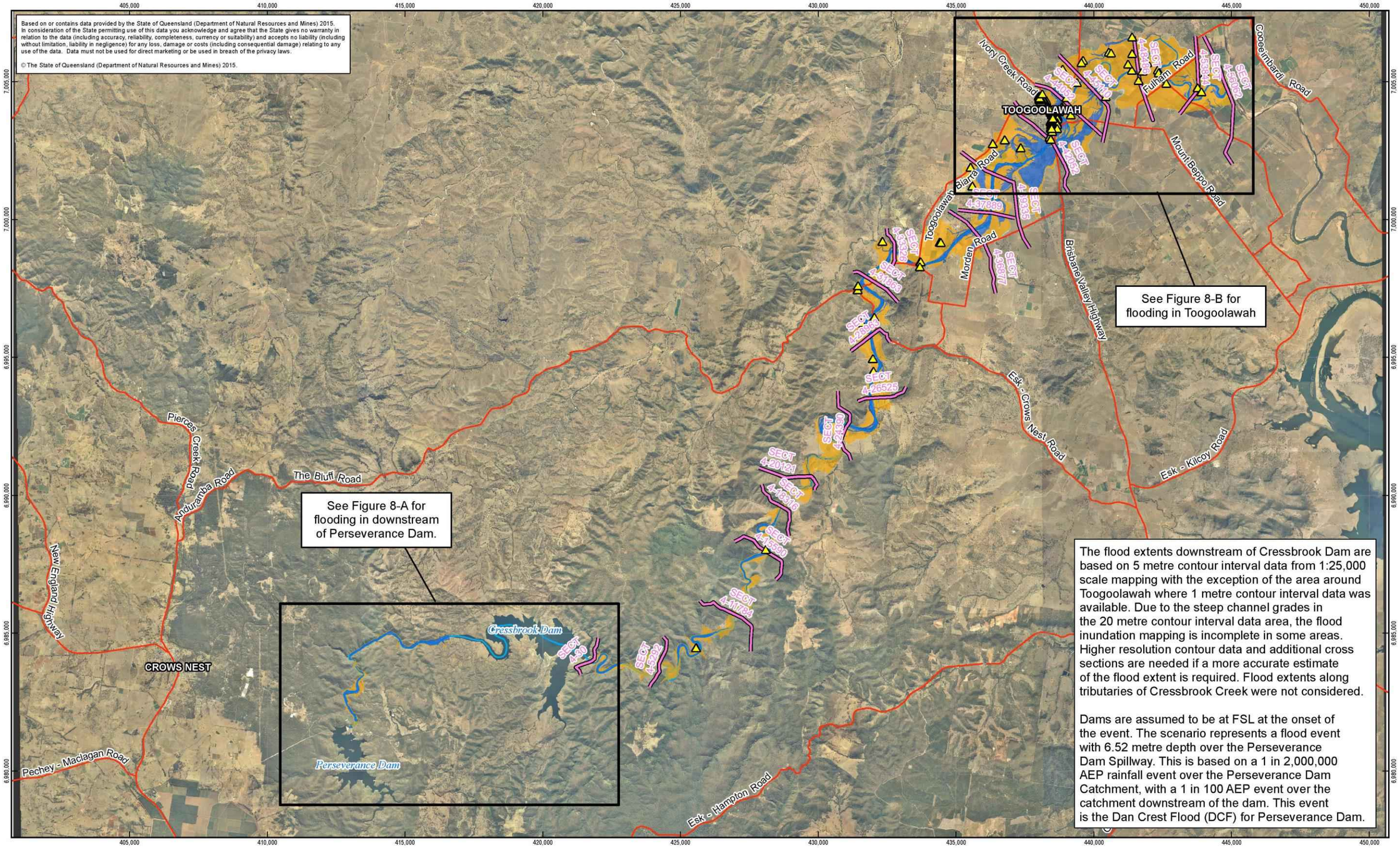
## Event Stage 5 - Water Level +6.52m Over Spillway Estimated Flood Inundation (AEP 1 in 2,000,000) Figure 6-B

G:\41\28851\GIS\Maps\41_28851_24.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




1:125,000 @ A3

0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Cascade Failure Flood Depth < 0.3m
- Dam Cascade Failure Flood Depth > 0.3m

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## Event Stage 5 - Water Level +6.52m Over Spillway Cascade Failure Flood Inundation (AEP 1 in 2M)

**Figure 8**

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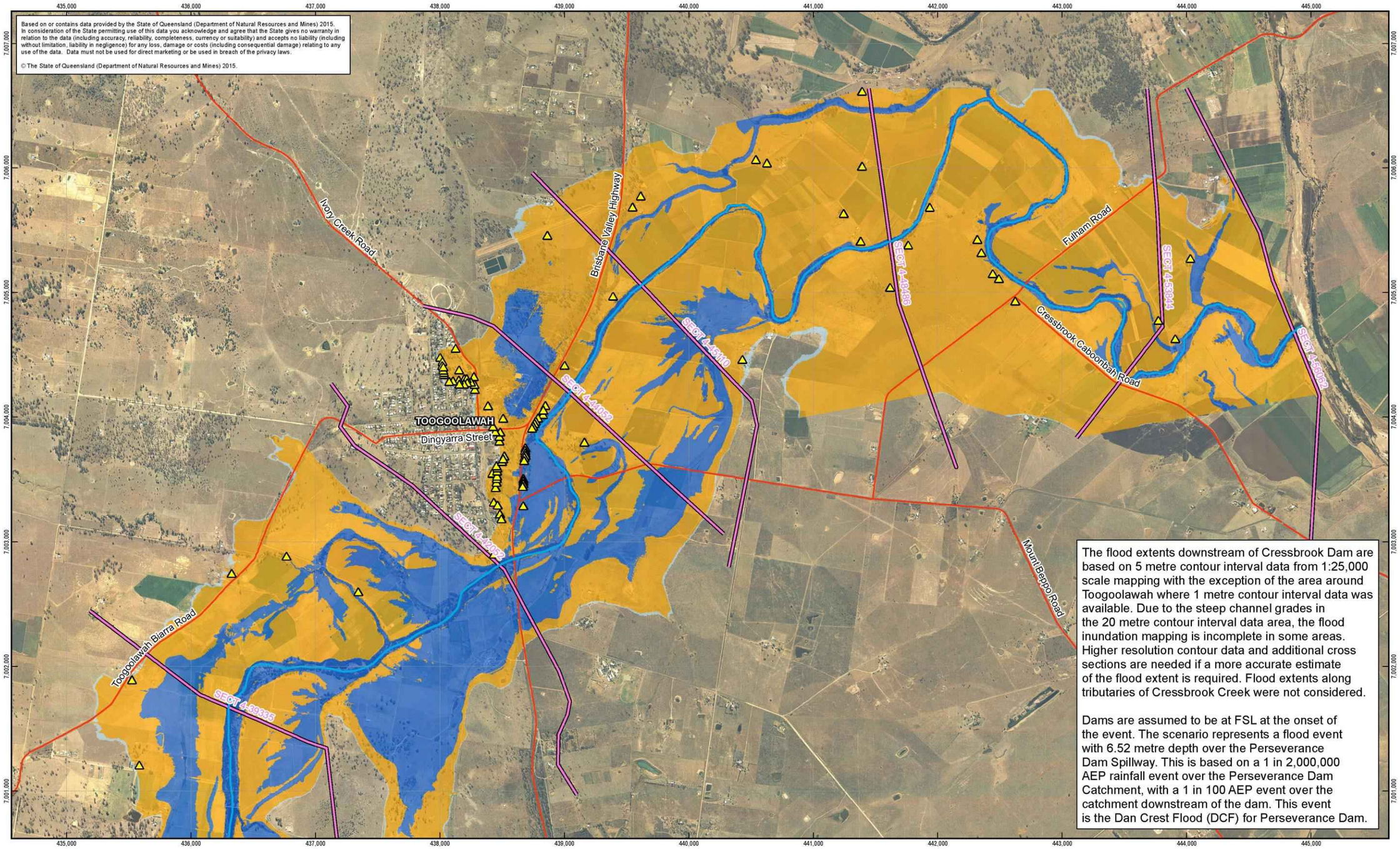
Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




1:25,000 @ A3

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Cascade Failure Flood Depth < 0.3m
- Dam Cascade Failure Flood Depth > 0.3m

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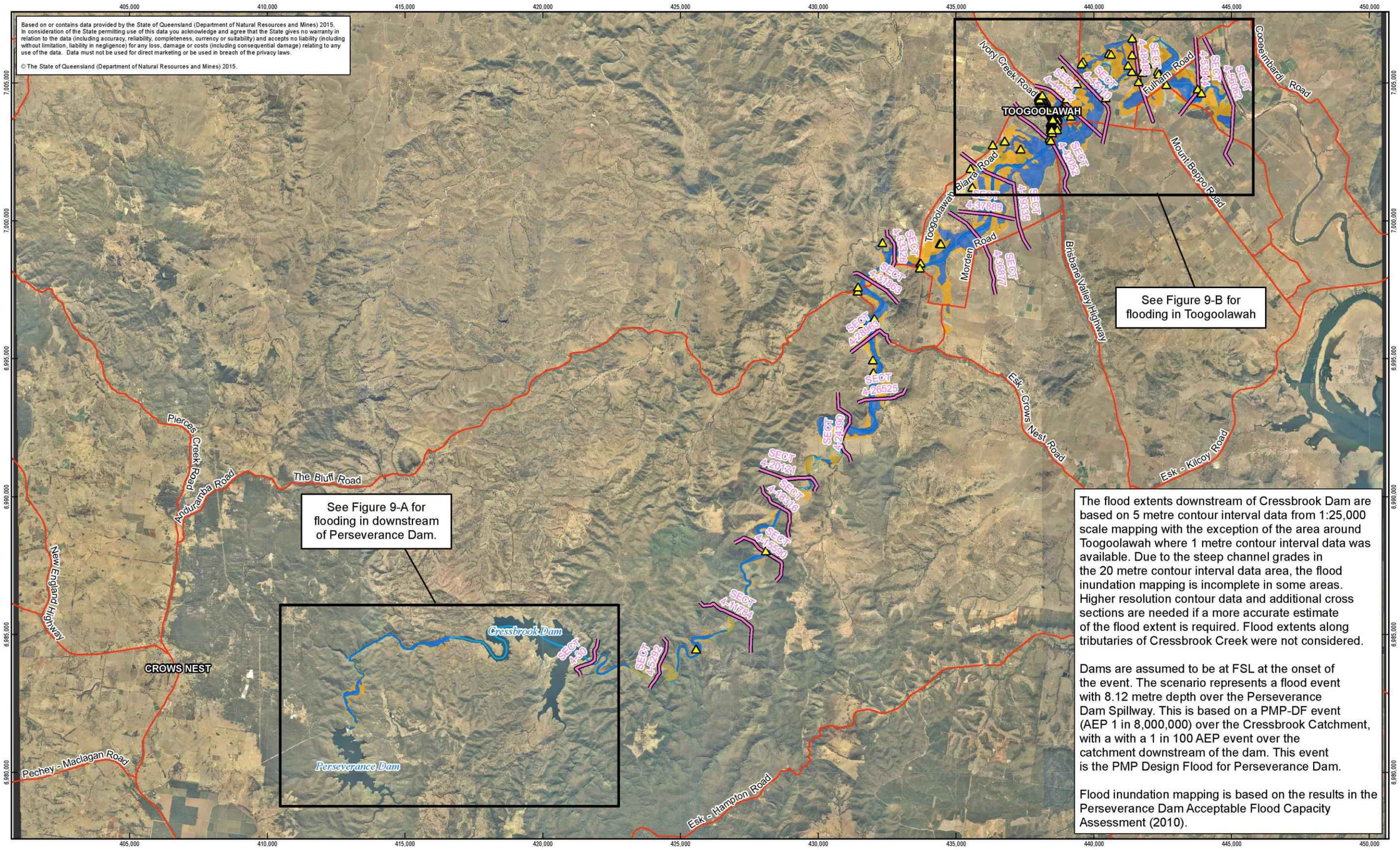
## Event Stage 5 - Water Level +6.52m Over Spillway Cascade Failure Flood Inundation (AEP 1 in 2M) Figure 8-B

G:\41\28851\GIS\Maps\41_28851_48.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




1:125,000 @ A3

0 1 2 3 4 5
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m
- Natural Flooding (No Dam Failure)

GHD

Toowoomba Regional Council
Perseverance Dam EAP Flood Mapping

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## Event Stage 5 - Water Level +8.12m Over Spillway Estimated Flood Inundation (PMP-DF)

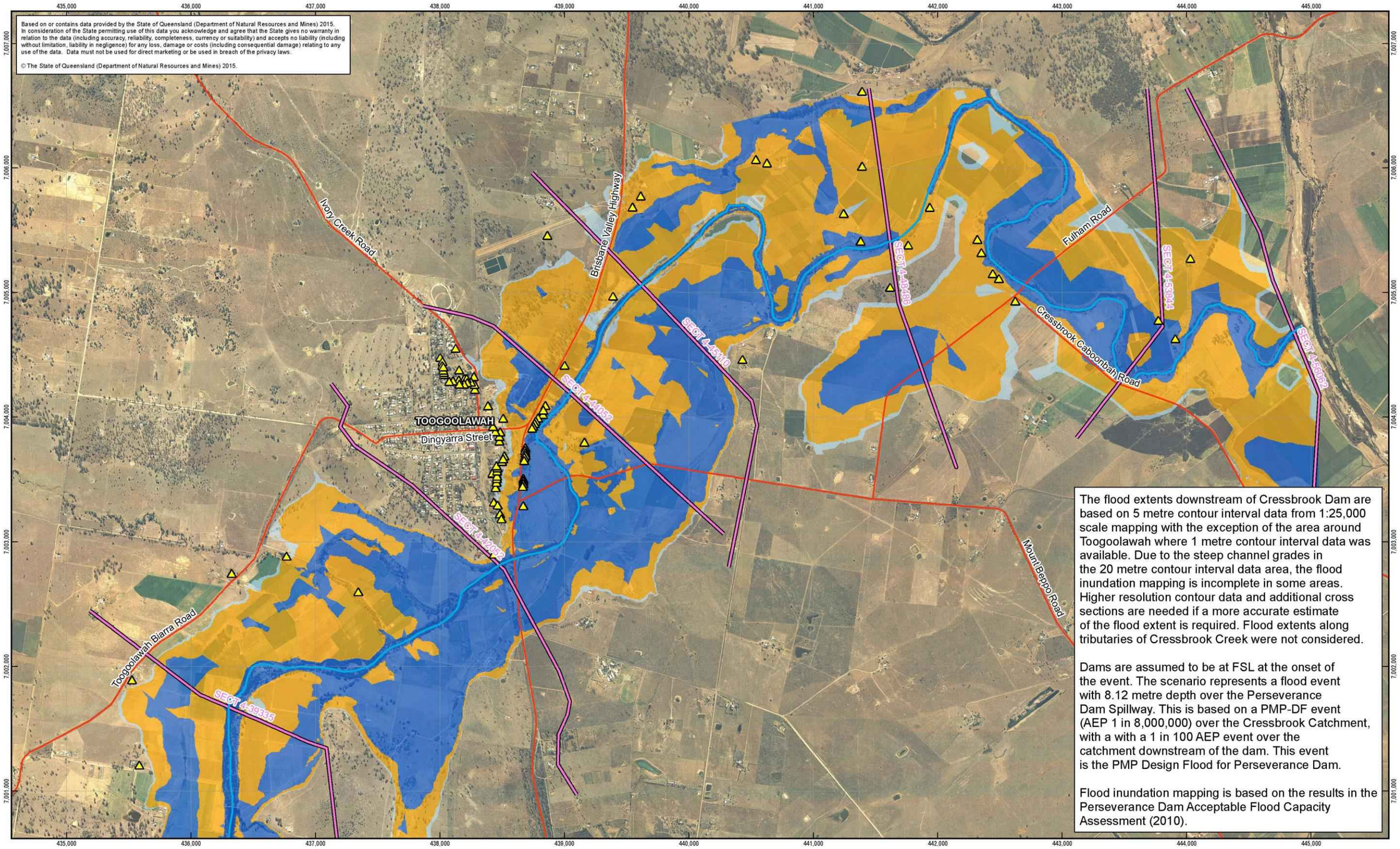
Figure 9

G:\41\28851\GIS\Maps\41_28851_52.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




The flood extents downstream of Cressbrook Dam are based on 5 metre contour interval data from 1:25,000 scale mapping with the exception of the area around Toogoolawah where 1 metre contour interval data was available. Due to the steep channel grades in the 20 metre contour interval data area, the flood inundation mapping is incomplete in some areas. Higher resolution contour data and additional cross sections are needed if a more accurate estimate of the flood extent is required. Flood extents along tributaries of Cressbrook Creek were not considered.

Dams are assumed to be at FSL at the onset of the event. The scenario represents a flood event with 8.12 metre depth over the Perseverance Dam Spillway. This is based on a PMP-DF event (AEP 1 in 8,000,000) over the Cressbrook Catchment, with a with a 1 in 100 AEP event over the catchment downstream of the dam. This event is the PMP Design Flood for Perseverance Dam.

Flood inundation mapping is based on the results in the Perseverance Dam Acceptable Flood Capacity Assessment (2010).



1:25,000 @ A3

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m
- Natural Flooding (No Dam Failure)

Toowoomba Regional Council
Perseverance Dam EAP Flood Mapping

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## Event Stage 5 - Water Level +8.12m Over Spillway Estimated Flood Inundation (PMP-DF)

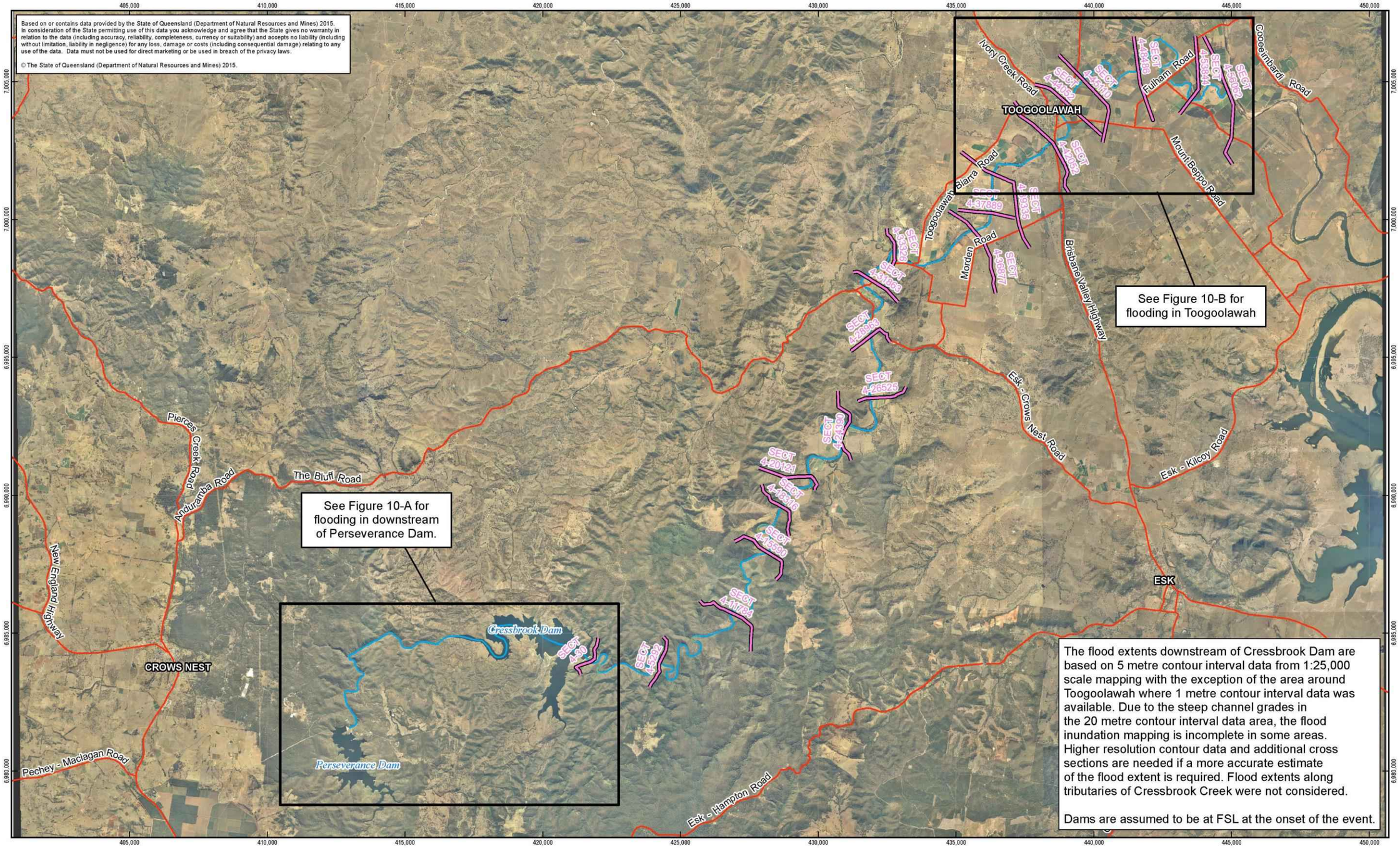
Figure 9-B

G:\41\28851\GIS\Maps\41_28851_54.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




1:125,000 @ A3

0 1 2 3 4 5 Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND
- Cross Section
- Major Road
- Cressbrook Creek
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
Perseverance Dam EAP Flood Mapping

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|---|---|
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## Sunny Day Failure at Full Supply Level

## Figure 10

G:\41\28851\GIS\Maps\41_28851_55.mxd

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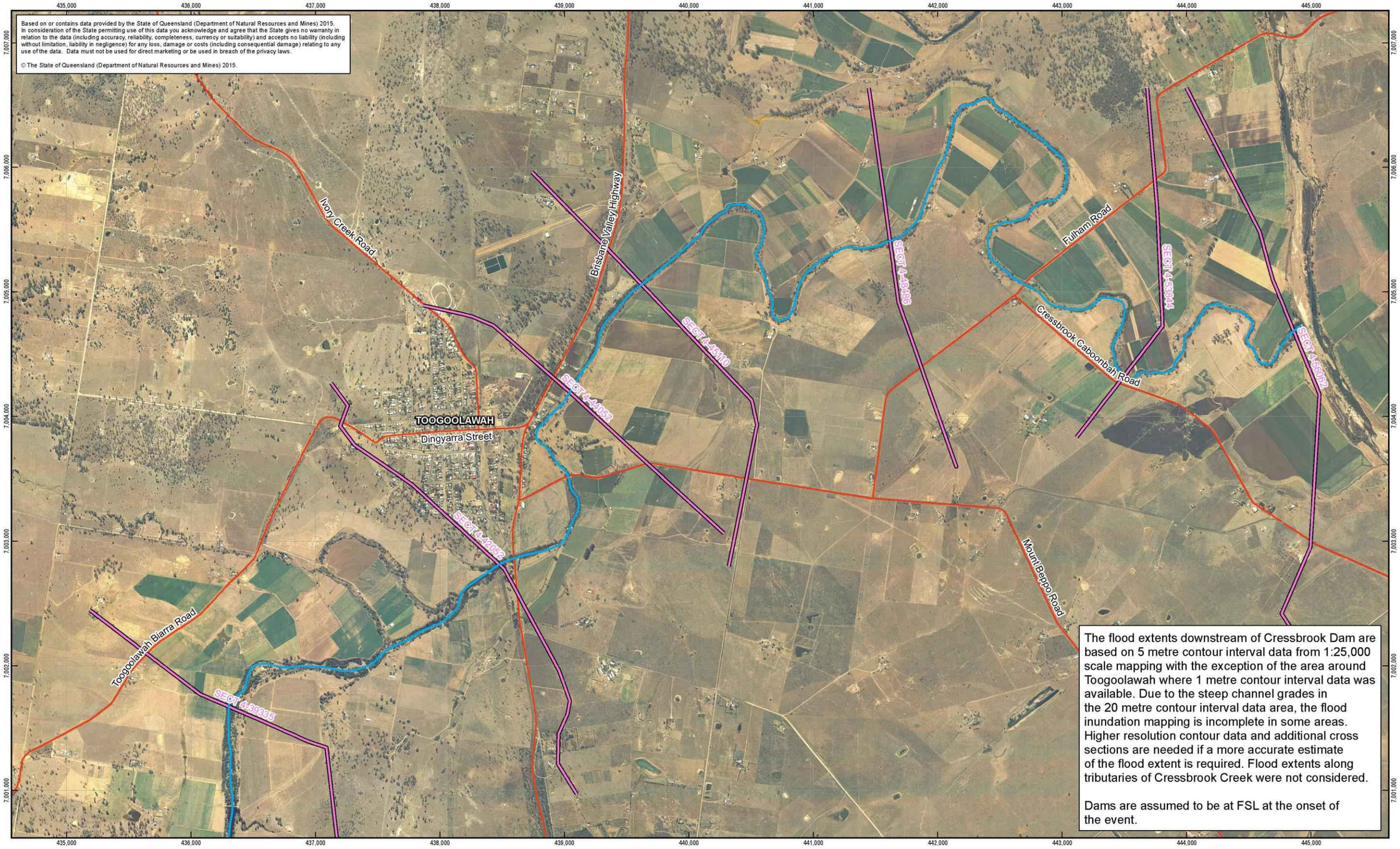
Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




1:25,000 @ A3

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cross Section
- Major Road
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
Perseverance Dam EAP Flood Mapping

| | |
|---|---|
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| Date | 18 Jul 2016 |

## Sunny Day Failure at Full Supply Level

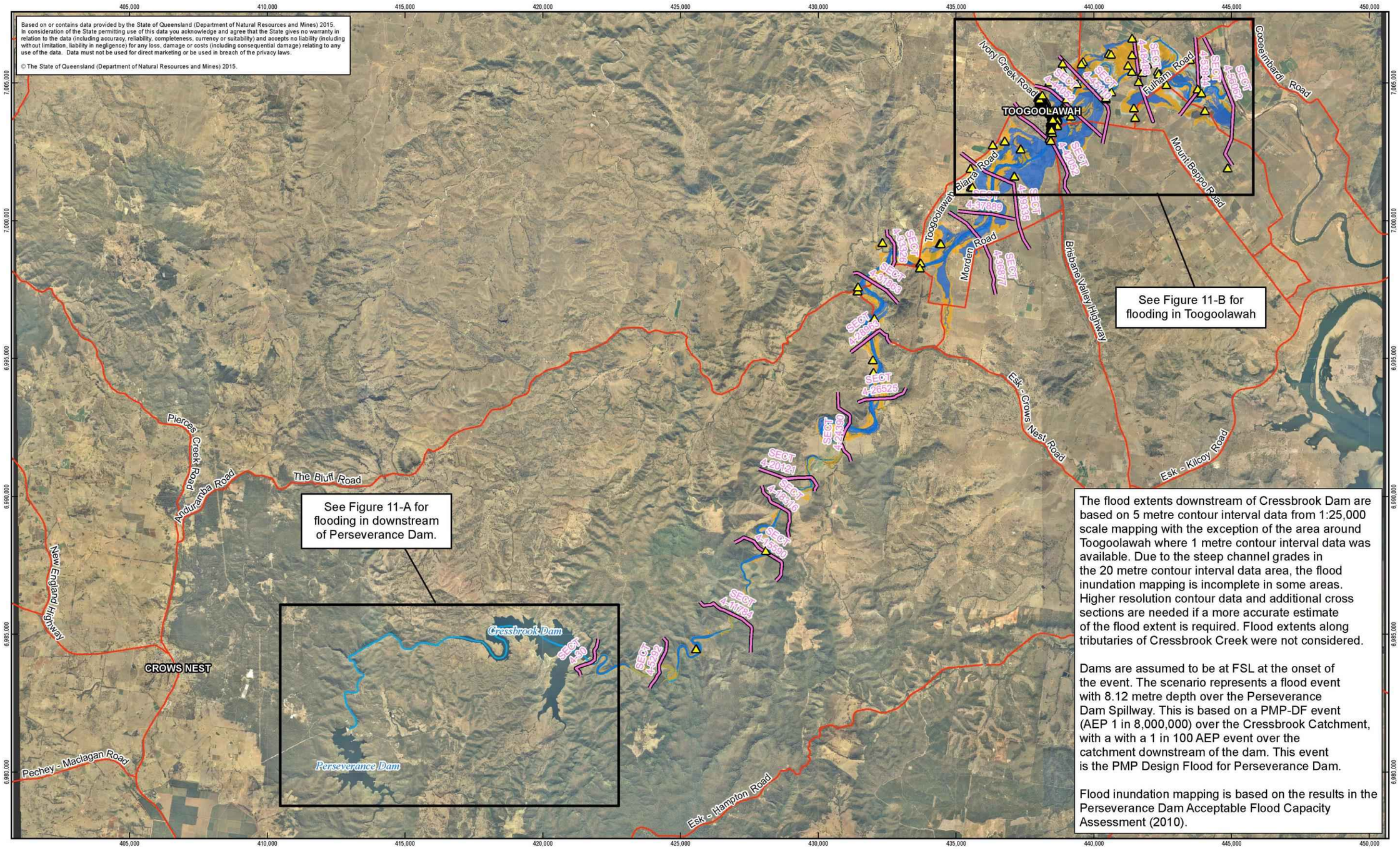
## Figure 10-B

G:\41\28851\GIS\Maps\41_28851_57.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




1:125,000 @ A3

0 1 2 3 4 5
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m
- Natural Flooding (No Dam Failure)

Toowoomba Regional Council
Perseverance Dam EAP Flood Mapping

| | |
|---|---|
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| Revision | 0 |
| Date | 18 Jul 2016 |

## Event Stage 5 - Water Level +8.12m Over Spillway Cascade Failure Flood Inundation (PMP-DF)

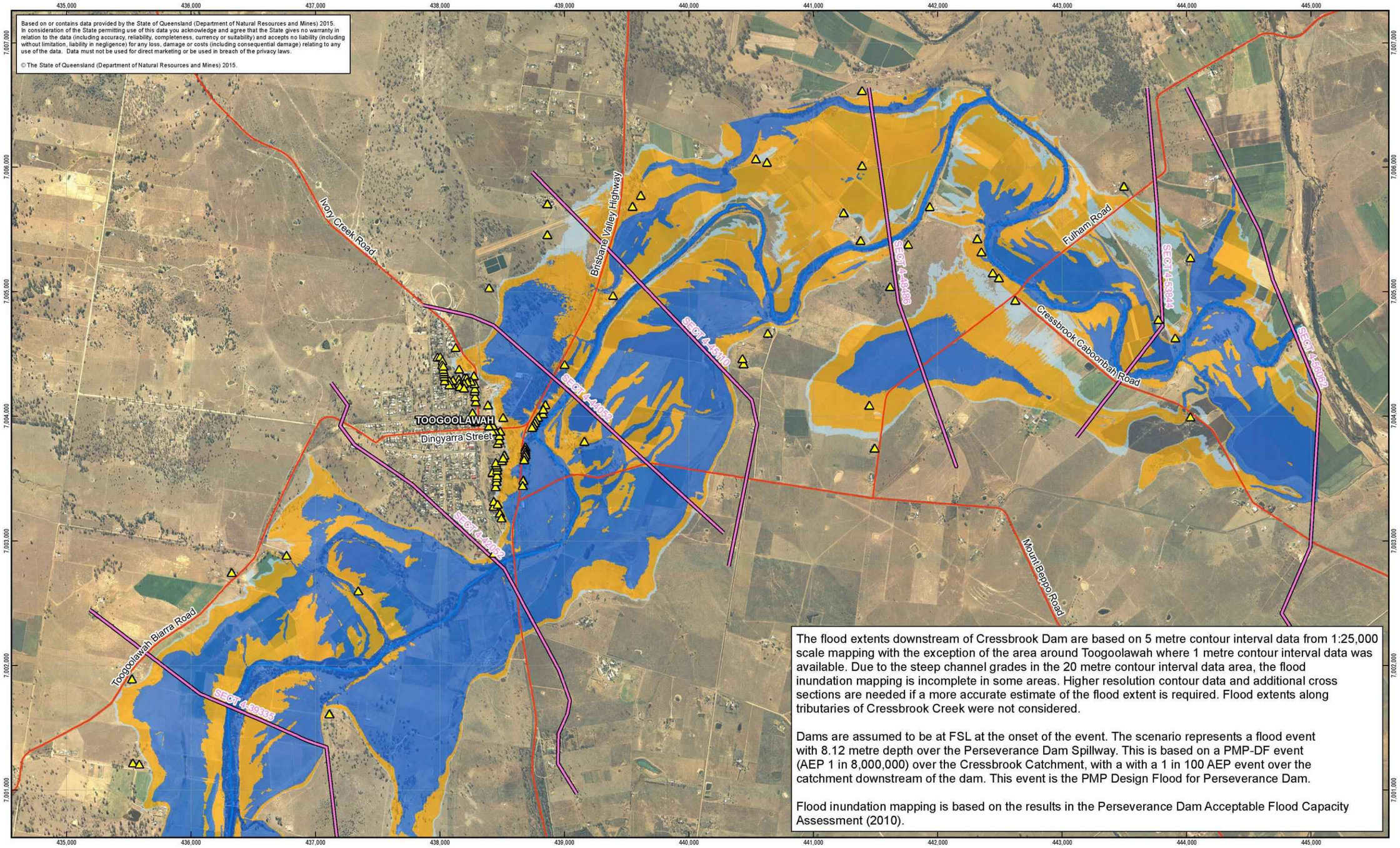
Figure 11

G:\41\28851\GIS\Maps\41_28851_62.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




The flood extents downstream of Cressbrook Dam are based on 5 metre contour interval data from 1:25,000 scale mapping with the exception of the area around Toogoolawah where 1 metre contour interval data was available. Due to the steep channel grades in the 20 metre contour interval data area, the flood inundation mapping is incomplete in some areas. Higher resolution contour data and additional cross sections are needed if a more accurate estimate of the flood extent is required. Flood extents along tributaries of Cressbrook Creek were not considered.

Dams are assumed to be at FSL at the onset of the event. The scenario represents a flood event with 8.12 metre depth over the Perseverance Dam Spillway. This is based on a PMP-DF event (AEP 1 in 8,000,000) over the Cressbrook Catchment, with a with a 1 in 100 AEP event over the catchment downstream of the dam. This event is the PMP Design Flood for Perseverance Dam.

Flood inundation mapping is based on the results in the Perseverance Dam Acceptable Flood Capacity Assessment (2010).

1:25,000 @ A3

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m
- Natural Flooding (No Dam Failure)

Toowoomba Regional Council
Perseverance Dam EAP Flood Mapping

| | |
|---|---|
| Job Number | 41-28851 |
| Revision | 0 |
| Date | 18 Jul 2016 |

## Event Stage 5 - Water Level +8.12m Over Spillway Cascade Failure Flood Inundation (PMP-DF) Figure 11-B

G:\41\28851\GIS\Maps\41_28851_64.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM

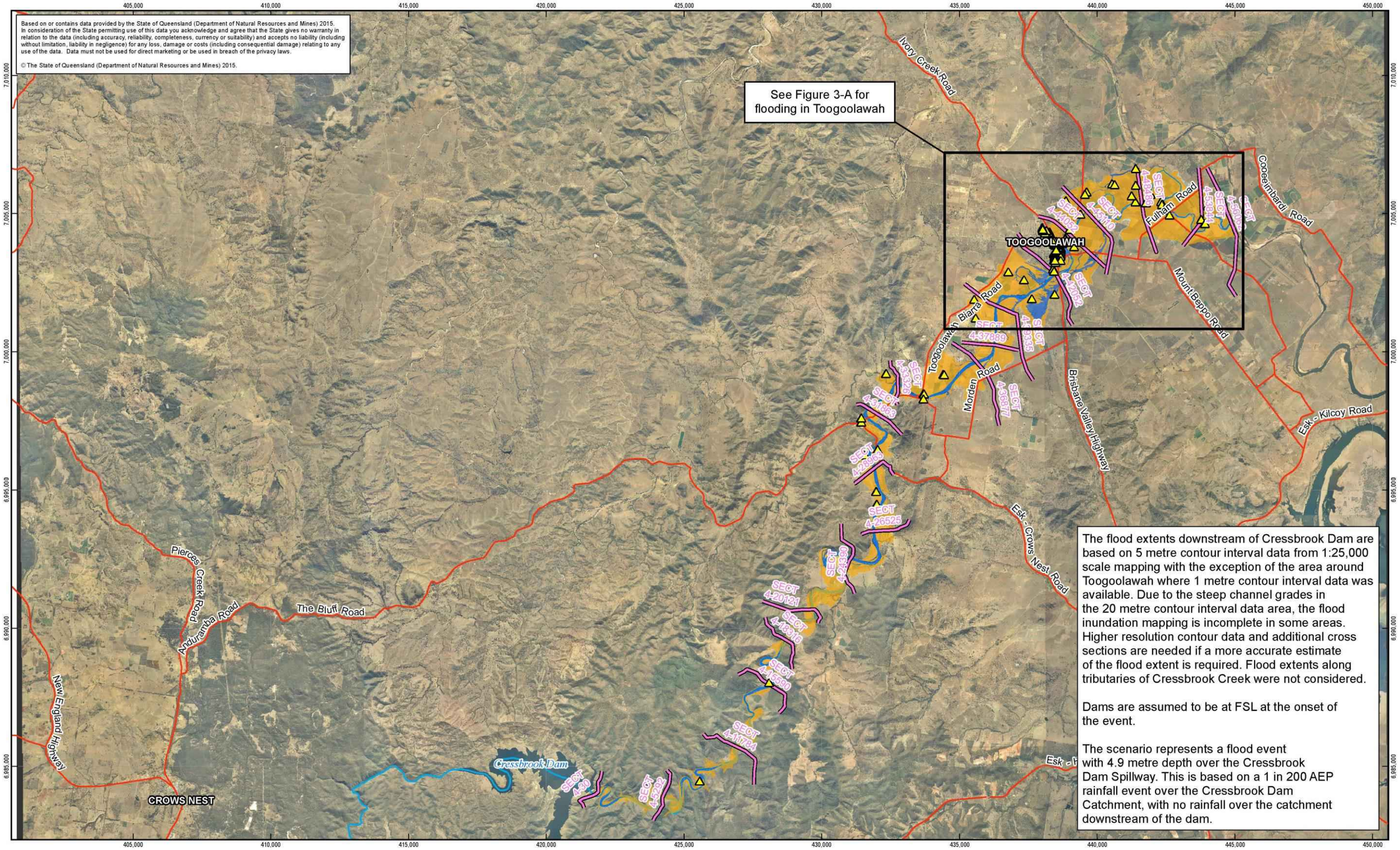
## Appendix C2: Cressbrook dam inundation maps

| Event | Reservoir Level | Map |
|---|---|---|
| Flood Event Stage 2 and Dam Failure | +4.9m over spillway -(AEP 1 in 200 Event) | Figure 3 and Figure 3-A |
| Flood Event Stage 3 and Dam Failure | +6.5m over spillway - (AEP 1 in 500 Event) | Figure 4 and Figure 4-A |
| Flood Event Stage 4 and Dam Failure | +9.0m over spillway -(AEP 1 in 10,000 Event) | Figure 5 and Figure 5-A |
| Sunny Day Dam Failure | At Full supply level | Figure 7 and Figure 7-A |
| Flood Event Stage 5 and Dam Failure | +10.0m over spillway -(AEP 1 in 17,000 Event) | Figure 8 and Figure 8-A |
| PMP -DF | +13.7m over spillway | Figure 9 and Figure 9-A |
| Sunny Day Cressbrook Dam Failure Cressbrook and Brisbane River Confluence | At Full supply level | Figure 10-A and Figure 10-B |
| Cascade Failure Scenario for both dams – Map heading Perseverance mapping | Brisbane River Confluence | Figure 11-A and Figure 11-B |

**Note:** Digital Excel files (DM#7455808) for lot plan details and DM#7456056 for each inundation maps have provided for Somerset LDMG use.

In Toogoolawah area, mapping was based on more accurate data including 1.0m interval contours as the PAR is relatively high.

Given the complexity of modelling the Brisbane river flood plain and Cressbrook Creek confluence, methodology adopted to identify additional PAR in that area, based on field verification process followed by flood estimation. This area is based on the RL 90 m contour (but excludes areas where the level is greater than 90 m). This level was chosen as it is similar to the peak water level simulated in Cressbrook Creek just downstream of Toogoolawah. This is a very conservative assumption, as it assumes no attenuation of flow downstream along the substantially larger Brisbane River. The simulated sunny day failure extent is very similar to the simulated cascade failure flood extent. The Inundation Maps in Figures 10-1 and 10-2 illustrates the estimated flood area along the Brisbane River for the for the sunny day failure of Cressbrook Dam. The Inundation Maps in Figures 11-1 & 11-2 illustrates the estimated flood area for Cascade Failure Scenario (for both Perseverance and Cressbrook Dams).




1:125,000 @ A3

0 1 2 3 4 5 Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

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## Event Stage 2 - Water Level +4.9m Over Spillway Estimated Flood Inundation (AEP 1 in 200)

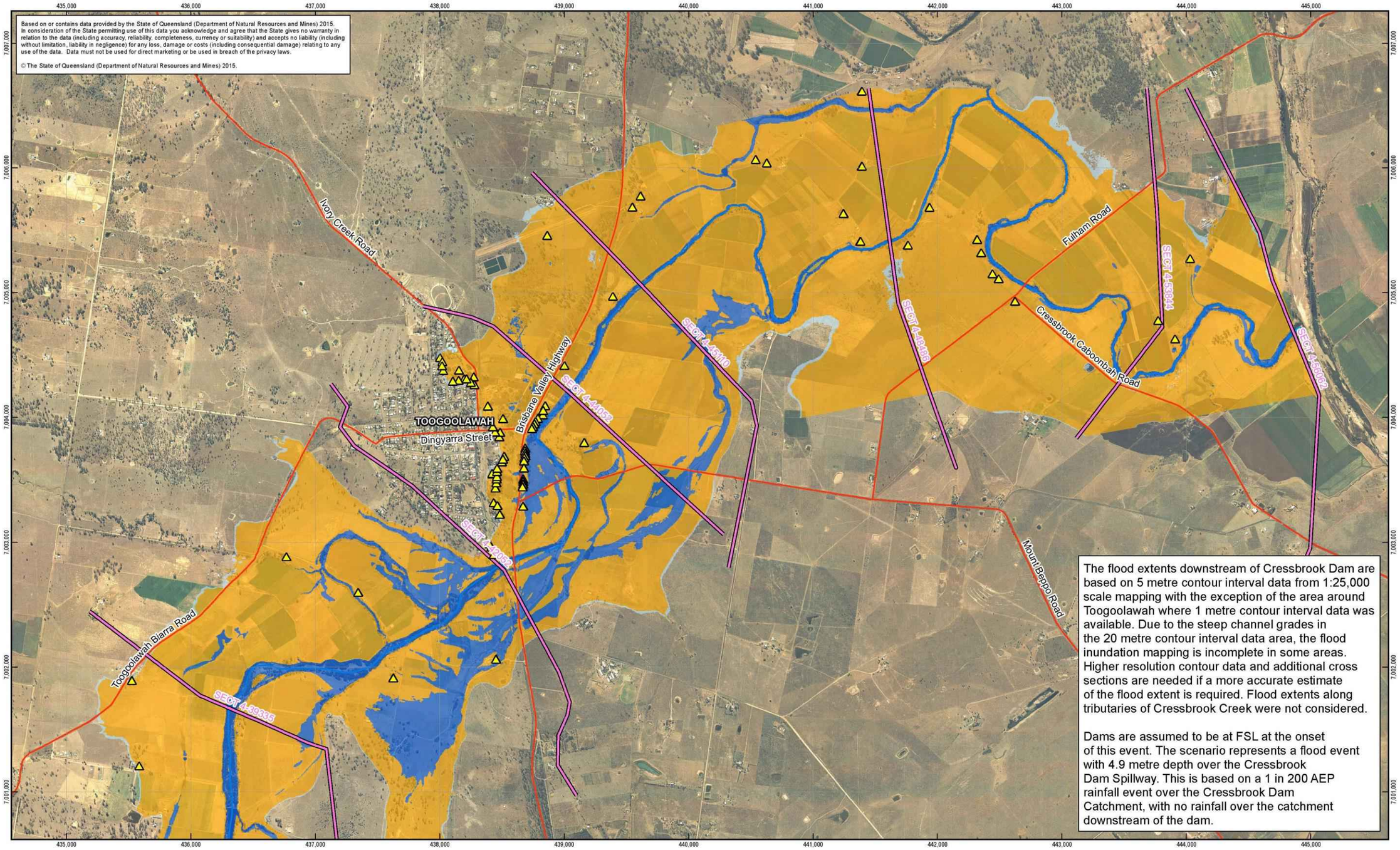
Figure 3

G:\41\28851\GIS\Maps\41_28851_27.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




1:25,000 @ A3

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

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|---|---|
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## Event Stage 2 - Water Level +4.9m Over Spillway Estimated Flood Inundation (AEP 1 in 200)

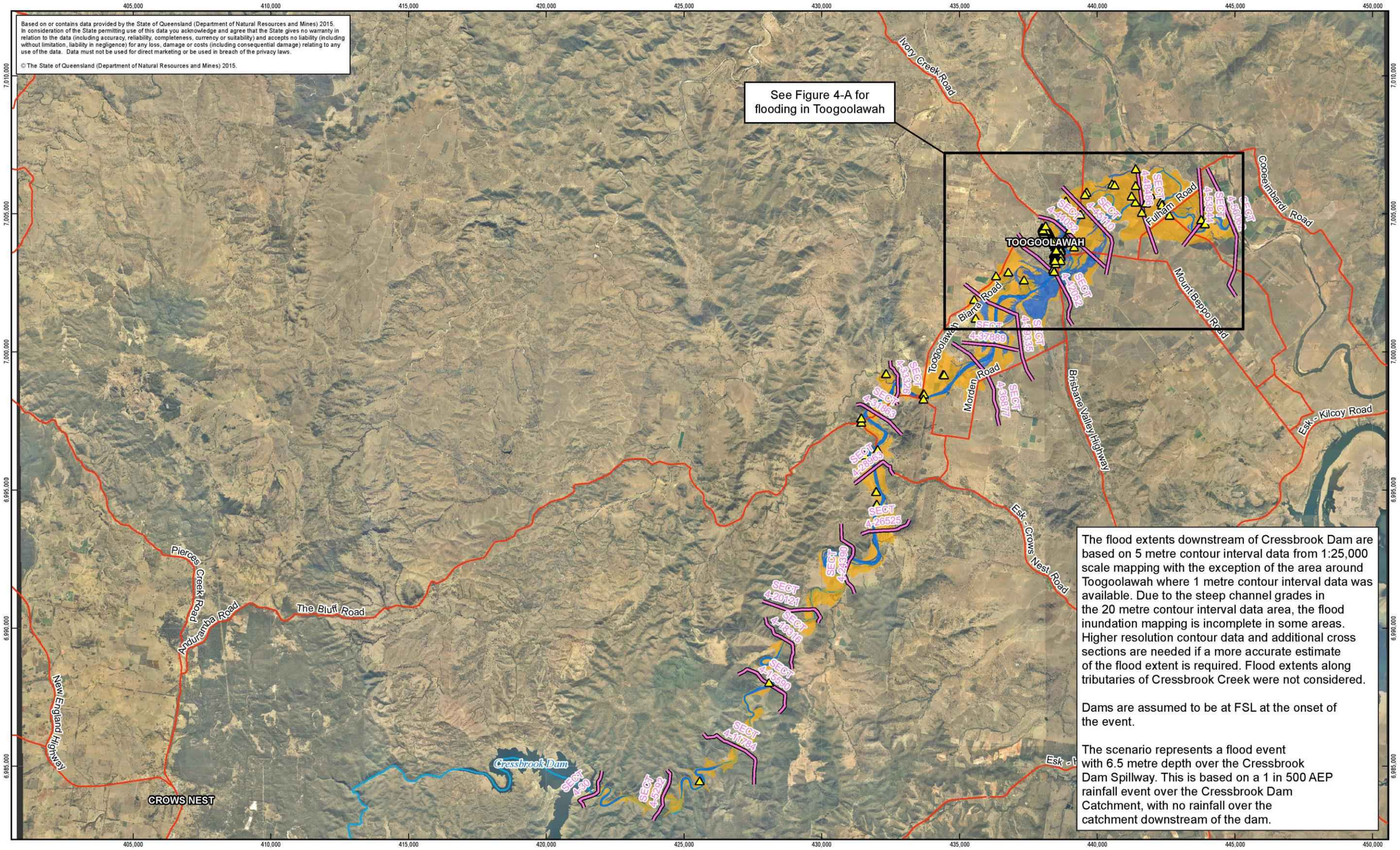
**Figure 3-A**

G:\41\28851\GIS\Maps\41_28851_32.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM






The flood extents downstream of Cressbrook Dam are based on 5 metre contour interval data from 1:25,000 scale mapping with the exception of the area around Toogoolawah where 1 metre contour interval data was available. Due to the steep channel grades in the 20 metre contour interval data area, the flood inundation mapping is incomplete in some areas. Higher resolution contour data and additional cross sections are needed if a more accurate estimate of the flood extent is required. Flood extents along tributaries of Cressbrook Creek were not considered.

Dams are assumed to be at FSL at the onset of the event.

The scenario represents a flood event with 6.5 metre depth over the Cressbrook Dam Spillway. This is based on a 1 in 500 AEP rainfall event over the Cressbrook Dam Catchment, with no rainfall over the catchment downstream of the dam.

1:125,000 @ A3

0 1 2 3 4 5
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

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|---|---|
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## Event Stage 3 - Water Level +6.5m Over Spillway Estimated Flood Inundation (AEP 1 in 500)

Figure 4

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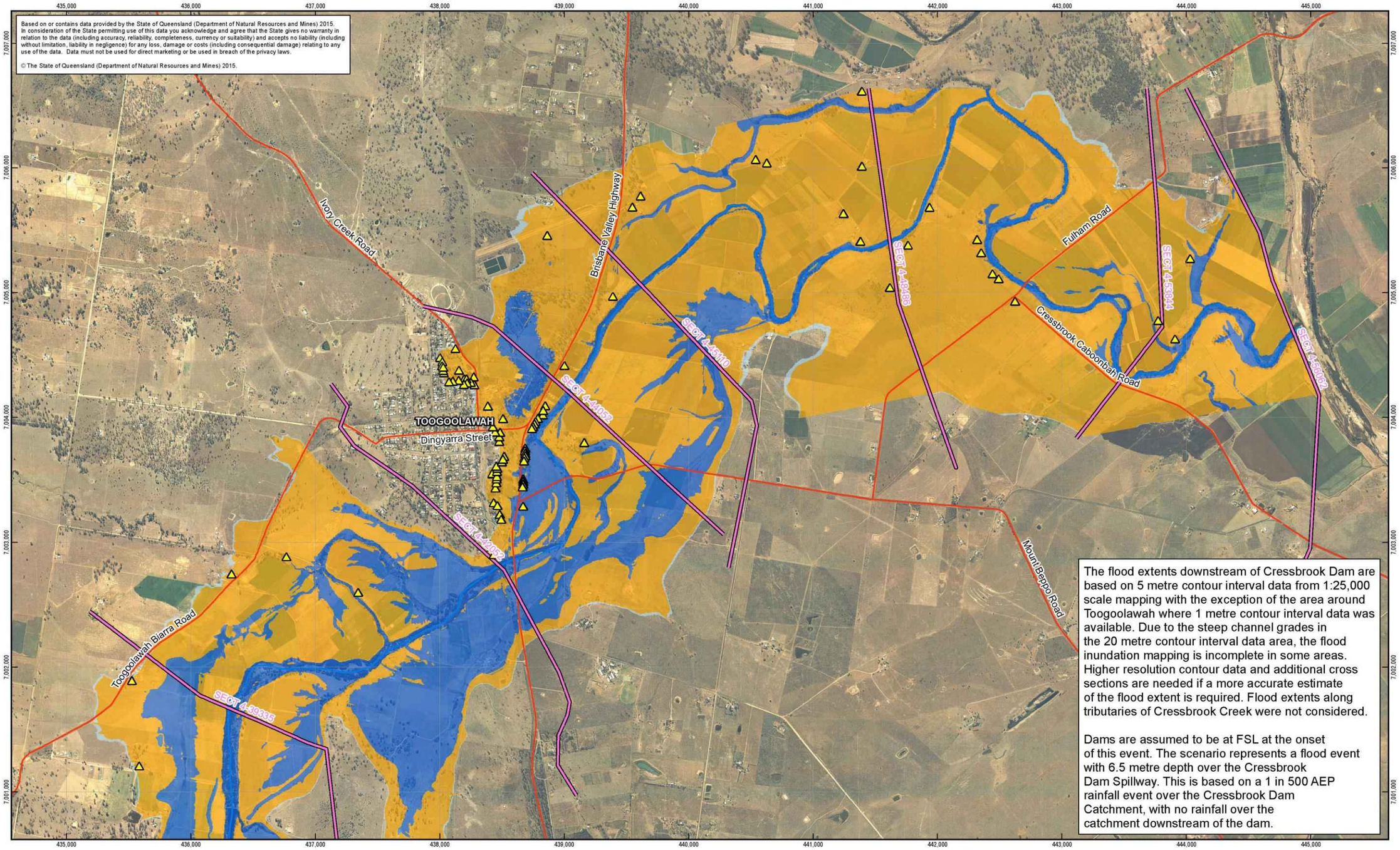
Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




1:25,000 @ A3

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

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## Event Stage 3 - Water Level +6.5m Over Spillway Estimated Flood Inundation (AEP 1 in 500)

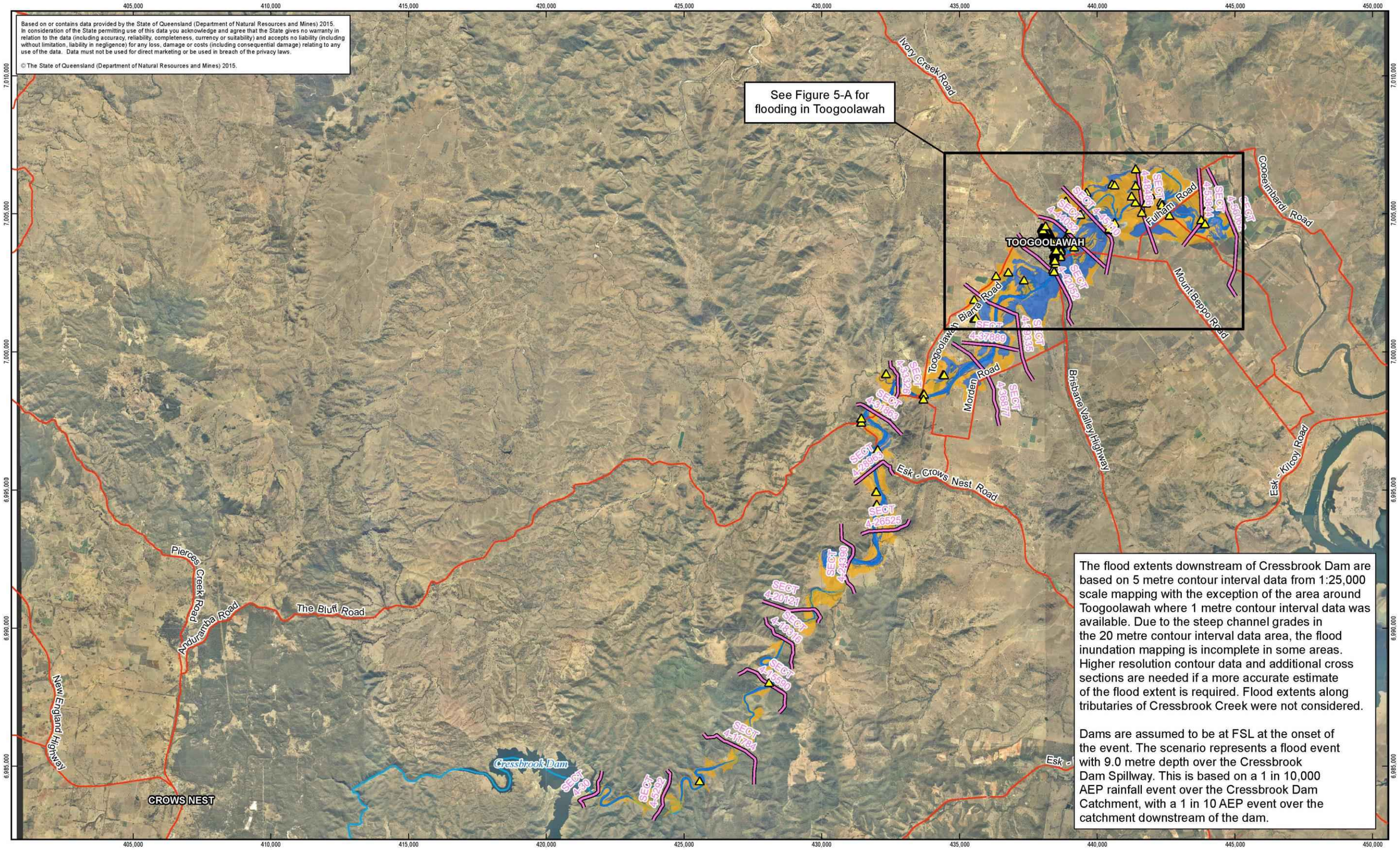
## Figure 4-A

G:\41\28851\GIS\Maps\41_28851_33.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM






1:125,000 @ A3

0 1 2 3 4 5 Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

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|---|---|
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## Event Stage 4 - Water Level +9.0m Over Spillway Estimated Flood Inundation (AEP 1 in 10,000)

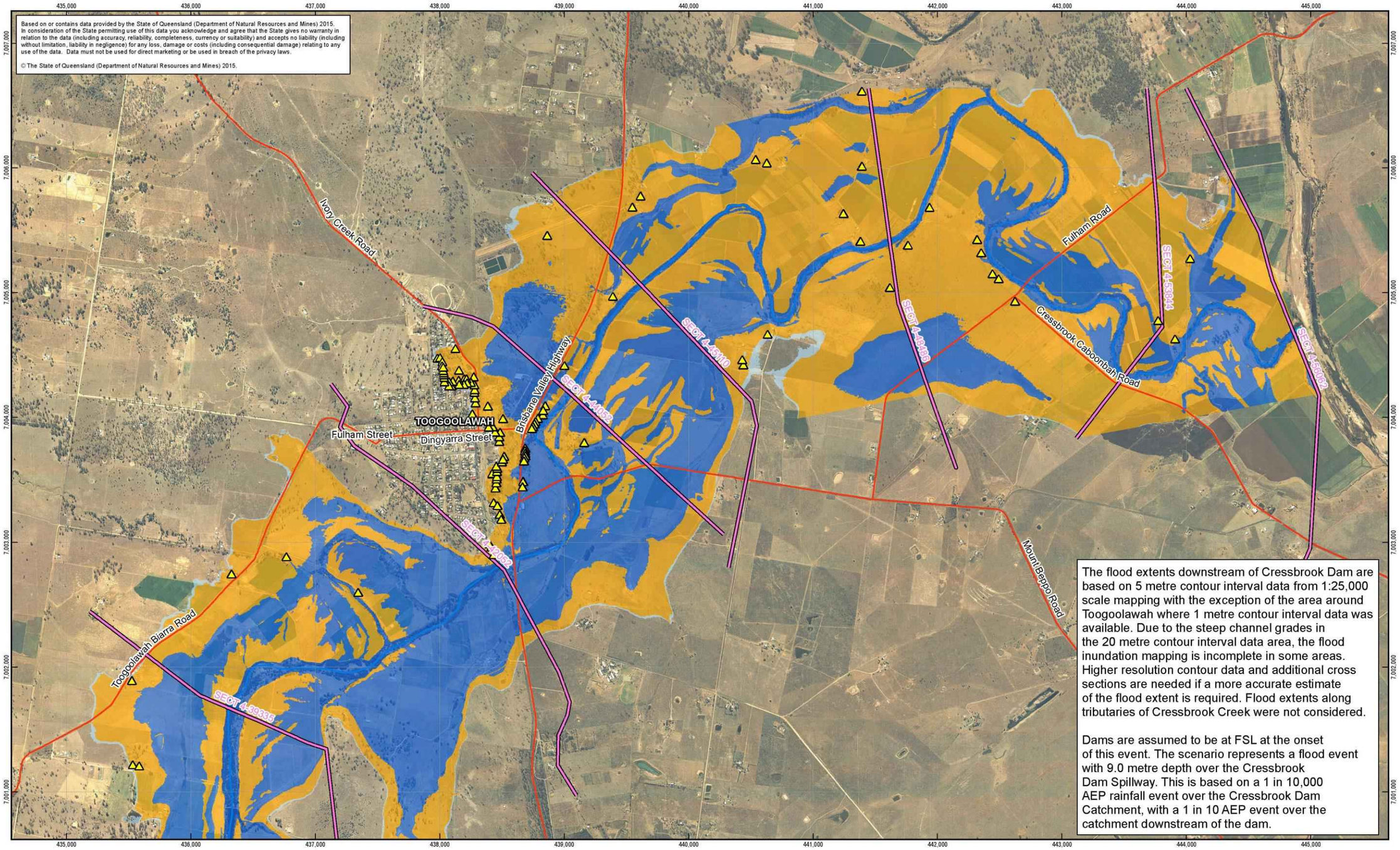
Figure 5

G:\41\28851\GIS\Maps\41_28851_29.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




1:25,000 @ A3
0 250 500 750 1,000
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND
- Incremental PAR
- Cross Section
- Major Road
- Natural Flooding (No Dam Failure)
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

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| Date | 15 Jul 2016 |

Event Stage 4 - Water Level +9.0m Over Spillway
Estimated Flood Inundation (AEP 1 in 10,000)

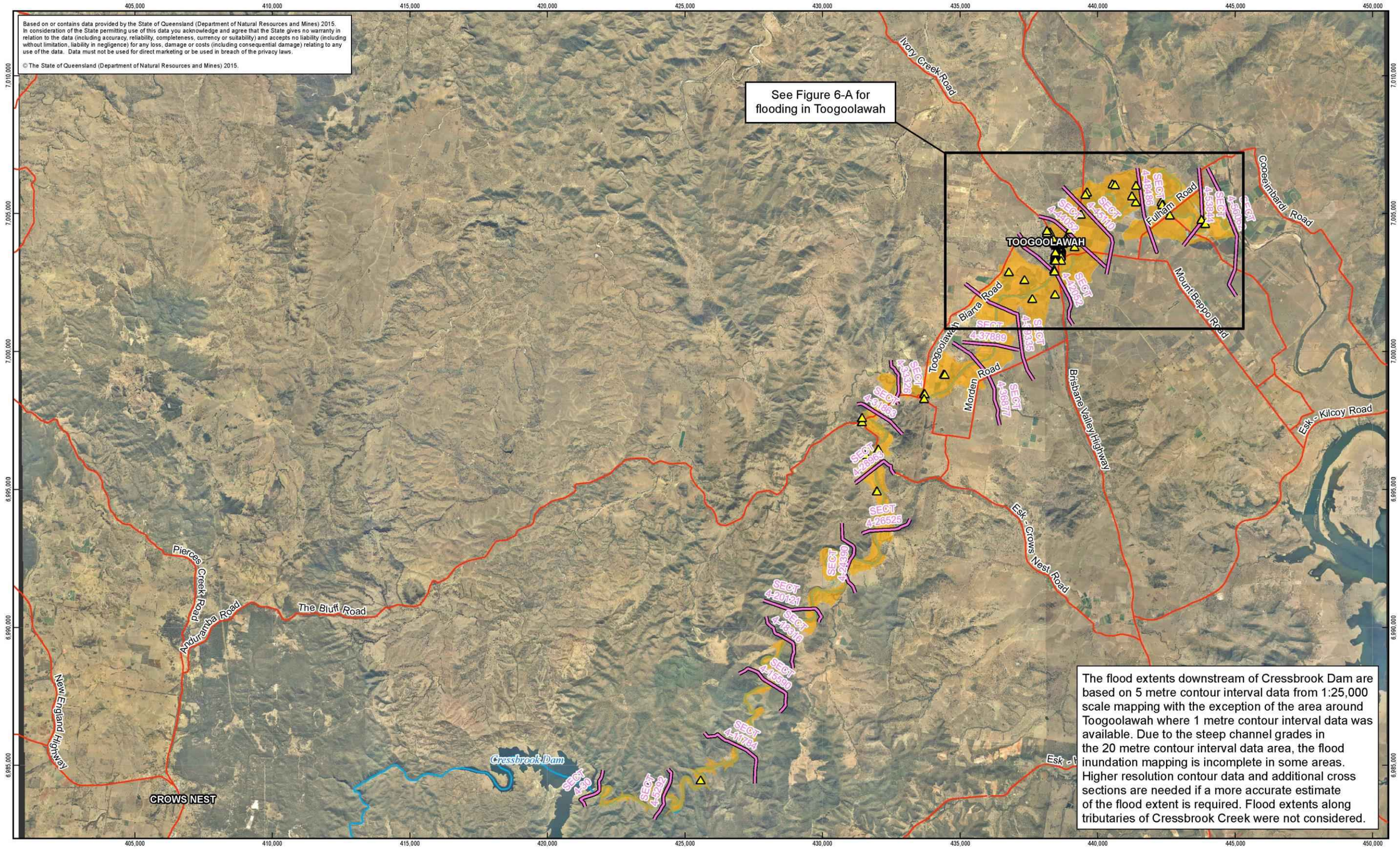
Figure 5-A

G:\41\28851\GIS\Maps\41_28851_34.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM






1:125,000 @ A3

0 1 2 3 4 5 Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- PAR
- Cross Section
- Major Road
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

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Cressbrook Dam EAP Flood Mapping

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| Job Number | 41-28851 |
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## Sunny Day Failure at Full Supply Level

Figure 7

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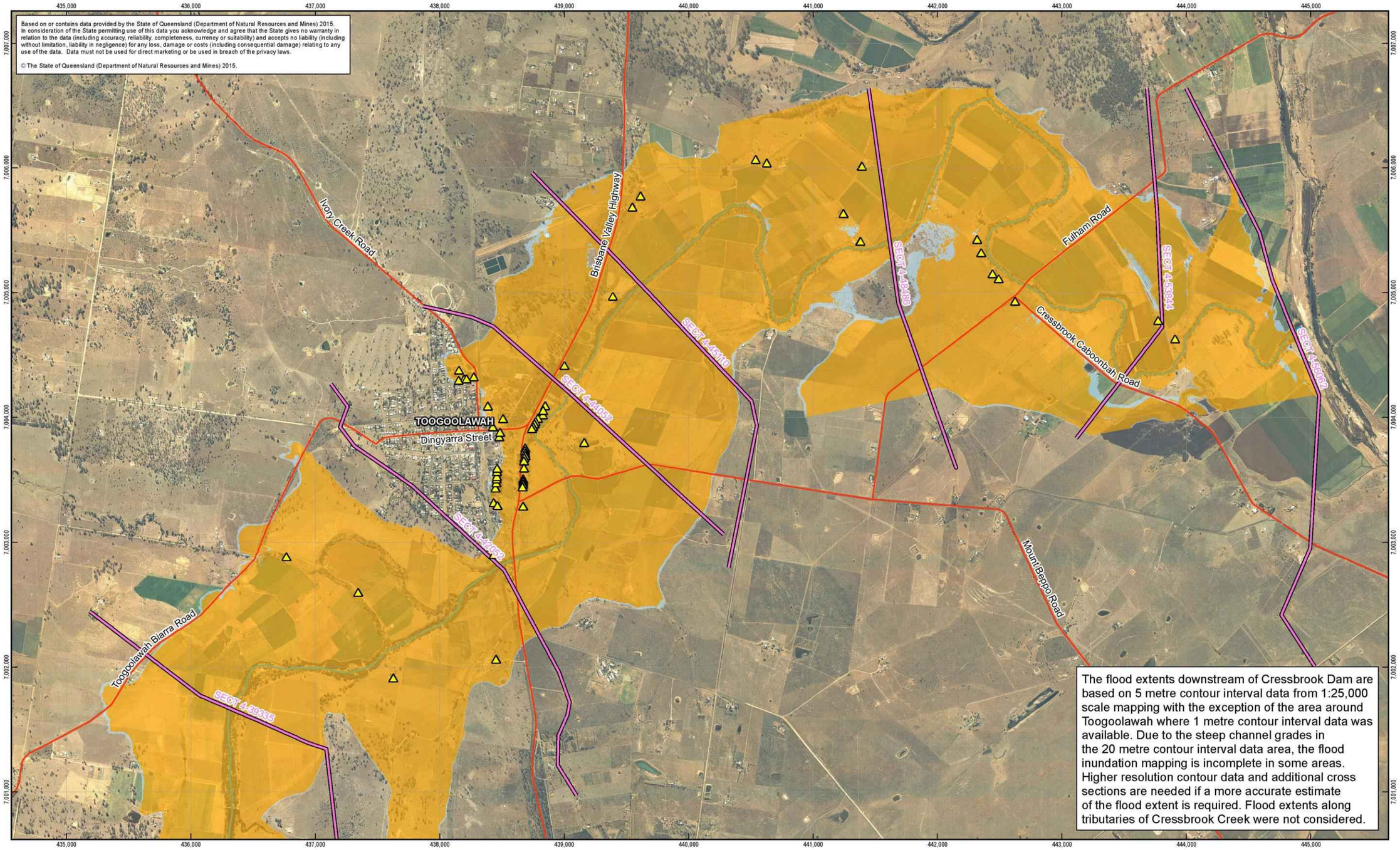
Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




1:25,000 @ A3

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Cressbrook Creek
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

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| Date | 15 Jul 2016 |

## Sunny Day Failure at Full Supply Level

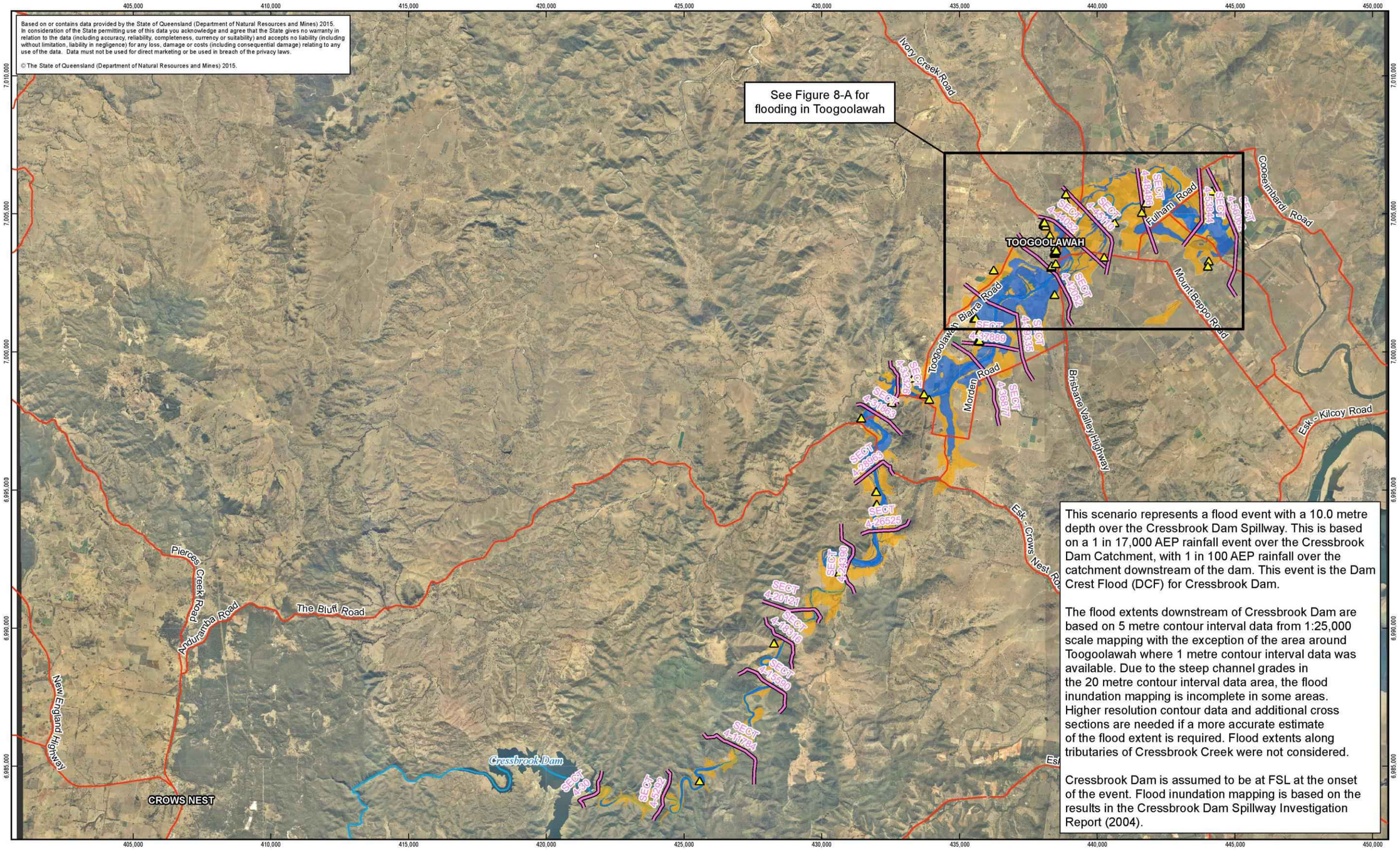
## Figure 7-A

G:\41\28851\GIS\Maps\41_28851_50.mxd



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com




1:125,000 @ A3

0 1 2 3 4 5 Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- PAR
- Cross Section
- Major Road
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m
- Natural Flooding (No Dam Failure)

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

| | |
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| Revision | 0 |
| Date | 15 Jul 2016 |

## Event Stage 5 - Water Level +10.0m Over Spillway Estimated Flood Inundation (AEP 1 in 17,000)

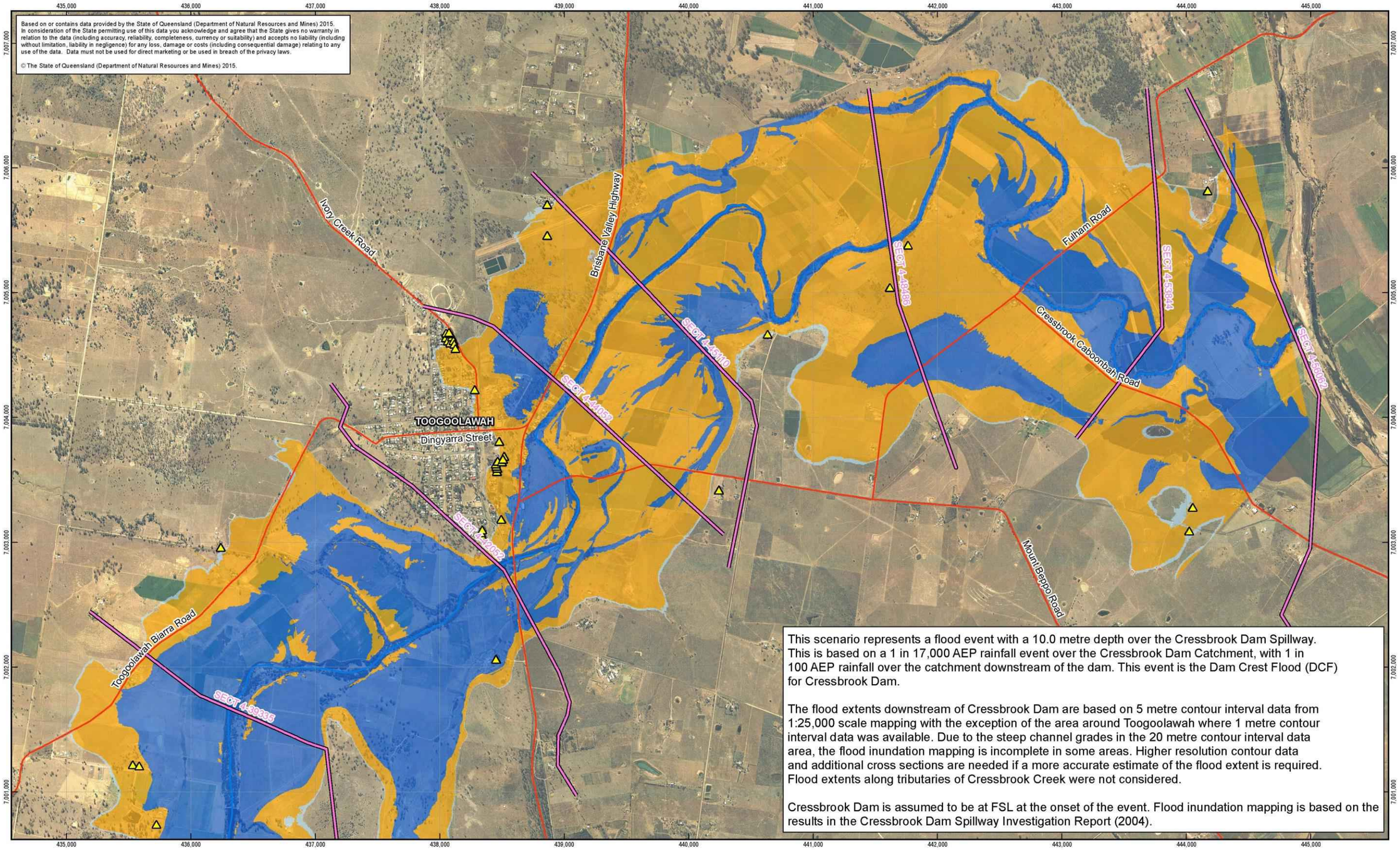
Figure 8

G:\41\28851\GIS\Maps\41_28851_58.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




This scenario represents a flood event with a 10.0 metre depth over the Cressbrook Dam Spillway. This is based on a 1 in 17,000 AEP rainfall event over the Cressbrook Dam Catchment, with 1 in 100 AEP rainfall over the catchment downstream of the dam. This event is the Dam Crest Flood (DCF) for Cressbrook Dam.

The flood extents downstream of Cressbrook Dam are based on 5 metre contour interval data from 1:25,000 scale mapping with the exception of the area around Toogoolawah where 1 metre contour interval data was available. Due to the steep channel grades in the 20 metre contour interval data area, the flood inundation mapping is incomplete in some areas. Higher resolution contour data and additional cross sections are needed if a more accurate estimate of the flood extent is required. Flood extents along tributaries of Cressbrook Creek were not considered.

Cressbrook Dam is assumed to be at FSL at the onset of the event. Flood inundation mapping is based on the results in the Cressbrook Dam Spillway Investigation Report (2004).

1:25,000 @ A3
0 250 500 750 1,000
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND
- Incremental PAR
- Cross Section
- Major Road
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m
- Natural Flooding (No Dam Failure)

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

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|---|---|
| Job Number | 41-28851 |
| Revision | 0 |
| Date | 15 Jul 2016 |

## Event Stage 5 - Water Level +10.0m Over Spillway Estimated Flood Inundation (AEP 1 in 17,000)

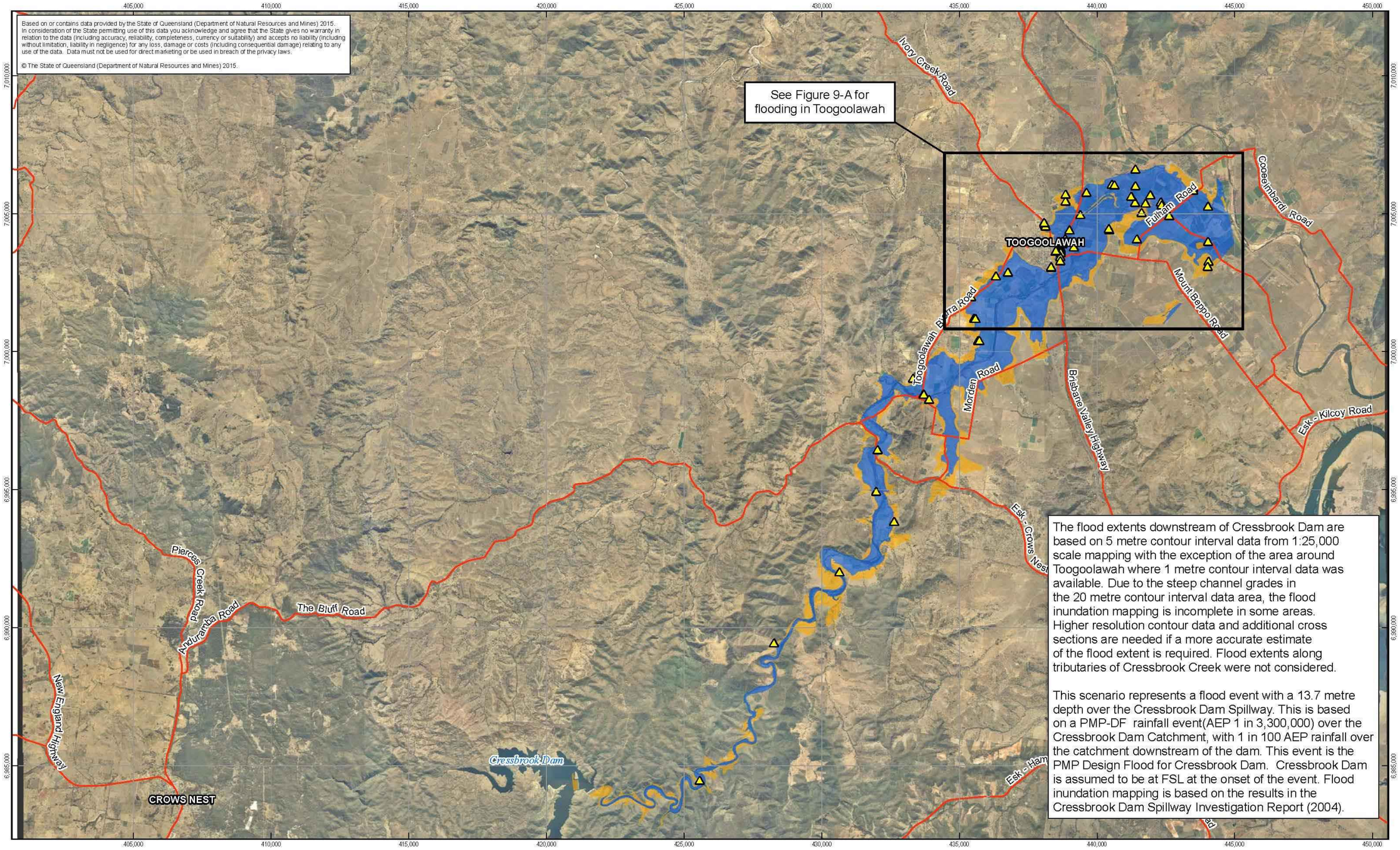
Figure 8-A

G:\41\28851\GIS\Maps\41_28851_59.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




The flood extents downstream of Cressbrook Dam are based on 5 metre contour interval data from 1:25,000 scale mapping with the exception of the area around Toogoolawah where 1 metre contour interval data was available. Due to the steep channel grades in the 20 metre contour interval data area, the flood inundation mapping is incomplete in some areas. Higher resolution contour data and additional cross sections are needed if a more accurate estimate of the flood extent is required. Flood extents along tributaries of Cressbrook Creek were not considered.

This scenario represents a flood event with a 13.7 metre depth over the Cressbrook Dam Spillway. This is based on a PMP-DF rainfall event(AEP 1 in 3,300,000) over the Cressbrook Dam Catchment, with 1 in 100 AEP rainfall over the catchment downstream of the dam. This event is the PMP Design Flood for Cressbrook Dam. Cressbrook Dam is assumed to be at FSL at the onset of the event. Flood inundation mapping is based on the results in the Cressbrook Dam Spillway Investigation Report (2004).

1:125,000 @ A3

0 1 2 3 4 5
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- PAR
- Cross Section
- Major Road
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m
- Natural Flooding (No Dam Failure)

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

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|---|---|
| Job Number | 41-28851 |
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## Event Stage 5 - Water Level +13.7m Over Spillway Estimated Flood Inundation (PMP-DF)

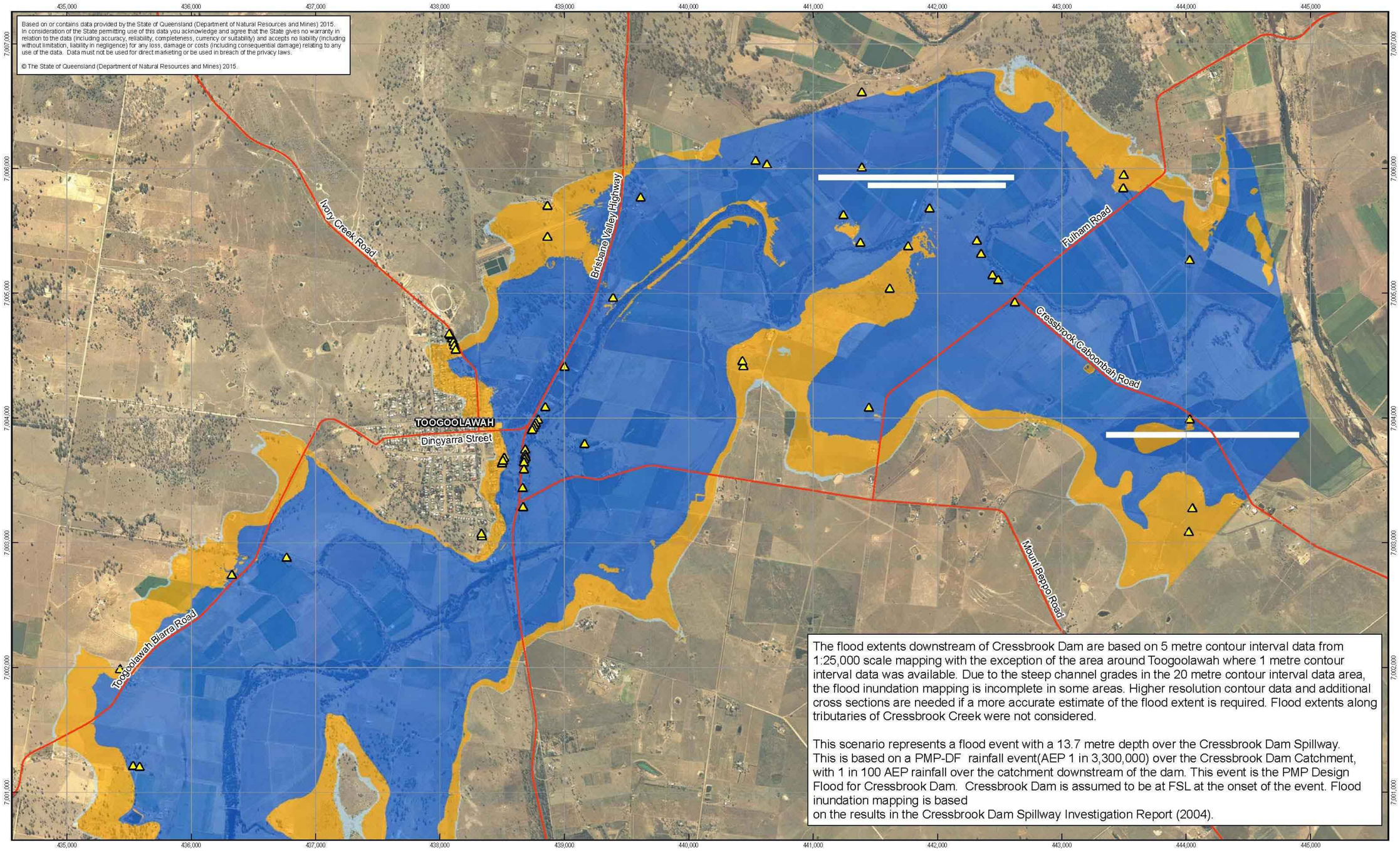
**Figure 9**

\\GHDnet\GHD\AU\Toowoomba\Projects\41\28851\GIS\Maps\41_28851_60.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM




The flood extents downstream of Cressbrook Dam are based on 5 metre contour interval data from 1:25,000 scale mapping with the exception of the area around Toogoolawah where 1 metre contour interval data was available. Due to the steep channel grades in the 20 metre contour interval data area, the flood inundation mapping is incomplete in some areas. Higher resolution contour data and additional cross sections are needed if a more accurate estimate of the flood extent is required. Flood extents along tributaries of Cressbrook Creek were not considered.

This scenario represents a flood event with a 13.7 metre depth over the Cressbrook Dam Spillway. This is based on a PMP-DF rainfall event(AEP 1 in 3,300,000) over the Cressbrook Dam Catchment, with 1 in 100 AEP rainfall over the catchment downstream of the dam. This event is the PMP Design Flood for Cressbrook Dam. Cressbrook Dam is assumed to be at FSL at the onset of the event. Flood inundation mapping is based
on the results in the Cressbrook Dam Spillway Investigation Report (2004).

1:25,000 @ A3

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Incremental PAR
- Cross Section
- Major Road
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m
- Natural Flooding (No Dam Failure)

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

| | |
|---|---|
| Job Number | 41-28851 |
| Revision | 0 |
| Date | 15 Jul 2016 |

Event Stage 5 - Water Level +13.7m Over Spillway
Estimated Flood Inundation (PMP-DF)

Figure 9-A

\\GHDnet\GHD\AU\Toowoomba\Projects\41\28851\GIS\Maps\41_28851_61.mxd

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com

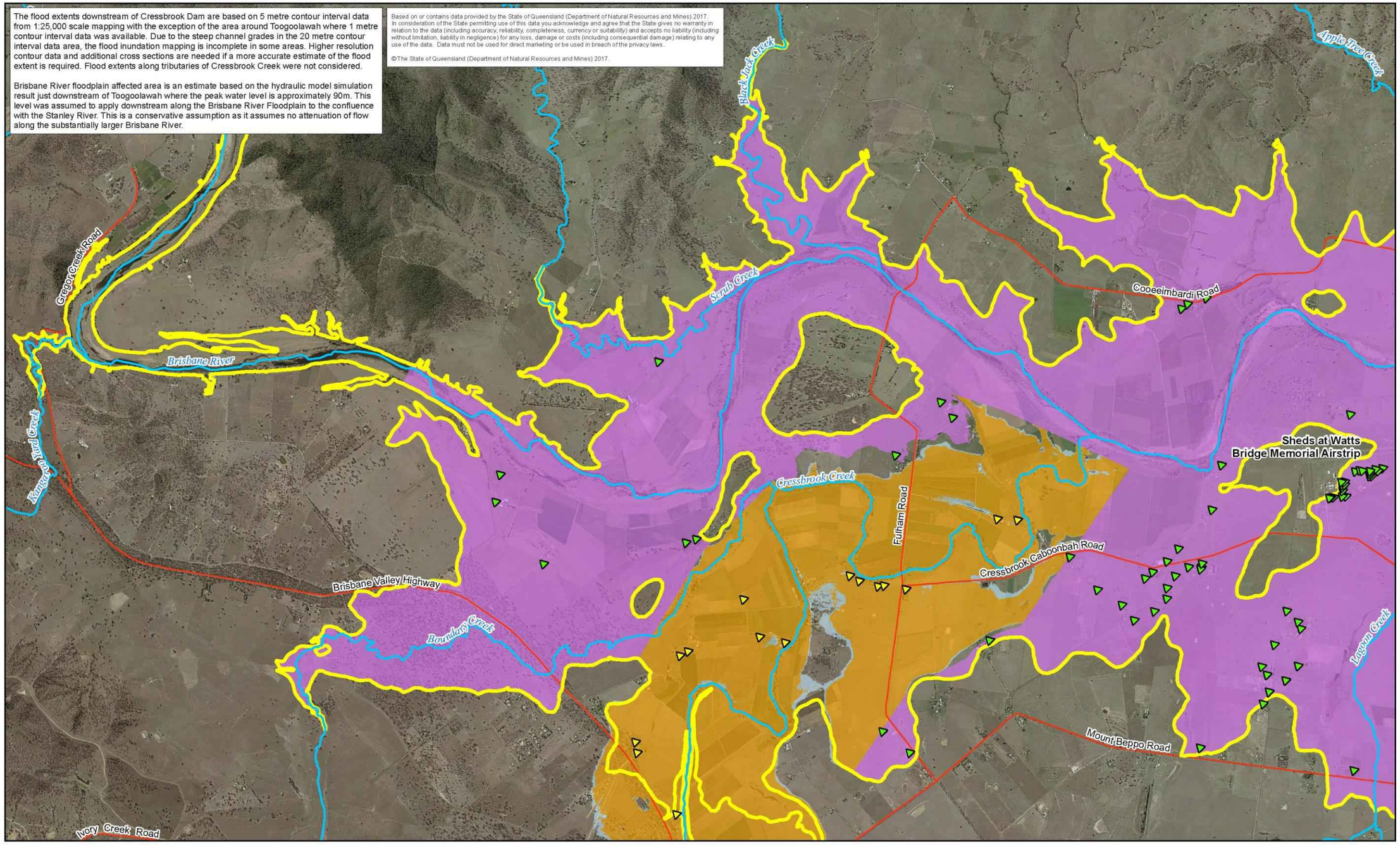


Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM

The flood extents downstream of Cressbrook Dam are based on 5 metre contour interval data from 1:25,000 scale mapping with the exception of the area around Toogoolawah where 1 metre contour interval data was available. Due to the steep channel grades in the 20 metre contour interval data area, the flood inundation mapping is incomplete in some areas. Higher resolution contour data and additional cross sections are needed if a more accurate estimate of the flood extent is required. Flood extents along tributaries of Cressbrook Creek were not considered.

Brisbane River floodplain affected area is an estimate based on the hydraulic model simulation result just downstream of Toogoolawah where the peak water level is approximately 90m. This level was assumed to apply downstream along the Brisbane River Floodplain to the confluence with the Stanley River. This is a conservative assumption as it assumes no attenuation of flow along the substantially larger Brisbane River.






1:35,000 @ A3

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND

- Potential Property At Risk
- Incremental PAR
- 90m Contour
- Major Road
- Brisbane River Floodplain Affected Area
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

| | |
|---|---|
| Job Number | 41-30839 |
| Revision | 0 |
| Date | 15 May 2017 |

Sunny Day Failure at Full Supply Level

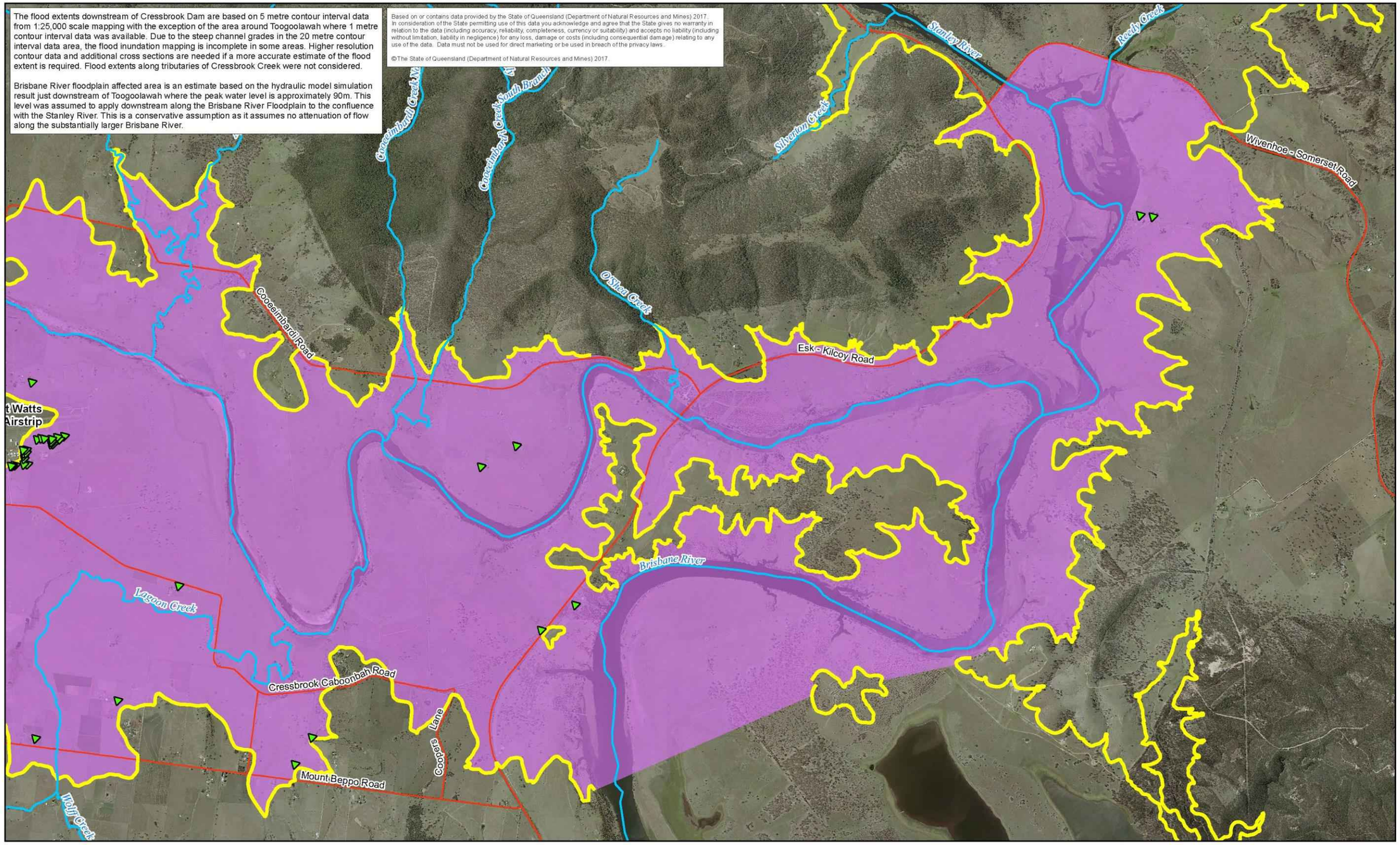
Figure 10-A

G:\41\30839\GIS\Maps\4130839_003.mxd



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com




1:35,000 @ A3

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND

- Potential Property At Risk
- Incremental PAR
- 90m Contour
- Major Road
- Brisbane River Floodplain Affected Area
- Dam Failure Flood Depth < 0.3m
- Dam Failure Flood Depth > 0.3m

Toowoomba Regional Council
Cressbrook Dam EAP Flood Mapping

| | |
|---|---|
| Job Number | 41-30839 |
| Revision | 0 |
| Date | 15 May 2017 |

Sunny Day Failure at Full Supply Level

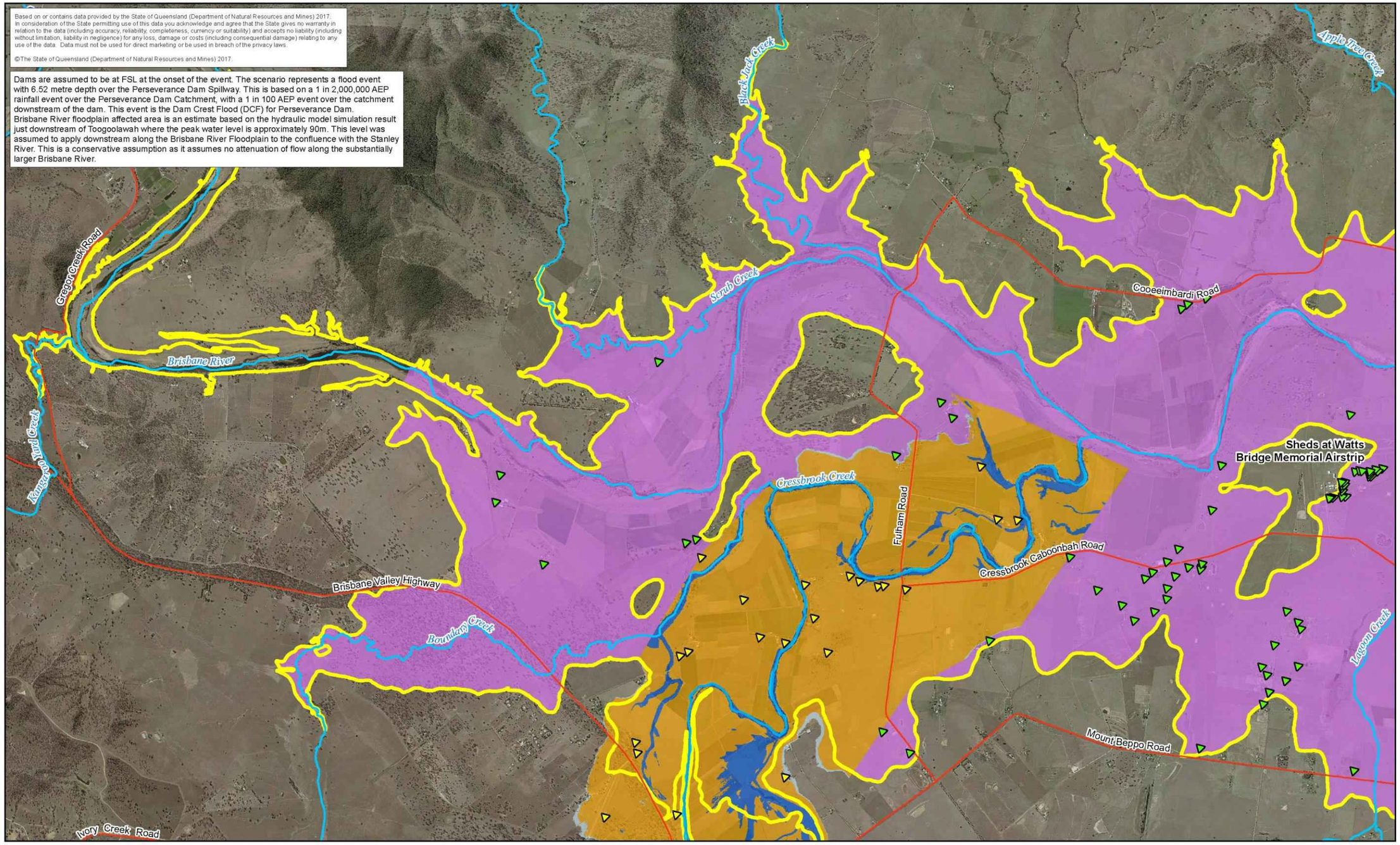
Figure 10-B

G:\41\30839\GIS\Maps\4130839_003.mxd



Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com






Dams are assumed to be at FSL at the onset of the event. The scenario represents a flood event with 6.52 metre depth over the Perseverance Dam Spillway. This is based on a 1 in 2,000,000 AEP rainfall event over the Perseverance Dam Catchment, with a 1 in 100 AEP event over the catchment downstream of the dam. This event is the Dam Crest Flood (DCF) for Perseverance Dam.
Brisbane River floodplain affected area is an estimate based on the hydraulic model simulation result just downstream of Toogoolawah where the peak water level is approximately 90m. This level was assumed to apply downstream along the Brisbane River Floodplain to the confluence with the Stanley River. This is a conservative assumption as it assumes no attenuation of flow along the substantially larger Brisbane River.

1:35,000 @ A3
0 250 500 750 1,000
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND
- Incremental PAR
- Potential Property At Risk
- Major Road
- 90m Contour
- Brisbane River Floodplain Affected Area
- Natural Flooding (No Dam Failure)
- Dam Cascade Failure Flood Depth < 0.3m
- Dam Cascade Failure Flood Depth > 0.3m

Toowoomba Regional Council
Perseverance Dam EAP Flood Mapping

| | |
|---|---|
| Job Number | 41-30839 |
| Revision | 0 |
| Date | 15 May 2017 |

## Event Stage 5 - Water Level +6.52m Over Spillway Cascade Failure Flood Inundation (AEP 1 in 2M) Figure 11-A

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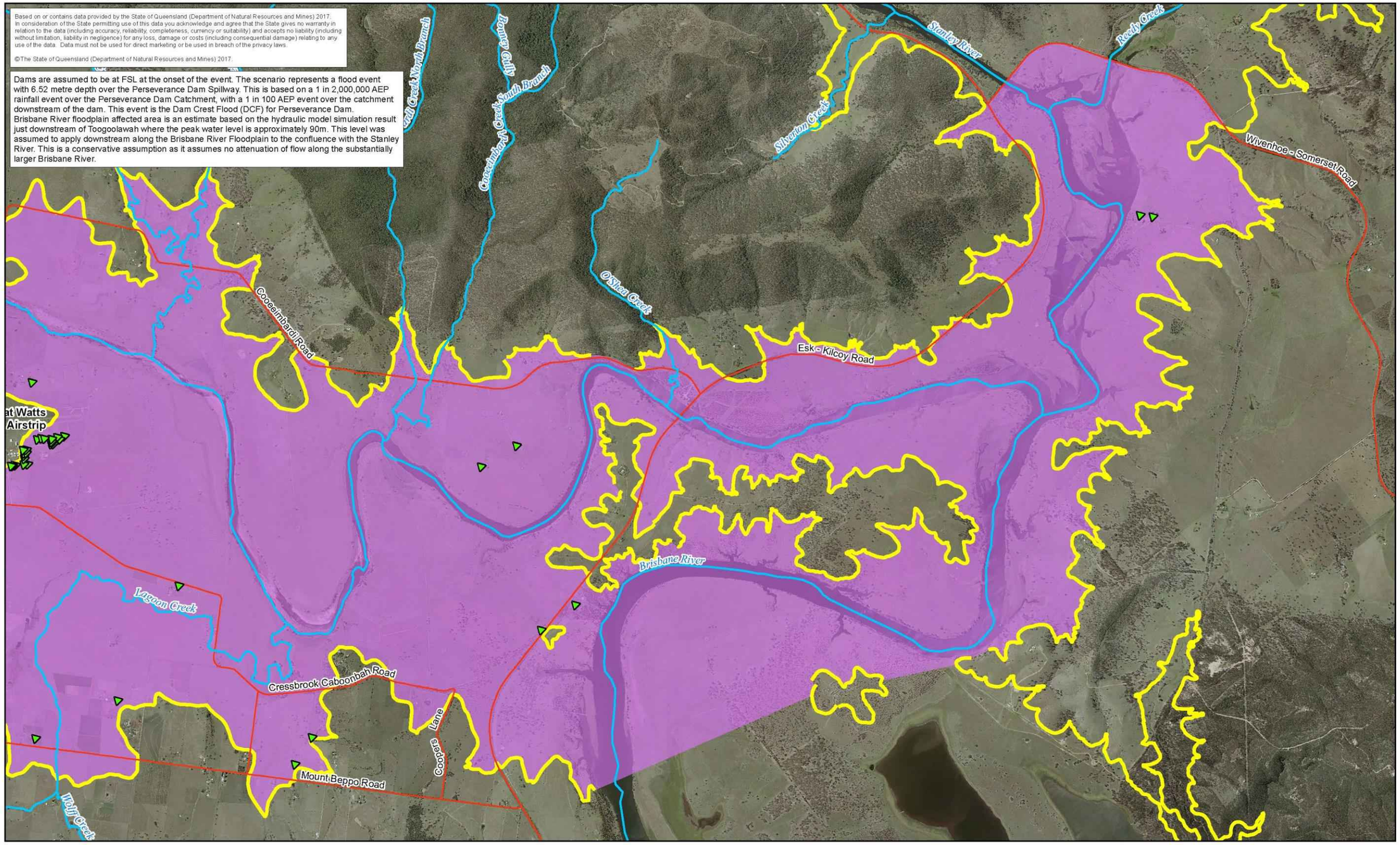
Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM

Suite 4, Level 2, 1-3 Annand Street Toowoomba QLD 4350 Australia T 61 7 4633 8000 F 61 7 4613 1687 E tbamail@ghd.com W www.ghd.com






Dams are assumed to be at FSL at the onset of the event. The scenario represents a flood event with 6.52 metre depth over the Perseverance Dam Spillway. This is based on a 1 in 2,000,000 AEP rainfall event over the Perseverance Dam Catchment, with a 1 in 100 AEP event over the catchment downstream of the dam. This event is the Dam Crest Flood (DCF) for Perseverance Dam.
Brisbane River floodplain affected area is an estimate based on the hydraulic model simulation result just downstream of Toogoolawah where the peak water level is approximately 90m. This level was assumed to apply downstream along the Brisbane River Floodplain to the confluence with the Stanley River. This is a conservative assumption as it assumes no attenuation of flow along the substantially larger Brisbane River.

1:35,000 @ A3

0 250 500 750 1,000
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND

- Incremental PAR
- Potential Property At Risk
- Major Road
- 90m Contour
- Brisbane River Floodplain Affected Area
- Natural Flooding (No Dam Failure)
- Dam Cascade Failure Flood Depth < 0.3m
- Dam Cascade Failure Flood Depth > 0.3m

Toowoomba Regional Council
Perseverance Dam EAP Flood Mapping

| | |
|---|---|
| Job Number | 41-30839 |
| Revision | 0 |
| Date | 15 May 2017 |

## Event Stage 5 - Water Level +6.52m Over Spillway Cascade Failure Flood Inundation (AEP 1 in 2M) Figure 11-B

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Data source: DNRM - Road Network (2014), TRC - Imagery (2009), GHD - Cross Sections (2010), Flood Extents (2015). Created by: PM

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## Appendix D Technical information

| | |
|---|---|
| Appendix D1 | Flood Rainfall record Sheets |
| Appendix D2 | Reservoir level graphs |
| Appendix D3 | Event Log Sheet |
| Appendix D4 | Record of Communication Sheet |
| Appendix D5 | Status Report |
| Appendix D6 | Emergency Event report Format |
| Appendix D7 | Cressbrook dam spillway rating curve |
| Appendix D8 | Perseverance Dam spillway rating curve |
| Appendix D9 | Modified Mercalli Intensity Scale for earthquake intensities |

Appendix D1 Flood Rainfall record Sheets

Dam Operator / Stand by Officer:…….. Shift Date and Hours:……

| DATE | TIME | RAINFALL mm | DAILY TOTAL mm | COMMENTS |
|---|---|---|---|---|
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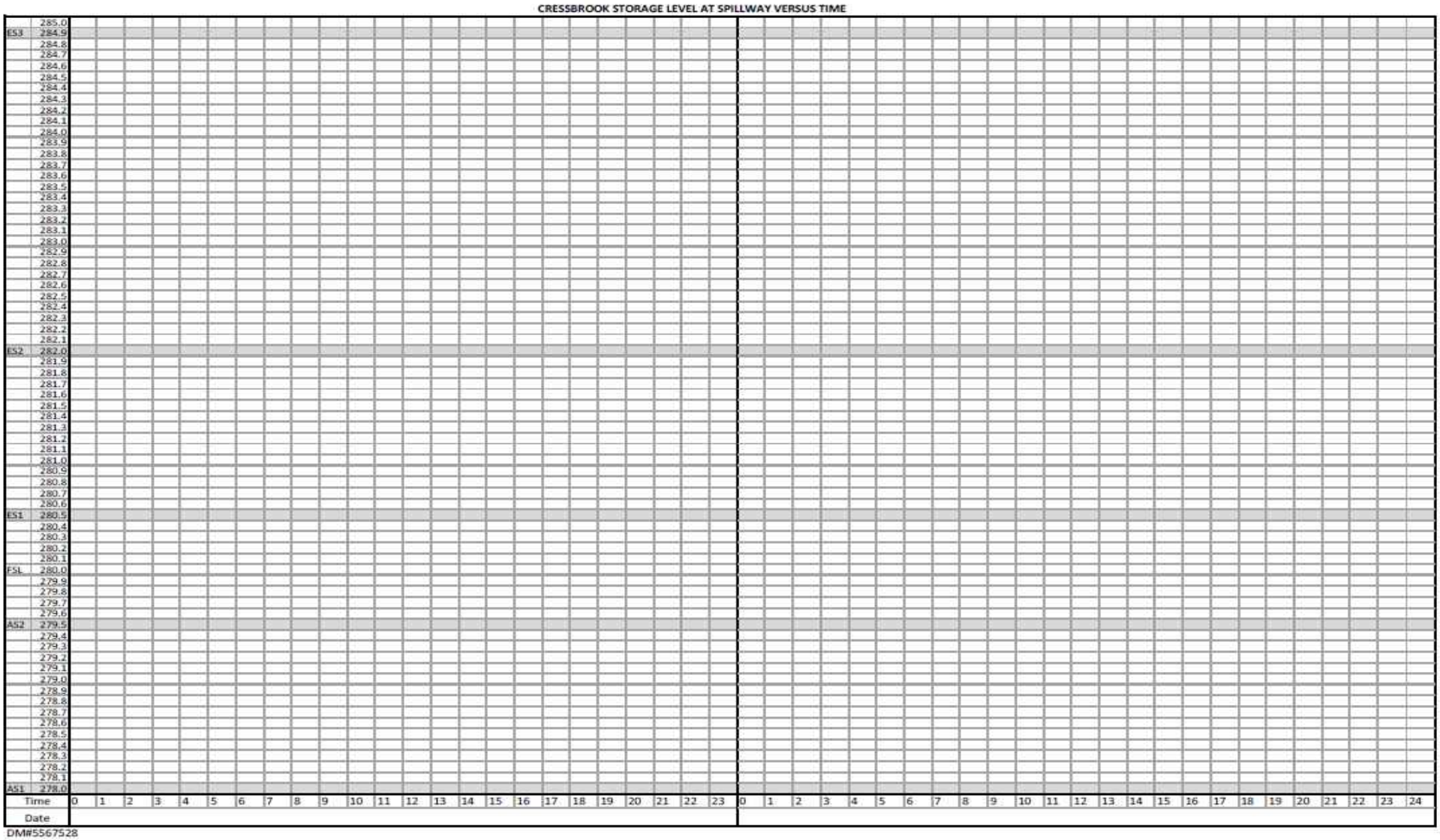
**RULE ACROSS UNDER EASCH DAYS TOTAL RAINFALL**

***Note:** use automatic rain gauge for recording hourly rainfall. Manual rain gauge should be used for daily rainfall once per day.

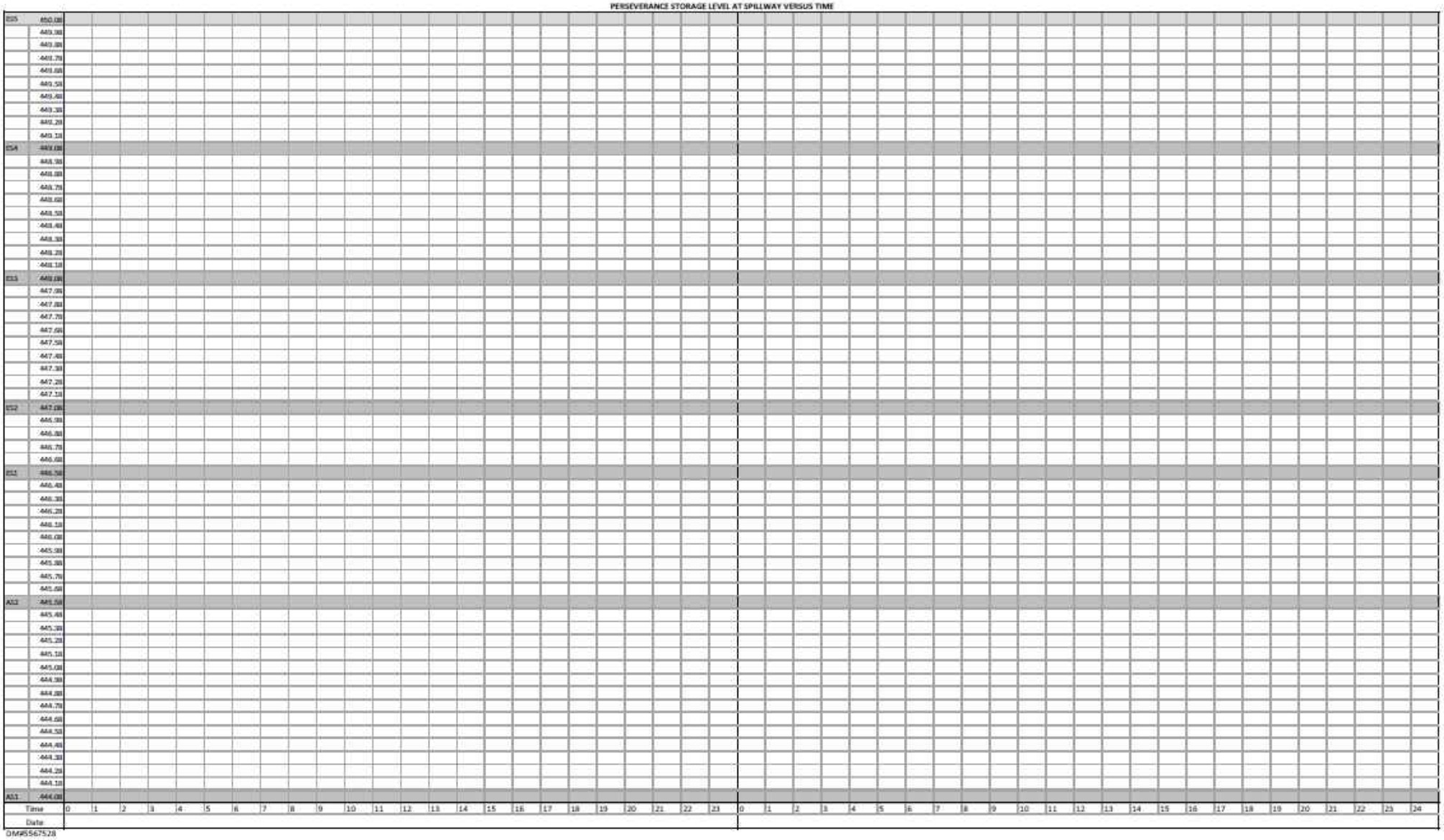
Appendix D2 Reservoir level graphs

Cressbrook and Perseverance reservoir level graph - Cressbrook




***Printable version use DM#5567528**

Cressbrook and Perseverance reservoir level graph - Perseverance




*Printable version use DM#5567528

Appendix D3 Event Log sheet

Dame operator / Duty Dam Officer: …….. Shift Date and Hours ……..

| Date | Time | Event description / Action carried out | Record entered by |
|---|---|---|---|
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Appendix D4 Record of Communication Sheet

Dam Operator / dam Duty Officer: ……. Shift Date and Hours …….

| Date | Time | Phone Number | Contact | Message sent / received | Call sent / Received by |
|---|---|---|---|---|---|
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Sequential Report Number

## Status Report Emergency Event at Dams

| Alert / Event Stage | |
|---|---|
| Cressbrook | |
| Perseverance | |
| Cooby | |

Report Period

Commencing: Date _____ Time _____

Statistics for Reporting Period:

| | Last Report Storage Level RL | Current Storage Level RL | Inflow M3/s | Discharge M3/s | Meters over Spillway |
|---|---|---|---|---|---|
| Cressbrook | | | | | |
| Perseverance | | | | | |
| Cooby | | | | | |

| Rate of Rise | Metre / Time | eg: 1.5 mt / hr | Spillway Discharge | Time and date event started |
|---|---|---|---|---|
| Cressbrook | | | Cressbrook | |
| Perseverance | | | Perseverance | |
| Cooby | | | Cooby | |

Damage Report for Dam structure and immediate vicinity downstream

| |
|---|
| Cressbrook: |
| Perseverance: |
| Cooby: |

Weather Conditions at Dams

| |
|---|
| Cressbrook: |
| Perseverance: |
| Cooby: |

General Comments: _____

Signature: _____ Designation: _____ / /

DOCS-#3453022-v8-Status_Report_Dam_Emergency_Event

Appendix D6 Emergency Event Report Format

**NATURE OF THE EVENT**
< Describe the Event, eg, Spillway discharge, Earthquake, Chemical spill, etc >

- Commencing Time……..Date……/……../……..
- Finishing Time……...Date……./……/……..

**DESCRIPTION OF THE EVENT**
< Describe in your own words the lead up to and progress of the Event, eg, a Spillway discharge.

Include such information as listed below >

- Weather conditions and rainfall in the Catchment
- The rate of rise of the Storage
- When the Spillway was overtopped
- When the first Gate opened (if applicable)
- Date and time of highest level
- Briefly describe any immediate downstream damage caused by the discharge
- Include any other information considered relevant

**STATISTICS**
- Total inflow. ……Megalitres
- Total discharge……...Megalitres
- Capacity of Storage prior to inflow…….%
- Volume prior to inflow……Megalitres
- Maximum inflow……Megalitres per day
- Maximum discharge……..…Megalitres per day

**EVENT PROGRESS**
< Briefly describe the daily rate of Storage rise, time to peak level, and weather conditions. Attach copies of the Spillway Level Versus Time Graph, the Communications Record Sheet, and the Log of Events / Actions Sheet (Annexures of the EAP) >

**ASSESSMENT OF EFFECTIVENESS OF COMMUNICATIONS DURING DAM HAZARD INCIDENT**

**GENERAL COMMENTS**
Any observations or comments' regarding the Event, such as Equipment malfunctions, improved Reporting, Safety issues, or any suggestions which may improve monitoring of the Event

What extent the approved EAP effectively dealt with the Dam Hazard Incident

Recommendations of any changes to the approved EAP

Details of any other matter that is relevant to the emergency event or how it was dealt with under EAP

**DAMAGE REPORT**
< Detail any tail water damage to the Embankment or Stream bank damage in the immediate area of the Dam.
Attach photos >

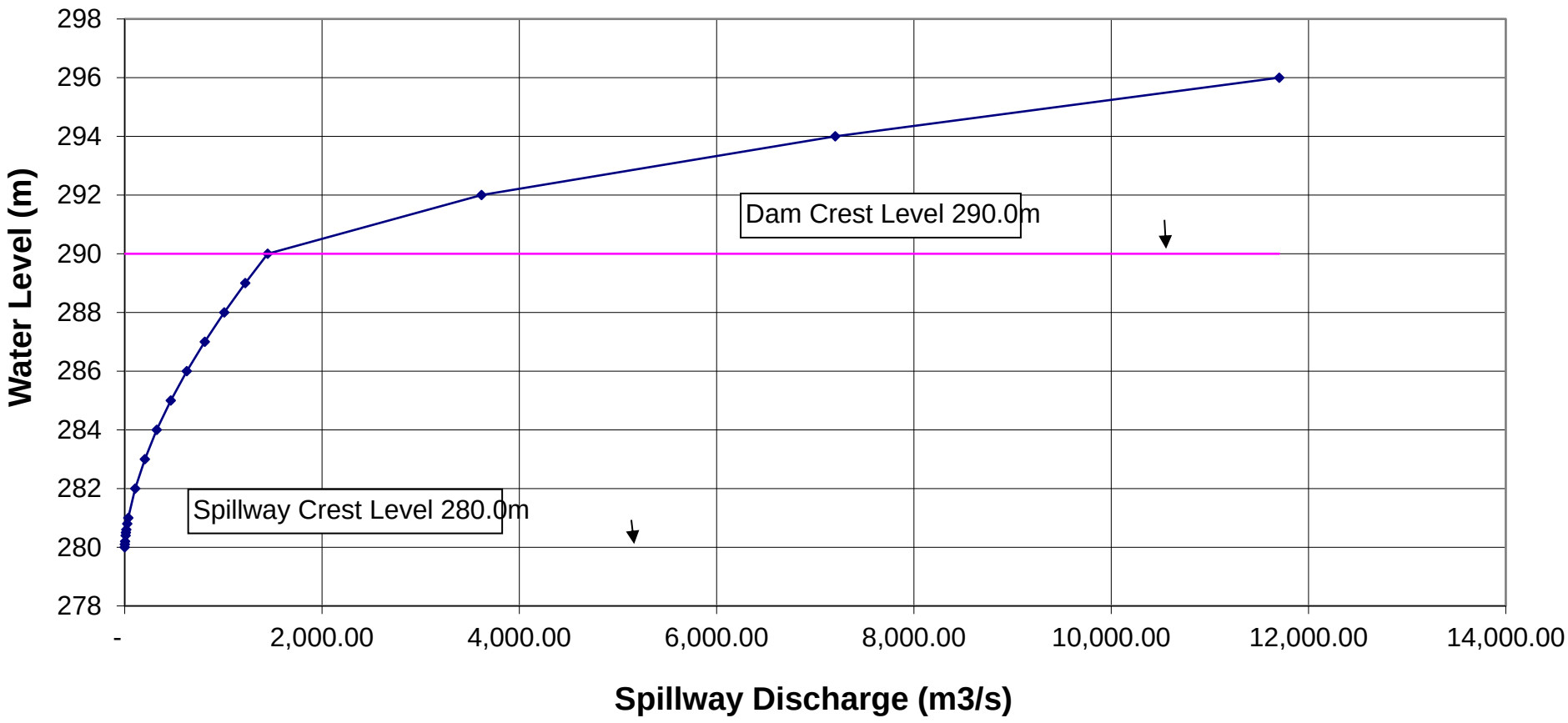
**ATTACHMENTS**
- Photos, video of the Event
- Spillway Level versus Time Graph
- Communications record sheet
- Log of Events / Action sheet
- Record of Gate opening (Gated Dams)

Signed……Designation……..Date……./……../……

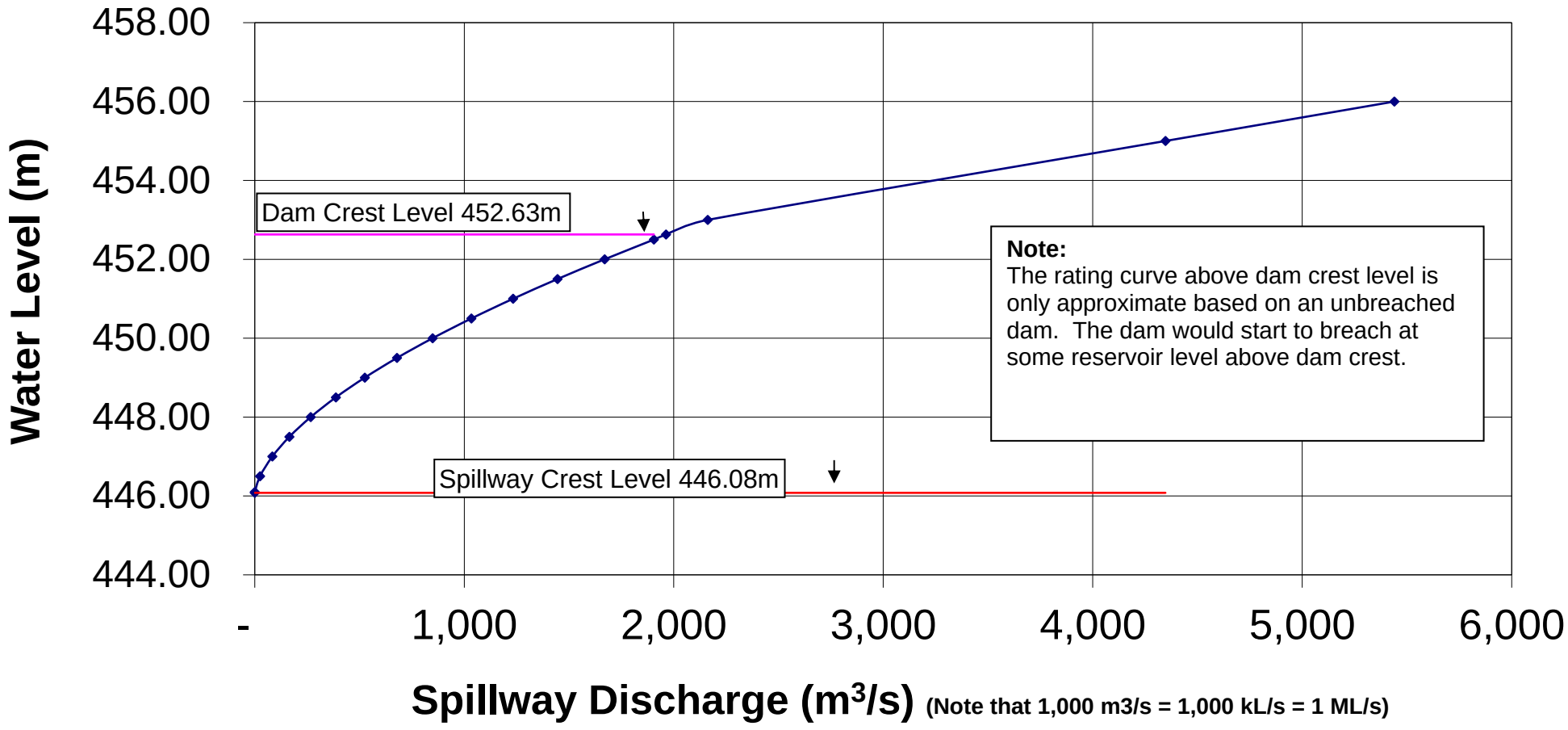
**FOWARDING INFORMATION**
Once report is complete forward to the **Manager of Water Operations**

# Spillway Rating Curve
# Cressbrook Dam

**(Note that 1,000 m3/s = 1,000 kL/s = 1 ML/s)**



# Spillway Rating Curve



Appendix D9 Modified Mercalli Intensity Scale for Earthquake Intensities

Magnitude and Intensity measure different characteristics of earthquakes. Magnitude measures the energy released at the source of the earthquake. Magnitude is determined from measurements on seismographs. Intensity measures the strength of shaking produced by the earthquake at a certain location. Intensity is determined from effects on people, human structures, and the natural environment.

The following table gives intensities that are typically observed at locations near the epicenter of earthquakes of different magnitudes.

| Earthquake Magnitude | Typical Maximum Modified Mercalli Intensity |
|---|---|
| **1.0 - 3.0** | **I** |
| **3.0 - 3.9** | **II - III** |
| **4.0 - 4.9** | **IV - V** |
| **5.0 - 5.9** | **VI - VII** |
| **6.0 - 6.9** | **VII - IX** |
| **7.0** and higher | **VIII** or higher |

| Intensity | Shaking | Description/Damage |
|---|---|---|
| I | Not felt | Not felt except by a very few under especially favorable conditions. |
| II | Weak | Felt only by a few persons at rest, especially on upper floors of buildings. |
| III | Weak | Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| IV | Light | Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. |
| V | Moderate | Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. |
| VI | Strong | Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. |
| VII | Very strong | Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. |
| VIII | Severe | Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. |
| IX | Violent | Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |
| X | Extreme | Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. |

Abridged from *The Severity of an Earthquake*, USGS General Interest Publication 1989-288-913

## Appendix E Cressbrook Dam Emergency Action Plan Tool kit

Appendix E1 Functional responsibilities of dam safety management group

Appendix E2 TRC Organization Chart

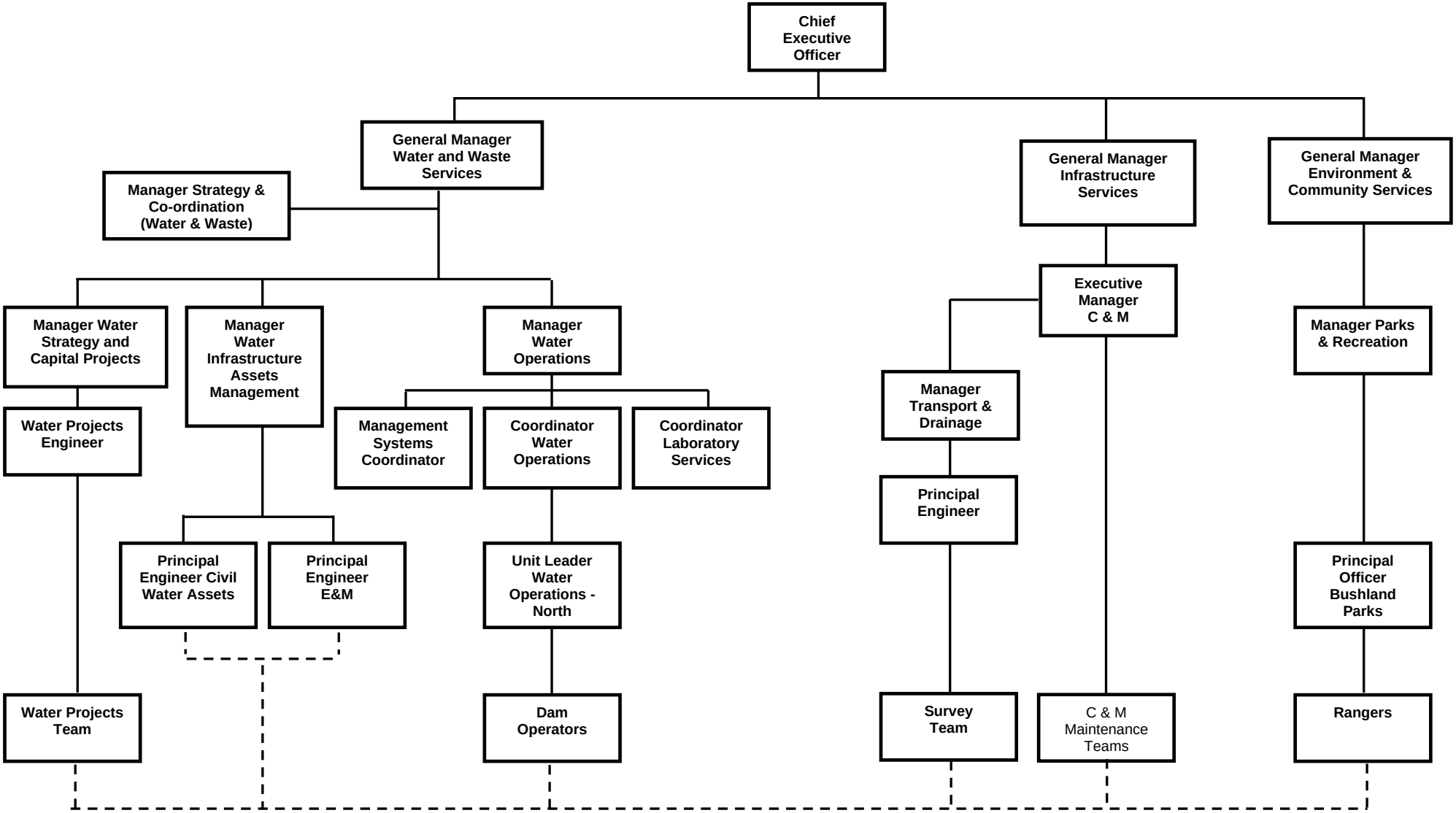
Appendix E3 Event Definitions

Appendix E1: Functional Responsibilities

| | |
|---|---|
| **Chief Executive Officer (CEO)** | The person responsible to the Toowoomba Regional Council for the overall management of the Council organization |
| **General Manager Water & Waste Services (GM W&WSG)** | The person responsible to the CEO for the overall management of the TRC's Water Services including water supply assets and water delivery services |
| **General Manager Environmental and Community Services (GMECS)** | The person responsible to the CEO for the overall management of TRC's Community and environmental services, including parks and other recreational facilities |
| **Principal Engineer Civil Water Infrastructure Services (PECWIS)** | The person responsible to the MWIS for providing TRC's Civil Asset Management Services; developing and maintaining TRC's Asset Management Systems; setting and auditing TRC's Maintenance, Operation, and Service Standards; and the developing and implementing of TRC's Dam Safety Program. |
| **Manager Water Infrastructure Services (MWIS)** | The person responsible to the GM W&WSG for providing TRC's Water Infrastructure Services; developing and maintaining TRC's Water Asset Management Systems; setting and auditing TRC's Water Maintenance, and Service Standards; coordinating TRC's SCADA Services; the letting of maintenance contracts; and responsible for developing and implementing TRC's Dam Safety Programs. |
| **Senior Mechanical Engineer, Water Infrastructure (SMEI)** | The person responsible to the PEME for coordinating activities for TRC's Infrastructure Asset Services; assist in maintaining TRC's Asset Management Systems; setting and auditing TRC's Maintenance, Operation, and Service Standards; coordinating maintenance crews and the letting of maintenance contracts; |
| **General Manager Infrastructure Services Group (GMIS)** | The person responsible to the CEO for the overall management of TRC's Construction and Maintenance Services. |
| **Senior Asset Engineer Water Infrastructure (SAEWI)** | This person is responsible to the MWIS for providing TRC's Asset Management Services, assisting the SCEWI in the maintenance, operation and service standards and developing and implementing TRC's Dam safety program. |
| **Principal Engineer Mechanical / Electrical (PEME)** | The person responsible to the MWIS for coordinating activities for TRC's Infrastructure Asset Services; developing and maintaining TRC's Asset Management Systems; setting and auditing TRC's Maintenance, Operation, and Service Standards; coordinating TRC's SCADA Services; the letting of maintenance contracts; |
| **Executive Manager C&M** | The person responsible to the GMIS for delivery of Civil Infrastructure works. |
| **Construction & Maintenance Team** | The group of civil-engineering trade-persons and trade-assistants responsible to the Executive Manager C&M for carrying out repairs and maintenance to TRC owned facilities and infrastructures, including pump station buildings, pipelines, and dam structures |
| **Manager Water Operations (MWO)** | The person responsible to the GM W&WSG for the overall management of TRC's Water Operations including employee training, and the WO's QA-System |
| **Coordinator Laboratory Services (CLS)** | The person responsible to the MWO for the monitoring and testing of environment and water quality including the water stored and drawn from the Dams. |
| **Coordinator Water Operations - Toowoomba (CWO-T)** | The person responsible to the MWO for the proving the Water Operations Branch with technical support. |
| **Water Supply Systems Controller (WSSC)** | The person(s) responsible to the PEC-WIS for the process control and telemetric monitoring of TRC's water reticulation system including pumping stations and reservoir s |
| **Dam Operator(s)** | The person(s) responsible to PEC-WIS for operating and routine monitoring and servicing of TRC's water supply facilities, including pump stations, treatment plants, and dams as well as – where necessary – implementing the directives from the PEC-WIS and monitoring seepage, rainfall, and dam water levels at the Dams. |

| | |
|---|---|
| **Manager Parks and Recreation (MPR)** | The person responsible to the DCES for the management of TRC's Parks and Recreational Areas and Facilities, including the public area at the Dams and the control of declared plants around the perimeter of the Dam Storage Areas |
| **Principal Officer Bushland Parks** | The person responsible to the MPR for coordinating activities for the control of declared plants and the maintenance of the recreational areas including those at the Dam |
| **Ranger** | The person responsible to the MPR for the control of vegetation and pests and the maintenance of the recreational areas including those at the Dam |
| **Manager of Water Strategy and Capital Projects (MWS&CP)** | The person responsible to the GM W&WSG for coordinating activities and providing engineering support to MWIS |
| **Water Projects Team** | Person responsible for providing Engineering Support to MWP |
| **Manager Transport & Drainage (MT&D)** | Responsible to the GMIS for delivery of Civil work and Services. |
| **Principal Engineer** | The person Responsible to the MT&D for coordinating Civil Infrastructure works. |
| **Supervisor Engineering Surveying (SES)** | Person responsible for coordinating surveying activities of dam walls |
| **Surveying Team** | The Persons responsible for conducting surveying activities at the dam sites. |

Appendix E2 TRC Organisational Chart



- **"DCF"** or

  ***"Dam Crest Flood"*** (Formerly IFF or Impending Failure Flood)
  The flood Event which when routed through the Reservoir just threatens failure of the Dam. The Reservoir is assumed to be initially at Full Storage Level.

- **"PMF" or**

***"Probable Maximum Flood"***
The flood resulting from the Probable Maximum Precipitation, coupled with the worst flood producing catchment conditions that can be realistically expected in the prevailing meteorological conditions.

- **"PMP" or**

***"Probable Maximum Precipitation"***
The theoretical greatest depth of precipitation for a given duration that is physically possible over a particular drainage system.

- **"Sunny Day Failure"**

  Unexpected failure of a dam not associated with flooding or natural disaster