

Appendix N

CONSULTATION REPORT

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Consultation Report

Introduction

PURPOSE

This report documents how key stakeholders were consulted during the Performance Review of the Flood Warning Gauge Network (FWGN). This project was commissioned by the Queensland Department of Natural Resources and Mines (DNRM) and executed by Kellogg, Brown & Root Pty Ltd (KBR) with subcontractor Pentair/Greenspan.

OVERVIEW

As part of the Queensland Government's commitment to improving the flood warning system in Queensland, a performance review of the FWGN was undertaken. The review focused on the monitoring of rainfall and stream level gauges by various local, state, private and Commonwealth entities, and the ongoing maintenance of these gauges for flood warning purposes. The project identified opportunities to rationalise and/or augment the network to reduce flood risk to the people of Queensland and its assets. As part of the review, consultation was undertaken with key stakeholders throughout the state.

Objectives

The review had multiple objectives:

- assemble an inventory of FWGN instrumentation that is:
 - currently used by the Bureau of Meteorology (BoM) and other entities for flood warning purposes
 - may be used to augment the FWGN in the future.
- assess the adequacy of the Flood Warning Network's spatial configuration
- assess the condition of instrumentation (using a sample of gauges)
- assess the reliability of data gathered from the instruments
- consider the data needs of stakeholders
- prepare technical standards and guidelines for instrumentation
- identify priorities for future improvements.

Study area

The review considered rainfall and stream level gauges across Queensland that are currently used by or could in the future be used by the Bureau of Meteorology and other entities for flood warning purposes.

Consultation approach

The project team recognised that stakeholders across Queensland held valuable information for the Review. Collecting this information was important to:

- answer critical questions that could not be addressed through other sources
- cross-check information gathered through desk-top research
- validate spatial modelling that was undertaken.

The consultation that was undertaken acknowledged:

- flood warning and management is integral to supporting and protecting local communities against flooding, particularly for local governments
- much valuable work has already been carried out by stakeholders in this area.

The consultation strategy was developed in liaison with DNRM, consistent with the Inspector-General Emergency Management Stakeholder Engagement Framework 2014-2018 and designed to ensure that the views and interests of stakeholders were consistently and meaningfully considered.

CONSULTATION OBJECTIVES

The objectives of the consultation were to:

- provide stakeholders with balanced and objective information to help them understand the purpose, process and intended outcomes of the Review
- obtain stakeholder input (perceptions, opinions and technical information) to enable a thorough Review of the FWGN throughout Queensland.

CONSULTATION RISKS AND OPPORTUNITIES

The main consultation risks (Table 1) and opportunities (Table 2) associated with the Review are outlined below.

Table 1 Potential consultation risks with proposed mitigation

Potential risk	Proposed mitigation
Questionnaires and requests for information may not reach the individuals that hold the appropriate knowledge to complete a response.	Initial contact was made with organisations to identify appropriate participants.
Local councils may not be in a position to provide adequate responses in a timely manner.	Requests for participation were accompanied by offers of assistance to complete the questionnaire and/or prepare responses.
Low response rates due to review timing and/or timeframes	To encourage participation a sensible time period of three weeks was set for initial responses and this was extended by an additional two weeks where organisations indicated that they could not meet the deadline for various reasons. A reminder email and follow up phone calls were also implemented.
Internet access may vary across key stakeholders' organisations.	Requests for participation were emailed and sent in hard-copy via Australia Post. To remove barriers to participation, respondents were able to provide information verbally, in hard-copy, via an online survey tool and email.

Potential risk	Proposed mitigation
Asset owners will be reluctant to provide responses fearing that funding cuts or reduced access to data may result.	Clear articulation of the Review objectives and reiteration that the overall aim was to help to inform governments and gauge owners to improve flood warning and reduce flood risk for Queensland communities. Existing disaster management networks were used to encourage participation in the review.
Definition of 'flood' and 'settlements susceptible to flooding' may be subjective.	Terms were clearly defined in communication materials.

Table 2 Potential consultation opportunities with proposed enhancement

Potential opportunity	Proposed enhancement
May generate greater awareness of and willingness to coordinate efforts and share assets and data.	The objectives of the Review were clearly articulated and it was reiterated many times that the overall aim of the review was to help to inform governments and gauge owners to improve flood warning and reduce flood risk for Queensland communities.
May contribute to local communities taking greater ownership and responsibility for the Flood Warning Network they rely on.	As part of the consultation process, the roles of DNRM and BoM in relation to the Flood Warning Network were articulated to aid other organisations to better understand their potential role and the contribution they do/could make.

TARGETED STAKEHOLDERS

The consultation targeted stakeholders identified in liaison with the project team (KBR, DNRM and Pentair/Greenspan) (Table 3).

Table 3 Targeted stakeholders identified for the Review

Stakeholders
Commonwealth Government <ul style="list-style-type: none"> • BoM • Department of Science, Information Technology and Innovation (DSITI)
State Government <ul style="list-style-type: none"> • DNRM • Queensland Rail • Department of Transport and Main Roads (DTMR) • Department of Energy and Water Supply (DEWS) • Department of Infrastructure, Local Government and Planning (DILGP) • Department of Premier and Cabinet (DPC)
Local government <ul style="list-style-type: none"> • 77 local councils throughout Queensland • Local Government Association of Queensland (LGAQ)
Disaster management groups and committees <ul style="list-style-type: none"> • Queensland Reconstruction Authority (QRA) • Inspector-General of Emergency Management (IGEM) • Public Safety Business Agency (PSBA) • Queensland Fire and Emergency Services (QFES)

Stakeholders

- Queensland Police Service (QPS)
-

Government-owned corporations

- Energex
 - Ergon Energy
 - PowerLink
 - Gladstone Area Water Board
 - Seqwater
 - Sunwater Limited
-

Private sector businesses

- Aurizon
 - Stanbroke Pty Ltd
 - Origin Energy
 - Glencore Coal Assets Australia
 - BHP Billiton Mitsubishi Alliance
 - QCG
 - Santos
-

Consultation methodology

Consultation occurred from 9 June and 9 September 2015. The timing of consultation activities was aligned to the project schedule to ensure gathered information could be incorporated into the Review.

The main consultation activities undertaken were:

1. meeting with the Key Stakeholder Group (KSG)
2. introducing the Review to other stakeholders and confirming appropriate contacts
3. collecting and collating information from stakeholders through:
 - a. questionnaire (local councils only)
 - b. in-depth interviews and site inspections (selected local councils)
 - c. meetings and requests for information (RFI) via email and formal letters (commonwealth and state government agencies, government-owned corporations and private sector businesses)
4. providing feedback to participants on findings of the review.

Each activity is described in detail in the following sections.

ESTABLISHING AND MEETING WITH KEY STAKEHOLDER GROUP

Chaired by the QRA, the KSG was comprised of senior officers from:

- | | |
|---------------|---------|
| • QRA (Chair) | • DSITI |
| • DNRM | • LGAQ |
| • BoM | • PSBA |
| • DEWS | • QFES |
| • DILGP | • QPS |

- DPC
- IGEM (Observer)

The KSG was established by DNRM prior to the Review starting. The group's role was to guide the Review and to encourage participation from members of their networks as appropriate. The KSG endorsed the consultation strategy before it was implemented.

The KSG was convened as three workshops throughout the Review and was occasionally required to provide out of session input. Table 4 outlines the date and purpose of each workshop.

Table 4 Key Stakeholder Group workshops

Workshop	Date	Purpose
Hold Point 1 Workshop	9 June 2015	Endorse the risk based methodology and consultation plan
Hold Point 2 Workshop	10 August 2015	Review preliminary findings and discuss key issues before draft report is finalised
Hold Point 3 Workshop	9 September 2015	KBR's presentation of draft report for comments from KSG over the following week

INTRODUCING THE REVIEW TO TARGETED STAKEHOLDERS

On 20 May 2015, DNRM distributed letters of introduction to targeted stakeholders that:

- provided a brief overview of the review and its objectives
- indicated that KBR would be consulting with their organisation
- offered assistance with preparing a response
- called for nomination of an appropriate contact for the consultation
- provided the contact details for the project team.

An example of this letter is included in Section 5.

Follow up emails and calls were made to confirm appropriate contacts where organisations were not prompt in nominating a person.

COLLECTING INFORMATION

In total, information was collected from 56 local councils (Figure 3-1) and eight other organisations from across the state via:

- questionnaire
- in-depth interviews
- site inspections
- meetings and requests for information (RFIs).

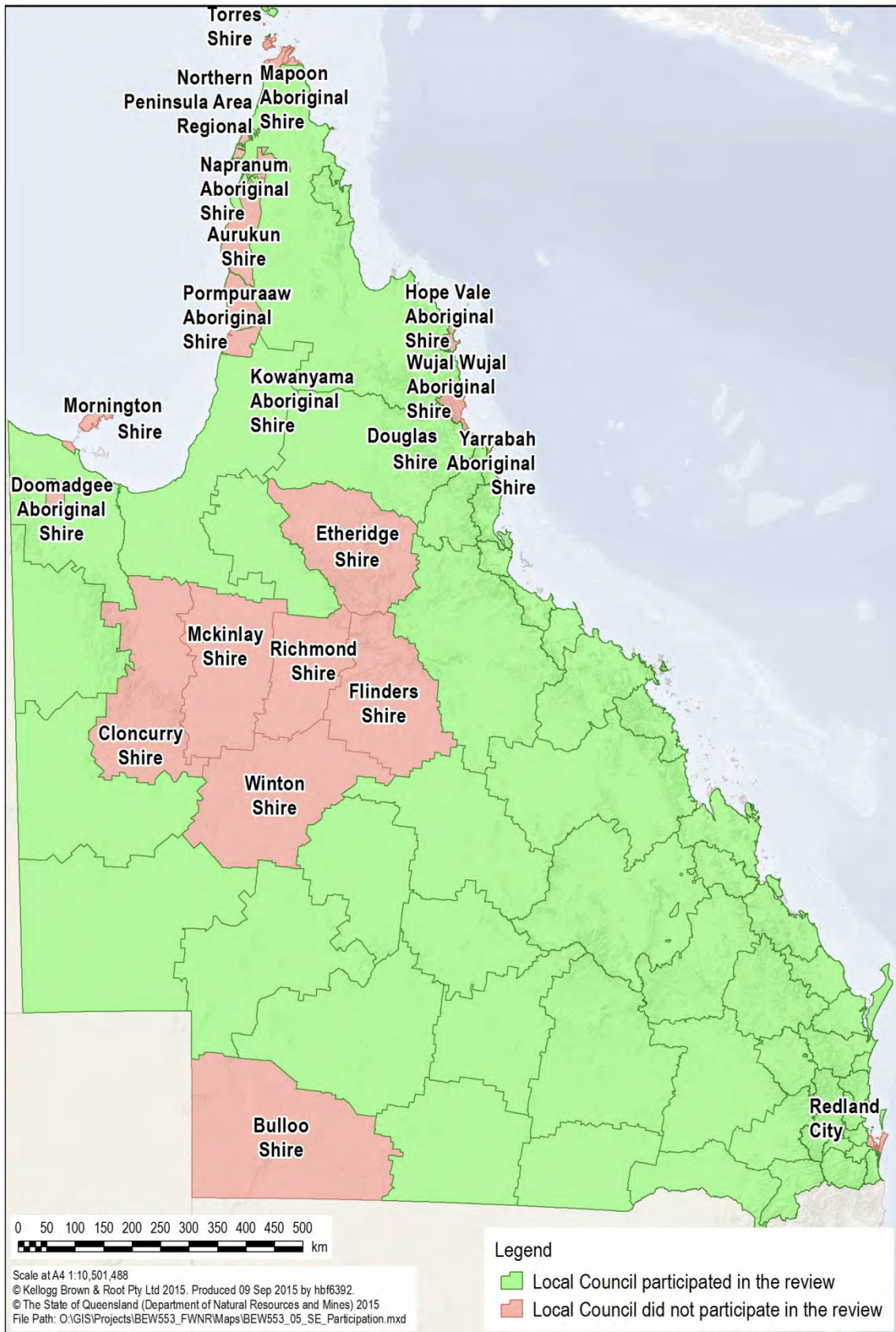


Figure 1
LOCAL COUNCILS THAT RESPONDED TO THE PROJECT TEAM'S INVITATION AND PARTICIPATED IN THE REVIEW.

Questionnaire for local councils

A questionnaire was prepared and distributed to the 77 local councils throughout Queensland. The questionnaire was designed to collect information on five topic areas:

- settlements and critical infrastructure impacted by flooding
- rainfall and stream level gauge locations
- use of data from gauges
- rainfall and stream level gauge reliability
- asset management.

A copy of the questionnaire is included in Section 5.

The questionnaire was distributed via email and in hard-copy in the post. The package of materials that accompanied the questionnaire included:

- Cover letter that requested the participation of the local councils in the Review.
- Project overview factsheet that briefly explained the objectives and methodology for the Review.
- Questionnaire factsheet that explained the questionnaire's purpose, and how to complete and return it within the required timeframe.
- Basin/s Map (showing sub-basin boundaries, local government areas, the location of known rainfall and stream level gauges accepted by BoM, and settlements known to flood).
- Gauge Meta-data Spreadsheet (if there were rainfall and stream level gauges within the local government area in question that are accepted by BoM).
- Template (spreadsheet) for providing additional meta-data on gauges that was not currently listed on the above spreadsheet but may be of interest in the future for flood warning purposes.

Copies of the factsheets are included in Section 5.

Key dates for the implementation of the questionnaire are outlined in Table 5.

Table 5 Key dates for implementation of the questionnaire

Date	Activity
23 June 2015	Questionnaire pack emailed and posted to nominated contacts within each local council
30 June 2015	Reminder email to encourage local councils to participate
2 July 2015	Letter emailed to QRA, QFES, IGEM and LGAQ formally asking for their support and for them to encourage, via their own networks, local council participation
10 July 2015	Initial deadline for questionnaire submissions
20 July 2015	Follow up calls to encourage local councils who had not responded, to complete the questionnaire and to offer assistance if required
31 July 2015	Extended deadline for questionnaire submissions (to account for council staff not being available or able to meet the earlier deadline due to school holidays, end of financial year obligations or other commitments)

The questionnaire could be completed:

- online (via the Wufoo survey platform)
- electronically using the form provided and emailing it with any appropriate attachments to the project team (floodstudies@kbr.com)

- in hard copy and mailing it to the project team (Flood Studies at KBR, Reply Paid 633, Brisbane Qld 4001)

The responses received to each question are summarised in Section 4.1.

In-depth interviews with local councils

In-depth interviews were carried out with 27 selected local councils from across Queensland between 6 July and 24 July 2015. Local councils were selected to ensure a representative cross-section based on:

- type of council (super council, regional hub council, rural council or indigenous council)
- location (inland or coastal)
- recent government investment in gauge installation (<\$50,000, \$50,000 to \$100,000, or no funding)
- number of high risk settlements already known to the project team
- logistical accessibility during the timeframes of the review.

In-depth interviews were used to gain a more detailed understanding of the council's:

- approaches to flood warning
- needs and capacity for establishing and maintaining the FWGN
- suggestions for improvements to the FWGN
- concerns in relation to the FWGN.

As well as further exploring some of the local council's responses to the questionnaire, and their knowledge and preparedness with regard to flooding and flood warning.

A copy of the interview guide (PowerPoint presentation) is included in Section 5.

The interviews were attended by up to four members of the project team including representatives from DNRM, KBR, and Pentair/Greenspan. They were also attended by a representative of the BoM Hydrology team. This cross-organisational mix of people with a multidisciplinary skill and knowledge base positioned the project team well to understand the diversity of political and physical operating environments of the local councils.

Face-to-face in-depth interviews were conducted with 25 local councils:

- Balonne Shire Council
- Banana Shire Council
- Barcaldine Regional Council
- Brisbane City Council
- Burdekin Shire Council
- Cassowary Coast Regional Council
- Central Highlands Regional Council
- Cherbourg Aboriginal Shire Council
- City of Gold Coast
- Goondiwindi Regional Council
- Gympie Regional Council
- Hinchinbrook Shire Council
- Ipswich City Council
- Lockyer Valley Regional Council
- Longreach Regional Council
- Mackay Regional Council
- Mareeba Shire Council
- Murweh Shire Council
- Paroo Shire Council
- Rockhampton Regional Council
- Sunshine Coast Regional Council
- Tablelands Regional Council
- Toowoomba Regional Council
- Whitsunday Regional Council
- Woorabinda Aboriginal Shire Council

In-depth interviews via telephone were held with an additional two councils where logistics prevented the project team from travelling to the location:

- Bundaberg Regional Council

- Mount Isa City Council.

An in-depth interview was also offered to Carpentaria Shire Council but required council personnel were not available during the Review period.

The results of the in-depth interviews are documented in Section 4.2.

Site inspections

Site inspections of 81 selected gauge sites were coordinated with travel for the in-depth interviews with local councils (between 6 July and 24 July 2015). The site selection was:

- based on geographic accessibility within logistical constraints of the project
- with the aim of visiting a range of gauge types
- with the aim of visiting gauges owned and/or operated by a range of stakeholders (BoM, DNRM and councils).

Generally, council representatives attended the site visits and provided additional insights into the rationale for the gauges and how the gauge information was used.

The site inspections were used to:

- validate the scope of the FWGN
- validate stations are fit-for-purpose or can support the flood warning service
- inspect instrument condition
- evaluate site risks (e.g. flooding, bushfire)
- identify risks to the communication network.

A copy of the site inspection check-list is included in Section 5.

Notes taken during the site inspections were incorporated directly into the project report.

Meetings and requests for information

Table 6 outlines the organisations to which RFIs were made and where appropriate face-to-face or teleconference meetings were held. It also identifies the organisations that responded with information.

Table 6 Organisations contacted for information

Organisation	FRI letter emailed	Meeting held	Response received
Aurizon	✓		
BoM		✓	✓
BHP Billiton Mitsubishi Alliance	✓		✓
DNRM	✓	✓	✓
DTMR	✓		
Ergon Energy	✓		
Gladstone Area Water Board	✓		✓
Glencore Coal Assets Australia	✓		
Origin	✓		
PowerLink	✓		

Organisation	FRI letter emailed	Meeting held	Response received
QGC	✓		
QRA	✓		
Queensland Rail	✓	✓	
Santos	✓		
Seqwater	✓	✓	✓
Stanbroke Pty Ltd	✓		✓
Sunwater Limited	✓	✓	✓

Key dates for the meetings and requests for information are outlined in Table 7.

Table 7 Key dates for the requests for information

Date	Activity
18 June - 7 August 2015	Meetings held
2 July 2015	Formal letter requesting information distributed via email
17 July 2015	Deadline for information submissions
20 July 2015	Follow up calls to encourage organisations who hadn't responded to provide information
31 July 2015	Extended deadline for information submissions

The questions posed in the RFIs and at the meetings were tailored for each organisation to reflect their current and/or potential future role in relation to the FWGN.

The information requested typically included:

- copies of organisational policies, procedures and technical standards relating to the installation, operation and maintenance of rainfall and stream level gauges that are currently used for, or may be used in the future for, flood warning
- review of any data provided by BoM on gauges currently maintained by the organisation
- any gauges that the organisation operate and maintain that are not currently accepted by BoM but may be considered to possibly augment the existing Flood Warning Network in the future
- gauges operated and/or maintained by their organisation that are considered particularly important to the Flood Warning Network used by BoM
- from field observations, any recent changes to the floodplain (e.g. levees, bridges, road works, developments, etc.) that might have impacted a gauging station site used by BoM for the Flood Warning Network
- the datum (if any) that gauges are survey to (e.g. Australian Height Datum)
- suggestions for any changes to rainfall or stream water level gauges that would improve flood warning time (e.g. addition or relocation of gauges)
- documents that helped to describe the changes outlined (see above)
- suggestions for any new directions for technological advancement in gauge instrumentation including communication systems
- copies of existing rainfall and stream level asset register

- fields within their existing asset register believed to be essential
- additional fields believed to be useful
- Which fields within existing asset registers are superfluous
- copies of documented operation and maintenance plans, with specific questions relating to:
 - what maintenance regimes are in place for the rainfall and stream water level gauges that DNRM operate and maintain? For example: reactive maintenance following flood or reported damage; proactive maintenance - once per year, twice per year, three times per year or another regime?
 - Do DNRM personnel carry out maintenance on the rainfall and stream water level gauges that DNRM operate and maintain, or are contractors used?
 - At what frequency are gauges calibrated?
- reliability issues with gauges

Notes taken during the meetings and other data collected from the RFIs are in Section 4.3.

Consultation results

QUESTIONNAIRE RESPONSES

The questionnaire achieved a 68% response rate, with 53 of the 77 local councils throughout Queensland providing a response. Of the 53, 28 councils emailed their response to the project team using the electronic form or a scanned hardcopy and 25 councils used the online survey. The local councils that responded included:

- Balonne Shire Council
- Barcardine Regional Council
- Barcoo Shire Council
- Blackall-Tambo Regional Council
- Boulia Shire Council
- Brisbane City Council
- Bundaberg Regional Council
- Burdekin Shire Council
- Burke Shire Council
- Cairns Regional Council
- Carpentaria Shire Council
- Cassowary Coast Regional Council
- Central Highlands Regional Council
- City of Gold Coast
- Charters Towers Regional Council
- Fraser Coast Regional Council
- Gladstone Regional Council
- Goondiwindi Regional Council
- Gympie Regional Council
- Hinchinbrook Shire Council
- Ipswich City Council
- Isaac Regional Council
- Livingstone Shire Council
- Lockhart River Aboriginal Shire Council
- Lockyer Valley Regional Council
- Logan City Council
- Longreach Regional Council
- Noosa Council
- Mackay Regional Council
- Maranoa Regional Council
- Murweh Shire Council
- North Burnett Regional Council
- Quilpie Shire Council
- Rockhampton Regional Council
- Scenic Rim Regional Council
- Somerset Regional Council
- South Burnett Regional Council
- Southern Downs Regional Council
- Sunshine Coast Regional Council
- Tablelands Regional Council
- Toowoomba Regional Council
- Torres Strait Island Regional Council
- Townsville City Council
- Western Downs Regional Council
- Whitsunday Regional Council

- Cook Shire Council
- Croydon Shire Council
- Diamantina Shire Council
- Mareeba Shire Council
- Moreton Bay Regional Council
- Mount Isa City Council
- Weipa Town Authority
- Woorabinda Aboriginal Shire Council

The individuals that completed the questionnaire on behalf of each local council were diverse in their roles and responsibilities. The titles of the individuals that provided responses to the questionnaire were:

- Acting Director of Engineering Services
- Arts and Cultural Officer
- Assistant Engineer
- Chief Executive Officer (two individuals)
- Consulting Engineer
- Coordinator Asset Planning
- Coordinator Disaster and Emergency Management
- Coordinator Disaster Management (two individuals)
- Coordinator Disaster Planning
- Coordinator Local Disaster (three individuals)
- Coordinator Emergency Management
- Coordinator Natural Hazards
- Coordinator Flooding and Stormwater Management
- Deputy Chief Executive Officer
- Design Office Manager
- Director Corporate Services/Local Disaster Coordinator
- Director Infrastructure Services
- Director of Engineering Services
- Disaster Management Officer (two individuals)
- Disaster Management Senior Officer
- Engineer Floodplain Management (two individuals)
- Engineer Infrastructure
- Engineer Roads
- Engineer Stormwater
- Environmental Engineer/Flood Modeller
- Executive Assistant to Chief Executive Officer and Executive Officer
- Flood Mitigation Project Manager
- Floodplain Project Officer/Hydrologist
- General Manager Engineering and Environmental Services
- Governance Officer/Disaster Management Officer
- Manager Asset Emergency
- Manager Design & Technical Services
- Manager Disaster Management
- Manager Engineering Services
- Manager Procurement and Community Security
- Manager Technical Services
- Project Officer
- Safety Advisor
- Senior Advisor Disaster Management
- Senior Engineer (two individuals)
- Senior Engineer Waterways and Drainage Planning
- Specialist Emergency Management
- Strategic Mapping/ Disaster Management Officer
- Technical Officer (three individuals)
- Technical Officer - Emergency Management
- Workshop and Fleet Manager

The following section summarises local councils' response to each question. Any interpretation of this information has been incorporated into the main body of the Performance Review Report.

1. Referring to the Basin Map provided, are there any additional settlements or critical infrastructure known to flood due to riverine flooding that are not shown on the map?

Response	Number of respondents	Percentage of respondents
No	23	44%
Yes	29	56%
TOTAL	52	

Respondents identified the following additional settlements or critical infrastructure known to flood due to riverine flooding that are not shown on the map.

Local government area	Additional settlements or critical infrastructure
Barcoo Shire Council	Jundah Township (specific infrastructure affected is the water treatment plant and associated infrastructure and caravan park)
Brisbane City Council	Large areas of Brisbane are subject to riverine flooding. For more detail please see Brisbane City Council's Flood Awareness Maps, "River" tab under the "Flood Sources" drop down menu. (http://www.brisbane.qld.gov.au/community/community-safety/disasters-emergencies/types-disasters/flooding/understand-your-flood-risk)
Bundaberg Regional Council	<p>North Bundaberg</p> <p>South Bundaberg</p> <p>East Bundaberg</p> <p>Givelda</p> <p>Morganville</p> <p>Tirroan</p> <p>Winfield</p> <p>Bucca</p> <p>Drinan</p> <p>Invicta</p> <p>Woodgate</p> <p>Branyan</p> <p>Sharon</p> <p>Millbank Water Treatment Plant (plus numerous sewer pumps)</p> <p>East Bundaberg Depot (Council's primary depot)</p> <p>Qld Fire and Emergency Services HQ in Bundaberg CBD</p> <p>Qld Ambulance Service primary station</p> <p>Childers Water Treatment Plant</p> <p>Gin Gin Water Treatment Plant</p> <p>Bundaberg Base Hospital</p>
Burdekin Shire Council	Ayr township
Cairns Regional Council	<p>Machans Beach</p> <p>Holloways Beach</p> <p>Yorkeys Knob</p> <p>Barron</p> <p>Stratford</p> <p>Kamerunga</p> <p>Freshwater</p> <p>Lake Placid</p> <p>Caravonica</p>
Carpentaria Shire Council	Normanton
Cassowary Coast Regional Council	<p>Midgenoo</p> <p>Japson</p>

Local government area	Additional settlements or critical infrastructure
Central Highlands Regional Council	<p>Emerald Irrigation Area on lower Nogoa Floodplain, i.e. lower Nogoa downstream of Emerald to its junction with Comet, and lower Retreat Creek to its junction with Theresa Creek.</p> <p>A couple of major coal mines on the floodplain — Ensham near confluence of Comet and Nogoa, and Curragh downstream of Bedford Weir on the Mackenzie River.</p> <p>Emerald should also include a number of residences that lie between the Fairbairn Dam spillway and the Emerald Township.</p>
City of Gold Coast	<p>Almost all "settlements" and "critical infrastructure" within City of Gold Coast can be affected by flood so the list below of affected flood areas is indicative only. These areas have higher likelihood to be affected by regional flooding:</p> <p>All major creeks and rivers</p> <p>Budds Beach Reserve (Surfers Paradise)</p> <p>Coombabah Lake</p> <p>Woongoolba</p> <p>Jacobs Well</p> <p>Steiglitz</p> <p>Merrimac</p> <p>Carrara</p> <p>Mudgeeraba Show Ground (Worongary)</p> <p>Firth Park (Mudgeeraba)</p> <p>Coplick Sports Park (Tallebudgera)</p> <p>Boundary Street (Currumbin Waters)</p> <p>Tugun</p> <p>Coolangatta</p>
Fraser Coast Regional Council	<p>Pacific Haven - settlement situated between Burrum and Cherwell</p> <p>Rivers eastwards of Howard</p> <p>Maaroom - coastal settlement southwards of Maryborough and approx. 10 km north of Boonooroo</p> <p>Little Tinana - rural settlement on Teddington Road off Cooloola Coast Road</p> <p>Mungar - rural settlement situated on Mungar Road northwest of Tiaro</p>
Goondiwindi Regional Council	<p>Inglewood</p> <p>Goondiwindi</p>
Hinchinbrook Shire Council	<p>Macknade (between Bemerside and Halifax)</p> <p>Note: Mount Gardiner is shown on the map in the incorrect location. Mount Gardener is just north of Bemerside at the base of the Cardwell Range.</p>
Ipswich City Council	<p>Amberley Air Base</p> <p>Multiple bridges on Bremer/Brisbane River</p> <p>North Booval</p> <p>Barellan Point</p> <p>Bundamba</p> <p>Tivoli</p> <p>North Ipswich</p> <p>Leichardt One Mile</p>
Lockyer Valley Regional Council	<p>Lockyer Waters</p> <p>Glenore Grove</p>
Logan City Council	<p>Logan Reserve</p>

Local government area	Additional settlements or critical infrastructure
Longreach Regional Council	Isisford Note: Ilfracombe and Yaraka are not subject to riverine or flash flooding.
Mackay Regional Council	Cremorne Mackay Central Business District East Mackay West Mackay South Mackay North Mackay Glenella
Mareeba Shire Council	Mt Mulgrave Road - Mitchell Road Crossing Strathaleven Road - Mitchell Road Crossing (Gamboola) Drumduff Link Road - Mitchell Road Crossing (Hughes Crossing) Burke Developmental Road - Lynd River, Walsh River (Trimbles), Walsh River (Ferguson's) Leadinghand Creek Road - Walsh River Wolfram Road - Walsh River
Moreton Bay Regional Council	Beachmere Lawnton Petrie Donnybrook Whiteside Flood prone buildings within the Moreton Bay Regional Council area are distributed over the various creek and river catchments. Within a single suburb there are typically flood prone properties impacted by different creeks and rivers and the flood impacts for these separate clusters of properties are related to different gauges. For example, within "Caboolture" Male Road properties are impacted by King Johns Creek, Appaloosa Close properties are impacted by Lagoon Creek, Mary Street properties are impacted by Caboolture River. A single water level gauge does not provide information relevant to all the properties within the one suburb and it is difficult to represent these various locations by a single point on the map. In addition there are many flood prone properties scattered throughout the region with only one or two within a suburb.
Murweh Shire Council	Augathella Charleville
Quilpie Shire Council	Adavale Eromanga.
Rockhampton Regional Council	Kabra
Scenic Rim Regional Council	Water and sewerage treatment plants
Southern Downs Regional Council	Note: Pratten is not known to flood due to riverine flooding
Sunshine Coast Council	Marcoola Bli-Bli Currimundi Yandina-Coolum Road Yandina-Bli Bli Road Nambour-Bli Bli Road David Low Way Crosby Hill Road

Local government area	Additional settlements or critical infrastructure
Toowoomba Regional Council	Yarraman Nobby Hodgson Vale Meringandan Quinalow Glenvale Clifton
Townsville City Council	Areas of the urban footprint are subject to riverine flooding
Weipa Town Authority	PDR crossings at Moreton Telegraph Station (Wenlock River) and Archer River which are significantly affected by seasonally riverine/flash flooding. These impact on Weipa, as it is the only road access north and south.
Woorabinda Aboriginal Shire Council	Pearl Creek Double Gully Anna Branch

2. Referring to the Basin Map provided, are there any additional settlements or critical infrastructure known to flood due to flash flooding that are not shown on the map?

Response	Number of respondents	Percentage of respondents
No	29	56%
Yes	23	44%
TOTAL	52	

Respondents identified the following additional settlements or critical infrastructure known to flood due to flash flooding that are not shown on the map.

Local government area	Additional settlements or critical infrastructure
Boulia Shire Council	Boulia to Mt Isa Road is subject to flash flooding at Upper Limestone Creek Sulieaman Creek Number of creek crossings between Mt Isa and Dajarra
Brisbane City Council	Brisbane is subject to flash flooding from its 38 major creek catchments as well as its many large overland flow paths. For more detail please see BCC Flood Awareness Maps, "Creek" and "Overland Flow" tabs under the "Flood Sources" drop down menu. (http://www.brisbane.qld.gov.au/community/community-safety/disasters-emergencies/types-disasters/flooding/understand-your-flood-risk)

Local government area	Additional settlements or critical infrastructure
Bundaberg Regional Council	<p>The rain event associated with Tropical Cyclone Oswald in January 2013 resulted in rapid escalation of riverine flooding (in particular, 500 mm rain overnight across the lower Burnett River catchment on the 28 January), with effects akin to flash flooding but in conjunction with riverine flooding, at these locations:</p> <ul style="list-style-type: none"> • North Bundaberg • South Bundaberg • East Bundaberg • Givelda • Morganville • Tirroan • Winfield • Bucca • Drinan • Invicta • Woodgate
Cairns Regional Council	<p>Suburbs recently impacted by flash flooding (2009 to present):</p> <ul style="list-style-type: none"> • Aeroglen • Manunda • Manoora • Mooroolooloolo • Babinda • Brinsmead • Brampston Beach • Caravonica • Cairns North • Cairns City • Portsmouth • Bungalow • Parramatta Park • Edmonton • Lake Placid • Mount Sheridan • Machans Beach • Holloways Beach • Yorkeys Knob • Palm Cove • Clifton Beach • Trinity Beach • Redlynch • Smithfield • Earlville • Stratford • Freshwater

Local government area	Additional settlements or critical infrastructure
	<ul style="list-style-type: none"> • Westcourt • Whitfield • Woree
Cassowary Coast Regional Council	Refer to Master Drainage Studies for Cassowary Coast Regional Council if required
Central Highlands Regional Council	Rubyvale township Carnarvon Gorge National Park and its associated camp and picnic grounds
City of Gold Coast	Almost all "settlements" and "critical infrastructure" within City of Gold Coast can be affected. Therefore, the list of affected flood areas is indicative and it does not represent all possible affected areas. The following areas have a higher likelihood to be affected by flash flooding: <ul style="list-style-type: none"> • Major overland flow path areas • All stormwater and drainage reserves
Goondiwindi Regional Council	Inglewood is believed to have 6-8 hour notice of flood events from dam walls. Issues. It would have 20-36 hour notice of a rain event likely to cause flooding
Ipswich City Council	Many areas are affected by flash flooding, the main ones are: <ul style="list-style-type: none"> • Grandchester • Calvert • Bellbird Park • Booval • Bundamba
Livingstone Shire Council	Yeppoon Central Business District
Logan City Council	Marsden Slacks Creek Logan Reserve
Mackay Regional Council	Mackay Central Business District East Mackay West Mackay South Mackay Glenella
Mareeba Shire Council	Bilwon Road and surrounding farms - Barron River Herberton Street, Mareeba - Barron River Mulligan Highway, Mareeba - Granite Creek Leedingham Creek Road - Bridge Leedingham Creek Pinnacle Creek Causeway Three Mile Creek Causeway Ootarn Road - Sandy Tare Road Mossman - Mt Molloy Road - Busay Creek Mulligan Highway - Mitchell River

Local government area	Additional settlements or critical infrastructure
Moreton Bay Regional Council	Deception Bay Mango Hill Everton Hills Bruce Highway North Coast Railway Dayboro Moodlu Burpengary East Upper Caboolture Bray Park Kallangur Morayfield Petrie
Noosa Council	Tewantin - Daintree Estate (Currently a major flood mitigation project is underway that will greatly reduce flooding of properties for events that are greater than a 1:100 event). Pomona - Rifle Street (a project to address this is underway but delayed due to land acquisitions issues). Noosaville - Lake Entrance Boulevard Lake Macdonald - There are a number of areas surrounding Lake Macdonald dam that are affected by flash flooding from this local catchment and Dam overflow areas.
Rockhampton Regional Council	Marmor Kabra
Scenic Rim Regional Council	Water and sewerage treatment plants (refer to Queensland Urban Utilities)
Somerset Regional Council	Gallinani Creek crossing across the Brisbane Valley Highway is often cut with little or no warning. This major highway being closed has isolated the township of Toogoolawah requiring establishment of evacuation centres
Southern Downs Regional Council	Note: Karara, Maryvale and Thulimbah are only known to flash flood not riverine flood as the mapping suggests.
Sunshine Coast Council	Mooloolah Alexandra Headland Warana Wurtulla Lansborough Golden Beach Tanawha Bruce Hwy at Coonowrin Crossings, Mooloolah River Interchange, Eudlo Creek Nicklin Way, Sunshine Motorway (East of Kawana Way interchange) Eumundi - Noosa Road Eumundi - Kenilworth Road Nambour Connection Road Steve Irwin Way Kilcoy - Beerwah Road Maleny - Kenilworth Road at Elaman Ck and along Mary River

Local government area	Additional settlements or critical infrastructure
Toowoomba Regional Council	Kulpi Highfields Pittsworth Southbrook Goombungee Crows Nest
Townsville City Council	Areas of the urban footprint are subject to flash flooding
Weipa Town Authority	PDR crossings at Moreton Telegraph Station (Wenlock River) and Archer River which are significantly affected by seasonally riverine/flash flooding. These impact on Weipa, as it is the only road access north and south.
Whitsunday Regional Council	Jubilee Pocket

3. Are there any settlements or critical infrastructure that are isolated or significantly inconvenienced by flooding?

Response	Number of respondents	Percentage of respondents
No	7	13%
Yes	45	87%
TOTAL	52	

Respondents identified the following additional settlements or critical infrastructure that are isolated or significantly inconvenienced by flooding.

Local government area	Additional settlements or critical infrastructure
Balonne Shire Council	St George Dirranbandi Bollon Thallon Hebel Mungindi Nindigully
Barcaldine Regional Council	Muttaburra Aramac Barcaldine Jericho Alpha
Barcoo Shire Council	Windorah Township Jundah Township Jundah Water Treatment Plant Jundah Health Clinic
Blackall-Tambo Regional Council	Tambo Blackall Barcoo River Bridge (between towns can get inundated and road cut) Areas of the Landsborough Highway either side of Blackall and Tambo where the roads are closed due to water.

Local government area	Additional settlements or critical infrastructure
Boulia Shire Council	Urandangie
Brisbane City Council	Moggill/Bellbowrie Mt Crosby/Karana Downs Pinkenba Moreton Island
Bundaberg Regional Council	Bundaberg (discrete locations within Bundaberg as well as more generally when the Bruce highway cuts). North Bundaberg (although this has been ameliorated up to a 2013 flood event following the raising of Gin Gin Road to act as an evacuation route). Gin Gin (on Bruce Highway) Childers (on Bruce Highway) Givelda Morganville Tirroan Winfield Bucca Drinan Invicta Woodgate Buxton Bargara South Innes Park North Tallon Bridge Burnett River traffic bridge at Bundaberg Millbank Water Treatment Plant (plus numerous sewer pumps) East Bundaberg Depot (Council's primary depot) Queensland Fire and Emergency Services Head Quarters in Bundaberg Central Business District Queensland Ambulance Service primary station Childers Water Treatment Plant Gin Gin Water Treatment Plant Bundaberg Base Hospital
Burdekin Shire Council	Ayr Home Hill Brandon Giru can become isolated with roads cut in all directions.
Burke Shire Council	Burketown Burketown Airport Burketown Water

Local government area	Additional settlements or critical infrastructure
Cairns Regional Council	<p>Flooding of Peets Bridge isolates Goldsborough Valley community.</p> <p>Flooding of Clydes Road bridge isolates East Trinity community.</p> <p>Flooding of Barron River Bridge and Western Arterial Road will effectively separate the city from its northern beach-side suburbs.</p> <p>Wastewater treatment plants located at Babinda, Gordonvale, Edmonton, Southern (Portsmith), Marlin Coast (Smithfield) and Northern (adjacent to Cairns Airport) for the Cairns area. There are in excess of 100 wastewater pumping stations throughout the Cairns area, most in the low-lying areas. Cairns Regional Council operates a remote monitoring and operational system (SCADA) that enables instantaneous feedback on all water and sewerage infrastructure. Backup power supplies are located at each WWTP and at major pump station facilities.</p>
Carpentaria Shire Council	Normanton
Cassowary Coast Regional Council	<p>Innisfail</p> <p>Tully</p> <p>Majority of other settlements (Refer to Cassowary Coast Regional Council Flood Study)</p>
Central Highlands Regional Council	<p>A group of properties on Apis Creek Road between Mackenzie River and Marlborough get isolated by Mackenzie River.</p> <p>At the Gemfields area: Graves Hill and Reward (Jurassic Park area).</p>
Charters Towers Regional Council	When the Basalt and the Clarke rivers flood access is cut to Greenvale therefore cutting off access to water and sewerage infrastructure.
City of Gold Coast	<p>Floods are random events and almost all "settlements" and "critical infrastructure" within City of Gold Coast can be affected. Therefore, the list below of affected flood areas is indicative and it does not represent all possible affected areas. The following areas have higher likelihood to be isolated by flood waters:</p> <p>Woongoolba</p> <p>Wongawallan</p> <p>Guanaba</p> <p>Clagiraba</p> <p>Beechmont</p> <p>Carrara</p> <p>Merrimac</p> <p>Worongary</p> <p>Mudgeeraba</p> <p>Bonogin</p> <p>Tallebudgera Valley</p> <p>Currumbin Valley</p>
Cook Shire Council	<p>Pompuraaw</p> <p>Palmer River Mining Area</p> <p>Maytown</p>
Croydon Shire Council	<p>Richmond Road</p> <p>Claraville Road</p> <p>Prospect Momba Road</p> <p>Guilford Road</p> <p>Coralie Road</p>

Local government area	Additional settlements or critical infrastructure
Fraser Coast Regional Council	Pacific Haven Maaroom Boonooroo Little Tinana Mungar Tinnanbah Glenwood Gundiah Bauple Tiaro Maryborough Ararama Broweena Aldershot Torbanlea Howard Burrum Heads Toogoom Hervey Bay Lenthalls Dam
Gladstone Regional Council	Agnes Water Seventeen Seventy Baffle Creek Deepwater Rules Beach Mount Maria Berajondo Lowmead Rosedale Pikes Crossing Many Peaks Ubobo Nagoorin Boyne Island Tannum Sands Benaraby Wurdong Heights Essendean Bridge (TMR asset on Bundaberg-Miriam Vale Road) Hills Road Bridge (one lane bridge access to Baffle Creek settlement areas) Road networks in the various catchments

Local government area	Additional settlements or critical infrastructure
Goondiwindi Regional Council	Nungunya Toobeah Talwood Goondiwindi Yelarbon Inglewood
Gympie Regional Council	Imbil Widgee Kilkivan Kandanga Southside
Hinchinbrook Shire Council	Lucinda Forrest Beach
Ipswich City Council	Karalee One Mile/Leichhardt
Livingstone Shire Council	Stanage Byfield
Lockhart River Aboriginal Shire Council	Lockhart River and Portland Road are isolated by flooding for approximately four months of the year for light 4WD vehicles. Heavy over land freight is normally confined to six months per year only. During large monsoonal events, Portland Road is isolated from the Lockhart River Airport.
Lockyer Valley Regional Council	All areas of Lockyer valley will be isolated in a large flood.
Logan City Council	Logan Reserve
Mackay Regional Council	Habana (Reliance Creek) Seaforth (Constant Creek) Cape Hillsborough Holiday Bay and Ball Bay (Seaforth Creek) Sarina Beach Campwin Beach Grasstree Hay Point (Bells Creek) Alligator Creek (Bruce Hwy south of Mackay) Antonio's Crossing (North Eton Road) Currans Crossing (Mirani-Eton Road) Golfinks Road (Beaconsfield) Keeleys Road (Slade Point) Vines Creek (North Mackay) Sandy Creek (Homebush) Sandy Creek (Eton) Sandy Creek (North Eton) Blackrock Creek (Calen - Yalbaroo Road) Finch Hatton Gouge Middle Creek (West Plane Creek Road) Prospect Creek (Sarina Marlborough Road) Mackay Airport (Shellgrit Creek)

Local government area	Additional settlements or critical infrastructure
	Northpoint Retail Complex - Heaths Road Glenella (Gooseponds Creek) Fourways Shopping Complex - cnr Nebo/Bridge Rd West Mackay
Maranoa Regional Council	Hodgson just north-west of Roma
Mareeba Shire Council	Settlements north side of Walsh River - Dimbulah All cattle stations north of Chillagoe who access the Burke Developmental Road Mary Farms District on Mulligan Hwy (Mt Carbine Area) Bilwon/Biboohra District Granite Creek sputs Mareeba town
Moreton Bay Regional Council	Bribie Island D'Aguilair Highway Morayfield Road Bribie Island Road Beachmere Road
Murweh Shire Council	Charleville Aughathella Morven
Noosa Council	Pomona Township is regularly cut in two by the low lying roads from the subway for the railway.
North Burnett Regional Council	Monto Eidsvold Mundubbera Gayndah Biggenden
Quilpie Shire Council	Adavale Quilpie Toompine Eromanga Cheepie
Rockhampton Regional Council	Alton Downs Ridgeland Mt Morgan Stanwell Bajool
Somerset Regional Council	Brisbane River (Burtons Bridge/Banks Creek areas) Linville/Mt Stanley areas Jimna Villeneuve Kilcoy township
Southern Downs Regional Council	Note: Pratten does not flood as the mapping suggests but is inconvenienced by isolation.

Local government area	Additional settlements or critical infrastructure
Sunshine Coast Council	Kenilworth Conondale Cambrook Gheerulla Kidaman Creek Belli Park Nambour Marcoola Mudjimba Pacific Paradise Bli Bli Diddilbah Currimundi Eudlo Kawana Forest Rainforest Sanctuary (Tanawha)
Tablelands Regional Council	Malanda <ul style="list-style-type: none"> • OzCare residential home just outside of 1:100 year event • Princes Crossing Bridge on Malanda-Atherton Road • Duncan Brown Bridge on Mary Street • Sewer pump stations - three secondary and one major Ravenshoe <ul style="list-style-type: none"> • Sewer pump station on Wormboo Street • Sewer treatment plant on Cemetery Road • Millstream water pump stations x2 • Tumoulin Road • Grigg Street • Kennedy Highway • Tully Falls Road (access to Koombuloomba Dam) Mt Garnet and Innot Hot Springs <ul style="list-style-type: none"> • isolated due to flooding of Kennedy Highway • Crooks and Wyndham Dams inaccessible during flooding • BP Service Station in Mt Garnet would be partially inundated Herberton <ul style="list-style-type: none"> • Herberton-Moomin Road (access to Wild River Dam) • Community would be isolated. • Atherton-Herberton Road • Longlands Gap-Herberton Road Wondecla <ul style="list-style-type: none"> • Community would be inconvenienced due to flooding but not isolated • Longlands Gap-Herberton Rd inundated Atherton <ul style="list-style-type: none"> • Water pump station by the Barron River on Picnic Crossing Road North – road also

Local government area	Additional settlements or critical infrastructure
	floods <ul style="list-style-type: none"> Sewer pump station - Danzer Drive, Mazlin Creek
Toowoomba Regional Council	Cecil Plain Jondaryan Oakey Quinalow Maclagan Cooyar Yarraman Pampas Yandilla Tummalville Clifton Millmerran Crows Nest
Townsville City Council	Much of the road network about Townsville is subject to closure from riverine or flash flooding.
Weipa Town Authority	Although the locations do not appear on the map, it is important to consider the PDR crossings at Moreton Telegraph Station (Wenlock River) and Archer River which are significantly affected by seasonally riverine/flash flooding. These impact on Weipa, as it is the only road access north and south.
Whitsunday Regional Council	Proserpine Airlie Beach and all surrounds become isolated Strathdickie Conway Beach & Wilson Beach Dingo Beach & Hydeaway Bay Heronvale Merinda Bowen Collinsville
Woorabinda Aboriginal Shire Council	Blackboy Creek and Central Creek when flooded cuts access to the three Woorabinda bores that supply portable water to the township. Also cutting access to two outstations which are Bore 4 and Blackboy camp.

4. Are there any settlements or critical infrastructure you believe do not have sufficient flood warning time?

Response	Number of respondents	Percentage of respondents
No	24	45%
Yes	29	55%
TOTAL	53	

Respondents identified the following additional settlements or critical infrastructure that do not have sufficient flood warning time.

Local government area	Additional settlements or critical infrastructure
Balonne Shire Council	Ballon - worst case scenario is about five hours to prepare for flood water and close the openings in the levee which takes more than 24 hours to complete.
Blackall-Tambo Regional Council	<p>There have in the past been instances where the Blackall community have considered there has not been sufficient flood warning time. In response to this Council installed ALERT river height recording stations at Duniera (535126) and Gillespie (535148).</p> <p>It is considered that a further river/rain automated recording station could be located at Swan Hill (GPS -24.596913 145.938234). This would enable improved early warning of flooding of the Barcco River Bridge on the Landsborough Highway.</p>
Boulia Shire Council	Mt Isa Road particularly at night when storms are in the district.
Brisbane City Council	<p>Typically Brisbane's creeks and overland flow paths have short times to flood peak. However, Council's FloodWise® Information System, allows it to respond to creek flash flooding and provide emergency management teams with accurate information in a timely manner. The system monitors real-time telemetry gauges (rainfall and stream height) across Brisbane and provides the current readings on a web portal. Automatic alerting is received via SMS or email by on-call duty officers across the organisation. Brisbane City Council offers the Creek Flooding Alert Service to identified properties that may be affected by creek flooding in the suburbs of: Albion, Archerfield, Boondall, Brookfield, Coorparoo, Corinda, Deagon, East Brisbane, Greenslopes, Hemmant, Herston, Kenmore, Moorooka, Northgate, Nundah, Oxley, Rocklea, Salisbury, Windsor, Woolloongabba, Wynnum and Wynnum West.</p> <p>Other areas (e.g. overland flow) may subscribe to Brisbane Early Warning Alert Service based on BoM weather warnings.</p>
Bundaberg Regional Council	Bundaberg Regional Council flood modelling has benchmarked flood time frames based on Paradise Dam (i.e. a level at Paradise Dam equates to a level downstream at Walla in about 12–18hours and a level at Bundaberg in about 24hours). While BoM's hydrological models provide earlier warning they do not quantify the extent of flooding typically (i.e. BoM warning will be primarily qualitative: "Minor; Moderate; Major". Based on this, there are a number of locations that receive less than 12hours notice of flood peaks, including: Goodnight Scrub, Morganville, Wallaville, Pine Creek and Bungadoo (roughly the Wallaville area)
Burke Shire Council	During the wet season/flood times, Burketown has limited knowledge of the state of the Nicholson River as there are no automatic stations. A manual gauge is at Doomadgee and Escott Station but a person is required to read them. The Nicholson catchment is monitored on BoM site but the information displayed is of the Gregory River and does not reflect the state of the Nicholson River. If the Nicholson, Gregory and Leichardt Rivers are all in major flood together, Burketown could have major inundation but would have sufficient warning if the information of the Nicholson at Doomadgee and Escott is readily available. The Escott gauge (29159) is said to be set up to be automatic but has not been followed through.
Cassowary Coast Regional Council	<p>Innisfail</p> <p>Tully</p> <p>others</p>
Central Highlands Regional Council	<p>Rubyvale - small catchment, rapid rise</p> <p>Sapphire, Reward and Graves Hill areas - mainly because of the foreign tourists that may be camped and located anywhere across the fossicking areas including on the flats and in close proximity to Retreat and May Creeks.</p>

Local government area	Additional settlements or critical infrastructure
City of Gold Coast	<p>Almost all "settlements" and "critical infrastructure" within City of Gold Coast can be affected.</p> <p>The Local Disaster Management Group is only activated if a disaster is declared although proactive steps and constant monitoring of the situation are undertaken.</p> <p>As noted, floods are random events and generally unpredictable in determining exactly where rainfall will fall and in what volume; potential impacts to 'settlements' and 'critical infrastructure' is generally not known until the event begins to unfold. Therefore, it is difficult to give exact information, noting that the areas mentioned in question 1, 2 & 3 (being the most likely to flood) are probably the areas that may not receive sufficient flood warning time.</p> <p>The list below of affected flood areas is indicative and it does not represent all possible affected areas:</p> <ul style="list-style-type: none"> • Wongawallan • Guanaba • Clagiraba • Beechmont • Carrara • Merrimac • Worongary • Mudgeeraba • Bonogin • Tallebudgera Valley • Currumbin Valley
Croydon Shire Council	<p>Belmore Creek on Guilford Road</p> <p>Esmeralda Creek on Richmond Road</p> <p>Clara River on Richmond Road</p> <p>Norman River on Richmond Road</p>
Gladstone Regional Council	<p>Calliope River Camping Grounds, a popular recreation spot with campers and caravaners. There are not enough gauges upstream to provide intelligence on the likelihood of water rises in terms of both depth and speed of onset.</p>
Goondiwindi Regional Council	<p>Inglewood town has very little notice in some events</p>
Ipswich City Council	<p>Generally all flash flood catchments provide little warning time. Upper areas of major rivers (riverine flooding) also have limited warning time.</p>
Livingstone Shire Council	<p>Yeppoon—there are no stream gauges to warn of flash flooding.</p>
Lockhart River Aboriginal Shire Council	<p>Portland Road would benefit from understanding the river conditions in Chillie Creek.</p> <p>Lockhart River would benefit from river height data being available on crossings at the Wenloch River (upper) and the Claudie River.</p>
Lockyer Valley Regional Council	<p>Muphys Creek—limited time to all areas</p>
Logan City Council	<p>Marsden</p> <p>Kingston</p>
Longreach Regional Council	<p>Longreach—needs an automated gauge at Camoola, however, the warning time with current gauges are satisfactory</p>

Local government area	Additional settlements or critical infrastructure
Mackay Regional Council	<p>Finch Hatton (base of Clarke Range feed by two separate tributaries of Cattle Creek) —very fast inflow, rapid rises and limited rainfall gauges in area (west of township). Evacuation to caravans in FH Showgrounds required March 2012.</p> <p>Glenella (Jane Creek)—rapid rises in Gooseponds Creek. Currently one rain gauge in Rowellan Park but not accessible during wet weather if failure occurs. Previous failures have occurred with several days to over a week of outage. Need additional rain gauge and river height near West Mackay-Glenella Road.</p> <p>East Mackay (Shellgrit Creek)—subject to flash flooding beside Mackay Airport.</p> <p>Antonios Crossing—subject to flash flooding and spilling of Kinchant Dam and dam releases required to maintain dam levels in accordance with EAP.</p> <p>Habana (Reliance Creek)—subject to rapid rises from localised flooding.</p> <p>Middle Creek—subject to overflows from Middle Creek dam.</p> <p>Walkerston (Bakers Creek) —subject to flash flooding west of township. Gauge in township.</p>
Maranoa Regional Council	<p>There are major settlements or critical infrastructure that does not have sufficient flood warning time Roma. Bungil Creek has three river monitoring station one at Tabers which has a lead time of 12hours to Roma, the second Tindarra with a lead time of 2hours, the third is in Roma at Bungil Street (Manual Read). Bungil Creek has a major feed from the Mooga Hills Catchment which has a major impact on the town of Roma. This catchment feeds the Bungil Creek by way of Mooga Creek, it feeds the Bingil Creek 2hours above the Tindarra station, and as in 2011/2012 Roma did not get sufficient warning to prepare the communities.</p> <p>In 2012 the Mooga catchment flood water pushed a 1.2 m wall of water over the top of the Bungil Creek flood water and this flood water caused the fatality off a Roma lady, crossing the long drain in town. The second problem with Tindarra Station is a reliability one. This station only gives Roma a 2hour lead time. A lot more data is needed on a more frequent basis and BoM need to request the information at 30 minute intervals this causes the River station to drop off line. This happened in 2010 and 2012 and Maranoa Regional Council did not have sufficient warning of the pending flood water.</p>
Mareeba Shire Council	<p>Bilwon - Barron R</p> <p>Mareeba - Grawite</p> <p>The needed information may be available but communication lines for alerts are not clear.</p>
Moreton Bay Regional Council	<p>Caboolture</p> <p>Deception Bay</p> <p>Mango Hill</p> <p>Samford</p> <p>Burpengary</p> <p>Dayboro</p> <p>These settlements do not have sufficient warning time because of the natural short response time of some of the catchments. Improved forecast data is required to improve flood warning time.</p>
Noosa Council	<p>All of the flash flooding affected areas listed in question 3 including:</p> <ul style="list-style-type: none"> • Tewanin - Daintree Estate • Pomona - Rifle Street and the Subway • Noosaville - Lake Entrance Boulevard • Lake Macdonald - surrounds
Rockhampton Regional Council	<p>Rockhampton (flash flooding)</p> <p>Stanwell</p> <p>Mt Morgan (Dee River)</p> <p>Bouldercombe (Dee River)</p> <p>Bajool</p> <p>Gonango</p>

Local government area	Additional settlements or critical infrastructure
Somerset Regional Council	<p>Esk—flash flooding during 2011 highlighted that there isn't sufficient warning time for Esk.</p> <p>Toogoolawah - Rosentretters gauge—relatively close to the township and cannot provide adequate warning time.</p> <p>Minden—forecast data not available .</p> <p>Jimna—not monitored/forecasted.</p> <p>Linville/Mt Stanley areas—large number of crossings with limited data available.</p>
South Burnett Regional Council	<p>Burnett Highway/Barambah Creek crossing has no stream level/rainfall station to the east advising if an event is going to impact on the highway. Tropical Cyclone Marcia traversed through the region in early March inundating the eastern catchment but not anywhere else in the region. An advisable site would be at the bridge adjacent to the Kilcoy-Murgon Rd/Pei Road intersection.</p> <p>Kearneys Road/Stuart River is an advisable site in advance of the Bunya Highway, just to the south west of Kingaroy. This site would provide lead time with a coordinated response towards managing one of the major highways in the region.</p> <p>Chinchilla Wondai Road/Stuart River is an advisable site due to its geographic location in respect to other stream level/rainfall stations and the acreage developments that exist around this location.</p> <p>Barkers Creek near Barker Creek Road/Nanango Brooklands Road Intersection is an advisable site in advance of the D'Aguilar Highway, just to the west of Nanango. This site would provide lead time with a coordinated response towards managing the busiest highway in the region.</p>
Sunshine Coast Council	<p>Kenilworth</p> <p>Conondale</p> <p>Cambrook</p> <p>Kidaman Creek</p> <p>Belli Park</p> <p>Nambour</p> <p>Marcoola</p> <p>Mudjimba</p> <p>Pacific Paradise</p> <p>Eudlo</p> <p>Rainforest Sanctuary (Tanawha)</p> <p>Glasshouse Mountains</p> <p>Beerwah</p> <p>All listed flash flood locations</p>
Tablelands Regional Council	<p>Malanda—gauges are downstream of township. During the February 2015 event the Glen Allyn ALERT, downstream of Malanda received 90 mm of rain in an hour. This event reached 500 mm below the record flood of 1967. An initial MINOR flood warning for the Johnstone River was issued at 09:38 on Sunday 8 February 2015. By this time, the bridge at Malanda Falls was already inundated. Several roads and bridges were already flooded in the Malanda community including homes and businesses.</p>
Toowoomba Regional Council	<p>Quinalow—Total inundation of town in events greater than 100year. No water level gauging upstream and very limited pluviograph network in the region.</p> <p>Cooyar—Inundation of town possible and has occurred in the 1980s. No water level gauging upstream and very limited pluviograph network in the region.</p> <p>Oakey—System is in place but would likely to have a better pluviograph network in the catchment.</p> <p>Jondaryan—Significant inundation and no water level gauging upstream and very limited pluviograph network in the region.</p>

Local government area	Additional settlements or critical infrastructure
Weipa Town Authority	PDR crossings at Moreton Telegraph Station (Wenlock River) and Archer River which are significantly affected by seasonally riverine/flash flooding. These impact on Weipa, as it is the only road access north and south.
Whitsunday Regional Council	Proserpine River has no ALERT river height or rainfall gauges. Airlie Beach and surrounds has no rainfall gauges. Conway Beach and Wilson Beach have no rainfall gauges. Dingo Beach and Hydeaway Bay has no rainfall gauges.

5. Are all of the rainfall and stream water level gauges your council operate and maintain shown on the map and is the information about each gauge in the spreadsheet accurate and complete?

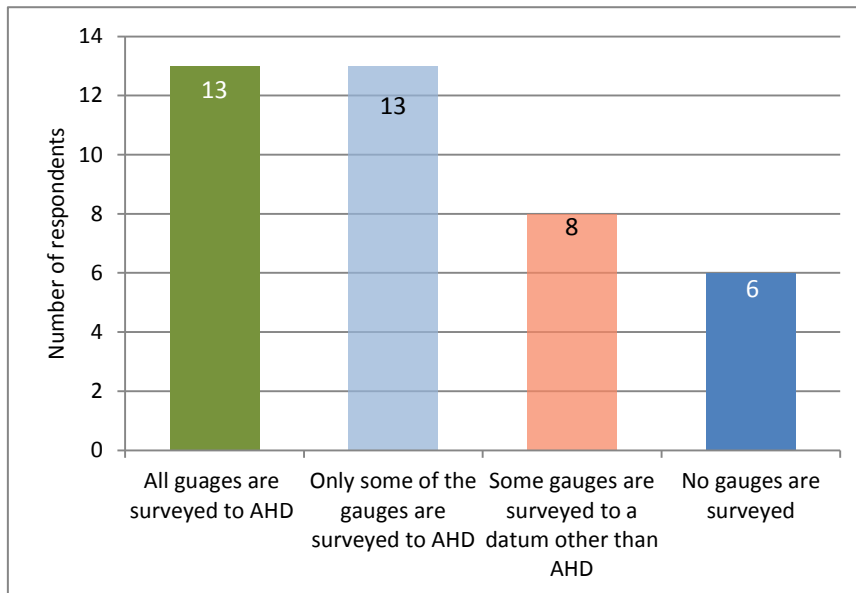
Response	Number of respondents	Percentage of respondents
No	18	41%
Yes	26	59%
TOTAL	44	

In addition to the above, one council noted they also maintain gauges in an adjacent local government area as well as their own local government area. Another council noted that they operate and maintain no gauges.

Seven of the 18 respondents that indicated the spreadsheet was incomplete or inaccurate provided additional information to address these shortcomings. The additional information has been integrated into asset inventory that was prepared as part of this Performance Review.

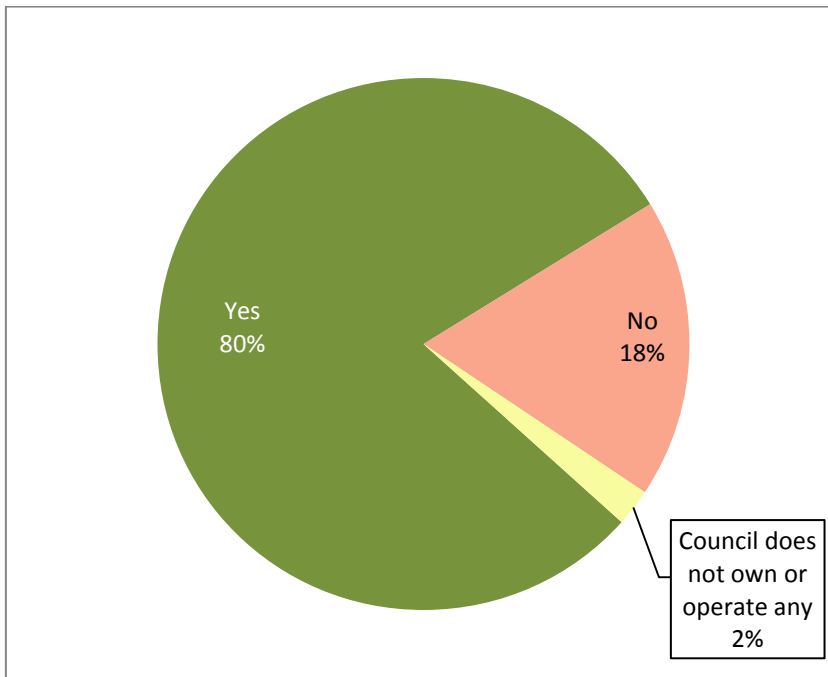
6. Are the stream water level gauges your council operate and maintain surveyed to the Australia Height Datum (AHD)?

Total number of respondents: 36



7. Are all of the rainfall and stream water levels gauges that your council operate or maintain on your Council Asset Register?

Total number of respondents: 44



Respondents identified the following gauges that were not on their Council Asset Register:

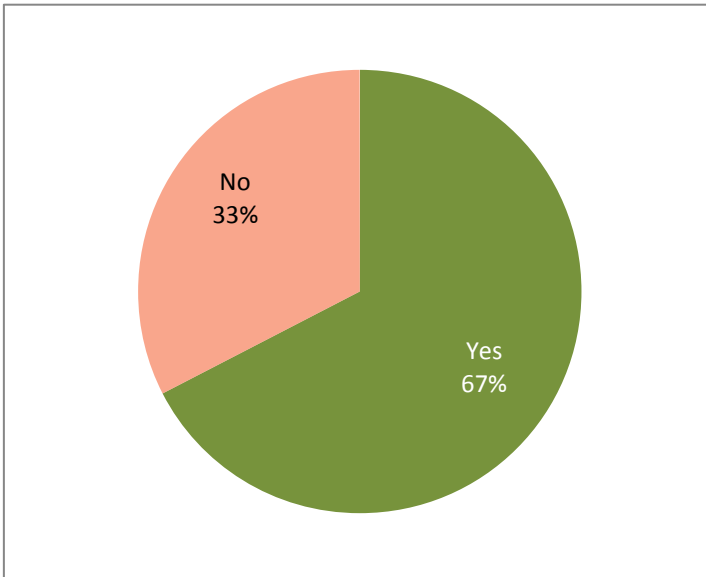
Local government area	Identified gauges not currently on Council Asset Register
Whitsunday Regional Council	All nine (9) river and rainfall gauges installed in 1989 have not been added to the Asset Register. Council does, however, pay for part replacement when necessary from general maintenance fund.
Southern Downs Regional Council	541091 Ballandean Hill ALERT 541092 Bony Mountain ALERT 541136 Durikai ALERT 541135 Cons Plain ALERT 541136 Gambubal Road ALERT 541138 Killarney (Spring Creek) ALERT 541139 Queen Mary Falls ALERT 541140 Spicers Peak ALERT 541143 Strathyre Road ALERT 541144 The Head ALERT
Mackay Regional Council	Four new gauges built in 2013 are fully on asset management system. Ex PRIT (Pioneer River Improvement Trust) gauges are on system to record maintenance but asset value was deemed to small when transfer from PRIT to Council in 2014. All PRIT gauges electronics, canisters ex where replaced when moved from Futuretech to ELPRO
Noosa Council	There has never been a documented handover of these assets and so they are yet to be written on to the asset register. They are on the maintenance activities register though.
Barcaldine Regional Council	Sedgeford ALERT Betanga ALERT Jericho ALERT Glencoe ALERT

Respondents also stated the following reasons for gauges not being on the Council Asset Register:

- projects to extend their gauge network were underway but final commissioning had not been completed
- a spreadsheet (separate to the asset register) is used to record gauge ownership
- new asset register software was being introduced across the council and spreadsheet records had not yet been loaded into it
- discussions were needed to clarify who the asset owner is (e.g. council, DNRM, BoM or other parties), especially where equipment is co-owned or jointly housed in the same shed or tower.

8. Are there any rainfall or stream water level gauge changes you believe would improve flood warning time (e.g. addition or relocation of gauges)?

Total number of respondents: 46



The potential changes suggested by respondents who answered 'yes' to this question included:

Local government area	Suggested changes
Barcaldine Regional Council	<p>Additional rainfall gauge higher up in Jordan Creek and Alpha Creek will provide 48hour warning.</p> <p>Register flood gauges recently installed at Burgoyne (Jordan Creek) 5 km south of Jericho.</p> <p>Additional ALERT stations in and up stream of Muttaborra (Thomson River) for early flood warning.</p>
Barcoo Shire Council	<p>New gauge on Westerton Road at Vergemont Creek in the Cooper Creek catchment upstream of Stonehenge for flood impacts on road access between communities.</p> <p>New gauge on Yaraka-Retreat Road at Powells Creek in the Cooper Creek catchment.</p> <p>New gauge on Connemara Road at Farrars Creek in the Diamantina River catchment.</p> <p>Possible additional gauge on adjoining watercourse channel to the existing Farrars Creek TM gauge.</p>

Local government area	Suggested changes
Blackall-Tambo Regional Council	<p>Addition of ALERT automated recording gauges south and south west of Tambo. Replacing manual stations (sites: 35073, 44168, 35190, 35142, 35129) would provide improved data during flood events benefiting Murweh Shire.</p> <p>Consider replacing manual sites (sites: 63134, 36081 , 36040) north west of Blackall with automated systems.</p> <p>There are other sites that would potentially provide beneficial information that have not currently been surveyed or have a manual reading station.</p> <p>New rain stations would be beneficial at:</p> <ul style="list-style-type: none"> • -24.722632 146.352727 (Windeyer Creek) • -24.065763 145.911997 (Dismal Creek) (a second rain gauge may be needed as a repeater for this site).
Bouli Shire Council	Need to utilise data from remote automated devices.
Brisbane City Council	Council has recently added four river gauges to the network as well as two gauges to monitor backflow prevention devices. River velocity gauges are currently also being considered.
Bundaberg Regional Council	<p>Addition of gauges at coastal catchments and sub-catchments associated with:</p> <ul style="list-style-type: none"> • Bargara • Burnett Heads • Elliott Heads • Woodgate • Moore Park Beach • Coral Cove • Innes Park <p>Without detailed knowledge of the upper Burnett catchment exact locations cannot be specified but there would be benefit in providing additional gauges in this catchment. The North Burnett Council have been undertaking great work in this area and would be in a better position to provide recommendations.</p>
Cairns Regional Council	<p>As a result of the Freshwater Creek Flood Study, Council is to install a rainfall and river height ALERT monitoring station at Goomboora Park, Brinsmead (edge of confluence of tidal influence in the Barron River). The study also recommended additional rainfall and river height monitoring stations further upstream within the catchment due to the geographic dependent influence of the topography and related rainfall intensity.</p> <p>A second site for installation of a rainfall and river height ALERT monitoring station would be in Babinda. Council recently benefited from a QFMP Level 2 Flood study in this area and a recommendation was for the installation of an ALERT station on Babinda Creek near Dickson Road.</p>
Carpentaria Shire Council	Difficult to predict until reliability of readings from new gauges can be determined.

Local government area	Suggested changes
Central Highlands Regional Council	<p>Old BoM manual gauge site Gainsborough at Dawson River crossing Capricorn Highway.</p> <p>Upper Retreat Rain Gauge to improve warning for Sapphire, Reward and Graves Hill area. Site selected with BoM but need to finalise approvals with landholder. Equipment has been purchased and installation likely before 2015/16 wet season.</p> <p>Emerald ALERT needs to be relocated to higher ground probably on eastern side of Nogoa River because of the flood modelling analysis work now completed.</p> <p>Tartus needs an ALERT gauge installed and perhaps an additional repeater rain gauge in between to ensure signal can reach the distance to Blackdown ALERT repeater.</p> <p>Having the gauges on the ALERT system ensures Council receives triggers real-time via its EnviroMon software and can make decisions or send alerts on to the public.</p> <p>An additional rain ALERT gauge in upper Comet on eastern side of catchment and a repeater rain gauge to enable data to transmit back to Rhoddas lookout or via Banana's network back to Blackdown Tableland.</p> <p>Rewan could then be upgraded to include the Sat over IP communications plus an ALERT canister as a backup on the DNRM gauge.</p>
City of Gold Coast	More sensors outside of Gold Coast catchments that Gold Coast can retrieve recordings from.
Croydon Shire Council	<p>Additional gauges at:</p> <ul style="list-style-type: none"> • Belmore Creek on Guilford Road • Esmeralda Creek on Richmond Road • Clara River on Richmond Road • Norman River on Richmond Road.
Fraser Coast Regional Council	The installation of a number of rainfall gauges namely at Mary River and anabranches, and Tinana Creek have been discussed with BoM. Any installation will depend on funding. No specific plans are in place but research has been undertaken.
Gladstone Regional Council	Additional gauges in the Calliope River catchment. Actual locations will depend on the finalisation of the Calliope River Flood Study and consultation with BoM and others.
Goondiwindi Regional Council	Additional gauges on the northern part of Inglewood, specifically the Canning Creek Catchment. The best organisation to comment would be BoM who rely on data to prepare flood warnings.
Hinchinbrook Shire Council	Additional rainfall station in the upper Stone River catchment to pick up rainfall in the upper catchment. The main rain gauge is at Michael Creek which is in a different watershed.
Ipswich City Council	<p>It would be beneficial to convert to AHD survey.</p> <p>Obviously more gauges the better, however, generally Ipswich City Council has good representation of major rivers and creeks.</p>
Isaac Regional Council Lockhart River Aboriginal Shire Council	<p>Unknown at this stage.</p> <p>Additional gauges at:</p> <ul style="list-style-type: none"> • Upper Wenlock • Claudie River (Lockhart) • Chillie Creek (Portland Roads).
Lockyer Valley Regional Council	Sandy Creek Forest Hill.
Logan City Council	Addition of a stream water level gauges around Kingston and Marsden
Mackay Regional Council	<p>Mirani ALERT does not have a backup and is critical to flood warning for Mackay (less than 4hours travel time). An additional gauge at Mirani Township (current gauge is on Sunwater property at Mirani Weir thereby limiting access.</p> <p>Hospital Bridge ALERT requires relocation due to change in surrounding conditions and trees etc. to be accurate.</p>

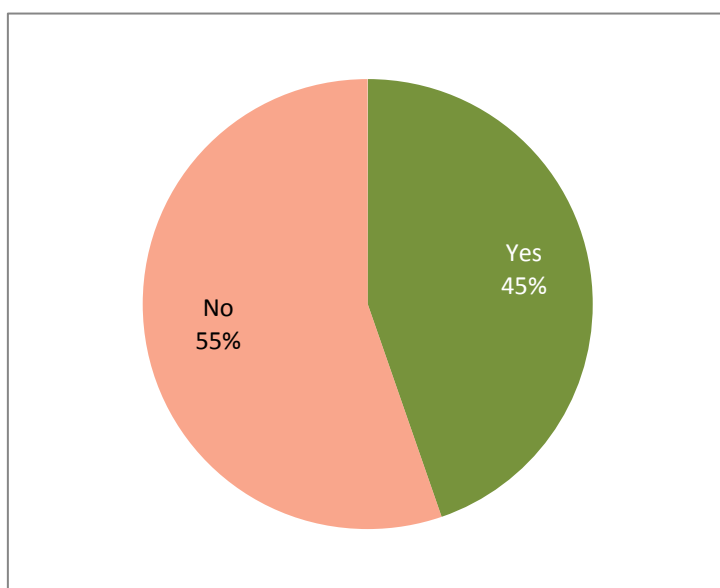
Local government area	Suggested changes
Maranoa Regional Council	<p>Additional rainfall or stream water level gauges at:</p> <ul style="list-style-type: none"> • Mooga Hills Catchment (Mooga Creek) • Bungil Creek Junction at: <ul style="list-style-type: none"> ○ Blyth Creek and Bungil Creek (Back up water and flow times/Height back into and Roma) ○ Bungeworogorai Creek and Bungil Creek (Back up water and flow times/Height back into and Roma). • Bungeworogorai Creek North-West of Roma (Flow times and height) • Maranoa River Catchment (Junction) • Maranoa River (West Branch)/Maranoa River(Eastern Branch) • Merivale River / Sandy Creek.
North Burnett Regional Council	<p>Council has used/piggy-backed off existing Sunwater sites where possible. The location of these sites was originally chosen for irrigation scheme purposes and are not necessarily ideal for flood warning purposes. However, to keep project costs down this was the best compromise. Additional work would be required to identify the optimum sites.</p>
Somerset Regional Council	<p>Consider installing gauges to give better warning to:</p> <ul style="list-style-type: none"> • Esk • Toogoolawah • Minden • Jimna • Linville/Mount Stanley areas <p>Some investigations/flood studies may have to occur to assist with this process.</p>
South Burnett Regional Council	<p>Additional gauges at:</p> <ul style="list-style-type: none"> • 26d41'48.2" 152d13'01.3" Elevation 351m • 26d41'42.5" 151d41'55.3" Elevation 458m • 26d22'20.3" 151d38'55.6" Elevation 371m • 26d42'36.6" 151d51'36.2" Elevation 367m <p>In addition to the above, we would recommend that the manual stations should be converted to ALERT/telemetry systems (e.g. RN40138), as the reliance on them for regional areas to assess response is pivotal. Catchment boundary BoM stations should be linked to both catchments for ease of assessment, rather than exiting one catchment's portal to obtain data on the boundary conditions e.g. Mt Mowbullian (Condamine/Balonne), as it also impacts on the Barambah/Stuart catchments from a rainfall perspective.</p>
Southern Downs Regional Council	<p>Rainfall ALERT gauges in the catchment of Leslie Dam.</p> <p>Stream water level gauge down stream of Leslie Dam.</p>
Sunshine Coast Council	<p>Additional gauge in Mooloolah Valley to improve rainfall understanding of the upper Mooloolah catchment.</p> <p>Gauges also required for the future Caloundra South community. Sites negotiated as part of the Council Infrastructure Agreement with Stockland.</p>
Tablelands Regional Council	<p>Possible relocation of gauges in the Malanda area. These gauges are not owned or maintained by Tablelands Regional Council.</p>
Toowoomba Regional Council	<p>Earlier this year, Toowoomba Regional Council commissioned ENGEMY to undertake a review of the existing hydrometric gauge network. The report includes several recommendations for new gauge locations. Council intends to implement these recommendations as funding becomes available.</p> <p>In addition, all gauge data available in real-time through BoM's EnviroMon software would be useful.</p>

Local government area	Suggested changes
Weipa Town Authority	Additional stream water level gauges could be installed at Moreton (Wenlock River) and Archer River.
Whitsunday Regional Council	Additional gauges at: <ul style="list-style-type: none"> • Proserpine River two new ALERT river/rainfall gauges. • Proserpine Catchment four new rainfall gauges: Jubilee Pocket, Cannonvale, Dingo Beach and Conway areas.

Respondents provided no additional documentation to further describe potential changes.

9. Does your council have any plans to increase the number of gauges and/or upgrade gauges in your local government area?

Total number of respondents: 47



The planned improvements of respondents who answered 'yes' to this question included:

Local government area	Suggested changes
Bouli Shire Council	Install gauges in the Upper Lime Stone Creek catchment.
Bundaberg Regional Council	Identified growth-areas are coastal with several small catchments/sub-catchments that can respond rapidly to heavy or prolonged rainfall. ABS data evidences the growth and demographic characteristics.
Cairns Regional Council	As described in question 8. Freshwater Creek this financial year. Babinda in the 2016-17 capital works budget.
Carpentaria Shire Council	Potential to increase the number of gauges or more locations where gauges are inundated if necessary.

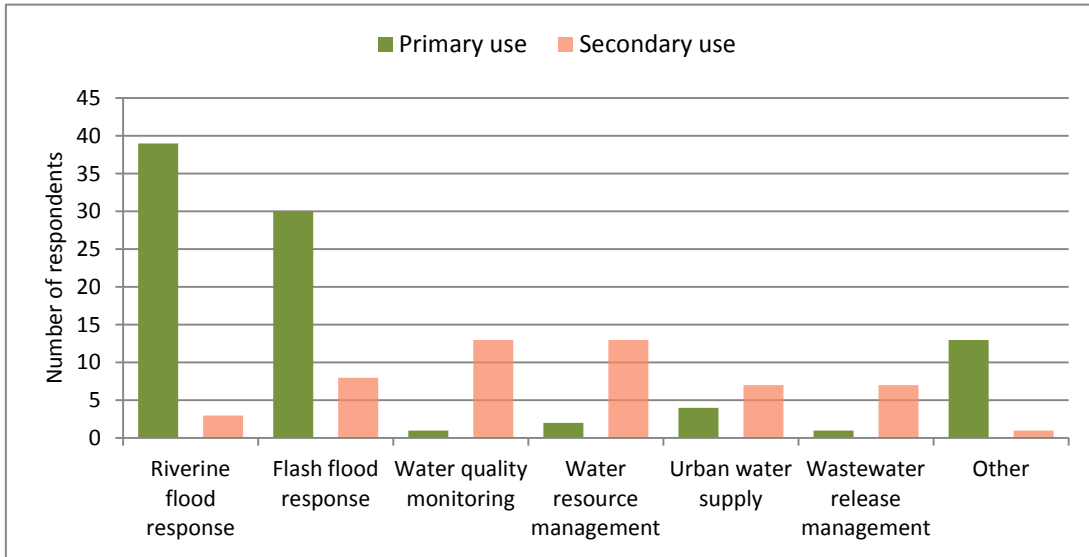
Local government area	Suggested changes
Central Highlands Regional Council	<p>Council is installing upper retreat rain ALERT gauge and a complete standalone backup ALERT gauge with data logger at Craigmore before December 2015.</p> <p>Council does not have capital works funds to do other flood warning installs work this coming financial year.</p> <p>Council would like to convert Penjobe, Mantuan Downs, Springsure and Bogantungan across to ALERT gauges. BoM would similarly like to see this happen.</p> <p>Currently they are aging TM gauges on Telstra carrier. Council has already held discussions with BoM and wants to introduce data redundancy systems into all of its key river height gauges. This requires adding a data logger to each ALERT canister and BoM has not yet provided their direction on the best most reliable and low maintenance way to do this on our existing network. Council currently relies on nitrogen gas bottle setup, which comes with some WH&S issues, but being pragmatic, it has stood the test of time in terms of reliability and low maintenance costs.</p>
City of Gold Coast	Assets custodians for the gauges plan for new gauges according to requests by others e.g. flood modellers and disaster managers.
Goondiwindi Regional Council	<ol style="list-style-type: none"> 1. Some sites need to be improved to reduce OH&S issues associated with maintenance 2. A new site in the upper reaches of Wyara Creek could provide more timely information on potential flooding of the national Gore Highway. Diversions need to be established at least 90 km north to this crossing so as much time as possible would be necessary. This crossing floods regularly and strands many motorists.
Isaac Regional Council	As previously advised the flood warning indicator network will be refurbished/repared this financial year and integrated into the regional information and alert system.
Lockyer Valley Regional Council	Further gauges across Warrego Highway.
Logan City Council	We have undertaken major enhancements to our network of gauges over the past few years, but there are still some areas that would benefit from additional gauges or safety measures such as smart flood warning signs.
Mackay Regional Council	Emergency Management team is currently preparing a Five Year Strategic Plan for Emergency Management and State Emergency Service for Council's consideration and endorsement. The draft plan contains funding for additional rainfall and river gauges to increase situational awareness. Council will also be looking at what joint funding opportunities exist to improve the network.
Maranoa Regional Council	<p>The sites currently available to Maranoa Regional Council to aid in early warning during flood events are limited. Additional sites are required to fill some of the gaps in the system to provide a more robust monitoring network with early warnings moving forward.</p> <ul style="list-style-type: none"> • Council is currently reviewing Disaster Management • Weather Data Network system. (Review): Discuss the network and look at how we may be able to improve the system moving forward (set an action plan) • Weather Data Network system: Investigate a data sharing agreement between Santos/ Origin/ Maranoa regional Council, DNRM and BoM/Council • Develop at Weather Data System (River height, road closure and forecasting). <p>Council is working on its website and public information display systems and options with the councils IT department. This Dataonline system has the ability to push data into the Council database. Overlays/maps/other information that can be derived from this data and presented through council's existing website. There are a number of options with this and it really depends on the scope/final outcome Council would like.</p> <p>One of the main objectives is the ability to have alarming level parameters. Given some historic information, existing systems on Dataonline can be configured to send emails/SMS to Council staff to aid in early warning of pending flood events. These triggers and types of alarms are all completely customisable by Council staff/managers.</p>

Local government area	Suggested changes
Moreton Bay Regional Council	Preliminary planning subject to budget allocation for additional gauges as follows: <ul style="list-style-type: none"> • Additional ALERT rainfall gauge for Bribie Island • Additional ALERT rain/river gauge for Lagoon Creek in the vicinity of Lagoon Street • Additional ALERT rain/river gauge on South Pine river upstream of Mt Samson Road.
Rockhampton Regional Council	Manual peak water height gauges in creek (Rockhampton). Rainfall gauges on all reservoirs in region. Re-instate Stanwell gauge (Neekol Creek). Investigate options at Bajool.
Scenic Rim Regional Council	Construction of additional site is nearing completion, with site to be fully operational and commissioned by 30 September 2015.
Southern Downs Regional Council	Rainfall ALERT gauges in the catchment of Leslie Dam. Stream water level gauge down stream of Leslie Dam Upgrading of the stream water level gauges to include a gas pressure sensor for the following locations: Killarney ALERT, Warwick ALERT, Connolly Dam ALERT, Murrays Bridge ALERT, Storm King Dam H/W ALERT and Granite Street ALERT. The above is only a concept plan and there has been no funding allocated to new or upgrading gauges at present and is unlikely for the foreseeable future.
Sunshine Coast Council	Additional gauge in Mooloolah Valley to improve rainfall understanding of the upper Mooloolah catchment. Gauges also required for the future Caloundra South community. Sites negotiated as part of the Council Infrastructure Agreement with Stockland. In addition, the Golden Beach gauge has problems with instrument drift and has been damaged by boating activity in the past. A DSITI (Radar) gauge is planned for the same location to inform Coastal Management at a higher resolution. Recommend using signal from new gauge and connecting to ALERT canister, decommission the pressure sensor of the ALERT gauge. Also considering a complimentary network of cheaper instruments to inform of road flooding so that this can be reported on Council's community portal (DisasterHub).
Toowoomba Regional Council	Earlier this year, Toowoomba Regional Council commissioned ENGENY to undertake a review of the existing hydrometric gauge network. The report includes several recommendations for new gauge locations. Council intends to implement these recommendations as funding becomes available.
Townsville City Council	A capital budget is allocated for the 2019/2020 financial year for additional rainfall and river level gauges. The budget is reviewed yearly and this program will be evaluated against competing priorities for the allocation of funds.
Western Downs Regional Council	Currently completing 'Round 2'. No further plans beyond that at this time.
Whitsunday Regional Council	Whitsunday Regional Council will be seeking funding for additional gauges at: <ul style="list-style-type: none"> • Proserpine River two new ALERT river/rainfall gauges. • Proserpine Catchment four new rainfall gauges: Jubilee Pocket, Cannonvale, Dingo Beach and Conway areas.

Two respondents (Blackall-Tambo Regional Council and Brisbane City Council) noted that they had no plans to make improvements now but didn't rule out improvements in the future. Specifically, Blackall-Tambo Regional Council state that if funding became available they would work with BoM to identify upgrades to the system. Brisbane City Council stated that the completion and implementation of new Catchment Flood Management Plans in coming years may identify the need for additional gauges. Expansion of the gauge network may also be required in response to population growth, urbanisation, climate change, legislation change and community needs.

10. How do you use the data from rainfall and stream water level gauges?

Total number of respondents: 48



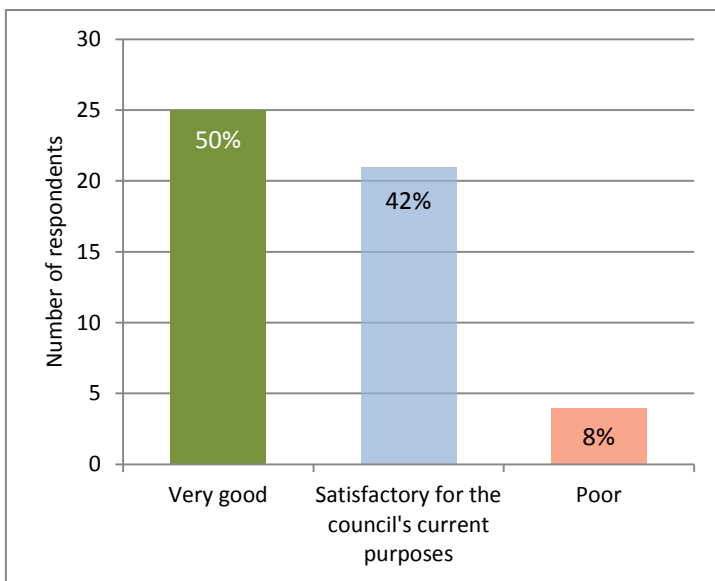
Other primary data uses identified by respondents included:

Primary use	Number of respondents that identified this use
Traffic management (issue of warnings and diversion planning)	4
Flood modelling	3
Support for road remediation	1
Town planning and infrastructure design (historical data)	1

The other secondary use identified by a respondent was calibration of Council Flood Models during the course of flood study reviews.

11. How would you rate the overall accuracy of the data from the rainfall and stream water level gauges that your council uses data from?

Total number of respondents: 50



Comments made by respondents that rated the overall accuracy as very good for their council's current purposes included:

- The process is automated and calibrated. However, there are typically some gauges that malfunction during events (not the same gauges each time). Despite weekly checks of data and routine maintenance, sometimes issues only become apparent when there is significant rainfall and water levels are rising. Constant diligence is required to make sure the gauge data is good.
- It provides constant, reliable and continuous data for the BoM hydrology unit who then provide us with good solid flood data.
- Very good from the automatic stations installed. A recent Central Highlands Regional Council Floodplain Management Study has, however, identified some issues with upper end of ratings tables on some gauges. Hence, a further synthetic rating tables project is being undertaken. Council does not undertake any instream flow calibration checks such as those done by hydrologists periodically during flood events on some of their gauges.
- Orifice blockage has occurred in the past which can lead to instrument drift. Regular purging required at some locations (Retrofit of timers is occurring).Gauge boards are recommended at locations of ALERT water level stations so that peak levels can be retrospectively verified.
- Bundaberg Regional Council has worked closely with BoM to install nearly two-dozen river/rain gauges since the record flooding at Bundaberg in 2013. This being the case, the gauges installed were completely aligned with BoM requirements. Additionally, batteries and solar panels were included in the install of these locations to ensure greater robustness in the face of significant weather events.
- Hydrology modelling carried out by BoM based on rainfall station records and stream gauge heights has produced very accurate predictions of peak river heights in recent events.
- Council's Hydrometric Network provides the delivery of real-time telemetry data from rainfall and stream height gauges; 24 hours a day, 7 days a week. A maintenance program is carried out each year to ensure this level of service.
- All gauges had electronics and canisters replaced in 2010/2011 when changeover from Futuretech to ELPRO. Reliability has improved significantly since this changeover and now have spare parts/canisters to undertake immediate changeovers if required.
- In major rainfall events and storm events our organisation relies heavily on the accuracy of the data received to model potential flooding areas. Where automated gauges have been installed near manual systems, the manual systems are still being read. Data is comparable.

Comments made by respondents that rated the overall accuracy as satisfactory for their council's current purposes included:

- The most recent gauges to be installed have yet to be rigorously tested due to below average rainfall. Other existing gauges are very good. Unable to refer to AHD in most cases, which creates issues when determining outcome of heights.
- Satisfactory for the Weipa BoM gauges. Poor for the Moreton/Archer River as information on river heights is provided informally back to Weipa Town Authority and Weipa Local Disaster Management Group by local residents.
- Council's consultant liaises directly with BoM and DNRM to obtain rainfall data from relevant rain gauges.
- Hydrographic patterns for the various catchments that have already been developed by the BoM would be handy.
- Newly commissioned system and Council is still ironing out some bugs.

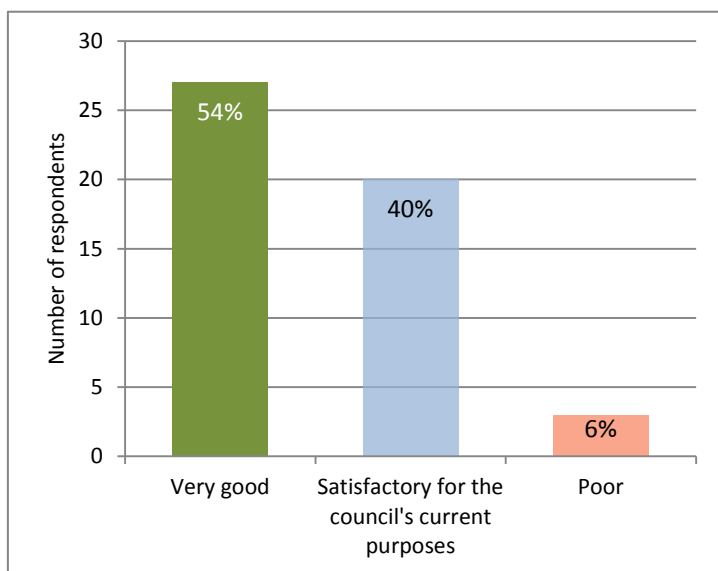
- Issues include but are not limited to: error with recording, malfunction during flood event, datum error, scale error, inability to communicate between neighbouring Councils or PCs.

Comments made by respondents that rated the overall accuracy as poor for their council's current purposes included:

- The information is accurate but the gauges are in the wrong location, e.g. downstream of the Malanda township.
- The recently completed Don River Flood Risk Study, 2015, identified issues with the BoM rating curve for the river. This differs significantly to that used by DNRM and leads to inaccurate flood warnings.
- Camoola - High risk due to manual readings and property owners not being available.
- No gauges in use

12. How would you rate the overall timeliness of the data from the rainfall and stream water level gauges that your council uses data from?

Total number of respondents: 50



Comments made by respondents that rated the overall timeliness as very good for their council's current purposes included:

- Only now because the system is updated every 30 minutes.
- Accessibility is not as efficient as Council would like as tedious to access through BoM website.
- Timeliness is heavily dependent on cloud cover.
- Generally real-time.
- The provision of EnviroMon program allows for constant monitoring on a 24 hour per day basis.
- Access to data from BoM website is timely.
- ALERT system is almost real-time and the EnviroMon software transmits this to Disaster Management staff mobile phones no matter where they are. Only issue is data redundancy. Without loggers, if for any reason data transmission from station fails for a period, the team cannot go back to station post-event and download data for flood analysis work.
- Through this survey I have been made aware of some gauges being operated by Sunwater that I was unaware of and that we have no data feed from.

- ALERT technology means that BoM and Council have access to data in virtual real-time.
- Have EnviroMon in the Coordination Centre to give live data.
- Obviously a major component is the understanding of the relationship between ALERT stations and the resultant establishment of trigger points when certain levels are reached/or predicted to reach particular heights. For example in the Barron, the Myola station reading at a level of 7 m or more constitutes a flood; minor below 8.5 m whereas levels above 10 m are considered major. The relationship between this station and Kamerunga is integral as the Kamerunga and Lake Placid stations provide more direct information in the delta. For the Kamerunga gauge, a minor flood is a reading at 6 m, moderate at 8 m and major at 9 m. BoM have good interpretive information on their website showing the comparative relationship between Myola and Kamerunga stations in major flooding events.
- Council operates an EnviroMon Alert system with BoM.
- Local reports from the community have been very positive regarding the data being available on the website very rapidly following rain events.

Comments made by respondents that rated the overall timeliness as satisfactory for their council's current purposes included:

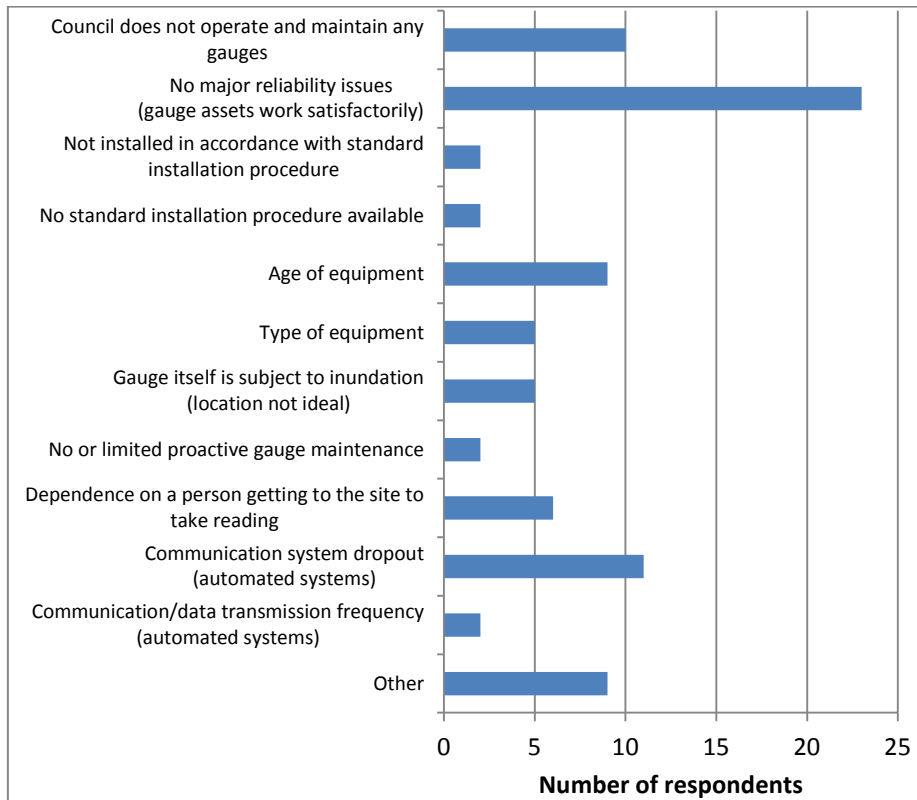
- Delay due to the use of satellite communications and going through a third party before being received by BoM.
- During rain events, the Fall Creek data takes a while to be uploaded to BoM.
- Some flash flooding events are very quick and stream rises can be rapid cutting off access before communities have much warning. This is largely a function of extreme rainfall intensity and relatively small catchments.

Comments made by respondents that rated the overall timeliness as poor for their council's current purposes included:

- The information is untimely because the gauges are in the wrong location, e.g. downstream of the Malanda township.
- Availability of historic data is extremely difficult to obtain for modelling purpose.
- No gauges in use.

13. Where your council operate and maintain rainfall and stream water level gauges, what are the reliability issues with these gauges?

Total number of respondents: 47



Respondents made the following comments on reliability issues:

- There are typically some gauges which malfunction during events (not the same gauge each time). Despite weekly checks of data and routine maintenance, sometimes issues only become apparent when there is significant rainfall and water levels are rising. Requires constant diligence to make sure the gauge data is good.
- Occasional data drop outs, may need to be resolved with the construction of an additional repeater station.
- Council currently has recently contracted reactive maintenance however generally is under resourced in the operation of the flood gauges.
- Every endeavour is made to adhere to the requirements of BoM. However, the monitors could be deemed to be antiquated with the use of the nitrogen gas bottles when compressor type equipment could be used.
- Gauge 29157 Burketown Airstrip is difficult to access in flood time, Burke Shire Council installed a river camera to help with this.
- There is a mix of new sites and retro fitting to existing Sunwater sites, as well as a mix of old and new hardware.
- Gauges are all relatively new.
- A successful maintenance program with BoM and Council working together is in place.
- Levels at Ferry Gully and O'Reillys Weir can be impacted if water levels are below doppler height. As such, it may not be evident when issues arise outside of the maintenance program.
- Tindarra Station has a low reliability. It only gives Roma a 2 hour lead time. A lot more and frequent data is required. BoM need to request the information at 30 minute intervals and this causes the river station to drop offline due to power usage. This happened in 2010 and 2012 and Maranoa Regional Council did not have sufficient warning of the pending flood water.

- Orifice blockages at some locations. Council recommends: purge timers, moisture shorts, five yearly battery replacement, 15 year canister replacement.
- Occasional failure due to storm damage, inadvertent public damage or vandalism.
- Stream water level gauges can be damaged due to flood debris striking the tubes and damaging them. The gas cylinder can also run out of gas. We presently have no way of knowing if the cylinder runs out of gas in between servicing visits. Warwick's main gauge did not record a reading in the last flood on 2 May for this reason.
- The extraordinary flood event of January 2013 saw some equipment in the Baffle Creek catchment inundated, however, with the topography of the terrain little can be done to alleviate this possibility.
- Since 2013, installation of new gauges had been done using appropriate technology prescribed by BoM. However, the ALERT gauge installed at the Mt Lawless site may be vulnerable as the Mt Lawless location (a hut) was inundated in 2013. Council has installed the ALERT gauge technology above the 2013 flood height in an attempt to mitigate inundation.
- Prior to 2013, there were few if any ALERT gauges in the region; the majority of gauges were telemetry gauges only or even manual gauges. There were numerous instances where telemetry gauges were unable to provide data due to damage or no power to telephone towers. Additionally, the gauge at Bundaberg township was a manual gauge and was itself damaged in 2013. However, these issues have been addressed by the installation of ALERT river/rain gauges at existing sites and new ALERT rain gauges more broadly across the region.
- The data from the gauges is delivered to Bundaberg Regional Council's EnviroMon system via two repeaters: Watalgan and Mt Goonaneman. This data is also delivered to BoM. If the EnviroMon system was to fail the data can still be delivered to BoM in Brisbane via Gympie from the Mt Goonaneman repeater.
- It would be ideal to have proper rating curves for gauges for improved calibration of flood models.
- Council has very limited skills and resources.
- Council's major issue and talking point with BoM relates primarily to advances in technology; particularly how the use of emerging technology can be integrated into the existing BoM networks and warning systems. Council experiences some frustration with the lack of consistency coming out of BoM redesign and equipment configuration specifications for new ALERT installations that don't necessarily have the traditional Elpro canister set-up. After reviewing current 'whole package' systems on the market and discussing with other Councils who have installed, Council certainly considers this technology moving forward in the expansion of our ALERT network. However, if BoM will not provide the data on EnviroMon, we are in a bind. With consideration to programming: as the equipment (aside from the compressor) and sensors are the same as the normal stations, the units have certified calibration and are installed in the same manner to spec. Council doesn't see a reason why BoM would not support the increase in available ALERT network data (on EnviroMon) irrespective of the manufacturer. It is Council's understanding that these systems meet all relevant certification.
- Debris or silt giving false readings.
- Council has no issues with equipment age affecting reliability as all electrical gear is under six years old and only in service for five years. This is supported by:
 - A proactive battery changeover policy
 - Constant monitoring by Emergency Management staff and Field Officer in active (daily) and non-active (weekly) season
 - Increased monitoring by Emergency Management staff in storm season and periods of high forecast rain.
- For manual gauges floods can cut access to the gauge.

- For automated gauges the system is partly reliant on internet access that can fail during a flood.
- While the gauges generally work well, errors/faults can occur as a result of servicing the gauges. Also, a lack of understanding about how the gauge network works can result in accidental incorrect operation of the gauges e.g. not ensuring sensors are reinstalled to their calibrated level after removal.

14. How is the maintenance funded for rainfall and stream water level gauges operated and maintained by your council?

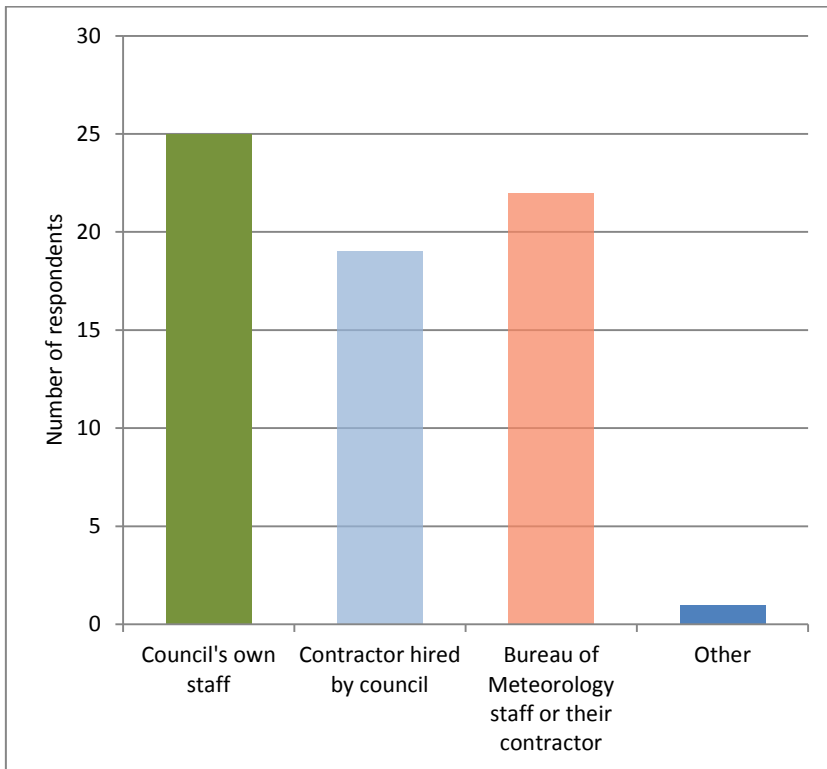
Total number of respondents: 35

Local government area	Funding mechanism
Barcaldine Regional Council	Local government budget. State government funding if available.
Barcoo Shire Council	From existing Council revenue sources. Council would prefer that additional external funding be provided for the operation and maintenance of these gauges.
Blackall-Tambo Regional Council	Ongoing maintenance expenses are accounted for in Council's budget. Council staff have been trained by BoM to undertake routine maintenance. BoM staff are engaged to undertake major maintenance. This has been supported by funding (funding to install stage 2 covered the maintenance of the existing sites which was undertaken when BoM was here to install new sites).
Boulia Shire Council	As per DTMR budget for main roads maintenance.
Brisbane City Council	Approved Hydrometric Asset Management Plan, and fully funded budget to ensure desired level of service is maintained.
Bundaberg Regional Council	An allocation is made by Council's Disaster Management area through the annual Council budget process. The budgeted amount is derived from previous years' costs and advice from BoM or external supplier (i.e. Prospect Environmental, who have installed two gauges in this area since 2013). In the short to medium term there will be a maintenance expense of up to \$15,000 as BoM technician is engaged to undertake proactive annual maintenance on a cost recovery basis. The medium term plan is for a Bundaberg Regional Council technician to undertake proactive as well as reactive maintenance.
Burdekin Shire Council	Council budget allocation.
Burke Shire Council	When required through Council's maintenance programs.
Cairns Regional Council	Council maintain the regions Flood Alert gauges with BoM monitoring and calibrating annually. An Electrical Services and Facilities Maintenance officer accompanies BoM on their annual visits.
Carpentaria Shire Council	Through Council budget.
Cassowary Coast Regional Council	Through the operational budget. Levels are reasonable at present but as gauges and installations age, more funding will be required.
Central Highlands Regional Council	Council operational budget, plus a very sound working relationship with technical officers in BoM.
City of Gold Coast	Funds are provided in the annual City budget.
Fraser Coast Regional Council	Through Council budget.
Gladstone Regional Council	Funding is included in operational budget allocations for Disaster and Emergency Management.
Goondiwindi Regional Council	BoM do six monthly proactive maintenance runs with council providing materials and consumables. Council does minor reactive maintenance
Hinchinbrook Shire Council	Funding for Maintenance and Operations is included in the Engineering Departments' Operating Budget.
Ipswich City Council	Recently it has been through operational budgets allocated yearly (previously no budget)
Isaac Regional Council	Through Council's operational budget
Lockyer Valley Regional Council	Through Council's budget

Local government area	Funding mechanism
Logan City Council	Through Council's budget
Mackay Regional Council	Through Council's budget
Maranoa Regional Council	Council's operational budget
Moreton Bay Regional Council	<p>Adhoc maintenance is undertaken internally by Council at Council Cost (staff and equipment costs Council Funded).</p> <p>For gauges installed before December 2012, annual gauge maintenance is undertaken by BoM with assistance from Council (BoM fund BoM staff costs, Council fund Council staff costs and equipment costs).</p> <p>For gauges installed after December 2012, annual gauge maintenance is undertaken by BoM with assistance from Council (Council fund BoM costs (BoM cost recovery), Council staff costs and equipment costs).</p> <p>Six monthly maintenance checks are undertaken internally by Council at Council Costs (staff and equipment).</p>
Noosa Council	An allocation for maintenance is provided however there is no scope to undertake any renewal works as it is yet to determine that these assets should be on Council's asset register.
North Burnett Regional Council	Through Council's operational budget.
Rockhampton Regional Council	Through Council's budget.
Scenic Rim Regional Council	Through Council's annual operational budget.
Somerset Regional Council	Original installation was paid for by NDRP funding. Ongoing maintenance paid by Council's operational budget.
Southern Downs Regional Council	<p>Funding is allocated Council's budget (Disaster Management) and is determined by Councillors.</p> <p>The current budget has seen a major reduction of funding to the Disaster Management Cost Centre and resulted in prioritisation against other disaster management activities and events.</p>
Sunshine Coast Council	Through Councils internal operational budget.
Toowoomba Regional Council	Through Councils internal operational budget (Transport & Drainage Planning Department).
Townsville City Council	Through Councils operational budget.
Western Downs Regional Council	Through Councils internal budget.
Whitsunday Regional Council	BoM do the annual maintenance assisted by Council Staff. Council pay for replacement equipment and items as required.

15. Who carries out the maintenance on rainfall and stream water level gauges your council operate and maintain?

Total number of respondents: 37



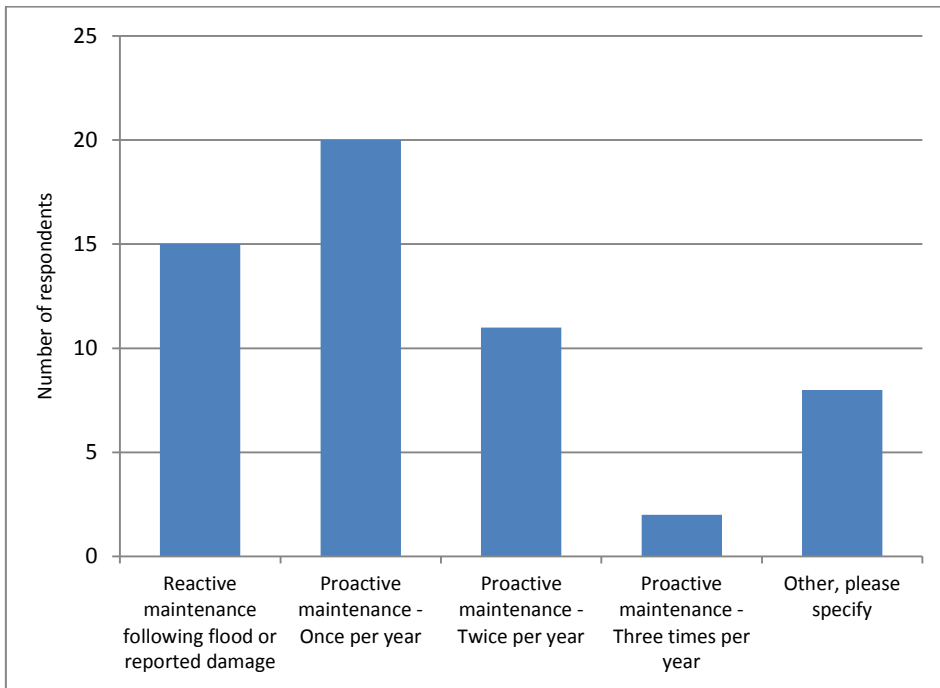
Where one respondent recorded that an 'other' party carried out the maintenance on rainfall and stream water level gauges their council operated and maintained they did not specify who this other party was.

Contractors that Council's identified they were hiring were:

- Prospect Group, Nundah
- Pentair/Greenspan,

16. What maintenance regimes are in place for the rainfall and stream water level gauges your council operates and maintains?

Total number of respondents: 37

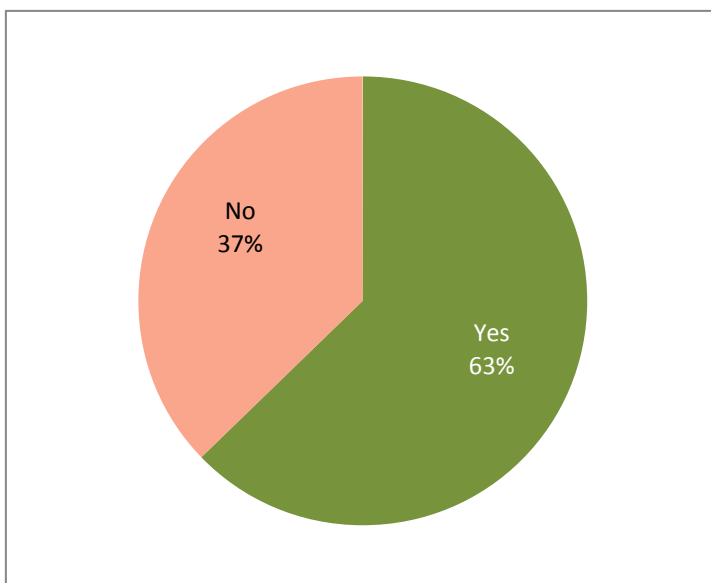


Other maintenance regimes that respondents specified included:

- Adhoc maintenance as issues arise
- Pre- and post- storm season servicing
- Quarterly checks
- No maintenance (for new gauges as regime is yet to be agreed with BoM)
- Reactive maintenance following EnviroMon review
- Proactive fire mitigation maintenance on key gauges considered at risk of excessive fuel load build-up.

17. Do you have any suggestions for improving the efficiency and coordination of maintaining rainfall and stream water level gauges, and/or sharing of data collected from gauges?

Total number of respondents: 51



The suggestions of respondents who answered 'yes' to this question were:

Local government area	Funding mechanism
Barcaldine Regional Council	Is flood data along the Thomson River being used and shared efficiently between all local governments within the catchment? For example, Barcaldine Regional Council data is useful to Longreach Regional Council. Investigate if automated stations along the Thomson will improve coordination.
Barcoo Shire Council	Maintenance in this remote region by one entity to achieve uniformity and cost efficiencies. Shifting from satellite data transmission to other alternative means when/if other communication services become available to avoid data delay and third party data handling.
Blackall-Tambo Regional Council	BoM online map could be larger or have the zoom capacity so we can zoom in on our region better.
Brisbane City Council	The maintenance of rainfall and water level gauges is a specialised field and not readily available to all authorities. Fostering and assistance with resources in this area should be considered.
Bundaberg Regional Council	<p>Neighbouring local government authorities have installed ALERT BoM-appropriate gauges. These gauges are being made visible on Bundaberg Regional Council's EnviroMon system (the software provided and utilised by BoM).</p> <p>Sunwater has requested access to Council's EnviroMon server; there are some issues with external agencies accessing Council systems that need to be resolved before this is finalised.</p>
Burke Shire Council	Installation of automatic gauges at Doodadgee (currently gauge 29158) and Escott Station (currently 29159) on the Nicholson will provide necessary information to accurately monitor flood levels of all of the Nicholson River catchment area.
Cairns Regional Council	Consideration should be given to the integration of new technologies that require less maintenance. There are new systems designed as a camera system with automated sign control and the ability to report on the ALERT network. Unfortunately, if the system does not use the BoM standard Elpro canisters/equipment e.g. Campbell's, it is not considered to meet their specifications. There are a number of Campbell- based sites online and transferring through BoM's system. Some of these have been operating for years so it would be nice to see some consistency and also currency in offering the best information possible to local government and the wider disaster management community decision makers.
Carpentaria Shire Council	Adjusting the numbering of some gauges to better reflect basin information.
Cassowary Coast Regional Council	<p>This review is needed to sort out ownership issues and maintenance responsibilities as records are often unavailable.</p> <p>Land access issue would be better managed through a consistent approach possibly lead by the State as each Council will be doing their own thing when freehold land changes hand there may be issues regarding access. BoM guys are great and very helpful.</p>
Central Highlands Regional Council	<p>Queensland is one of the few states where BoM has technical support staff that do work in the field with Local Government officers both in maintenance advice and support , and with siting of flood warning equipment. They are perhaps under-resourced now with the number of additional gauges installed since 2010/11 floods. While there is scope to have private contractors maintain equipment, what fails in that process is the network relationships that become absolutely critical for good sensible dialogue during a disaster event between the Emergency leaders and Councils LDMG (these are too late to be built during an event). Also the direct learnings and connections made by Council staff and BoM staff working in the field pre-season are invaluable in discussing catchment behaviour. The interpretation and warnings system is currently relying on some experienced staff in both DNRM and BoM and as these retire, without a planned and strategic staff development program - knowledge will drop away.</p> <p>While Council can develop its own modelling expertise and improved capability to develop better in-house predictions, this must never come at the expense of supporting and enhancing the capability of the central agency, BoM, who is chartered with this responsibility and will always have far greater skills base and longitudinal capacity to deliver this role.</p> <p>Joint regional flood warning discussions and workshops between asset managers and key disaster management staff might be useful in a tight financial market as we are now. DNRM, BoM, Sunwater and local government to discuss flood warning networks and improve the collective way in which all the agencies collaborate and decide on regional priorities and direct capital funds to see the necessary and high priority changes occur. Currently funding</p>

Local government area	Funding mechanism
	is either a direct result of a catastrophe or piecemeal shire by shire. Catchment boundaries do not follow shire boundaries; early warning for one shire is often early warning for the next.
City of Gold Coast	A central database for storing all recordings which all Councils have access to and regular meetings with different stakeholders.
Diamantina Shire Council	Possible upgrade in future required for automated systems.
Fraser Coast Regional Council	There are over 100 agencies across Australia that operate rainfall and flood monitors. It is high time that all monitors are placed under the control of a single agency be that State or Federal level. They could also be provisioned with specific funding for maintenance from either government level.
Gladstone Regional Council	It would be beneficial to be able to access rainfall data from neighbouring local government areas for situational awareness and for input to modelling as appropriate. (Link through EnviroMon?) Also, the ability to access historical data from other agencies and organisations to inform flood studies and provide background awareness would be beneficial.
Goondiwindi Regional Council	Gauges should be under ownership and control of one national body as our flood water for most settlements is created by rain events in northern NSW. This would limit duplication that exists at some locations and provide for greater utilisation of the available data. Users of the data like councils, Sunwater and state agencies could subscribe to the controlling body for access to the information.
Ipswich City Council	Apply standard procedures/policy/guidelines adopted nationally/state wide Allocate dedicated staff to operate and maintain flood gauges as a critical asset Adopt AHD nationwide Data and services for disaster management purposes should generally be made free of charge. For example: Should not charge for subscriptions for improving disaster management/flood forecasting, such as rainfall grids etc., as it possibly disadvantages smaller Councils that cannot afford these services.
Lockhart River Aboriginal Shire Council	Expand network and fast track upload of data to BoM.
Lockyer Valley Regional Council	A better method of coordination, e.g. all gauges by one owner and the capability to send data to appropriate agencies.
Longreach Regional Council	Refer previous comments about the need for automated river height gauges.
Mackay Regional Council	If online access to DNRM gauges was available this would assist in forecasting and monitoring weather events and provide greater situational awareness. Also if more opportunities to have more joint sheds with DNRM with own equipment installed to enable alerting would be a cost advantage. Need to take advantage of better data sharing, maintenance and cost sharing if applicable.
Mareeba Shire Council	Data from all gauges should be readily available to local government.
Moreton Bay Regional Council	It probably needs to be recognised that with the large increase in number of gauges that BoM resources to maintain the gauges are stretched and a collective pressure may be required to ensure the appropriate resources are provide to meet this need (2014/2015 annual maintenance is certainly much behind schedule).
Noosa Council	These are expensive equipment and whilst Council is very appreciated of the technical support of BoM to undertake an annual inspection and maintenance there is very limited funding for renewing or replacing these assets.
Rockhampton Regional Council	Convert to automatic systems and make publically available details of the gauges (age, type, error range). More consultation with Councils on location of gauges and maintenance. More details on costs and greater cost sharing.
South Burnett Regional Council	Private gauge results should also be made available to the Local Government Area that they are sited in, to assist with further responsive action. For example, South Burnett has North Burnett gauges and Western Downs gauges located with its boundaries yet have no access to that information unless it is sought as a reactive measure.

Local government area	Funding mechanism
Sunshine Coast Council	<p>AWRIS was meant to be the facility for sharing of data collected under the Water Act. This is still required.</p> <p>Council has a desire to have near real time access to ALERT rain gauges from other LGA's, so that rainfall totals can be readily observed on internal systems (TARDIS, DisasterHub) as an event approaches. This data should be readily accessible via FTP from BoM.</p>
Tablelands Regional Council	<p>Better cross boundary cooperation across local governments when installing rainfall and river height gauges to ensure that the benefits are wider than a single council area.</p> <p>All agencies to agree access to their gauges with BoM which in turn enables public/agency access. Aware that many different agencies have gauges but not all are accessible.</p>
Toowoomba Regional Council	<p>Make STREAMS data (Main Roads) available to Councils in real time through EnvironMon</p> <p>Make Queensland Rail data available to Councils in real time through EnviroMon</p> <p>Provide assistance to Councils to upgrade old pluviometers to BoM standard (205mm) pluviometers.</p>
Townsville City Council	<p>The TARDIS software developed by Council is a web-based interface which complements the EnviroMon software. TARDIS gets processed data from EnviroMon. The entire archive of data within TARDIS can be searched and then displayed as IFD charts and various reports. Set up appropriately, TARDIS can be used for flood-forecasting using Thiessen polygons. TARDIS also has an option for integrating BoM Meteye rainfall predictions for flood-forecasting. In addition, there are a number of asset management features in TARDIS such as communication outage alerts.</p>
Weipa Town Authority	<p>More regular updates of gauge readings on BoM website. Water levels can change very frequently through the season; it would be useful if the information would be updated more regularly.</p>
Whitsunday Regional Council	<p>Share information with Queensland Rail who also has gauges.</p>
Woorabinda Aboriginal Shire Council	<p>DNRM to come to the community and run a workshop with community, Council and other interested parties on this project and its objectives.</p>

IN-DEPTH INTERVIEWS SUMMARY

Interview summary sheets follow.

Consultation communication materials

This section provides copies of:

- Letter of introduction
- Local government questionnaire
- Overview factsheet

FWN REVIEW (BEW551)
INTERVIEW RECORD SHEET

Organisation BOM
Date 4/08/2015
Method Face to face meeting
Present

Name	Organisation
Chris Gimber	KBR
Greg Scroope	KBR
Wai-Tong Wong	DNRM
Chris MacGeorge	BOM
Rob Webb	BOM
Bruce Gunn	BOM

ID	Flood susceptibility	Network		Operation		Maintenance		Out of scope
		Current	Improvement	Current	Improvement	Current	Improvement	
1	BOM believe local council is best placed to interpret and respond to flash flooding since they know the local area and landuse (and recent changes).	Gauge data that is not formally accepted by BOM still provides a useful function - e.g. overview information, general awareness, movement of peaks etc	Push towards national standardisation of equipment. Facilitated through the national infrastructure working group (in early stages)	SLS relies on non-BOM gauges. If gauges are removed this will affect the service available		4 people maintain approx 1200 sites		
2		BOM will often view third party data (e.g. South West NRM Ltd), but it is not directly adopted for input to models	Certification of equipment (e.g. approved suppliers) may occur in the future. This has been successfully applied to aviation equipment	BOM provides substantial support to local councils. This includes network design (hydrologists) and design details (technical staff)		Typical maintenance cost is \$600-\$1,000/a per site. Lower end if rain gauge only, higher end if rain/river		
3		FWN performance is reviewed regularly in the form of an event debrief. This includes assessment of where gaps exist and where upgrades would be beneficial	Move towards performance specification, rather than product (technology) specification. This will open up the field to more suppliers and innovation	Risk is high staff turnover in council and loss of intellectual knowledge on flooding		BOM \$150K operational cost (excluding FTEs) including repeater maintenance		
4		There is only one supplier of ALERT (Alpro Technology), which should be addressed to increase commercial competition	More governance around how the network should be developed and funded	BOM's role in flash flood is to provide information on heavy rainfall and understanding the type of rain that may lead to flash flooding. Interpretation and response is best performed by council.		Asset replacement typically \$50-100K/a (excluding manual only sites) and uniformly distributed year on year		
5		Key weaknesses in the current FWN are: 1) lack of standards; 2) lack of governance		Council need to match flash flood risk to resourcing. i.e. a risk based approach		Maintenance cost should be 10% of capital cost if performed properly		
6		KPIs for network performance are under development (not yet available)		The FWN is very resilient. BOM can still provide a flood warning service even if components break down (although the accuracy of the service may diminish)		Typical replacement life of: Battery - 2y, Canister - 10y, Infrastructure - 20y		
7		KPIs are required around all components of the system. For example, a 3rd party system could be operating but there may be a breakdown in the connection between a 3rd party and BOM.		Data accuracy during an event is checked by spatial visualisation, filters etc. During an event a technician is assigned to review data, compare flows and identify unusual data		Maintenance report given to council after inspection - includes recommendations		
8		Benefit of ALERT is that it avoids reliance on 3rd parties, meaning there are fewer points of failure		BOM resources are prioritised by the lead forecaster. Duty officers are assigned to specific catchments for the duration of the event. Allocation of resources depends on the size of the event, complexity etc				
9		BOM feel the main source of failure is third party communications providers		Forecasters have degree qualifications in environmental science or engineering and complete in-house training				
10		BOM guidance if for gauge station housings to be situated above historical flood peak levels						

FWN REVIEW (BEW551)
INTERVIEW RECORD SHEET

LGA Cassowary Coast Regional Council
Date 17/07/2015
Method Face to face meeting
Present

Name	Organisation
Kyra Stemm	KBR
Graeme Milligan	DNRM
Chris McGeorge	BOM
Tristan Richter	Greenspan
Jason Hemmingway	Cassowary Coast RC
David Sharp	Cassowary Coast RC
Rod Hayley	Cassowary Coast RC

ID	Flood susceptibility	Network		Operation		Maintenance		Out of scope
		Current	Improvement	Current	Improvement	Current	Improvement	
1	A number of communities get cut off from flooding	Rely on BOM to issue warnings	Access to QR and TMR gauges and integrate with the flood network (avoid duplication of infrastructure)	Flood studies/modelling have been undertaken for emergency management	There are some challenges in getting the community to believe/understand the PMF flood levels as they generally only understand the 1967 event (which modelling suggests is a 1:30 year event)	Annual budget is minimal based on the previous year (rather than asset management). Unsure of expenditure due to aging gauge equipment.	Having a dedicated resource (Technician) for the flood gauges. Currently there is not a huge amount of experience as maintaining the gauges is only one of the priorities	Access issues identified included access to private property - it takes time for farmers to grant access to the gauges. Issues due to Panama outbreak on Banana farms.
2	The highway is susceptible to flooding and Tully gets cut-off	7 gauges are owned/maintained by Council which are located outside the LGA region	Integrate with gauge information on the SKADA network (ie. Try to do more with one gauge)	CCRC have modelling (level 3 modelling) for 2 to 500 year events	Would like to do more on identifying "Minor", "Moderate" and "Major" indicators as they don't reflect the current modelling.	Currently CCRC are trying to put a good management plan together including a condition assessment to identify what is Council's and setup a maintenance strategy	Regular clearing program as part of the maintenance.	Planning scheme identifies a required floor level and freeboard for new structures, however it is unsure what the final level is as there is no final floor survey. Would help in understanding flood impacts.
3	Innisfail was identified as vulnerable	There are some gauges installed by "Rivertrust" which still exist. At present it has not been formalised that Council own the gauges that were originally installed by Rivertrust	There is a gauge which is currently located upstream of the confluence and perhaps downstream of the confluence would be better for warning	Enviromon is in the main office (Innisfail) and visualised on the server	Better understanding of flood impacts by understanding the flood height related to over-floor flooding. Properties would require floor survey.	Council's gauge network is treated as one asset in the finance register	Access for maintenance/repairs especially in events) is a key issue for CCRC. Some gauges are located in adjacent LGAs where there have been some issues with access being locked. A masterlock system would be beneficial for shared gauges.	
4	Jumbun Aboriginal Community may be vulnerable to flash flooding.	WBM have assessed the distribution of gauges	More communication with DNRM and BOM (some DNRM gauges are not on ALERT)	Enviromon receiver in Tully		Annual maintenance every October with BOM	National Parks lock gates before an event (to prevent campers etc. from entering) however it cuts off access to gauges and clearing immediately after an event. Master key or other access provisions would be beneficial.	
5		Gauges in the network are sufficiently placed	Access to DNRM sites (eg. Silkwood)	Can access enviromon information from any office		Maintenance of gauges relies heavily on recommendations from the BOM maintenance		
6			ALERT gauge/s for Cardwell			Battery replacement is usually 3 yearly with ADHOC maintenance for batteries etc based on Enviromon		
7			More rain gauges to provide more information on temporal distribution and correlate gauge heights with rainfall			Solar panel replacement on an as-needed basis		
8						Some available spares		
9						Technicians with computers are brought in from Tully if canisters require reprogramming		

FWN REVIEW (BEW551)
INTERVIEW RECORD SHEET

LGA Lockyer Valley
Date 6/07/2015
Method Visit
Present

Name	Organisation
Haydn Betts	KBR
Andrew Chapman	KBR
Wai-Tong Wong	DNRM
Greg Scroope	DNRM
David Mazzaferrri	Lockyer Valley RC
Tristan Richter	Pentair

Sites inspected

UPPER LOCKYER ALERT (540566 - Council)
 SPRING BLUFF ALERT (540527 - Council) ; SPRING BLUFF TM (540507 - DNRM)
 WOODLANDS ROAD ALERT (540680 -Council)
 MULGOWIE ALERT (540528 – Council)

ID	Flood susceptibility	Network		Operation		Maintenance		Out of scope
		Current	Improvement	Current	Improvement	Current	Improvement	
1	Almost all townships vulnerable to rapid onset flooding (flash)	All LVRC council gauges are shared with BOM and transmit via UHF	Some valleys not properly gauged	Direct enviromon access		LVRC carry some equipment spares (canisters, batteries, solar panels)		
2		LVRC has direct access to a enviromon server on site	Flows breaking out of channel in agricultural areas not easily monitored – creeks are mobile and flooding mechanisms change	Proper equipment and construction used for installations.		Shared maintenance with BOM. LVRC undertake 6 month inspection (clean, test battery, cylinders, etc) and team up with BOM for annual service		
3		Some gauges with real time video feed to look for changing conditions across roads or channel breakouts in perched systems	Would like automatic text message alerts sent to public when set triggers are reached	Emergency Management coordinator knows the system well.		Maintaining the O&M funds is challenging.		
4		Need a lot of repeater stations due to the terrain		Manual gauge readings provided by members of public.				
5				Weekly network status check via online system (enviromon)				
7	Mostly flash flooding and some riverine	All gauges are in partnership with BOM	Deadspot at Tenthill Creek Mount Sylvia	Share information with other entities - with SEQWater, Somerset RC and Ipswich		Spend 15K to inspect gauges each year		Erosion changes flow directions, Junction View
8	High with major flooding and loss of life: Gatton, Murphys Creek, Laidley, Forest Hill etc	Rain gauges critical for flash flooding	Sandy Creek	Enviromon system is used for maintenance surveillance - identifies if there are holes in the data		Risk is that is no flooding for a long period, budget will be cut		Risk: Tourists to Glenrock
9	Bridge and road losses	Some cameras have been installed, they are most useful for flash flooding (e.g. check if bridges are cut)	Alice Creek	Enviromon generates alarms for flash flooding (based on predefined triggers)		BOM has implemented cost recovery with council		DTMR: local not keen on council supplied website onto DTMR system
10		Cameras highly valued if pan, tilt zoom Cameras report through 4G, LVRC is revamping its website using Somerset RC website as a model	Warrago Highway	Heuristic response to flash flooding (i.e. based on past experiences)		Council perform reactive maintenance		
11		Spatial network of river gauges could be improved, future investment should be on more rain rain gauges - better value	Better ability to log onto websites	Flash flooding - council will phone normal customers impacted to provide warning		Routine maintenance is undertaken by BOM, but council attend so they can learn		Guage Lats and Long should be to 6 digits after decimal point
12		Have own ENVIROMON server all in VHF and repeaters BOM has a backup LVRC has a firewall There are no gauges that are not in the BOM system BOM/LVRC maintain together	More gauges at breakout points			Prosect and Greenspan provide fallback maintenance options if BOM are not available and council do not have the skill		
13		LVRC buys equipment and spares Standardised on ELPRO	Holes in valleys susceptible to thunderstorm flooding					
14		Funding 33/33/33 or 50/50	Capabilty to improve warning by text/sms service					
15		Battery checks every 6 months	Would never have too many gauges					
16		Annual network maintenance						
17		Not resourced enough so pay BOM to maintain and operate						

**FWN REVIEW (BEW551)
INTERVIEW RECORD SHEET**

LGA Lockyer Valley
Date 6/07/2015
Method Visit
Present

Name	Organisation
Haydn Betts	KBR
Andrew Chapman	KBR
Wai-Tong Wong	DNRM
Greg Scroope	DNRM
David Mazzaferri	Lockyer Valley RC
Tristan Richter	Pentair

Sites inspected

UPPER LOCKYER ALERT (540566 - Council)
 SPRING BLUFF ALERT (540527 - Council) ; SPRING BLUFF TM (540507 - DNRM)
 WOODLANDS ROAD ALERT (540680 -Council)
 MULGOWIE ALERT (540528 – Council)

ID	Flood susceptibility	Network		Operation		Maintenance		Out of scope
		Current	Improvement	Current	Improvement	Current	Improvement	
18		Trigger levels based on Minor, Moderate and Major flood levels.						
19		Repeaters Mulgowrie, Mt Garigal Road						
22		Cameras are more susceptible to vandalism (particularly in remote areas)						
23		Redundancy has been incorporated into new installations - e.g. bigger batteries and panels; still have telemetry parallel to ALERT systems; maintain manual gauges						

FWN REVIEW (BEW551)
INTERVIEW RECORD SHEET

LGA Mackay Regional Council
Date 9/07/2015
Method Face to face meeting
Present

Name	Organisation
Haydn Betts	KBR
Graeme Milligan	DNRM
Andy Barnes	BOM
Tristan Richter	Greenspan
Bruce Chester-Martin	Mackay RC
Robin ? (SW Engineer)	Mackay RC
Luke ? (Planner)	Mackay RC
Patrick (Rick) O'Riely (civil ops)	Mackay RC

ID	Flood susceptibility	Network		Operation		Maintenance		Out of scope
		Current	Improvement	Current	Improvement	Current	Improvement	
1	Pioneer River - only get 10 hours notice with Mirani providing 4 hours	All gauges moved from the Pioneer River Improvement Trust to MRC	Plane Creek above Sarina		Add TARDUS system for others to see data from ENVIROMON	Rick does with BOM Does casual maintenance		
2	Heavily dependent on ALERT system	In 2009 change from Futuretec to ELPRO	Middle Creek Dam above Sarina		Council has a quality management system but not sure whether it is in place for FWN. DO daily checks to see if system is working Not set up as SOP - a to do job	No real budget restrictions: have separately rates fund \$600kpa, of which 80% to capital Thinking about another fund for risk management		
3	Have ENVIROMON server and pager	Clark Range has two stand alones about 2m apart - needed for lightning strike				KPI - all working within 2 days of going out		
4	Radio linked with triple redundancy - Mackay, Paget and BOM		Obtain access to DNRM gauges at Mirini, Marion, Gorgette(?), Finch Hatton, Dumbleton (on opposite side), Whiteford			Keep maintenance records		
5	Vulnerabilities: Finch Hatton, population to the north - main road is out, Dumbleton.		Gargett on old road could be better positioned			100% of batteries less than 5 years, prefer 2 years		
6	Have list of stations and warning implications		Flash flood cameras/flashing lights on TMR Peak Downs Hgy and causeway at Sandy Creek			Stations - expect 98% to be working -3 day outage		
7	2m Tiger Dam was not successful - too difficult to set up and vulnerable		Need PTZ camera for Mitani Weir, Middle Ck Dam					
8	Still to review Minor, Moderate and Major flood classifications		Sarina Depot does not have backup power					
9	Flash flood areas - urban area of Mackay Sarina		Batteries now 5 years on and need replacing					
10	Dam failure - impact on the southern side of Sarina		Mirani needs a back up as a time critical catchment. At present have to run through SunWater					
11	BOM website updates 23 mins part the hour		No gauges in Sarina area - need Plane Ck and Middle Ck, east side of Sarina - Bells Creek which is a major access road					
12	Critical infrastructure: Wetherston Shopping Centre, Airport, CBD _ Telstra, Police, Rural; View - McCready Street - access to the new cyclone shelter is an issue		MRC would like access to more DNRM sites - dial in ?					
13	No gauge superfluous - running very lean		Radar gets cut for 1.5 hours twice a day while BOM recalibrates???					
14	Access lost: Alligator Creek to south Plane Ck Peak Donws Hgy Sandy Ck at Eaton North at Lane Ck - Kolizo and Black Rock floodway							

FWN REVIEW (BEW551)
INTERVIEW RECORD SHEET

LGA SunWater
Date 14/07/2015
Method Face to face meeting
Present

Name	Organisation
Haydn Betts	KBR
Graeme Milligan	DNRM
James (Jimmy) Stuart	SunWater
Jason Venables	SunWater
Ben	SunWater

ID	Flood susceptibility	Network		Operation		Maintenance		Out of scope
		Current	Improvement	Current	Improvement	Current	Improvement	
1	Callide - refer IGEM report	Ross R dam: access data through Townsville City Council	Sunwater has installed a new gauge in Callide system	Doing internal training	Sunwater will provide access to its gauges for the ALERT network			
2	Mackay City - is set up, large number of people in the floodplains - about 5000-6000 people in the Emergency Apert Polygons - effectively a flood warning system	Others - feed off ENVIROMON data - FTP available within an hour	Need gauges at Paradise and other high risk dams	have SOP, O&M Plans, internal training register, part of A&M process				
3	Callide - we have highlighted issues with temporal patterns used to design dams - for small catchments (less than 500km2) under dispute		For new dam sites, a hydrologic network exists in the Connors River - rain gauges are in the bush probably owned by nobody - need to check with John Ruffini at DSITI	Gauges are examined - quarterly as a minimum				
4	Townsville and Mareeba - all DNRM		Priority is dam safety: all high risk dams have at least one gauge	Annual calibration on river stations				
5	Cairns - ALERT system is all for Cairns, nothing for Mareeba		Large gaps in the flood warning network - need ALERT for Mareeba and Pioneer Valley	More detailed examination of dams - will check WUIN and then gauge level				
6	Tinaroo - all DNRM - upper catchment	Tinaroo - need upper catchment pluvios	Rating curve are from BOM and synthetic	Do rely on DNRM gauges - a legacy issue				
7	Paradise and other high risk dams		Looking at own system - Water Infrastructure Network					
8	St George has a manual gauge - different to ALERT		Data mgt HYDSTRA					
9	Clair has 3 gauges - staff, DNRM and BOM ALERT - which is being reported?		Flash flooding is a major risk to Sunwater - dam safety eg North Pine and Callide					
10	All state datum now converted to AHD		Current gauges are to be configures to ALERT eg Mareeba and an additional pluvio					
11	Have tail water gauges							
12	Sunwater want to avoid confusion and insist on AHD for water levels behind a dam - primary purpose is water management, secondary is emergency management							
13	Sunwater has SCADA system and currently investigating how to ingest that into Sunwater system							
14	Technical standards - use AS 3778, uSGS and Dept Interior BOM 2013 standard ofr instruments is expensive							
15	Key vulnerabilities: mobile networks Redundancy - back up needed timeliness of data support of councils Sunwater is only on 3G with 6 on land line flood debris - rippling out capillary lines							

FWN REVIEW (BEW551)
INTERVIEW RECORD SHEET

LGA Ipswich City Council
Date 14/07/2015
Method Face to face meeting
Present

Name	Organisation
Haydn Betts	KBR
Wai Tong Wong	DNRM
Adam Berry	ICC
Hoy Song Yau	ICC

ID	Flood susceptibility	Network		Operation		Maintenance		Out of scope
		Current	Improvement	Current	Improvement	Current	Improvement	
1	Flash flood forecasting is a concern but under resourced	11 new gauges	Think pretty well covered, good coverage on the Bremer	ICC has gone through a massive upgrade program using 3m and 4m poles - this poses significant WHS issues	Seeking a real time flash flood forecasting tool but non in Aus yet	Prospect dues annual maintenance		Trailing rain on grid modelling , 2m grid using RAFTS temporal patterns
2	How is flash flood managed? Scared, no resources, ICC relate well with SES teams 3 hour duration storms	18 upgradeds including some complete replacements have tried the tilting poles - but BOM won't maintain	Have stream gauge gap on a dam	Height of poles is a trade off between WHS and the required immunity of gauges (no good for flood warning if they are flooded)		BOM does a pre-season run		Don't have a disaster management officer
3		Configuration of the platform - swinging gates considered	ICC WANTS A STANDARD			Prospect fixes faults: to be fixed within two days unless urgent		Council is aware of the need but not the need for resources
4	Don't pay much attention to Warrill Creek - flood risk is low		Amberly needs a rain gauge for its warning			Don't have people in councils that can maintain - we can do but don't have the resources		Having a meeting with other councils and SEQWater for mutual support
5	BOM forecast points: currently reviewing with BOM, for Rosewood and Amberly. BOM have three forecast locations - ICC say need 9 BOM is overloaded					Gauges now treated as an asset		Need to refine waterRIDE for 3 hour events
6	Flash flooding: bundamba, Woogaroo					Have Service Level Agreement for existing stations		Thinking about an alternate platfor ofr ENVIROMON - Aquareious, Hydronet, TARDIS, not thought about mobile apps, IT is outsourced
7						11 new stations - ICC to maintain		Struggling with rating curves
8						Not resourced enough - can't employ a full time equivalent		BOM Minor, Moderate and Major classifications: outdated, source of confusions, tend to underestimate, need to be reviewed - base on rural classifications: Risk is that if there is a change in meaning, the public will not understand - ICC needs an extreme classification
9								Policy: worried about liability particularly for flash flooding, run risk of engineers doing work for which not trained
10								Want FPMgt Guidelines that have uniformity
11								No State policy on floodplain management
12								Need BOM to review temporal patterns
13								Succession planning is a risk



20 May 2015

Department of
Natural Resources and Mines

Mr Bernie McCarthy
Chief Executive Officer
Aurukun Shire Council
39 Kang Kang Road
AURUKUN Queensland 4892

Dear Mr McCarthy

Performance Review of Flood Warning Gauge Network in Queensland

The Queensland Government is committed to improving the flood warning system in Queensland and has commenced a performance review of the Flood Warning Gauge Network dealing with the monitoring of rainfall and stream flow information by various local, state, private and Commonwealth entities, and its on-going maintenance for flood warning purposes, used primarily by the Bureau of Meteorology.

The study has multiple objectives including assessing:

- The adequacy of the spatial distribution of the hydrometric network used for flood warning
- The standards of instrumentation, making an inventory of instrumentation, assessing asset condition and developing agreed technical standards
- The asset management arrangements, asset owner capacities and identifying options for alternative arrangements
- Flow rating curves, survey datum for river height gauges, geo-location and gauge metadata.

The project is being managed and assisted by this department, and overseen by a Key Stakeholder Group chaired by the Queensland Reconstruction Authority. The Local Government Association of Queensland is a member of the group.

The review is being undertaken by KBR (with subcontractor Pentair/Greenspan). Both KBR and Pentair have extensive experience in flood warning systems.

KBR will be consulting with your organisation, with a questionnaire dealing with the flood warning network of your area. The Department may assist you in responding, if required. From the data returned, KBR will identify and approach a sample set of organisations requesting a meeting to gain a more detailed understanding. The meeting will also discuss potential improvements in the spatial extent and management of flood warning networks.

To assist the review process, I would appreciate your ***nominating an officer*** in your organisation that will be available for technical discussions of flood warning gauging matters. Please provide contact details for the nominee by 27 May 2015 to Greg.Scroope@dnrm.qld.gov.au .

Thank you for your assistance in these matters.

Should you have any further enquiries, please contact Mr Graeme Milligan, Project Director of the department on telephone (07) 3199 8706.

Yours sincerely

Lloyd Taylor
Executive Director
Operations Support

Performance Review of Flood Warning Gauge Network in Queensland: Local Government Questionnaire

Before starting the questionnaire

Please ensure you have reviewed the information provided to you with your invitation to participate. In particular, you will need to have reviewed:

- *Basin/s Map* (showing sub-basin boundaries, local government areas, location of known rainfall and stream water level gauges that are accepted by the Bureau of Meteorology (BOM), and settlements known to flood).
 - *Gauge Meta-data Spreadsheet* (rainfall and stream water level gauges that are accepted by the BoM).
 - Template for providing additional gauge meta-data.
- You will be asked to refer to these documents as you complete the questionnaire so please have them at hand.

SECTION 1 : YOUR CONTACT DETAILS

Name

Role

Organisation

Your involvement with rainfall
and stream water level gauges

Phone

E-mail

Postal address

SECTION 2: SETTLEMENTS AND CRITICAL INFRASTRUCTURE IMPACTED BY FLOODING

In the context of this review, a 'settlement known to flood' has been defined as one that has in the past been damaged by flood waters (on-property or over-floor flooding) in residential, commercial or public space areas within the recognised settlement boundaries. This definition of flood includes both flash flooding and riverine flooding, where:

- flash flooding is any flooding of short duration with a relatively high discharge in which the time interval between the observable causative event and the flood is less than six hours
- riverine flooding is any flooding where the rain-to-flood delay time is relatively high and typically more than six hours but excludes flooding caused by: elevated sea levels, storm surge, flash floods or the failure of any man-made infrastructure (e.g. dams or levees).

Settlements are considered to be isolated or significantly inconvenienced by flooding when the settlement itself is not inundated but major transport routes (road and/or rail) or other critical infrastructure (e.g. water, electricity supply, power stations, airports, mines, etc.) is disrupted by flooding.

1. Referring to the *Basin/s Map* provided, are there any additional settlements or critical infrastructure known to flood due to riverine flooding that are not shown on the map?

No

Yes, please list names of these settlements or critical infrastructure:

2. Referring to the *Basin/s Map* provided, are there any additional settlements or critical infrastructure known to flood due to flash flooding that are not shown on the map?

No

Yes, please list the names of these settlements or critical infrastructure:

3. Are there any settlements or critical infrastructure that are isolated or significantly inconvenienced by flooding?

No

Yes, please list names of these settlements or critical infrastructure:

4. Are there any settlements or critical infrastructure you believe do not have sufficient flood warning time?

Yes, please list names of these settlements or critical infrastructure:

SECTION 3: RAINFALL AND STREAM WATER LEVEL GAUGE LOCATIONS

To answer questions 5-9 please refer to the *Gauge Meta-data Spreadsheet* and *Basin/s Map* provided. If your council doesn't operate and maintain any gauges in your local government area please go to question 10.

5. Are all of the rainfall and stream water level gauges that you operate and maintain shown on the map and is the information about each gauge in the spreadsheet accurate and complete?

No

Yes

If No, please provide the details of any additional gauges or corrections to the provided data by:

- i. Attaching your own asset register or other spreadsheets, reports or documentation that provide meta-data about the gauges
- ii. Making corrections/additions to and then attaching the provided *Gauge Meta-data Spreadsheet* (please colour the cells of the spreadsheet yellow where you make changes)
- iii. Completing and attaching the *Template* for providing additional gauge meta-data.

6 Are the stream water level gauges that Council operates and maintains surveyed to the Australia Height Datum (AHD)?

All of the gauges are surveyed to
AHD

Only some of the gauges are
surveyed to AHD

Please identify the gauges that
are surveyed to AHD:

Some of the gauges are
surveyed to a datum other than
AHD

Please identify the gauges and
which datum they have been
surveyed to:

None of the gauges are surveyed

Comments:

7. Are all of the rainfall and stream water levels gauges that your council operate or maintain on your Council Asset Register?

No

Yes

If no, please identify the gauges
not on your Council Asset
Register:

Comments

8. Are there any rainfall or stream water level gauge changes you believe would improve flood warning time (e.g. addition or relocation of gauges)?

No

Yes

Please describe the change/s
and the sub-basin/s in which
they would occur:

Please attach any documents that help to describe the change/s you have outlined (optional), e.g. mark-ups on the provided *Basin/s Map*

9. Does your council have any plans to increase the number of gauges and/or upgrade gauges in your local government area?

No

Yes

Please describe the changes
that you have planned:

SECTION 4: USE OF DATA FROM GAUGES

10. How do you use the data from rainfall and stream water level gauges? (please indicate the **primary use/s** for which you use the data by typing a number '1' in the relevant box and any **secondary use/s** by typing a number '2' in the relevant boxes.

Riverine flood response

Flash flood response

Water quality monitoring

Water resource management

Urban water supply

Wastewater release
management

Other, please specify

SECTION 5: RAINFALL AND STREAM WATER LEVEL GAUGE RELIABILITY

In the context of this review, a reliable gauge is considered to be one from which the data collected is accurate and timely (available when needed).

11 How would you rate the overall timeliness of the data from the rainfall and stream water level gauges that your council uses data from? (please tick the one box that best applies)

Comment

Very good

Satisfactory for the purposes your council currently uses the data

Poor

12. How would you rate the overall accuracy of the data from the rainfall and stream water level gauges that your council uses data from? (please tick the one box that best applies)

Comment

Very good

Satisfactory for the purposes your council currently uses the data

Poor

13. Where your council operate and maintain rainfall and stream water level gauges, what are the reliability issues with these gauges? (please tick all the boxes that apply)

Comment

No major reliability issues (gauge assets work satisfactorily)

Installation (not properly installed in accordance with standard installation procedure)

Installation (no standard installation procedure available)

Age of equipment

Type of equipment

Gauge itself is subject to inundation (location not ideal)

No or limited proactive gauge maintenance

Dependence on availability/ability of a person to get to the site to take reading

Communication system dropout (for automated systems)

Communication/data transmission frequency (for automated systems)

Other, please specify

SECTION 6: ASSET MANAGEMENT

14 How is the maintenance funded for rainfall and stream water level gauges operated and maintained by council? Please describe:

15. Who carries out the maintenance on rainfall and stream water level gauges that you operate and maintain? (please tick all of the boxes that apply)

Council's own staff
Contractor hired by Council, please provide their name and address
Bureau of Meteorology staff or their contractor
Other, please specify

16. What maintenance regimes are in place for the rainfall and stream water level gauges your council operates and maintains?

Reactive maintenance following flood or reported damage
Proactive maintenance - Once per year
Proactive maintenance - Twice per year
Proactive maintenance-Three times per year
Other, please specify

17. Do you have any suggestions for improving the efficiency and coordination of maintaining rainfall and stream flow gauges, and/or sharing of data collected from gauges)

No, current arrangements are effective.
Yes, please describe

Thank you for your contribution to this important project.
The Department of Natural Resources and Mines
will keep you informed as this project progresses.

Please return your completed survey and the relevant attachments to the project team via:

- email: floodstudies@kbr.com
- post: Flood Studies at KBR
Reply Paid 633, BRISBANE QLD 4101:

PROJECT OVERVIEW

What is the purpose of the review?

The Queensland Government is committed to improving the flood warning system in Queensland and has commenced a performance review of the Flood Warning Gauge Network. The project focuses on rainfall and stream water level gauges that are monitored by various local, state, Commonwealth and private entities, and the ongoing maintenance of these gauges for flood warning purposes.

The objectives of the review are to:

- Assemble an asset inventory of the flood gauge warning instrumentation in Queensland that is currently used by the Bureau of Meteorology (BoM) and other entities for flood warning purposes, or may be used to augment the Flood Warning Gauge Network in the future
- Assess the adequacy of the spatial configuration of the flood gauge warning network
- Assess the condition of instrumentation (using a sample of gauges)
- Assess the reliability of data gathered from the instruments
- Consider the data needs of stakeholders
- Review asset management arrangements
- Prepare technical standards and guidelines for instrumentation.

What is the desired outcome?

The aim of the project is to identify priorities for improving the flood warning gauge network in Queensland. This will help efforts to make more timely and accurate flood warnings and forecasts.

Who is involved in the review?

Several parties are involved in the review:

- Department of Natural Resources and Mines (DNRM) is managing and assisting the review.
- A Key Stakeholder Group is guiding the review. This group is comprised of senior officers from agencies involved in flood warning, disaster management and floodplain management including BoM, Queensland Reconstruction Authority (chair of group), Local Government Association of Queensland (LGAQ), etc.
- Kellogg, Brown and Root Pty Ltd (KBR) are conducting the review.
- Other stakeholders are being consulted throughout the review including local government representatives and gauge owners and operators.

How is the review being conducted?

The review applies a risk-based methodology to analyse the flood warning network using spatial analysis, review of historical data, site inspections and stakeholder input.

Stakeholder consultation is being carried out in four steps:

1. Inviting local governments to complete a questionnaire
2. Conducting more in-depth interviews with a selection of local governments
3. Meeting with other gauge owners and operators (including state government departments)
4. Providing feedback to all participants of the outcomes of the review once the project is completed.

LOCAL GOVERNMENT QUESTIONNAIRE

Why complete the questionnaire?

It is recognised that local governments across Queensland hold valuable information for the review. We know local governments regard flood warning and management as integral to supporting and protecting local communities against flooding. We also recognise that much valuable work has already been carried out by local governments in this area.

Your information will be used as part of a review of the Flood Warning Gauge Network in Queensland, so more efficient and coordinated approaches can be established for maintaining rainfall and stream water level gauges, and sharing collected data.

Ultimately, the outcomes of the review will help to inform governments and gauge owners to improve flood warning and reduce flood risk for Queensland communities.

Before starting the questionnaire

Please ensure you have reviewed the information provided with your invitation to participate. In particular, you will be asked to refer to the following documents to complete the questionnaire:

- *Basin/s Map* (showing sub-basin boundaries, local government areas, the location of known rainfall and stream water level gauges accepted by BoM, and settlements known to flood)
- *Gauge Meta-data Spreadsheet* (if there are rainfall and stream water level gauges within your local government area that are accepted by BoM)
- *Template* for providing additional gauge meta-data.

How long will it take?

To complete the six short sections of the questionnaire, we anticipate between 30 minutes and one hour will be required.

How to complete the questionnaire

The questionnaire can be completed:

- Online (<https://engagement1.wufoo.com/forms/performance-review-of-flood-warning-gauge-network/>)
- Electronically using the form provided and emailing it with any appropriate attachments to the project team (floodstudies@kbr.com)
- In hard copy and mailing it to the project team (Flood Studies at KBR, Reply Paid 633, Brisbane Qld 4001)

Completing the online questionnaire

The online questionnaire must be completed in one session and cannot be stopped part-way through and returned to later. However, each section of data you enter will be saved when you click next so if there is a disruption, the work you have completed will not be lost.

To respond to some questions you have the option of uploading your existing asset management registers or other documents. Please have these available. The maximum data quota that can be uploaded during the questionnaire is 20MB, however not more than 10MB can be uploaded in any one field. Documents can also be emailed to the project team if this is more convenient.

Deadline for completed questionnaire

Please ensure your completed questionnaire is submitted by Friday 10 July 2015.

Need help completing the questionnaire?

For assistance responding to specific questions please contact Greg Scroope (DNRM) on (07) 3199 7815.

If your online entry is disrupted for any reason, or for other queries about returning your completed questionnaire please contact Cindy Hammill (KBR) on (07) 3144 9230.