QRA QUEENSLAND RECONSTRUCTION AUTHORITY

# Queensland Strategic Flood Warning Infrastructure Plan

Queensland Government

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# Drivers for change

Flooding is one of the most significant disaster risks in Queensland, which is why it is important to work together to ensure communities in flood prone areas have access to timely and accurate flood warnings. Flood waters only respond to their physical environment, and all at-risk communities and responding agencies rely on information from an effective flood warning system to keep their communities informed.

# Queensland's Flood Warning Gauge Network

Queensland's Flood Warning Gauge Network comprises more than 3200 rainfall and river gauges that are owned and operated by more than 60 entities including state and local government, the private sector, and the Bureau of Meteorology (the Bureau). A high level of collaboration and information sharing is necessary to ensure accurate and consistent flood warning information is being provided to the Bureau and to our local communities.

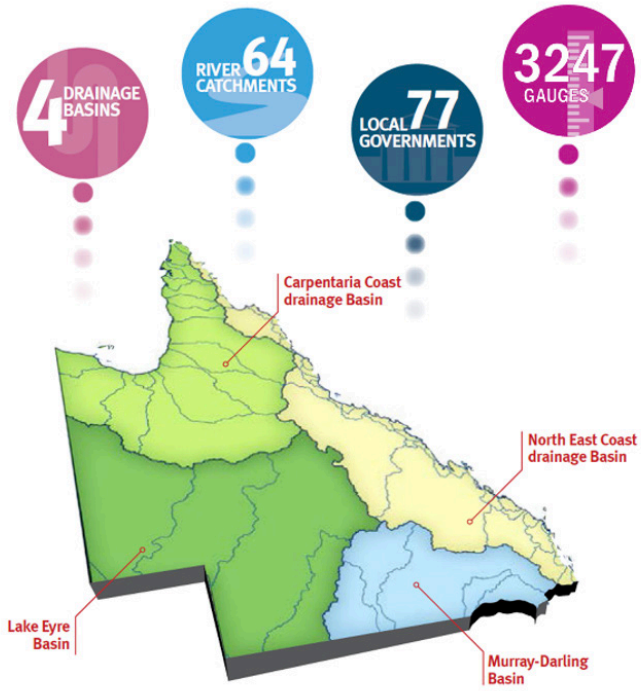



*Figure 1: Flood Warning Gauge Network in numbers (2020)*

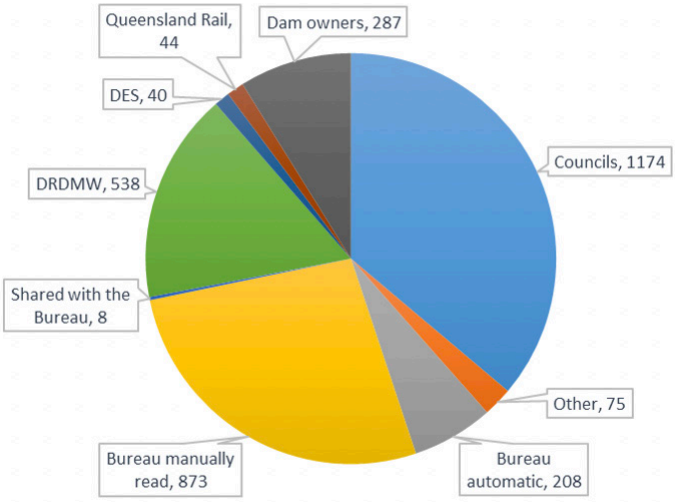



*Figure 2: Gauge ownership*
*(Queensland Service Level Specification – November 2020)*

# Purpose of the strategic plan

The purpose of this strategic plan is to support Queensland communities to better prepare and respond to flood events, and improve community resilience to flood events, through development of a best practice network of flood warning gauges. This plan does not relate to coastal inundation from storm tide events. This strategic plan embraces the guiding principles of the Queensland Strategy for Disaster Resilience (QSDR) and enables the four QSDR objectives:

1. we understand the potential disaster risks we face
2. we work together to better manage disaster risk
3. we seek new opportunities to reduce disaster risk
4. we continually improve how we prepare for, respond to and recover from disasters

*Above: The four objectives of the Queensland Strategy for Disaster Resilience.*

# Principles

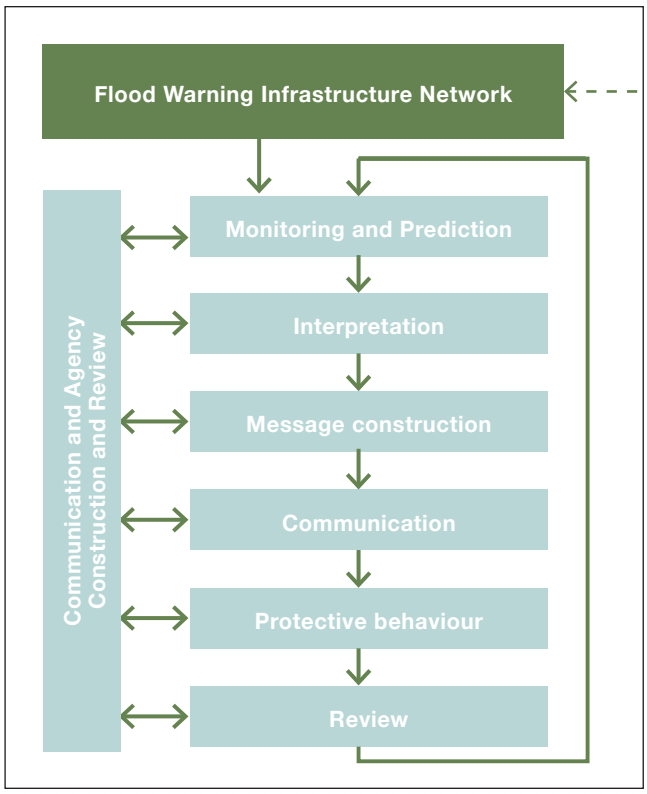
Best practice flood warning infrastructure provides the right information, to the right people, at the right time. Therefore, this strategic plan is guided by six key principles which, in combination, deliver best practice.

| | Queensland's Flood Warning Gauge Network: |
|---|---|
| 1. | supports the Bureau of Meteorology's Total Flood Warning System |
| 2. | meets the national standard for flood warning infrastructure |
| 3. | provides real-time situational awareness and suitable data for flood forecasting models and timely early warnings |
| 4. | is reliable, accurate and fit for purpose |
| 5. | is continuously improved through ongoing review, endorsed governance structures and investment in upgrades |
| 6. | is managed collaboratively for shared benefits and cost effectiveness |

# Best Practice

## Total Flood Warning System

A flood warning system is made up of a number of components which all must be present and integrated if the system is to operate effectively. The scope of this strategic plan is to facilitate development of a best practice flood gauge network, along with associated stakeholder collaboration, communication and information sharing. The network, which includes gauges and supporting infrastructure, is responsible for the monitoring of environmental and meteorological conditions which lead to flooding and enables the remaining components of the total flood warning system to be undertaken. Optimisation of the network, and ongoing review, is the backbone of ensuring the right people have the right flood information at the right time.




**The scope of this strategic plan is to facilitate development of a best practice flood warning gauge network, which enables the Total Flood Warning System to operate efficiently and effectively**

The components of the Total Flood Warning System *(shown in blue in the flowchart)* are as follows:

- **monitoring** of rainfall and river flows that may lead to flooding
- **prediction** of flood severity and the time of onset of particular levels of flooding
- **interpretation** of the prediction to determine the likely flood impacts on the community
- **construction** of warning messages describing what is happening and will happen, the expected impact and what actions should be taken
- **communication** and dissemination of warning messages
- **response** to the warnings **(protective behaviour)** by the agencies involved and community members
- **review** of the warning system after flood events.

*Figure 3: Components of the Total Flood Warning System (Source: Australian Emergency Manual Series, Manual 21 Flood Warning, Australian Government 2009).*

It is noted that, whereas the Total Flood Warning System concept is entrenched in the Australian flood sector and promoted by the Australian Government, a review is underway to extend the Total Flood Warning System to include components of the more holistic Australia's Total Warning System (ATWS). The ATWS defines the essential elements of delivering warnings for all types of hazards effectively, with a lifecycle of action before, during and after emergency. The Australian Warning System (AWS) is a new national, all-hazard approach to information and warnings for hazards like bushfire, flood, storm, cyclone, extreme heat and severe weather. Implementation of the AWS in Queensland is proposed to commence in early to mid-2021.

## National standard for flood warning infrastructure

Flood warning has specific requirements for data accuracy, range, spatial density and data availability. Therefore, gauges and supporting infrastructure need to meet specific performance requirements to ensure the sustainability of the flood warning network.

*The Flood Warning Infrastructure Standard* (2019) identifies the specific performance requirements for infrastructure, sensing, collecting and communicating data for flood forecasting and warning purposes. It is used to set the minimum performance requirements for the design, development and monitoring of fit-for-purpose flood warning infrastructure in Queensland and can be applied to both existing and new infrastructure.

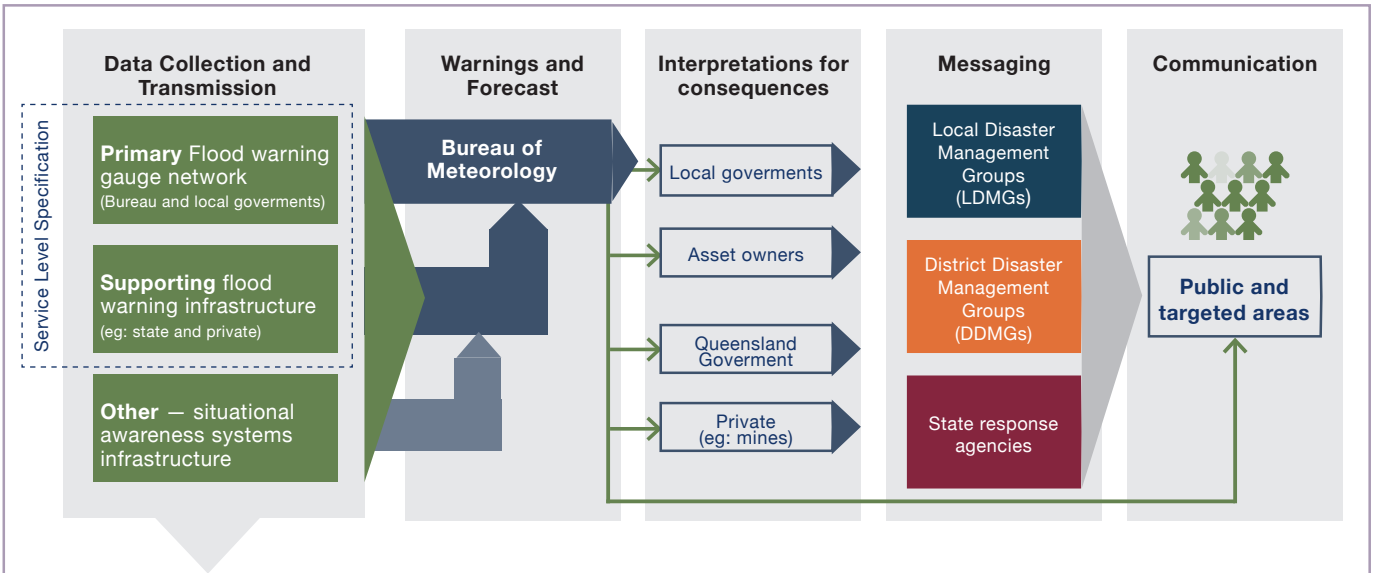
## Situational awareness

Situational awareness is provided through the flood warning network for responding agencies and at-risk communities. A fully optimised Total Flood Warning System means:

The Bureau has what it needs to issue forecasts and warnings as per the latest published version of the *Service Level Specification for Flood Forecasting and Warning Services for Queensland* (Bureau) (SLS).

- All stakeholders have the right situational awareness for them to interpret the consequences of the forecasts or warnings.
- The right messages can be provided to the right people at the right time through the Queensland disaster management arrangements.
- Ultimately, the community is well informed and understands their risks.

The activities within each of the Total Flood Warning System components are shared amongst agencies across all levels of government. The integration of activities required for the system to operate effectively and efficiently can present coordination issues. In practice, the delivery of the Total Flood Warning System in Queensland, from monitoring through to communication, is represented by the following figure.




**Data collection and transmission sources:**
**Primary –** purpose built flood warning infrastructure
**Supporting –** purpose of these assets is functions other than flood warning, but data can supplement the primary network
**Other –** assets not for used for flood warning but can add situational awareness eg: flood cameras and traffic cameras.

*Figure 4: How data is supplied to the Bureau and how forecasts and warnings are communicated for consistent situational awareness.*

# Roles and responsibilities

## Facilitation: Queensland Reconstruction Authority

The Queensland Reconstruction Authority (QRA) is legislatively responsible for facilitating the development of a network of flood warning gauges that complies with best practice. To this end, QRA collaborates with key stakeholders including the Bureau and Queensland's 77 local governments and one town authority, to ensure the flood gauge network is providing the best possible warnings for our communities.

> *Queensland Reconstruction Authority Act 2011*
> s10 Authority's functions
> (1) The main functions of the authority are as follows—
> (h) to facilitate mitigating against potential disasters, including facilitating the development of a network of flood warning gauges that complies with best practice.

## Coordination and governance: Queensland Flood Warning Consultative Committee

The role of the Queensland Flood Warning Consultative Committee (QFWCC) is to coordinate the development and operation of flood forecasting and warning services in Queensland, acting as an advisory body to the Bureau and participating state and local government agencies. Membership of the Committee includes:

- Bureau of Meteorology - *Chair/secretariat*
- Queensland Department of Regional Development, Manufacturing and Water (DRDMW) (previously Department of Natural Resource, Mines and Energy (DNRME))
- Queensland Department of Transport and Main Roads (DTMR)
- Inspector-General Emergency Management (IGEM) - *observer*
- Queensland Fire and Emergency Services (QFES)
- Seqwater
- Sunwater
- Queensland Reconstruction Authority (QRA)
- Local Government Association of Queensland (LGAQ)
- Other observers as appropriate

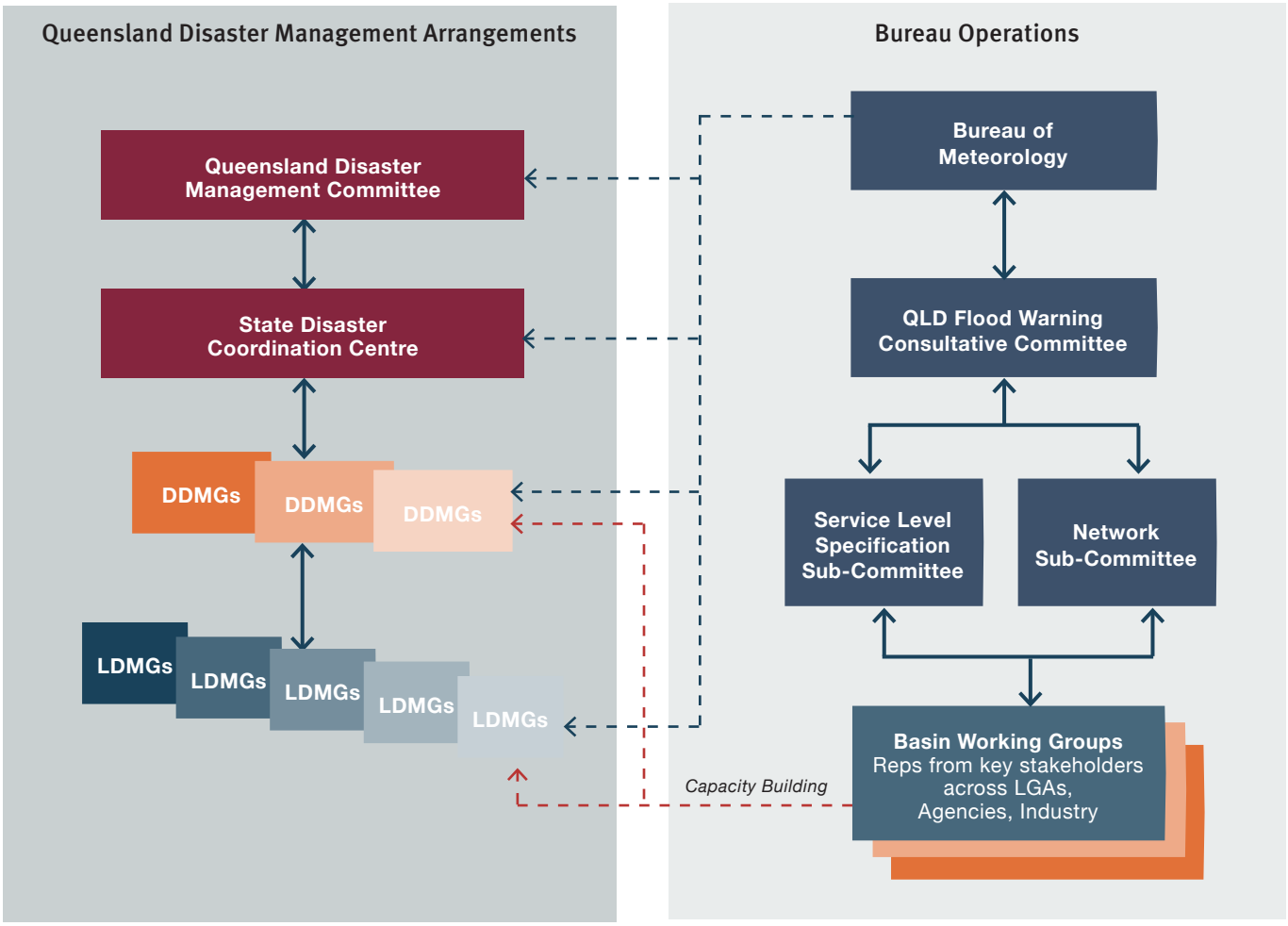



*Figure 5: Approved governance structure reporting to the Queensland Flood Warning Consultative Committee (QFWCC) and the relationship to the Queensland Disaster Management Arrangements (QDMA).*

Further groups which report to the QFWCC on flood warning infrastructure and flood services include:

**Flood Warning Infrastructure Network Sub-Committee:** The purpose of the Network Sub-Committee (NS-C) is to ensure confidence in the flood warning infrastructure. The NS-C broadly sets the strategic direction for flood warning infrastructure based on agreed best practice arrangement and will oversee implementation and liaison with Basin Working Groups and industry.

**Basin Working Groups (BWGs):** The BWGs are the primary mechanism for coordination of activity (such as network efficiencies and operations in general) at the regional level, coming together with representation at the NS-C. Each BWG is comprised of owners of water monitoring assets that can contribute to flood warning and can share situational awareness during events. The BWGs are catchment-focused locally-led with local champions and are supported by the QRA, LDMGs and the Bureau.

**Service Level Specification (SLS) Subcommittee:** The role of the SLS Subcommittee is to advise and support the QFWCC in relation to the operational implementation of the SLS and prioritising any SLS requests for change, particularly associated with Schedule 2 of the SLS.

## Assets and infrastructure: purpose, locations, ownership and maintenance

The network assets and their supporting infrastructure are an integral component of a total flood warning system. Optimisation of the network is the backbone to ensuring the right people have the right flood information at the right time. In Queensland, assets are owned and maintained by a range of stakeholders, therefore all stakeholders need to be included in network analysis, optimisation and decision-making. The following table identifies key stakeholders and shows the complexity of network asset ownership and maintenance.

| Aspect | Stakeholders | Asset functions | Asset maintenance |
|---|---|---|---|
| **Primary flood warning gauge network:** | | | |
| **Commonwealth gauges** | Bureau of Meteorology | **Primary:** flood warning<br>**Secondary:** climate/weather data collection, water availability and stream flow forecasting | Maintained by the Bureau |
| **Local gauges** | Local governments | **Primary:** flood warning<br>**Secondary:** monitoring local infrastructure and situational awareness | Generally maintained by contractors to local government<br>The Bureau is currently maintaining in some locations |
| **Identification of network gaps** | Local governments in consultation with the Bureau | **Primary:** flood warning<br>**Secondary:** monitoring local infrastructure and situational awareness | Asset owner's responsibility<br>Generally maintained by contractors for relevant asset owner |
| **Network efficiency** | Local governments in consultation with the Bureau and other asset owners | **Primary:** flood warning<br>**Secondary:** monitoring local infrastructure and situational awareness | Asset owner's responsibility<br>Generally maintained by contractors for relevant asset owner |
| **Supporting flood warning infrastructure:** | | | |
| **State agency gauges:** | Department of Regional Development, Manufacturing and Water (DRDMW) | **Primary:** water quality and water management/allocation<br>Secondary: Operations of water infrastructure | Maintained by internal resources |
| | Department of Transport and Main Roads (DTMR) | **Primary:** traffic management<br>**Secondary:** monitoring inundation and transport corridor overtopping | Maintained by a mix of contractors to department and internal resources |
| | Department of Environment and Science (DES) | **Primary:** tidal and storm surge information | Generally maintained by contractors to department |
| | Queensland Rail (QR) | **Primary:** inundation of rail infrastructure<br>**Secondary:** monitoring water inundation and overtopping of rail corridors and access routes | Maintained by a mix of contractors to QR and internal resources |
| **State-owned entity gauges:** | Seqwater and Sunwater (dam owners) | **Primary:** monitoring dam inflows and outflows<br>**Secondary:** flood warnings | Maintained by a mix of contractors to relevant dam owner and internal resources |
| **Private gauges:** | Various owners, for example, mining companies and pastoral stations | Various functions, for example, environmental compliance and water quality and discharge allocation | Generally maintained by contractors to asset owner |

## Data: collection, management and sharing

Data from the network assets enables stakeholders to undertake analysis and deliver timely forecasts and warnings. Data collection, management and sharing is also complex, due to the number and range of stakeholders involved in the process. The following table identifies the key stakeholders and the mechanisms which are used for maintaining consistent data collection, management and sharing.

| Aspect | Stakeholder | Mechanisms |
|---|---|---|
| **Data collection** | Asset owners | *National Flood Warning Infrastructure Standard*, 2019 |
| **Data sharing** | Asset owners<br>Bureau* | *Service Level Specification for Flood Forecasting and Warning Services for Queensland*, Bureau<br>Governance structures and data sharing agreements are developed and endorsed by each BWG and other stakeholders |
| **Data management (software, formats etc)** | Bureau | *Service Level Specification for Flood Forecasting and Warning Services for Queensland*, Bureau |
| **Data use: flood modelling and prediction** | Bureau | n/a |
| **Data use: flood warning, messaging and communication** | Bureau<br>QFES<br>LDMGs, DDMGs, SDCC | Queensland Disaster Management Arrangements<br>Disaster Management Data Coordination portal |
| Data for asset management operations | Asset owners | BWG working on network efficiency (catchment-scale approach) |

** The Bureau has established data sharing agreements with various data providers.*

*Rain River and Camera.*

*Automatic rainfall gauge.*

*Rain and river height gauge with a traffic camera.*


*Manual river height gauge.*

# Approach to best practice in Queensland

## Opportunities

Queensland has an established baseline of assets and arrangements which provide an excellent basis for achieving a best practice flood warning system:

- existing extensive and building asset base (3200+)
- new assets future proofed for emerging technologies
- effective and integrated governance
- stakeholder willingness to collaborate and invest time and funding in network efficiencies
- recognition of the benefits of whole of catchment approach
- established national standards for data quality and assets
- established communications through Queensland Disaster Management Arrangements.

These strengths enable stakeholders to collaborate and capitalise on identified opportunities which improve progress towards the best practice flood warning system, such as:

- consistency with the *Flood Warning infrastructure Standard* (2019) for all gauge installation projects across all levels of government
- emerging support for centralised coordination of asset prioritisation, maintenance and data sharing between agencies
- cost efficiencies with capital and recurrent expenditure through collaboration
- catchment approach to network optimisation
- catchment-level governance and leadership
- grant-funded flood warning infrastructure upgrades supported regionally and through approved investment plans
- ongoing investment and support by non-traditional stakeholders
- technology improvements delivering greater awareness for lower costs
- improved situational awareness through a single point of truth in the context of warnings and disaster messaging.

## Challenges

The process of working towards the best practice flood warning system also has a range of constraints and challenges to be managed:

- multiple gauge owners (60+)
- over 3200 river height and rainfall gauges, with varying primary purpose
- co-dependencies at many sites (ie: different stakeholders own and maintain different components of monitoring sites)
- lack of complete knowledge of the assets available in the network
- varying levels of understanding of how the network operates, flood impacts and flood classifications
- mix of technologies for data collection and communication
- examples of poor locational choice of assets relative to flood behaviour and network gaps
- increasing numbers of manual gauges not being read
- limited shared situational awareness for catchment stakeholders
- difficulty tailoring messages appropriate to the varying audiences
- isolated blockages with stakeholder communication and information sharing
- inability or unwillingness to undertake active collaboration on gauge installation projects and data sharing by all concerned entities
- machinery of government changes
- changes in stakeholder policy positions
- limited understanding of interdependencies or infrastructure linkages that have the potential to cause network failure
- stakeholder and organisational resilience (knowledge loss through staff changes, landowner changes etc)
- lack of clear responsibilities for monitoring gauge status and data quality
- lack of clear reporting on monitoring gauge status and data quality, which affects the transparency around the quality of data upon which decisions are being made.

## Pathways to best practice

Strategic pathways that are based on the principles of this strategic plan underpin a best practice flood gauge network. These pathways enable the operationalisation of a collaborative and catchment scale approach to the flood warning network, which assists communities to be well informed by timely and appropriate warnings. Four pathways have been identified for Queensland, as shown in the following table.

| Pathways | Approaches | Key outcomes and links to principles |
|---|---|---|
| **Enduring network governance** | Established governance mechanisms and partnerships.<br>Commit to collaboration for asset standards, operations, data sharing and flood risk management.<br>Collect and share data, in suitable formats, for mutual benefit. | Linkages to components of the Total Flood Warning System are maintained (Principle 1).<br>Data is suitable and visible to asset owners and stakeholders (Principle 3).<br>Situational awareness is consistent, to enable decision making and response (Principle 3). |
| **Asset planning, operations and maintenance** | Catchment-based approach.<br>Optimise asset types and locations, based on risk assessment, catchment knowledge and identified synergies.<br>Align with other infrastructure upgrade programs for efficiency and cost gains.<br>Coordinate maintenance for time and cost savings (where appropriate) with other asset owners in the catchment. | Assets and infrastructure comply with best practice standards (Principle 2).<br>Network is fit for purpose (Principle 4).<br>Integrated maintenance programs are cost effective and efficient for asset owners (Principle 6).<br>Data capture and transmission is accurate, consistent and shared (Principle 3). |
| **Proactive funding** | Proactively plan for funding for network efficiency including assets, supporting infrastructure and activities, software etc.<br>Collaborate on regional priorities for funding. | Funding opportunities are realised (Principle 5).<br>Investment in upgrades is achieved (Principle 5). |
| **Sustained action** | Systems-based approach which complies with best practice guidelines.<br>Clear program of action.<br>Apply learnings from work to date.<br>Enable proactive up-skilling and knowledge transfer. | Network is reliable and resilient (Principle 4).<br>Continuity of service is delivered (Principle 4).<br>Continuous improvement is achieved (Principle 5). |

These pathways have been used to develop a step-by-step methodology which sits within the structure of the QSDR objectives. The detailed methodology has been refined in a pilot study for the Fitzroy Basin. Ongoing actions to be rolled out within further basins and across Queensland have also been identified. These are provided in the following sections.

# Case study

The Fitzroy Regional Resilience Strategy Pilot Project was completed in January 2020, as a regional resilience strategy which focused on a forensic review of flood warning infrastructure at a whole-of-catchment level.

Working closely with local stakeholders the project considered the range of flood resilience issues for the catchment such as building a risk-based intelligence understanding of the catchment, increasing community resilience, land use planning and building controls, environmental management and disaster management.

The project delivered the following products:

- Regional Resilience Strategy – Phase 1 with supporting documents:
  - Regional Action Plan and a Technical Evidence Report
  - Network Audit and Analysis Report (including data transmission and asset prioritisation and optimisation)
  - Flood Classifications Review
  - Flood Modelling Master Plan – Fitzroy Basin
  - Common Asset Management Plan (with a supporting visualisation tool)
  - Third Party Maintenance Arrangement
  - Catchment Situational Awareness Tool
  - Knowledge Transfer & Upskilling Framework
  - Integrated governance arrangements with supporting Terms of Reference

The deliverables produced will allow the newly formed Fitzroy Basin Working Group (BWG) to undertake regional and catchment level discussions to provide a greater understanding of how the flood warning network operates and how it further informs local governments, asset owners and communities at risk.

In addition, this new information promotes discussion to occur about the potential for further efficiencies, data sharing, and system and process improvements for the catchment.

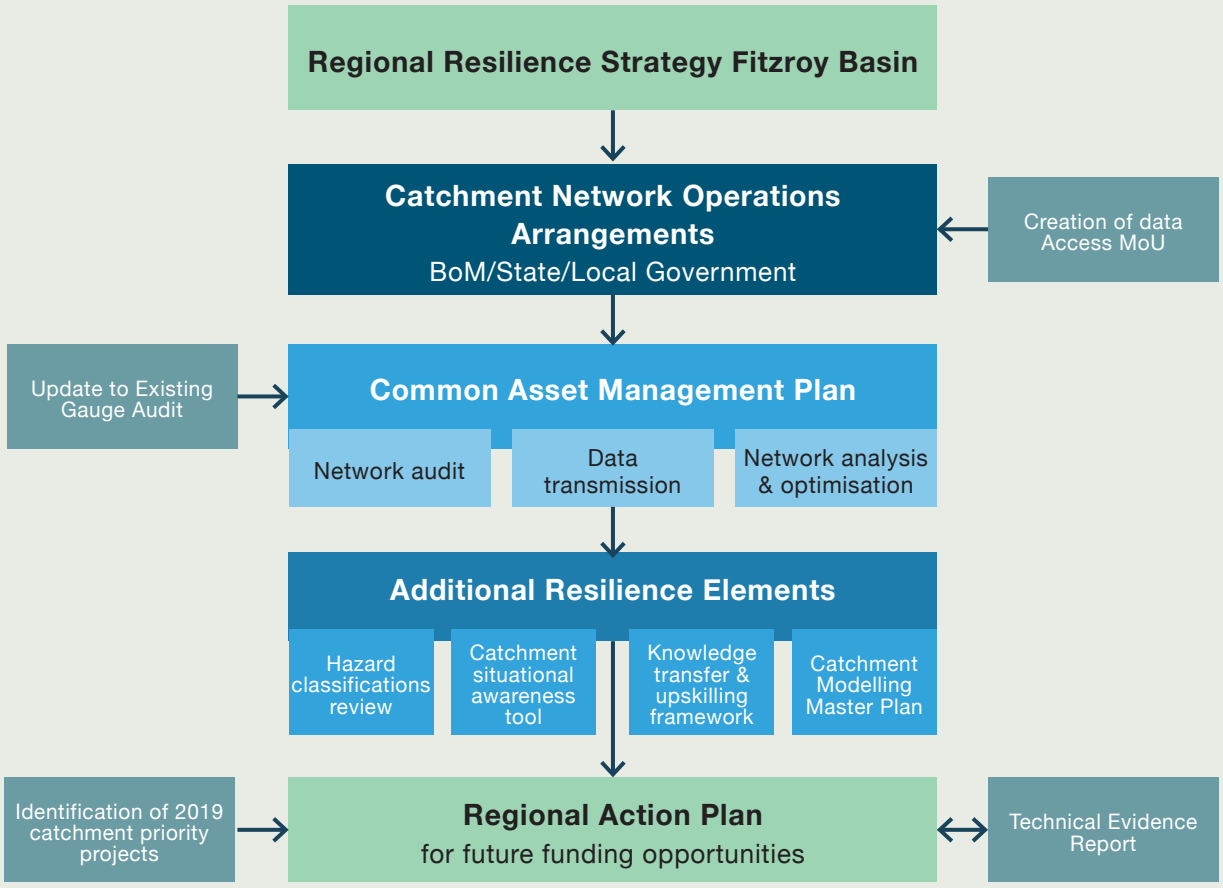



*Figure 6: Alignment between deliverables and Regional Resilience Strategy.*

# Queensland's Flood Warning Gauge Network Delivery Process

**1** we understand the potential disaster risks we face

| Actions | State-wide progress | Basin / catchment progress: Fitzroy Regional Resilience Strategy Pilot |
|---|---|---|
| **Identify flood hazard** | ✓ **Action:** State-wide mapping through Queensland Flood Mapping Program (QFMP)<br>**Deliverable:** Queensland Floodplain Assessment Overlay (Level 1 flood mapping) | ✓ **Action:** Basin-scale and town-level flood studies and mapping through QFMP, Brisbane River Catchment Flood Studies and other completed regional and local scale flood studies. |
| **Identify locations at risk** | ✓ **Action:** Priority locations identified for town-based flood studies under the QFMP<br>**Deliverable:** completion QFMP in 2015 | ✓ **Action:** series of 'Big Map' workshops to understand the makeup and context of the catchment, to establish a shared understanding of the catchment and risks<br>**Deliverable:** Flood Modelling Masterplan Fitzroy Basin (2019) |
| **Review existing flood warning network** | ✓ **Action:** In 2015, a state-wide Performance Review was undertaken of Queensland's rainfall and river gauge network | ✓ **Action:** The Fitzroy Regional Resilience Strategy Pilot Project reviewed:<br>• known assets in catchment against the SLS<br>• new or unknown assets<br>• ownership of infrastructure<br>• existing operations, maintenance, service details<br>• makeup of the flood warning network (functions, gauge type and hierarchy)<br>• surveys linking river height gauges to known reference points such as crossings |
| **Identify improvements and avoidable risk** | ✓ **Deliverable:** The state-wide Performance Review made 19 recommendations including identification of priority local governments for detailed consideration for further improvements in their early flood warning infrastructure<br>**Action:** In 2016 and 2017 more than 50 stakeholder workshops were held, which identified potential locations for new infrastructure such as rainfall and stream flow gauges, and cameras on bridges | ✓ **Action:** The Fitzroy Regional Resilience Strategy Pilot Project identified:<br>• gaps and duplications in the catchment<br>• possible redundancy for critical locations<br>• opportunities for efficiency gains |

| Ongoing actions | Outcomes and Deliverables | Who is involved |
|---|---|---|
| **State-wide:** Ongoing management and maintenance of FloodCheck and update FloodCheck with up-to-date flood study outputs.<br>**Regional:** Additional flood studies to be undertaken at basin and catchment scale | **Outcome:** Understanding of existing flood hazards in the floodplains<br>**Deliverable:** state-wide, regional and local mapping for use by local governments as a potential flood hazard area<br>**Deliverable:** Database of up to date flood studies, maps and models for disaster management | **DRDMW (former DNRME) (lead)**<br>**QRA**<br>**QFES**<br>**Local government** |
| **State-wide:** Identify gaps in the availability of flood hazard mapping<br>**Regional:** 'Big Map' workshops to be undertaken at basin and catchment scale in future regional studies / projects | **Outcome:** Understanding of current gaps and of local flood hazard areas and flood prone towns<br>**Deliverable:** Prioritise locations (catchments) for action | **QRA (lead)**<br>**DRDMW (former DNRME)**<br>**Dam operators**<br>**DTMR**<br>**Queensland Rail**<br>**Local government** |
| **State-wide:** Consider development of state-wide guidelines for network efficiency<br>**Regional:** Ongoing and regular review of the performance of the network to be undertaken at basin and catchment scale in future regional studies/ projects | **Outcome:** Understanding of the flood warning network at a catchment-scale (Principle 5) | **Network Subcommittee**<br>**Asset owners**<br>**Basin Working Groups** |
| **State-wide:** Ongoing implementation of the 19 recommendations from the state-wide Performance Review<br>**Regional:** Opportunities to be identified at basin and catchment scale in future regional studies/ projects | **Outcome:** Asset owners and stakeholders with a greater understanding of network risks and opportunities for improvements in efficiency (Principle 5) | **Basin Working Groups (lead)**<br>**Asset owners**<br>**Network Subcommittee** |

## 2 we work together to better manage disaster risk

| Actions | State-wide progress | Basin / catchment progress: Fitzroy Regional Resilience Strategy Pilot |
|---|---|---|
| **Prioritise locations collaboratively** | ✓ **Action:** Locations were reviewed and 11 communities were recommended to the Bureau for a forecast location based on their identified flood risk | ✓ **Action**: An audit and an analysis was undertaken to determine priority locations and potential opportunities for efficiency gains<br>**Deliverable:** Network Audit and Analysis Report (including data transmission & prioritisation / optimisation) |
| **Establish governance structures** | ✓ **Action:** Groups have been established:<br>• Queensland Flood Warning Consultative Committee<br>• Service Level Specification Sub-Committee<br>• Flood Warning Network Sub-Committee<br>• Basin Working Groups – in progress | ✓ **Action:** Governance arrangements were developed (based on the Roads Alliance)<br>**Deliverable:** Queensland Flood Warning Infrastructure Alliance – Governance Documents |
| **Establish knowledge transfer and upskilling** | In progress **Work in progress:** Development of local accredited training programs for those asset owners who require "in house" or local resources to manage and maintain their flood warning infrastructure. Pilot running in North West Queensland and RAPAD | ✓ **Action:** A process to enable knowledge transfer and upskilling was developed<br>Deliverable: Knowledge Transfer & Upskilling Framework |
| **Establish data management and sharing agreements** | In progress **Work in progress:** A working protocol has been developed, to be rolled out across Queensland | ✓ **Action:** An agreement was developed to further improve interoperability and shared situational awareness<br>Deliverable: Data Access Memorandum of Understanding |
| **Establish asset operation and maintenance agreements** | In progress **Work in progress:** One of the driving principles of the Flood Warning Network Sub-Committee is to establish conditions and an environment for a consistent approach to asset management and maintenance agreements and to guide BWGs as they establish. A working protocol has been developed, to be rolled out across Queensland as a template | ✓ **Action:** Opportunities to develop minimum standards for operating procedures and maintenance protocols for flood warning infrastructure were identified<br>**Deliverable:** Common Asset Management Plan (with supporting visualisation tool)<br>**Deliverable:** Third Party Maintenance Arrangement |

| Ongoing actions | Outcomes and Deliverables | Who is involved |
|---|---|---|
| **State-wide:** Undertake reviews after flood events, to check flood classifications, early warning system functionality etc<br>**Regional:** Audits to be undertaken at basin and catchment scale in future regional studies / projects | **Outcome:** Further network efficiencies can be achieved, including identification of critical locations, redundancy for critical assets, and gaps and duplication across Queensland catchments (Principle 5) | **Flood Warning Consultative Committee**<br>**SLS Subcommittee**<br>**Network Subcommittee**<br>**Basin Working Groups** |
| **State-wide:** Groups continue to operate and meet<br>**Regional:** Fitzroy Basin Working Group (established in the pilot project) to continue operations. Further Basin Working Groups to be established | **Outcome:** Shared role and responsibility for the care and management of the state's flood warning network (Principle 6)<br>**Outcome:** More consistent approaches to asset management across the more than 3200 assets owned by over 60 different entities across the state (Principle 6)<br>**Outcome:** Alignment with the National Standards and other strategic initiatives where possible (Principle 2) | **All stakeholders** |
| **State-wide:** Development of an accredited training course is underway<br>**Regional:** Frameworks to be developed at basin and catchment scale in future regional studies/ projects | **Outcome:** Continuity of network service without loss of knowledge and experience (Principle 4)<br>**Outcome:** Increase in capacity and capability of regional areas (Principle 6) | **Network Subcommittee**<br>**Basin Working Groups** |
| **State-wide:** A data sharing agreement guideline is being developed at the state level<br>**Regional:** Agreements to be developed at basin and catchment scale between relevant stakeholders, in future regional studies / projects | **Outcome:** Consistent situational awareness (Principle 3) | **Network Subcommittee (lead)**<br>**The Bureau**<br>**Basin Working Groups**<br>**Asset owners**<br>**QFES**<br>**SDCC/DDMGs/LDMGs** |
| **State-wide:** Continue to work with asset owners across Queensland to align asset management and data coordination through its support of regional resilience strategies<br>**Regional:** Agreements to be developed at basin and catchment scale between relevant stakeholders, in future regional studies / projects | **Outcome:** Flood warning infrastructure is maintained to meet national standards, which is essential for timely and accurate flood warning information (Principles 2 and 3)<br>**Outcome:** Coordination of maintenance activities across the network may reduce costs associated with operations and maintenance (Principle 6) | **Network Sub-Committee**<br>**The Bureau**<br>**Basin Working Groups**<br>**Asset owners** |

## 3 we seek new opportunities to reduce disaster risk

| Actions | State-wide progress | | Basin / catchment progress: Fitzroy Regional Resilience Strategy Pilot | |
|---|---|---|---|---|
| **Identify flood warning requirements** | In progress | **Deliverable:** *Flood classifications in Queensland: A best practice guide for local governments*, QRA 2020<br>**Work in progress:** QRA, the Bureau and QFES work with local governments to ensure that the implications of floods are reflected in disaster management plans or disaster management guidelines at the local and district level | In progress | **Action:** A review of flood classifications has been commenced, to ensure alignment to disaster management arrangements and community awareness<br>**Planned Deliverable:** Flood Classifications Review<br>**Deliverable:** Catchment Situational Awareness Tool (pilot) |
| **Regular audits of existing flood warning network and its effectiveness** | Ongoing | **Work in progress:** Audits of flood warning infrastructure are ongoing. A generic approach to the collection and storage of data is being refined, to enable spatial (GIS) display and analysis<br>**Deliverable under development:** A database of flood warning infrastructure throughout Queensland is being developed, and includes rainfall gauges, river height gauges, cameras and automatic signage | Ongoing | As per State actions |
| **Regular audits of asset ownership and maintenance** | Ongoing | **Ongoing action:** The database of the flood warning assets and their details is shared with BWGs, LDMGs, DDMGs, and State and Commonwealth agencies | Ongoing | **Action:** Template asset management and third party maintenance agreements have been developed and are currently under review to determine a fit-for-purpose product for the Fitzroy |
| **Ongoing recommendation of flood warning infrastructure** | Ongoing | **Ongoing action:** QRA continues to collaborate with the Bureau, local governments and other asset owners to identity efficiencies for flood warning systems and networks | Ongoing | **Ongoing action:** the Fitzroy BWG collaborates with the Bureau, local governments and other asset owners to identity efficiencies for flood warning systems and networks |

| Ongoing actions | Outcomes and Deliverables | Who is involved |
|---|---|---|
| **State-wide:** Flood classifications vary throughout Queensland. QRA will continue with ongoing collaboration with local governments, the Bureau and other stakeholders. SLS sub-committee is well placed to ensure all members are clear on the setting of flood classifications, to ensure no misinterpretation<br>Regional: as per state-wide | **Outcome:** Consistent application of flood classifications across Queensland (Principle 4)<br>**Outcome:** Flood level thresholds align to community impacts (Principle 3) | **Basin Working Groups (lead)**<br>**The Bureau**<br>**Network Subcommittee**<br>**SLS Subcommittee**<br>**Flood Warning Consultative Committee**<br>**Local governments**<br>**SDCC / DDMGs / LDMGs**<br>**QFES** |
| **State-wide:** A collaborative approach to timely collection and sharing of flood warning infrastructure metadata is required, detailing the currency of assets across Queensland to support the quality of the Bureau's capacity to predict, forecast and provide timely warnings for flooding<br>**Regional:** Basin Working Groups will be encouraged to collect the required metadata using the state approach. Local governments will be further encouraged to engage the Bureau in a timely manner when installing new flood warning infrastructure | **Outcome:** Assets across Queensland continue to support the Bureau's capacity to predict, forecast and provide timely warnings for flooding (Principles 1, 2 and 3) | **Basin Working Groups (lead)**<br>**Asset owners**<br>**Network Subcommittee** |
| **State-wide:** Share templates with Basin Working Groups as they are created. Encourage ongoing update and use of the database, and the holistic approach to asset operations and maintenance<br>Regional: Basin Working Groups to develop fit-for-purpose maintenance plans | **Outcome:** Fit-for-purpose and well-management network (Principle 4) | **Basin Working Groups**<br>**Asset owners**<br>**Network Subcommittee** |
| **State-wide:** This Strategy guides the processes and governance for best practice networks that align with national standards. The Bureau is developing implementation priorities to upgrade priority manual gauge locations to automatic<br>**Regional:** Regular network reviews, to assess network performance and opportunities for improvements, will be undertaken after flood events | **Outcome:** The ongoing improvement in the network will continue to improve the accuracy of information and improve situational awareness provided through the flood warning network (Principle 3) | **Network Subcommittee**<br>**Local governments**<br>**The Bureau**<br>**Asset owners**<br>**Basin Working Groups** |

## 4 we continually improve how we prepare for, respond to and recover from disasters

| Actions | State-wide progress | Basin / catchment progress: Fitzroy Regional Resilience Strategy Pilot |
|---|---|---|
| **Develop investment plans** | ✓ **Deliverable:** Flood Gauge Warning Network Investment Plans have been developed, taking a catchment-based approach, to assist 62 local governments to prioritise new investment in their networks | ✓ **Deliverable:** Fitzroy Basin Regional Action Plan (for future funding opportunities)<br>**Deliverable:** Technical Evidence Report |
| **Identify opportunities to implement plans** | In progress<br>**Ongoing action:** The Network Investment Plans enable:<br>• future network improvements<br>• necessary technical rigour to be approved for grant funding<br>• the transmission of data suitable for use by the Bureau<br>• real-time visibility of data to relevant local governments, the SDCC and the Bureau | In progress<br>**Action:** Ongoing delivery of the Fitzroy Basin Regional Action Plan by relevant stakeholders |
| **Create Basin Working Groups (BWGs)** | ✓ Pilot<br>**Ongoing deliverable:** formation of Basin Working Groups, with representatives from local governments, state and commonwealth agencies and industry | ✓ Pilot<br>**Deliverable:** Fitzroy Basin Working Group (BWG) has been formed<br>**Deliverable:** Fitzroy Regional Resilience Strategy Pilot Project was completed in January 2020 |

| Ongoing actions | Outcomes and Deliverables | Who is involved |
|---|---|---|
| **State-wide:** Continue working with local governments and other asset owners, investigating options to fund new assets in addition to addressing the ongoing costs to manage and maintain their rising asset base of flood warning infrastructure<br>**Regional:** Basin Working Groups and local governments to work with the State on investigating and prioritising opportunities for investment and cost efficiency improvements | **Outcome:** Flood Warning Gauge Network Investment Plans inform any further investments in flood warning infrastructure, reducing unnecessary operations and maintenance costs where possible (Principles 5 and 6)<br>**Outcome:** The plans are based on a hydrological assessment and provide sufficient detail to initiate the network design phase (Principles 4 and 5)<br>**Outcome:** A number of local governments have used their investment plans to source funding through the various grant programs (Principle 5) | **QRA (lead)**<br>**Network Subcommittee**<br>**Basin Working Groups**<br>**The Bureau**<br>**Local governments**<br>**Asset owners** |
| **State-wide:** Notify Basin Working Groups and local governments of potential funding opportunities, where appropriate<br>**Regional:** Continue to identify funding opportunities for implementation of plans | **Outcome:** Queensland will continue to align with the national standards and strategic initiatives where possible (Principle 2)<br>**Outcome:** Assets and infrastructure will comply with best practice standards (Principles 1, 2 and 3) | **QRA (lead)**<br>**Network Subcommittee**<br>**The Bureau**<br>**Local governments**<br>**Basin Working Groups**<br>**Asset owners** |
| **State-wide:** QFWCC-endorsed governance arrangements will continue:<br>**a.** QRA will chair the Network Subcommittee<br>**b.** QRA and the Bureau will continue to work with stakeholders within defined catchments in developing and assisting Basin Working Groups.<br>**Regional:** Further network efficiencies can be achieved by undertaking a catchment approach to the flood warning network | **Outcome:** The QFWCC-endorsed governance arrangements outlines roles and responsibilities for the management of the state's flood warning network (Principle 6)<br>**Outcome:** Delivery of locally-led and catchment-based best practice flood gauge warning network (Purpose and all Principles) | **QRA (lead)**<br>**Network Subcommittee**<br>**The Bureau** |

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