A collaborative catchment

Fitzroy Regional Resilience Strategy

A best practice flood warning infrastructure network for the Fitzroy Basin

January 2020

Acknowledgement of Country

We acknowledge the Aboriginal peoples and Torres Strait Islander peoples as the Traditional Owners and Custodians of this Country. We recognise and honour their ancient cultures, and their connection to land, sea and community. We pay our respect to them, their cultures, and to their Elders, past, present and emerging.

Image: Floods, Rockhampton region, January 2011.
Photo by Michael Marston.

A collaborative catchment Fitzroy Regional Resilience Strategy

*Delivering a best practice flood warning infrastructure network
for the Fitzroy Basin to provide a better understanding of flood risk
and to support improved social and economic resilience
outcomes for our communities.*

Contents

Image: Floods, Rockhampton region, January 2011.
Photo by Michael Marston.

Image: Floods, Rockhampton region, January 2011.
Photo by Michael Marston.

About the Fitzroy Regional Resilience Strategy

The Fitzroy region is no stranger to floods. This vast catchment is one of Australia's largest river systems, taking in the Isaac, Nogoa, Connors, Comet, Mackenzie and Dawson rivers and the mighty Fitzroy River itself.

The people who call the region home rely on this landscape for their social and economic wellbeing, as do all people of Queensland - whether it be through agriculture, mining, manufacturing or energy.

For the Fitzroy Basin, resilience is fundamentally about understanding risk. The vast basin has a long history of flooding in all its sub-basins and townships.

Purpose

The Queensland Government is focused on strengthening disaster resilience so communities are better equipped to deal with the increasing prevalence of natural disasters in line with the Queensland Strategy for Disaster Resilience (QSDR) objectives.

As the most disaster-impacted state in Australia, it is critical we harness best practice and look for new ways to work together to improve the resilience of communities across Queensland, adopting pathways toward a safer, stronger and more resilient Queensland.

The purpose of A collaborative catchment: Fitzroy River Resilience Strategy (the Strategy) is to understand risk in a fulsome and technical way, so leaders can fill gaps in assets and knowledge to better address risk in the future. Knowing if, where, when and how the catchment floods is vital to those who live here. Not just for safety, but for protecting livelihoods, property and people. Businesses operating in the catchment need to know how it works to make risk-informed investment and operational decisions.

Good flood warning infrastructure can help everyone understand how the catchment behaves, so that we can all live smarter in this region that provides so much to Queensland. A properly operating Flood Warning Network is an essential part of understanding flood risk, which in turn helps improve disaster resilience.

One of the challenges for the basin is the spatial extent - floods do not respect governance boundaries. The second objective of the QSDR involves working together across governance, basin, catchment, and other jurisdictional boundaries. Collaborating for resilience and to improve the Flood Warning Network is a cornerstone to success - with so many people, businesses, organisations and groups relying on the network, it truly is a shared responsibility to improve and maintain.

Scope and objectives

As background, the Strategy was developed as a pilot project in response to a request by the Central Queensland Disaster Managers Forum (CQDM) via the Central Queensland Regional Organisation of Councils (CQROC) for support to develop a catchment-scale approach to the Flood Warning Network and situational awareness in the Fitzroy River Basin.

The scope of the Strategy is a Total Flood Warning System Framework piloting a best practice flood warning infrastructure network for the Fitzroy Basin.

The Strategy has been developed through a partnership between the state government, local councils, and multiple public and private sector stakeholders in the Fitzroy region as a regional resilience strategy under Resilient Queensland 2018 - 2021: Delivering the Queensland Strategy for Disaster Resilience (Resilient Queensland).

The objectives of the Strategy are:

1. **understand risk** - linking the optimisation and operability of the Flood Warning Network (and other hazards where relevant) to risk awareness, community education and business continuity

2. **work together** - understanding how best to share technical capability, knowledge and resources across the catchment for collective benefit and a common approach to asset management.

Image: Manual river height gauge in the Fitzroy catchment. Courtesy of QRA.
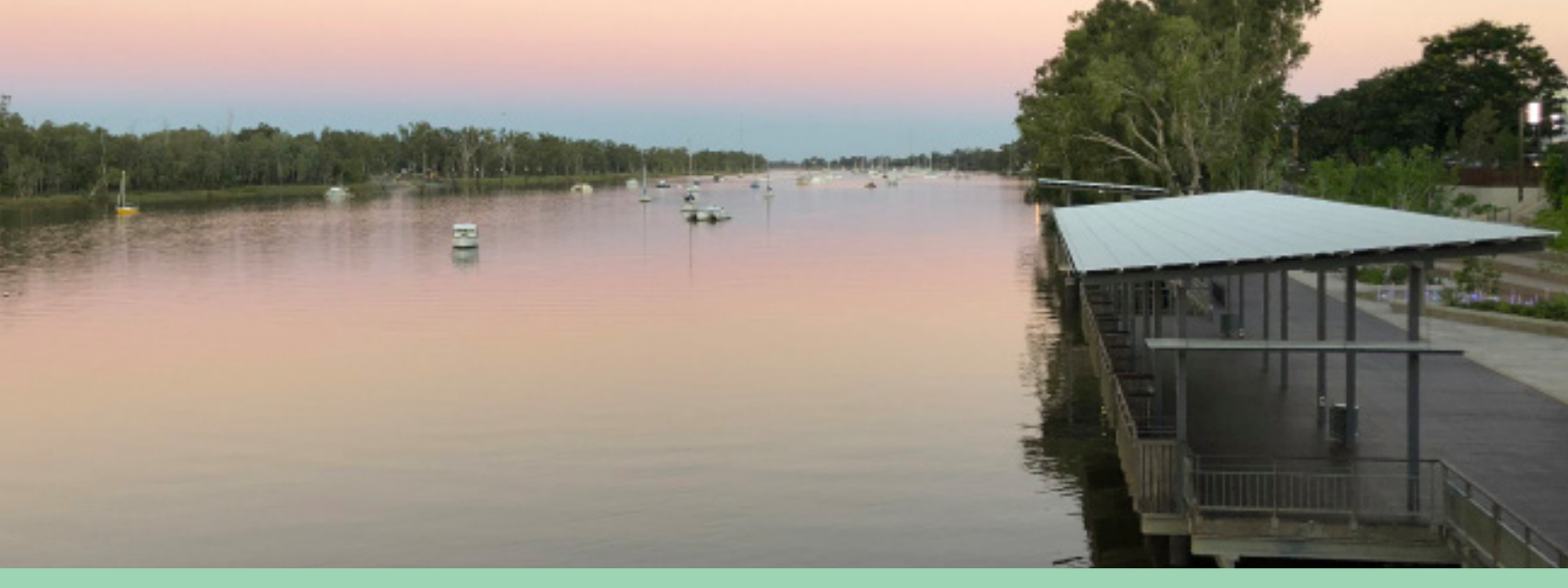
Achievements

The essential groundwork undertaken for the Strategy builds a physical and robust baseline of data for the Fitzroy region, and creates a framework for continuous improvement and future actions.

Benefits of the strategy are that it has tested ways to develop a best practice flood warning infrastructure network for the Fitzroy region, and provides:

- an audit and analysis of the existing flood warning infrastructure network
- a better understanding of flood risk that supports improved social and economic resilience outcomes for the community
- a new basin-scale working group aligning to existing governance arrangements that helps to draw other stakeholder groups into the flood warning system, including the resources sector and natural resource management bodies
- a plan for collaborative action to optimise the Fitzroy Basin flood warning infrastructure network set against funding options.

Ongoing collaboration

The Strategy provides pathways to flood warning infrastructure optimisation and process improvements, linked to funding opportunities over time via a programmed pathway of actions for collective implementation.

Collaboration continues with partner councils and other key stakeholders to seek the most appropriate opportunities for betterment, and to create a strong fabric of working together, and enhanced knowledge for the greater good of the Fitzroy region.

Future actions

It is anticipated that future actions for the Fitzroy Regional Resilience Strategy may include an integrated, multi-hazard and multidisciplinary approach to coordinating resilience actions across the Fitzroy region.

A key outcome of Resilient Queensland 2018-21 is the development of regional resilience plans that support the coordination and prioritisation of future resilience building and mitigation projects across Queensland. By 2022, every local government in Queensland will be part of a regional resilience strategy that clearly identifies and prioritises actions to strengthen disaster resilience over time.

Queenslanders are disaster resilient when...

Diagram: The four objectives of the Queensland Strategy for Disaster Resilience

Image: Fitzroy River, Rockhampton. Courtesy of QRA.

Fitzroy River catchment

Moranbah

Isaac River

Isaac River

Connors River

Dysart

Mackenzie River

Rockhampton

The Gemfields   Emerald   Blackwater

Mount Morgan

Dee River

Nogoa River

Comet River

Don River

Biloela

Claude River

Moura

Brown River

Theodore

Dawson River   Taroom

Our shared vision for a flood warning system

We know how the Fitzroy floods, we trust the forecast and situational information we are getting, and we collaborate to share information with all when it does flood.

Our resilience aspirations

- We collaborate to operate and maintain a Flood Warning Network that supports prediction, interpretation and messaging, appropriate for our catchment's needs.
- We understand the fundamental elements of, and have confidence in, the assets and data used to inform the Total Flood Warning System.
- We have timely and accurate flood forecasts and warnings.
- We have the right flood information at the right time – whether before, during, or after an event.
- We know where to go to access information.
- We understand what the information means and any likely consequences.
- We use flood warning information to inform our other flood risk management and resilience activities.
- We build an understanding of flood risk into our everyday lives, our business operations and our future decision-making.
- We capture flood evidence post-event to improve our network and the operations it supports.
- We share collected data and intelligence to ensure timely and common situational awareness.
- We actively share our knowledge and capability with others in the catchment to build skills and improve organisational resilience.

Related work

Improvements to the flood warning system in the Fitzroy cannot be done in isolation of the bigger picture. Increased population, economic development opportunities, community safety and environmental restoration all rely on flood resilience borne out of a good understanding of risk.

Improvements to the flood warning system need to be made through the multiple lenses of economic, social, infrastructure, environment and settlement resilience. The following bodies of work also relate.

Resilient Queensland 2018-21

The Queensland Government is focused on strengthening disaster resilience so that communities are better equipped to deal with the increasing prevalence of natural disasters.

A key outcome of Resilient Queensland 2018-21 - Delivering on the Queensland Strategy for Disaster Resilience (Resilient Queensland) will be the development of regional resilience plans that support the coordination and prioritisation of future resilience-building and mitigation projects across Queensland.

By 2022, every local government in Queensland will be part of a regional resilience strategy that clearly identifies and prioritises actions to strengthen disaster resilience over time.

The Fitzroy Regional Resilience Strategy is one of three regional resilience strategies piloted throughout Queensland as part of Resilient Queensland during 2019. It will be used to guide future regional resilience strategies. Collaborating with a region that has experienced serious flooding events in 2008, 2009, 2011, 2013, 2015 and 2018 provides the opportunity to ensure subject matter experts are lending their guidance and capability towards a shared solution to a common problem.

Integrating related programs and projects

This Strategy integrates and builds upon a range of local and regional strategic documents to articulate the various aspects of resilience action identified across the Fitzroy Basin. A number of key plans, projects and studies have been drawn upon to inform this Strategy.

Image: Lower Fitzroy catchment. Courtesy of the Department of the Environment and Science.

National Disaster Risk Reduction Framework (NDRRF)

The NDRRF is a multi-sector collaboration led by the National Resilience Taskforce within the Australian Government Department of Home Affairs. The framework was co-designed with representatives from all levels of government, business and the community sector. Over 100 participants from more than 80 diverse organisations came together at a three-day intensive 'policy sprint' to develop key components of the Framework.

The Framework outlines a coordinated approach to reducing disaster risk, which is a critical component of enabling resilience. It is designed to leverage the great work and progress made across all sectors since the 2011 release of the National Strategy for Disaster Resilience, and better understand and reduce disaster risks, improve resilience and bolster the capability and capacity of communities to withstand natural hazards.

More than ever, limiting the impact of disasters now and in the future requires a coordinated effort across and within many areas, including land use planning, infrastructure, emergency management, social policy, agriculture, education, health, community development, energy and the environment.

The Flood Warning Infrastructure Framework

The Standardisation of Bureau of Meteorology Hazards Services Taskforce (the Taskforce) was established by the Australia-New Zealand Emergency Management Committee (ANZEMC). The role of the Taskforce was to respond to recommendations made in the 2011 Munro Review, which investigated the Bureau of Meteorology's (the Bureau's) capacity to respond to extreme weather and seasonal forecasting.

In August 2014, the National Flood Warning Infrastructure Working Group (the Working Group) was established by the Taskforce. The Working Group developed a risk-based National Strategic Flood Warning Infrastructure Framework for the effective management of flood warning infrastructure, including:

- field instruments (rainfall and river level gauges)
- data transmission using a number of different technologies
- the collection of data for flood forecasting and warnings that provides situational awareness to all stakeholders including the public.

Image: Lower Fitzroy catchment. Courtesy of the Department of Environment and Science.

The National Strategic Flood Warning Infrastructure Framework was to be based on individual jurisdictional strategic flood warning infrastructure plans. Thus, Queensland developed the Queensland Strategic Flood Warning Infrastructure Plan in consultation with the Bureau, relevant Queensland state agencies, local councils and other flood warning infrastructure owners. This Plan has been endorsed by the Queensland Flood Warning Coordination Committee. It identifies opportunities for improvement in the following working areas:

- operations and maintenance – improving the operations and maintenance processes for the Queensland Flood Warning Infrastructure Network (FWIN), particularly accounting for the cessation of the Bureau shared maintenance arrangement
- network efficiency and optimisation
- following a catchment approach
- looking for opportunities to develop partnerships and collaboration for shared outcomes
- asset management
- network governance – adopting a holistic approach to the governance of FWIN and aligning with best practice including the Bureau National Arrangements
- flood classifications – working with local governments to review existing flood classifications in order to better align Bureau classifications with contemporary community impacts
- supporting the aims of Resilient Queensland, as detailed above, by adopting a catchment approach to the FWIN.

Concurrently, Queensland conducted a review of the FWIN in 2015, which made 19 recommendations for improvement of network operations. These recommendations are addressed in the 2019 Queensland Strategic Flood Warning Infrastructure Plan and informed by the development of the 44 flood warning investment plans for 62 local governments completed in 2017.

Central Queensland Economic and Infrastructure Framework

The Central Queensland Economic and Infrastructure Framework outlines the region's competitive strengths and economic development opportunities. This framework further outlines a number of the key whole of region trends and drivers. Competitive strengths listed in the region include coal, agriculture, manufacturing, construction, coal seam gas/liquefied natural gas, tourism and military training. Economic development opportunities include mining, energy and mineral processing, mining supply chain, agriculture and food processing, construction, tourism, education and training, support services for defence, provision of industrial land, and transport and logistics. These regional competitive strengths and economic development opportunities have been recognised and integrated into the Strategy.

Central Queensland Regional Plan

The Central Queensland Regional Plan provides strategic direction and policies to deliver regional outcomes which align with the state's interests in planning and development. The Plan plays a focussed role in resolving competing state interests on a regional scale, by delivering regional policy aimed at achieving specific regional outcomes. Regional policies outlined in the Plan aim to protect priority agricultural land uses while supporting co-existence opportunities for the resources sector, and provide certainty for the future of towns.

Fitzroy Basin Association Strategic Plan

The Fitzroy Basin Association (FBA) Strategic Plan, delivered in 2016, aims to inspire and empower communities who value the basin's natural assets by providing the region with the resources, knowledge and skills to maintain the region's assets for future generations. This Plan has seven key goals:

1. community engagement and involvement

2. best management practices

3. informed land use planning and management

4. resilient and adaptable industries

5. long term sustainability planning

6. healthy rivers and waterways

7. healthy ecosystems that support biodiversity.

Applying lessons learnt

The learnings from this pilot are already informing the approach to the flood warning system in other parts of the state.

Many days of unprecedented monsoonal flooding in North and Far North Queensland in early 2019 laid bare some clear limitations in the flood forecasting, warning and situational awareness capabilities of the warning network, particularly in North West Queensland.

In response, the Commonwealth Government announced the procurement of two new weather radar sites in northern Queensland to address several rainfall 'black spots', at Maxwelton and Charters Towers. Other sites announced in Queensland include Oakey and Taroom.

Further, the combined state and federal Category D funding package under the Disaster Recovery Funding Arrangements (DRFA) includes $2 million in flood warning infrastructure for the 39 councils activated for DRFA for that event.

The Queensland Reconstruction Authority (QRA) is now working with councils, agencies, regional organisations of councils and of other entities in north Queensland to apply the Total Flood Warning System framework, collaborative governance and programmed rollout approach of this pilot in those activated local government areas.

Image: Fitzroy catchment in flood.
Courtesy of the Fitzroy Basin Association.

Broader integration

It is intended the outcomes of the Strategy will be considered and factored into a range of cross-discipline strategies including (but not limited to):

- regional plans
- regional economic development strategies
- regional transport and infrastructure plans
- natural resource management plans
- water resource plans
- local and district disaster management plans
- local asset management and capital works plans
- local corporate and community development plans
- land use planning schemes
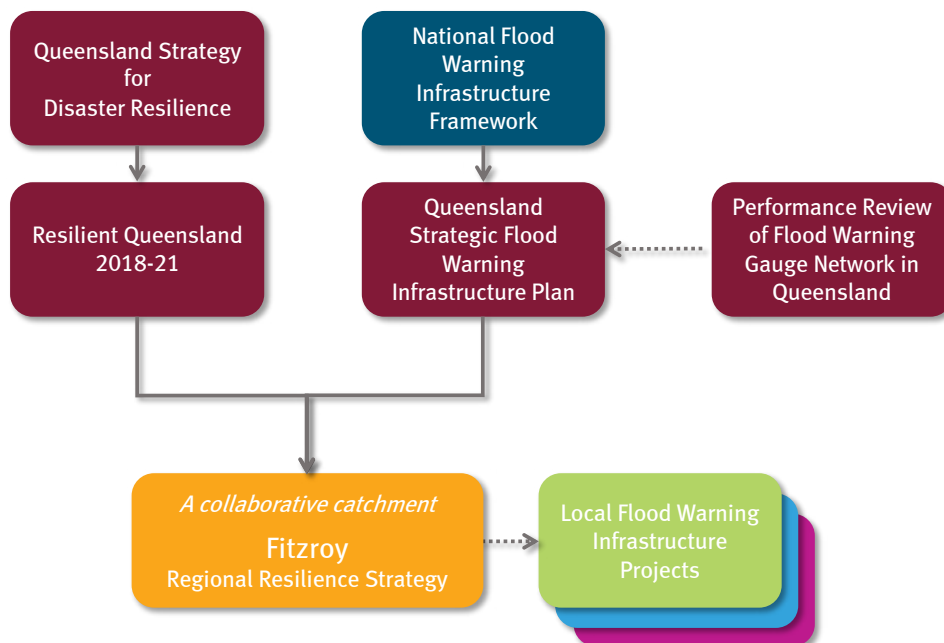- local and regional health strategies.

Diagram: The Flood Warning Infrastructure Policy Framework

Image: Fitzroy River in flood in 2008.
Courtesy of the Fitzroy Basin Association.

About the Fitzroy catchment

The Fitzroy River catchment is a vast area collecting water from extensive inland plains, coastal highlands and the Great Dividing Range. It extends from Nebo in the north to Theodore in the south, and Clermont and Injune in the west. It is home to approximately 235,500 people. The Fitzroy Basin is the largest of six river catchment areas flowing into the Great Barrier Reef Marine Park, with an area of 156,000 square kilometres or 8.2 per cent of Queensland's land mass. It represents 37 per cent of the total Great Barrier Reef catchment area and contains over 20,000 kilometres of rivers, creeks, tributaries and waterways. Its immense size and fan-like shape spreads across central Queensland and funnels the catchment to drain into the ocean at Rockhampton. The Fitzroy River catchment can produce severe flooding following heavy rainfall events. Major floods can result from rainfall in the sub-basins.

The Fitzroy Basin major tributaries join together about 100 kilometres west of Rockhampton and the catchment is commonly discussed in terms of its 11 rivers (Callide, Comet, Connors, Fitzroy (lower), Upper and Lower Dawson, Upper and Lower Isaac, Mackenzie, Nogoa and Theresa Creek) or six distinct sub-basins. The northernmost sub-basin takes in the Isaac River, draining the vast Isaac Plains, which is joined by the Connors River from the rainforests of the Connors Range and Blue Mountain. The southern tip of the Isaac sub-basin joins the Mackenzie River at the base of Broadsound Range.

The westernmost is the Nogoa River sub-basin, which starts at the Great Divide and Drummond Range, flowing down the valley to Fairbairn Dam just west of Emerald. The Theresa Creek catchment joins it from the north and together they flow into the Comet River. Further south and almost parallel to the Nogoa, is the Comet River valley and sub-basin, starting as the Brown River. It changes to the Comet at Rolleston and flows north until it meets the Nogoa and forms the Mackenzie, halfway between Emerald and Blackwater.

The Mackenzie sub-basin is in the centre of the broader Fitzroy catchment area and flows north-east from Blackwater to Tartrus where the Isaac joins it, turning south and collecting the waters of Carnarvon Creek along the way. Duaringa is the meeting place of the southern sub-basin of the Dawson River. It flows as the Upper Dawson River from as far as Injune, west and north through Taroom, Theodore and Baralba before joining the Mackenzie at Dauringa to form the Fitzroy. The remaining catchment is the lower Fitzroy which winds its way north through The Gap and Yaamba before heading south east to Keppel Bay and discharging into the Pacific Ocean.

The broader catchment area is characterised by vast areas of inland Central Queensland renown for cattle grazing, scenic landscapes and the resource deposits of the Bowen Basin, rich in coal and gas. The Bowen Basin extends north-south across the entire river catchment from Collinsville to Moura, a length of about 650 kilometres. Mining features strongly in the Isaac and Central Highlands areas with mines operating in the far north of the catchment (at Hail Creek, Goonyella and Coppabella), further south (at Saraji and Middlemount) down to Curragh and Crinum around Blackwater and Baralaba and Dawson mines in the Banana shire.

As a result, the Fitzroy basin is home to a number of purpose-built mining towns such as Moranbah, built in 1970, Dysart in 1973 and Middlemount and Tieri in the early 80s. Other principal townships include Biloela, Blackwater, Emerald and Clermont, the latter an old gold mining town steeped in history.

The Carnarvon, Dawson and Gregory highways are popular inland tourist routes running south to north from Roma to Clermont through the scenic landscapes of the Carnarvon Ranges and tableland country to Emerald, Lake Maraboon and the gem fossicking attractions at Sapphire and Rubyvale. The Capricorn Highway runs east-west from Rockhampton to Longreach through the townships of Duaringa and Blackwater.

Image: Fitzroy catchment viewed from the Drummond Range Lookout. Courtesy of QRA.

Local governments

The Fitzroy Basin reaches eleven local government areas, five of which sit completely within the catchment (Rockhampton, Isaac, Central Highlands, Banana and Woorabinda). In addition, a number of local government areas are on the periphery of the catchment (Blackall-Tambo, Gladstone, Livingstone, Mackay, Maranoa, and Western Downs).

The Rockhampton Regional Council, situated 600 kilometres north of Brisbane on the Tropic of Capricorn, is the largest local government in area and population. The lower Fitzroy River forms a boundary in part between Rockhampton and Livingstone councils to the north and east. To the south-east is Gladstone Regional Council, south west is Banana Shire and Central Highlands to the west. The Rockhampton local government area has no substantial coastal areas as the boundary ends at the junction of the mouth of the Fitzroy River, Raglan and Casuarina Creeks. The Rockhampton region has a current population of 81,206 people and a land area of 657,549 square kilometres. Just under 39 per cent of the population has moved since 2011, and of those just over 40 per cent are new to the region.

The Isaac region is the most northerly local government area within the catchment and includes the Isaac and Connors rivers sub-basins, and part of the Nogoa sub-basin, specifically, Theresa Creek. The council area includes a small coastal portion which drains to the ocean rather than the Fitzroy. The residential population of 24,275 people is spread across more than a dozen small coastal, rural and mining communities such as the Clermont, Coppabella, Dysart, Glenden, Middlemount, Moranbah, Nebo and St Lawrence.

Isaac Regional Council shares a boundary with Mackay and Livingstone in the east, Central Highlands to the south, Whitsunday and Charters Towers to the north and Barcaldine to the west. The council area is 58,000 square kilometres with a population of 21,185 people. It is in the unique situation of hosting 21,462 jobs – more than its total resident population.

The Central Highlands region encompasses an area of 60,361 square kilometres and is home to 28,610 people, who live in the thirteen unique communities of Arcadia Valley, Bauhinia, Blackwater, Bluff, Capella, Comet, Dingo, Duaringa, Emerald, Rolleston, Sapphire Gemfields, Springsure and Tieri. A total of 26.1 per cent of the population are under 15 years old, which is 5.5 per cent higher than the Queensland average. In contrast, the region has half the state average of over 55 year olds, at 7.6 percent, compared with a state average of 15 per cent. A total of 36 per cent of the population had a different address between the 2011 and 2017 census.

Central Highlands is bounded by Isaac to the north, Rockhampton to the east, Banana, Maranoa, Murweh and Blackall-Tambo to the south and Barcaldine to the west. The region contains the Nogoa, Comet and Mackenzie sub-basins and the scenic Carnarvon Ranges and tablelands high country.

The Banana region covers a total area of 28,610 square kilometres, of which only 27 square kilometres is urbanised. It has a population of 15,209. The Banana shire contains the Dawson sub-basin including Callide Creek. The shire shares a boundary with Gladstone to the east, Western Downs and North Burnett to the south, Maranoa to the west and Central Highlands and Rockhampton to the north.

The population and administrative centre are in the town of Biloela with 5371 people. Moura and Taroom are other significant urban centres in the shire. Banana, Baralaba, Dululu, Goovigen, Jambin, Thangool, Theodore, Wowan and Cracow comprise the remaining towns of the shire.

The town of Woorabinda is located 170 kilometres south west of Rockhampton, on the Fitzroy Development Road. Situated on the traditional lands of the Wadja Wadja/Yungulu Aboriginal people, the shire is 391.2 square kilometres and consists of five parcels of land with a total area of 39,000 hectares. The shire has a population of 962 people and is completely bounded by the Central Highlands Regional Council land. Woorabinda was established in 1927 and the community was sustained through stockwork that led to the formation of the Woorabinda Pastoral Company. There are approximately 52 clans represented in Woorabinda, with a vast number of language groups from throughout Queensland.

Image: Sunset near Tieri.
Courtesy of QRA.

Our land and environment

Falling to the east of the Great Dividing Range and flowing to the Great Barrier Reef, the Fitzroy region is comprised of a diverse array of landscapes from towering and dramatic sandstone cliffs of the tablelands to vast rich soil plains and nationally significant wetlands. Each landscape supports a unique community of native plants and animals, some of which live nowhere else in the world.

There are 20 listed wetlands of national significance in the Fitzroy region, including major wetland ecosystems in the Fitzroy delta. Some of these are also listed under The Ramsar Convention on Wetlands and form part of the Great Barrier Reef World Heritage Area. These wetlands support over 791 plant species, 445 different fish, threatened marine turtles and 226 bird species, including migratory species that are protected under international conservation agreements. Water quality is a primary management issue for the catchment given the importance of local wetlands and the proximity of the Great Barrier Reef.

The landscape varies across the region from the coastal swamps and wetlands to mature eucalypt woodlands and open forest. Acacia scrub woodlands dominate the inland areas. Grazing is widespread on natural and modified pasture, irrigated cropping and horticulture is undertaken on the richest soils.

Hidden in the rugged ranges of Queensland's central highlands, Carnarvon Gorge and the rangelands features towering sandstone cliffs, vibrantly coloured side gorges, diverse flora and fauna and Aboriginal rock art. Carnarvon forms part of Queensland's Sandstone Wilderness with a string of conservation estates across the south of the region from Theodore to Emerald: Isla Gorge, Nuga Nuga Lakes, Carnarvon National Park, and Blackdown Tablelands to name a few.

Further north Wolfang Peak rises dramatically from the surrounding plains between Moranbah and Clermont. At 572 metres it takes approximately an hour to summit. It has significant scenic and geological values and climbers will discover a colony of bats and look out for the giant St Andrews spiders near the summit. Once there a 360 degree view of the surrounding farmland and landscapes offers one of the most unique panoramas in Queensland.

Image: Bowinda Gorge, Carnarvon Gorge National Park. Courtesy of Tourism Australia.

Stock routes across the catchment reflect the importance of the beef industry from Clermont to Emerald, Springsure and Moura and also Taroom to Roma. The landscape offers rich experience from Fairbairn Dam and Lake Maraboon to fossicking on the public reserves of the Central Highlands gemfields. Goodedulla and Mt Archer national parks offer visitors alternative experiences. The region is home to unique fauna including the Kroombit frogs, the Fitzroy River Turtle, and the Capricorn Yellow Chat.

Our community

The catchment boasts isolated and yet well connected and resourceful communities. The communities service vast areas of rural Queensland and with growing tourist numbers, the region is celebrated regularly and its character reflected through the range of events held.

The unmissable Nebo Rodeo is held every year in May for the professional rider circuit.

Rockhampton has been celebrating the newly refurbished riverside since 2015 and Riverfest attracts thousands of people in July each year for music, art and culture. The river comes alive again in October for the Capricorn Food and Wine Festival.

There's no better place to celebrate the origin, appeal and sheer beauty of the outback than at Gemfest in Sapphire: the home of the largest sapphire fields in the Southern Hemisphere. The annual Festival of Gems is recognised as one of the most popular celebrations of sapphires and gems in Australia. Crowds of over 7000 people converge on Central Queensland's Gemfields for the annual four-day festival, held every year in the second week of August.

Australian heritage and culture at its best has been celebrated at Mount Morgan for over 40 years. This community has played an integral part in the lives of many: such was the nature of one of the richest gold mines in the southern hemisphere. Like the gold discoveries throughout the world Mount Morgan attracted its share of migrants – people who came here to make their fortune or merely to find a job. These pioneers of the Golden Mount were the founding fathers and their legacy is celebrated on a daily basis as locals and the like recall the "glory days" of the town. The festival runs a variety of events and competitions but none as enduring as the Gold Dig and Running the Cutter. Both of these events have been loosely based around the traditions of the past. The event is held over four days on the May Day weekend.

The Moura Coal and Country Festival began in 1971 as the Coal Festival. With the Moura Mine operating since 1961, the Moura Coal and Country Festival has proven to be a community stabiliser, in the face of past tragedies and uncertainties. Many mining families, who left town, are drawn back each year by the annual event to reunite with old friends and family for a week in August each year. Coal shovelling was introduced at the first festival and remains a stalwart of the event which now hosts the Queensland Coal Shovelling titles.

Biloela hosts the VDM Music Festival in October, an over-18 event at the Showgrounds.

Central Australia would not be complete without a celebration of the cattle industry. Australia's national beef expo is one of the world's great beef cattle events and is held once every three years in Rockhampton. Held in early May it celebrates all facets of the Australian beef industry. The expo facilitates new trade and export opportunities by exposing the local supply chain to the international industry leaders; and features more than 5000 cattle and over 30 breeds. The trade fair promotes more than 500 businesses; a symposium, seminars and property tours to deliver new research information to producers; restaurants, celebrity chefs and cooking demonstrations for visitors to appreciate the quality and flavour of Australian beef.

Our economy

Rockhampton is the junction of major road and rail networks, with proximity to the Bowen Basin and strategic access to the Galilee Basin. Rockhampton is also a key service and logistics hub for the coal industry, providing road, rail and air services. The Bowen Basin in Central Queensland is the nation's largest coal reserve and has 46 operational coal mines extracting more than 200 million tonnes of coal annually. Coal is also found further south as far as Moura. The Callide power stations produce about 20 per cent of the states' electricity.

The Isaac economy contributes over 75 per cent of the region's GRP of $5.9 billion and consistently generates in excess of $1 billion in royalty payments each year. Agriculture is an important industry with an annual output of $308 million.

Image: Callide Station in the Dawson sub-catchment. Courtesy of QRA.

Central Highlands is similarly rich in minerals and agriculture, thriving on irrigation sourced from storage on the Nogoa and Comet rivers. The region produces significant amounts of cotton, broadacre crops, fruit, nuts and vegetables. Its niche horticulture producers service the growing international demand for safe and clean premium products. The town of Emerald hosts Ag-Grow, one of the most successful marketing events for businesses wishing to access opportunities throughout the region. The sector contributes nearly a quarter of the state's total exports and is part of Queensland's $13 billion primary industry sector.

Theodore supports a diverse rural sector with its main industry being cotton. Almost 80 per cent of the Shire's cotton is grown in the Dawson Valley Area. The beef industry is the region's dominant agricultural industry and is a significant contributor to local economies as well as Queensland's exports. The region is home to Queensland's largest livestock exchange. Rockhampton is also known as the beef capital of Australia and hosts Australia's national beef expo, Beef Australia, every three years. The Biloela meatworks is the third largest in Queensland and processes meat for export throughout Australasia.

With its wide-open spaces, the region is becoming increasingly well known for its drone-testing opportunities, providing innovations for use in agriculture and other sectors. Continued expansion of the agriculture industry will see increased demand for the development of education, training and infrastructure projects. Opportunities also exist for foreign direct investment into the region to add further value to the sector.

Tourism is a key contributor to the regional economy with the growing road travellers' market. While the bulk of the visitor numbers are due to the mining and industry uses there are an abundance of opportunities for leisure visitors. Domestic overnight leisure visitors spend over $500 million in the Fitzroy Region, with tourism accounting for 10.9 per cent of all employment. Key factors in Central Queensland's favour are the stronger domestic drive market, upon which Central Queensland relies for almost 80 per cent of its visitors and the daytrip market which is supported by population growth. Only 10 per cent of visitors to Central Queensland are international. Attractions are plenty including the unique landscapes of the sandstone wilderness areas and the associated national parks and reserves. The region is home to the largest sapphire-producing fields in the Southern Hemisphere. Taroom is well known historically for the Leichhardt Tree. Situated in the main street, this tree bore the initials of explorer, Ludwig Leichhardt, as he travelled through the district in the mid 1840s, as an example of only one of the many towns steeped in Australia heritage such as Mount Morgan, Clermont and Nebo.

Our flood history

The Fitzroy River has a long and well documented history of flooding dating back to 1859. The highest recorded flood occurred in January 1918 and reached 10.11 metres on the Rockhampton gauge. Rockhampton has exceeded the major flood level three times this decade and in 2011 the Fitzroy River reached 9.20 metres at Rockhampton – still almost a metre below the 1918 levels. The figure below shows the significant flood peaks which have occurred at Rockhampton during the last 150 years.

Early floods of 1864, 1869 and 1875 in Rockhampton predate accurate gauge height. In 1890, when 1397mm of rain fell during the first three months of the year and one of the cylinders of the bridge gave way. 1896 was the highest flood up to that time at 152.4mm higher than 1890.

The Fitzroy River provided all transport and communications for much of Central Queensland through the port of Rockhampton, but the location at the bottom of one of Australia largest river basins made it vulnerable to flooding. In the last century three events reached record heights: in 1918 (10.11 metres), 1954 (9.3 metres) and 1991 (9.3 metres). The first of these in 1918, remains the greatest test of Rockhampton's endurance.

The 1918 flood was a result of a perfect combination of events: downpours in the headwaters a fortnight earlier meant the river was already swollen. More rain fell in the aftermath of the cyclone which struck Mackay, the river broke its banks, and left elevated parts of the town isolated in a vast sea of brown swirling waters. Eight people drowned in floodwaters.

These historic events from the start of record keeping were also described as devastating and catastrophic. The community experienced loss, suffering, emotional and financial distress, the economy suffered, farmers lost livestock and infrastructure was damaged. The town was isolated for a lengthy period without technology or communications with the outside world.

This last decade events affected communities across the catchment in Emerald, Rolleston and Theodore with their largest floods on record. A total of 79 warnings were issued for the Fitzroy River system including the Nogoa River during December 2010 and January 2011. The major event in 2011 was preceded by heavy rainfall throughout the catchment with Emerald township suffering the rise of the Nogoa River as 600mm of rain fell. Over 400mm fell in the Carnarvon ranges between December 26 and 28. Emerald recorded major flooding in December 2010 causing significant inundation to the town. Major flood level (15 metres) was exceeded from December 30 to January 2. An estimated 1000 houses and 95 per cent of properties were inundated.

Emerald flood height records began in 1950 with three major flood peaks in the record. The last major flood was 15.36 metres in January 2008, but previous to that was 15.7 metres in 1950. Flooding peaked at a new record of 16.05 metres on December 31 and remained above 14 metres for five days.
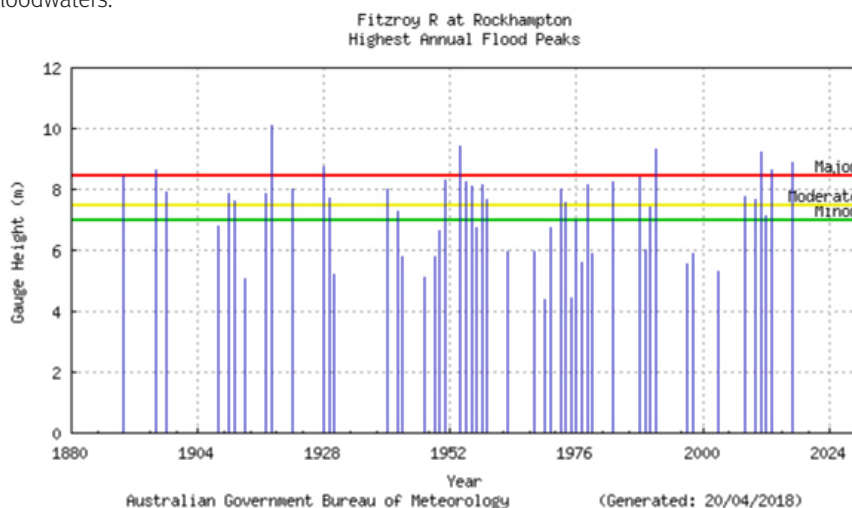
Image: Fitzroy River peaking at 8.8m in 2017.
Courtesy of QRA.

Prior to the events of the last decade, Cyclone Joy brought significant falls and flooding from 23 December 1990 after crossing the coast near Ayr. Alerts were issued for the Mackenzie, Isaac, Connors and Fitzroy. The event peaked in Rockhampton in early 1991 and caused $300 million in damage. The rainfall pattern was widespread with 458mm falling in the most northern extreme of the catchment at Blue Mountain while the coastal areas of Rockhampton itself was experiencing 100mm per day. This rainfall continued in January and flood events in the Fitzroy Basin can often be associated with widespread good seasonal rains cumulating at the lower Fitzroy.

Case study:
Clermont Floods 1916

The 1916 flood changed the shape of Clermont forever. The town had previously been inundated by swift flood waters in 1870 and again in 1882 losing 15 and three residents respectively on those occasions. At this time Clermont was a thriving gold town with surrounding agriculture. The main street boasted five hotels, two sawmills, three saddlers and the rail head, supporting the nearby Copperfield gold enterprises. On 27 December 1916, a cyclone crossed the coast between Bowen and Mackay filling the Wolfgang Creek catchment with over 419mm of rain. Further heavy falls of between 500mm and 600mm were recorded between Clermont and Coppabella. The floods were a state level tragedy and resulted in the deaths of 60 residents, and much of the township was washed away.

"A large part of Clermont will have to be rebuilt, and before the reconstruction begins it would be well to consider the question of removing the lower part of the town to the higher ground adjoining. There is a natural, but often a dangerous tendency in a new and arid country to build as near the water as possible, hence part of Clermont, like part of Rockhampton, is built virtually in the bed of a great watercourse."

Morning Bulletin (Rockhampton, Queensland : 1878 - 1954), Wednesday 3 January 1917, page 4.

The extent of the devastation and the location of the township resulted in the ascension of the Clermont Flood Relief Act of 1917. This may have been Australia's first land swap as a result of a natural disaster:

"The bill provides that the Minister shall cause to be surveyed into lots of not exceeding one-half an acre in area, a sufficient number of allotments of Crown land at a site, south of the present railway station at Clermont, and also any other area of land acquired for the Crown under this section, for the purpose of providing residence areas for such of the sufferers by the recent flood at Clermont as have lost their homes by that flood."

Telegraph (Brisbane, Queensland. : 1872 - 1947), Saturday 3 February 1917, page 7.

Much of the township was relocated to higher ground closer to the railway on the current site including the Commercial, Grand and Leo Hotels. The lower flood prone areas are now the popular public Centenary Parklands of Hoods Lagoon. The event is recalled to visitors through the continued placement of a replica piano in a tree on the entrance to the township, which gives an appreciation of the strength and height of the floodwaters at the time. By 1918 after a raft of serious flooding throughout Queensland, including Brisbane, Innisfail, Mackay and Rockhampton, the need to relocate townships away from flood waters was well documented and debated.

Images: (top) 1916 Clermont Flood damage,
Drummond Street. Photo by Gordon Pullar.
Courtesy of SLQ. (Left) Flooding Rockhampton, 2011.
Photos by Michael Marston.

Case study:
Isaac Disaster Coordination Centre

A coordination hub for disaster management personnel during times of severe weather events officially opened in the Isaac region in late 2019 with the assistance of the Queensland Reconstruction Authority and the Queensland Disaster Resilience Fund and Anglo American.

The Moranbah's SES training facility on Bacon Street has been upgraded into the Isaac Local Disaster Coordination Centre and transformed the base into a quality centre for disaster coordination. The new disaster base will allow the disaster management team to better collaborate, secure resources, and communicate vital warnings and information out to our community.

The facility includes a dedicated 45KVA generator, video teleconferencing facilities, and operational upgrades to ensure our community can remain connected and supported if disaster strikes. With back-up power, and improved technology services, the disaster management team can streamline information sharing, and remain self-sufficient in any emergency, keeping residents up to date with the latest information.

Experience shows that communities who are well prepared and supported before a disaster, are more resilient, and able to recover faster.

The opening is evidence of working partnerships between all levels of government and private enterprise to bring the best to our local communities. Council's Disaster Dashboard is also an invaluable tool for the community to use during an emergency. Extreme weather in Queensland is not an 'if' but a 'when' and Isaac residents are encouraged to prepare their household emergency plan along with an evacuation and emergency kit to ensure they are disaster ready.

https://www.isaac.qld.gov.au/about-council/media-releases

Case study:
'The Hub' – Livingstone Shire Council Disaster Centre of Excellence

Marking a monumental day for Livingstone Shire, on Monday 30th April 2018 the newly completed Centre of Excellence for Disaster Management, Innovation and Community Resilience (The Hub) was opened. The $6.225 million project, will be a lasting legacy and will have an ongoing positive impact on the community as a focal part of the Town Centre in providing a community resource for advice, guidance, engagement, training and education purposes.

The multi-use facility will not only be activated in times of disaster but be available for multiple agencies to utilise as a venue for their involvement in building community resilience.

The project received $3.35 million in funding under the Natural Disaster Resilience Program and $2.875 million from Livingstone Shire Council.

This proposed structure will ensure research and academia are embedded into the operational functionality of the facility with potential for partnerships with tertiary institutions

It's an example of what can be achieved when three levels of government collaborate and work together. The Hub was purposely planned to be in the centre of Yeppoon to always be a beacon for the Community and a reminder of the importance of resilience.

Embedded within the Hub is the Local Disaster Coordination Centre (LDCC) fully operational at all times hosting technology that can be used by all agencies. AV equipment was designed to ensure that the LDCC can be used as a coordination centre for not only the Local Disaster Management Group, but by any agency as required for coordination.

Without a doubt the highlight so far are the multiple school visits held in the Hub. School groups are given a presentation of hazards and risks then embedded into a disaster scenario given tabards and positions in the LDCC, then through visual displays and Q and A regarding the cells of the AIIMS structure discuss roles.

Image: The Hub - Livingstone Disaster Centre of Excellence. Courtesy of QRA.
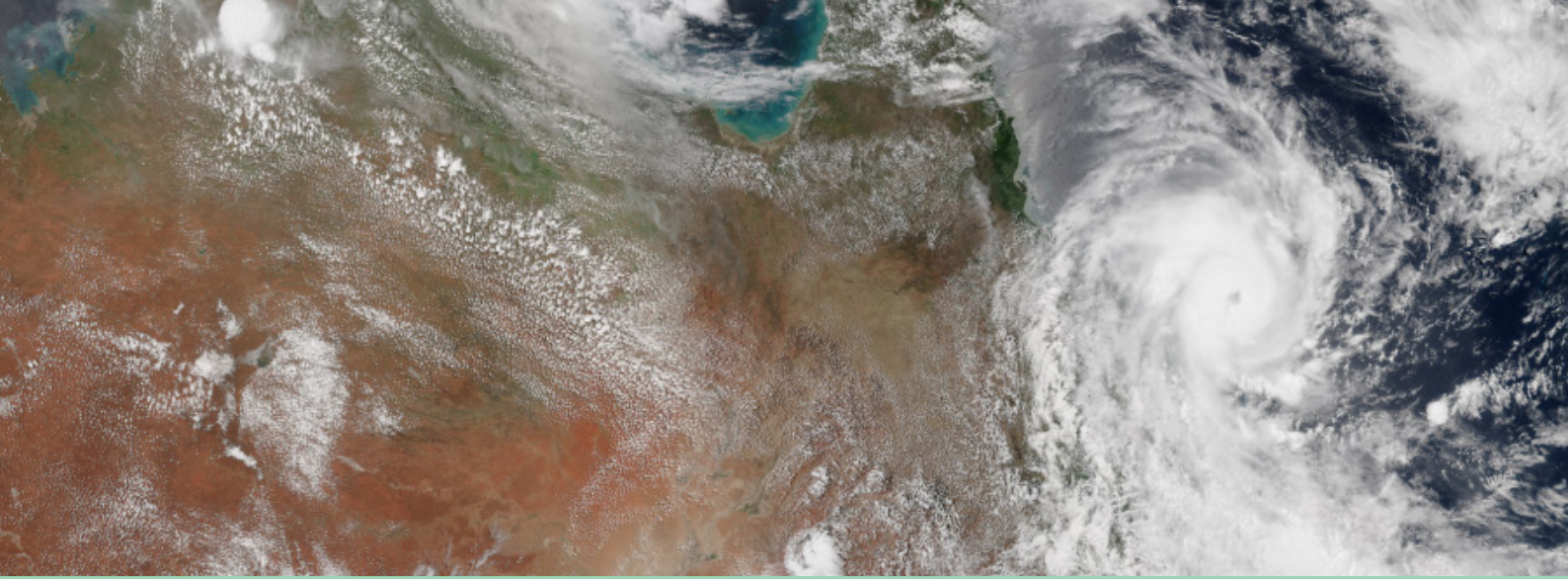
Case study:
The day Marcia came to town

The tropical low that eventually became severe Tropical Cyclone Marcia was first identified and tracked on 15 February 2015, observed on the monsoon trough southeast of Papua New Guinea in the Coral Sea. On 18 February, after several days of drifting eastward with little change, the system turned southwest and began intensifying. The system was officially designated a Category 1 cyclone that evening, subsequently undergoing rapid intensification to a Category 4 in approximately ten hours. By 20 February, Cyclone Marcia had intensified to a Category 5; crossing the Queensland coast at Shoalwater Bay at 8:00am, 90 kilometres north-north-west of Yeppoon.

As Yeppoon marked the first anniversary of Cyclone Marcia, the community launched creative works in response to the disaster. The book was the idea of local Lincoln Bertoli and illustrated by local artist Jet James.

The Day Marcia Came to Town, is written from the perspective of a young boy named Lachlan, whose grandfather tells him the story of the cyclone.

The book was distributed to every child in schools around the region from prep to year four. The distribution to the schools also gave an opportunity for Lincoln to speak to the kids and have some first-hand discussion on the impacts of the event.

The discussion can give greater insight into how people work together and collaborate for the collective good. This discussion was important because working together is a key theme of the book: stick together and help each other.

Images: Cyclone Marcia. Courtesy of NASA Earth Observatory. (Inset) 'The Day Marcia Came to Town' by Lincoln Bertoli.

Walking the landscape

The Strategy is supplemented by a separate body of work led by the Department of Environment and Science, called Walking the Landscape. The Walking the Landscape website for the Lower Fitzroy can be viewed via the WetlandInfo website.

The primary aim of Walking the Landscape is to help develop a whole-of-landscape understanding to improve evidence-based decision making for the sustainable management and restoration of ecological systems.

The framework incorporates available knowledge on landscape components (e.g. groundwater dependent ecosystems, lacustrine wetland, riparian vegetation etc.) and processes (hydrological, geological etc.). The framework integrates existing scientific information with local knowledge about how catchments work.

Through this process, the Department of Environment and Science worked with local stakeholders, local and state government and communities to gain a collective understanding of many Queensland catchments from Cape York to South East Queensland.

The process helps answer questions like how the landscape impacts water movement or why groundwater dependent ecosystems occur in certain locations.

The primary aim of the framework is to help develop a whole-of-landscape understanding to improve evidence-based decision making for the sustainable management and restoration of ecological systems.

https://wetlandinfo.des.qld.gov.au/wetlands/ecology/processes-systems/water/catchment-stories/

Images: Fitzroy catchment in flood. Photo by Michael Marston.
(Inset) Walking the landscape webpage.

System overview

The flood warning system

A flood warning system is made up of four elements:

- gauge assets like rainfall and river gauges
- supporting infrastructure like data transmission and power supply
- flood prediction services
- communications/messaging processes.

Each of these elements need to function properly before, during, and following a flood event in order for people to fully understand their flood risk. Optimisation of the infrastructure network (i.e. the gauges and the supporting infrastructure) is the backbone of ensuring the right people have the right flood information at the right time.

The Bureau of Meteorology notes that flood warning is an integral component of counter disaster arrangements for a community at risk from flooding. The aim of the warning system is to minimise loss of life and property damage by warning people of the likelihood and size of a flood so that they may evacuate, shift property or stock to higher ground, or implement other temporary flood loss reduction measures.

Warnings are of limited value unless they are delivered in a timely and effective manner and property owners and residents in the flood-threatened area believe the warning and take appropriate action in advance of being flooded.

Our collective flood warning challenge

Queensland has more than 3000 flood warning gauges that are owned by 54 different entities that support and inform the Bureau's Service Level Agreement (SLS). Ownership of the gauges supporting the SLS is predominately shared between the Bureau of Meteorology, local governments, the Department of Natural Resources, Mines and Energy, and dam owners Seqwater and SunWater.

There is an emerging number of assets being commissioned by a range of agencies/entities for their own purposes – whether that be for flood warning, water quality, or other water monitoring purposes. These entities include resource companies, natural resource management groups, and transport entities such as rail network operators and freight/logistics entities.

Whilst individual assets are relatively low cost, they operate as networks which are collectively considered 'assets of national importance'.

We don't always have a complete picture of the Total Flood Warning System – nor whether the network is as optimised as it could be.

Who owns what infrastructure and where? Are the assets in the right location to meet prediction and warning purposes? Will they be destroyed by a flood if it occurs? Are assets duplicated by different entities in the same place? Are there opportunities to share data between entities so that we can reduce costs and operational complexity of the network? How can we develop a collective understanding of the network and its upgrade requirements so that we can fund appropriate upgrades and maintenance over time?

It is therefore paramount that the whole network is effectively managed and maintained to ensure timely and accurate warnings to Queenslanders of flood risks.

Image: Flood gauge on the Yaamba Road.
Courtesy of QRA.

Do we have.....

- A complete picture?

- Assets in the right locations for the right purpose?

- Assets vulnerable to flood?

- Opportunity to share data?

- Unnecessary duplication?

- Collective understanding?

- Appropriate funding and maintenance arrangements?

What is the service level specification?

Flood warning and forecasting services for Queensland are provided by the Bureau of Meteorology under what is known as the Service Level Specification (SLS).

http://www.bom.gov.au/qld/flood/brochures/SLS-2014-15-QLD-SIGNED.pdf

It sets out how the details of these services provided by the Bureau to Queensland government agencies, councils, communities, and businesses, and how the Bureau consults these entities in delivering those services. It provides a description of the various activities, associated products, and target levels of service that constitute the current standard services provided freely by the Bureau.

As per the SLS, the Bureau's main role in the Total Flood Warning System is focussed on monitoring and prediction, and to a lesser extent interpretation, message construction and communication components.

Interpretation, message construction, and communication components are more so the responsibility of other entities through the Queensland Disaster Management Arrangements (QDMA), before, during, and following a flood event.

The Bureau also has a role in the ownership, management, and maintenance of many of the infrastructure assets (like flood and rain gauges) used to make the predictions – but they don't own every infrastructure asset. That is why it is important to collaborate across entities to make sure we have a flood warning infrastructure network that is optimised to enable the Bureau to do what it does best.

Image: Mackenzie River in flood, 2017.
Courtesy of Fitzroy Basin Association.

A Total Flood Warning System approach

The Strategy develops Queensland's first catchment-scale and multi-stakeholder approach to a Total Flood Warning System concept. It seeks to integrate optimised flood warning infrastructure with collective governance to support better predictions and shared situational awareness, community messaging, and disaster management operations.

The work will focus primarily on the data collection and transmission phase, while setting a framework and inputs for the balance of the stages in the Total Flood Warning System concept.

What does a fully optimised Total Flood Warning System look like?

The Total Flood Warning System approach is the basis for how the Bureau expects to provide its flood forecasting and warning services, as defined in the Australian Emergency Manuals Series – Manual 21 Flood Warning. The Bureau notes that the Total Flood Warning System recognises that a fully effective flood warning service is multi-faceted in nature and its development and operation involves input from a number of agencies each with specialised roles to play.

A collective catchment: The Fitzroy Regional Resilience Strategy has shown that in order for the Bureau to perform its monitoring and prediction services, it needs a fully operational and optimised flood warning infrastructure network.

A best-practice, catchment scale Total Flood Warning System operates in the manner below. The focus for the Strategy is providing the right infrastructure that can collect and transmit appropriate data so that agencies like the Bureau can undertake prediction, councils and others can interpret that information for consequences, and the participants in the Queensland Disaster Management Arrangements can message and communicate correct information to their constituents.

Communication and agency consultation and review

- monitoring and prediction
- interpretation
- message construction
- communication
- protective behaviour
- review

Image: Rail infrastructure can contribute to situational awareness. Courtesy of QRA.
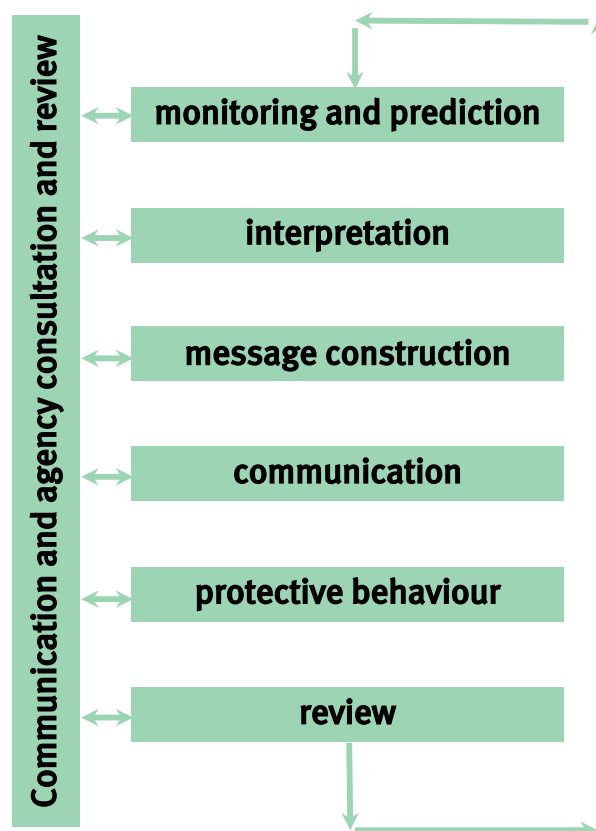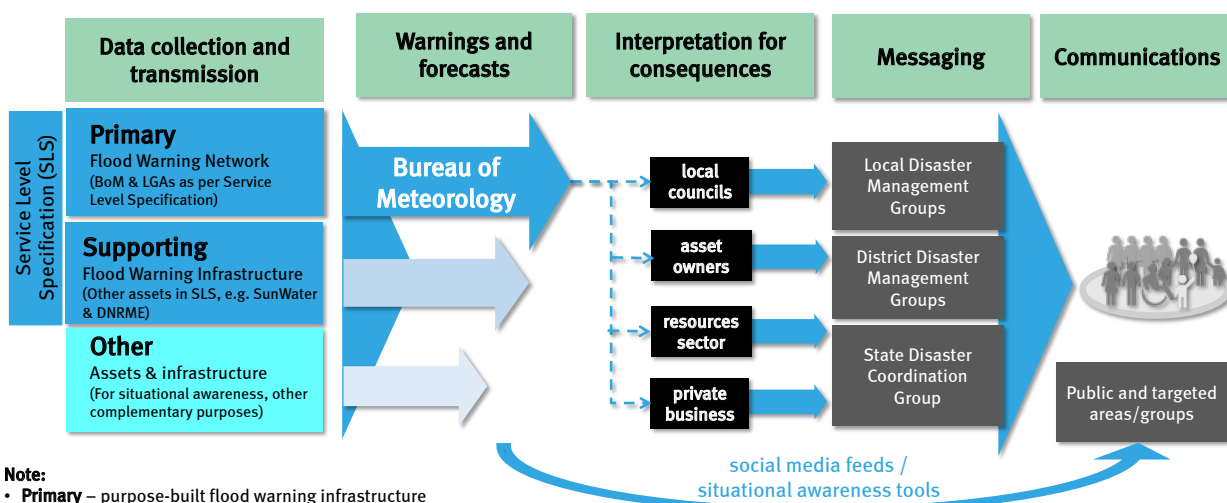
Note:
- **Primary** – purpose-built flood warning infrastructure
- **Supporting** – primary purpose of these assets is for functions other than flood warning
- **Other** – assets not used for flood warning but can assist situational awareness

Challenges with delivery of the Total Flood Warning System approach

Challenges for delivery of a fully optimised Total Flood Warning System identified through co-design with project stakeholders include:

- lack of complete knowledge of the assets available in the network – there are many more assets available for inclusion in the network than have been previously known

- limited understanding of interdependencies or infrastructure linkages that may cause network failure – single point sensitivity in data transmission and power supply arrangements can mean parts of the network fall silent when they are needed most

- poor locational choice relative to flood behaviour – often assets now used for flooding warning were located within the floodplain originally for other purposes (like water quality/flow monitoring), which means when a flood occurs often these are damaged as they are not located appropriately

- manual gauges not big need as there are no personnel to read them and report to the Bureau

- stakeholder and organisational resilience – many personnel within the catchment with intimate knowledge of its workings and that of the flood warning infrastructure are nearing retirement age. This includes landowners charged with reading manual flood gauges, and the personnel within councils and other agencies with responsibility for maintaining the network

- tailoring messages appropriate to the varying audiences – the catchment is diverse, from remote and rural areas to highly urban environments. It is home to generational landholders, to a transient workforce, and retirees. Having the right flood information to communicate to people in these different places, who are so demographically different, is a significant challenge in messaging and communication the flood warning infrastructure system needs to anticipate.

A common theme that cuts through all these challenges is collaboration – active collaboration by all concerned entities within the catchment would avoid or address these challenges to the delivery of the Total Flood Warning System.

*Image: Manual boards can provide redundancy.
Courtesy of QRA.*

Optimising the network to drive a Total Flood Warning System approach

Currently, the following gaps exist:

- limited situational awareness for all stakeholders in the catchment, which is a key requisite for understanding risk, including key data inputs such as catchment flood modelling and appropriate flood classifications
- inability to share information between agencies and entities – for example, traffic cameras and gauges from resource companies in diverse ownership have limited interoperability and collect data which is unable to be shared
- proper optimisation of the network – instances of asset duplication, vulnerability of priority asset gauge locations and limited redundancy exist
- common approaches to maintenance – multiple different infrastructure systems means spares, parts, and maintenance requirements can be highly varied
- catchment-wide governance of the network that is needed to inform its proper use.

The importance of getting it right

A fully optimised Total Flood Warning System allows us to meet our shared vision for the catchment. It means the Bureau has what it needs to issue forecasts and warnings as per the 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 QDMA, and ultimately that the community is well informed and understands their risks.

A fully optimised Total Flood Warning System is one of the objectives of the Queensland Strategy for Disaster Resilience in action.

Image: Rockhampton in flood, 2011.
Photo by Michael Marston.

Regional collaboration

Local leadership and technical insight

The preparation of the Strategy has been informed by a range of stakeholders from across the region, and across Queensland, from government, business, industry and environmental groups.

Local government leadership and regional coordination have been critical in the development of the Strategy. The work was requested by the Central Queensland Disaster Managers Forum (CQDM) in 2018 via the Central Queensland Regional Organisation of Councils (CQROC). The CQROC has been actively engaged throughout the development of the strategy and its component deliverables, providing strategic direction and support to the work.

Local technical insight was also critical to the delivery of the work. A multi-stakeholder Technical Working Group, has provided technical support and local knowledge on the landscape and the Flood Warning Network operation. Key stakeholders included:

- local governments from across the Fitzroy Basin
- state agencies, including Department of Natural Resources, Mines, and Energy, and Department of Transport and Main Roads
- Sunwater
- resources and transport companies including Queensland Rail and Aurizon
- environmental/natural resource management groups including Fitzroy Basin Association and River Health.

This locally led, regionally coordinated, and state facilitated approach to resilience building is a hallmark of Resilient Queensland.

Image: Whole-of-catchment collaboration.
Courtesy of QRA.

Relevance of the flood warning system to our communities

The people of the Fitzroy Basin appreciate the hazard that flood brings to their region. It disrupts their lifestyle, economy, social ties, community fabric, access and mobility in and around the region and often inflicts significant environmental change. Vulnerable residents are impacted more acutely with less ability to quickly recover.

Flood waters don't respect boundaries. It is therefore extremely important for all areas of Queensland to have information from other flood warning systems to understand their risk and be informed by timely weather and flood warnings and forecasts.

Schools and hospitals often double as evacuation centres in times of need. Twenty-five per cent of schools across the LGAs are identified as susceptible to potential flooding, thankfully much of this can be land and sporting fields rather than buildings. In Rockhampton almost half the education facilities are vulnerable to flood impacts. There are 31 hospital facilities located across the LGAs, with approximately one-third of them subject to possible flood-related impacts. Major flood events may cause cascading impacts in terms of access to electricity and challenges for evacuation or access in emergencies.

Individual properties, localities and towns in the catchment can become isolated for extended periods. The lower catchment areas with wide, flat floodplains, usually have longer periods of inundation. Flooding of the road network presents challenges for moving people to safer locations. In remote regions, people are more likely to shelter in place during floods. The loss of road connectivity will also result in economic repercussions as supply chains are cut off.

Residential areas are a commonly affected by flooding. This is especially so for highly urbanised areas such as the city of Rockhampton. Urban areas adjacent to the Fitzroy River, including Rockhampton City, Depot Hill, West Rockhampton, Berserker, Kawana, Koongal, Lakes Creek and Park Avenue, are amongst those areas most heavily affected. Outside the city, other locations affected include Gracemere, Mount Morgan and mining towns such as Emerald, Biloela and Blackwater.

During 2010-11 the total value of agricultural output in the region was approximately $1 billion, with the largest commodity being vegetables, which accounted for more than 29 per cent of the region's total agricultural output in value terms. The fertile floodplains upon which much of the catchment's agricultural activity occurs, is also prone to potential flood impact.

Recent events, particularly within the Mackenzie, Dawson and Isaac Rivers west of Rockhampton, have led to cumulative crop losses over recent seasons – frustrating growers' attempts to diversify cropping and farming methods to recover from these impact and reduce the impact of future events.

Agricultural land includes production from dryland and irrigated agriculture and plantations. The Central Highlands has the most agricultural area exposed to flood. Whilst other industries may be able to recover relatively quickly following a flood event, the impact on agricultural and grazing areas can be long-lasting. Impacts include degraded soils as well as damaged and destroyed buildings, equipment, contour banks and fencing. This is in addition to the devastation of stock and crop losses that impacts not only the duration of recovery, but the overall ability for business recovery.

Loss of power has significant implications during and after flood events. There are 5272 kilometres of transmission lines and 19 out of 130 substations across the LGAs situated in the flood hazard area. In terms of the road network, state-controlled roads span some 5112 kilometres across the LGAs, with an estimated 870 kilometres susceptible to potential flood impact.

Image: Fitzroy River in flood, 2008.
Courtesy of Fitzroy Basin Association.

Project background and deliverables

The Strategy responds to a request by the Central Queensland Disaster Managers Forum, through the Central Queensland Regional organisation of Councils (CQROC) for a catchment-scale approach to the flood gauge network in the Fitzroy River Basin. There is a demonstrated desire to act regionally to address their disaster risks and improve capability and capacity.

The pilot project provides an opportunity to work in partnership across government to develop a prioritised plan of actions and program of delivery, matched to possible funding avenues that can be implemented over time by councils and overseen by the regional group of councils. Whilst this will focus primarily on the gauge network, it may also address other resilience matters that align to the QSDR objectives.

The project was guided by the strategic philosophy of local co-design, regional coordination and State facilitation. The following methodology sets out the broad approach to project delivery. Initially a desktop study established a community profile and understanding of the context of the Fitzroy Basin. This is followed by a conveyance of the purpose and objectives of Resilient Queensland to stakeholders to foster understanding of how the pilot projects would be delivered and implemented. Following that the project was able to move through the local co-design process of the project itself and arrive at a terms of reference for strategy development.

One of the tenets of the pilot project is centred around finding shared solutions to common challenges. The shared regional experiences of local government may be physical (i.e. catchment-based), geographic, economic, social; and environmental. Locally led co-design seeks to enable local governments to design the project they feel will deliver maximum benefit and meet local expectations and requirements.

Image: Broad Sound, 2008.
Courtesy of Fitzroy Basin Association.

The outcomes of the initial community and stakeholder contact was the clear identification of challenges with the flood warning infrastructure network.

The locally led approach finds pragmatic ways to improve regional resilience over time, but initially through the flood warning network improvements. In this way the catchment stakeholders could build a clearer picture of the Basin with a greater understanding of risk. The project will seek to alleviate some resilience challenges in the short-term through support to local councils, whilst also establishing a proactive approach to sustaining resilience well into the future.

In addition, the opportunity for data gathering to inform funding and innovation in disaster management as resilience needed to be part of the scope. The project methodology needed to tackle the tenure variation and a range of governance and implementation issues across the member councils and asset owners.

The aims of the pilot were separated into a range of tasks that the total system needed to perform to complete the risk understanding and catchment knowledge. These are spread across assets; data transmission and data visualisation. In addition, the co-design process identified a need to update flood classification at gauges to ensure alignment with the Bureau, enhance modelling and situation awareness. Further deliverables included a governance structure for the ultimate system along with an up skilling program.

The specific deliverables for the project are:

- a flood network asset audit and analysis across the Basin
- a common asset management plan
- recommendations and opportunities to address gaps from results of the audit
- a flood classification review for priority gauges
- a catchment situational awareness tool
- a catchment modelling masterplan
- a capacity building and upskilling framework
- a regional action plan linked to funding opportunities.

1. community overview
2. understanding arrangements
3. locally-led co-design
4. deliverables and technical inputs
5. strategy development and governance pathways
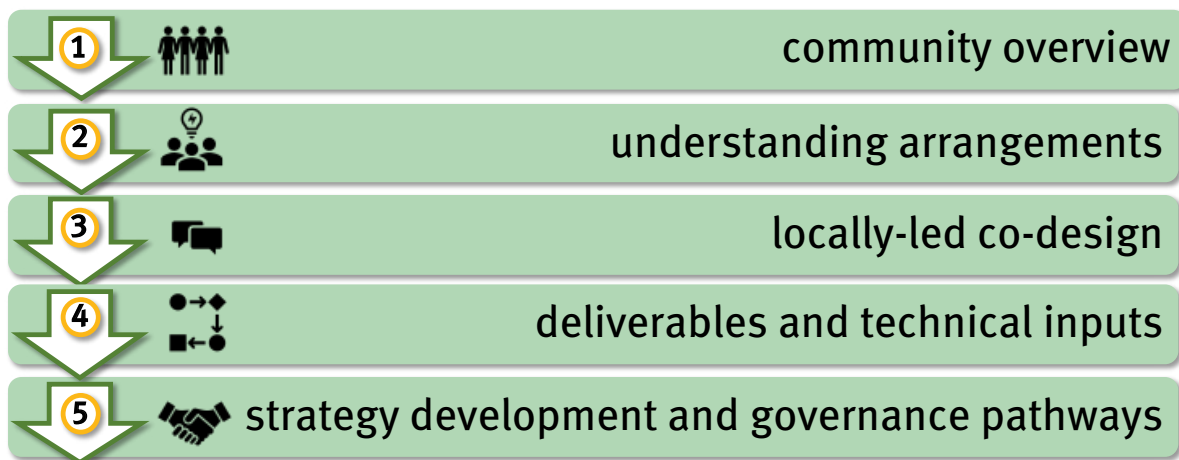
Image: Fitzroy River flooding, 2008.
Courtesy of Fitzroy Basin Association.

```
                    ┌─────────────────────────────────┐
                    │   Regional Resilience Strategy   │
                    │          Fitzroy Basin          │
                    └─────────────────────────────────┘
                                     │
                                     ▼
                    ┌─────────────────────────────────┐        ┌──────────────────┐
                    │  Catchment Network Operations    │ ◂┈┈┈┈  │ Creation of Data │
                    │         Arrangements             │        │   Access MoU     │
                    │    BoM/State/Local Government     │        └──────────────────┘
                    └─────────────────────────────────┘
                                     │
 ┌──────────────┐                    ▼
 │  Update to   │       ┌─────────────────────────────────┐
 │   Existing   │ ┈┈┈▸  │   Common Asset Management Plan   │
 │ Gauge Audit  │       │  ┌─────────┐ ┌──────┐ ┌────────┐ │
 └──────────────┘       │  │ Network │ │ Data │ │Network │ │
                        │  │  audit  │ │trans.│ │analysis│ │
                        │  └─────────┘ └──────┘ └────────┘ │
                        └─────────────────────────────────┘
                                     │
                                     ▼
                        ┌─────────────────────────────────┐
                        │  Additional Resilience Elements  │
                        └─────────────────────────────────┘
```

Regional Resilience Strategy Fitzroy Basin

Catchment Network Operations Arrangements
BoM/State/Local Government

Creation of Data Access MoU

Update to Existing Gauge Audit

Common Asset Management Plan

Network audit

Data transmission

Network analysis & optimisation

Additional Resilience Elements

Hazard classifications review

Catchment situational awareness tool

Knowledge transfer & upskilling framework

Catchment Modelling Master Plan

Identification of 2019 catchment priority projects

Regional Action Plan
for future funding opportunities

Technical Evidence Report

Image: Rockhampton floods, 2011.
Photo by Michael Marston.

Flood warning system audit

The audit and analysis stages of the work have revealed a complex operating environment for flood warning infrastructure in the Fitzroy Basin.

The total number of potential flood warning infrastructure assets that exist in the Fitzroy (i.e. those assets that can, but may not currently, perform a formal flood warning function as they are currently used for other purposes) is far greater than originally understood.

The ownership of assets by stakeholders is also widely varied – these entities traditionally have not provided flood warning data into the Queensland Disaster Management Arrangements in a formal way.

This provides a clear opportunity to collaborate to draw these assets into the broader network through collective governance in order to provide better predictions by the Bureau and situational awareness by disaster managers and the community.

Image: Fairbairn Dam.

Method and process for audit

The audit is a primary task for understanding risk. The audit delivers a comprehensive baseline picture of what assets the region has, and builds the understanding of asset criticality – a method to prioritise future actions and identify opportunities. The audit incorporates existing initiatives into one common operating picture. The outcomes of the audit were to:

- analyse existing infrastructure upgrade initiatives against identified risk areas
- identify gaps in the flood warning infrastructure network
- develop and apply principles for prioritisation across the areas of operation
- prioritise flood warning infrastructure improvements across the areas of operation; and
- support procurement of infrastructure.

Data on assets within the catchment was received from 14 separate organisations who participated in the Strategy. These organisations ranged from the Bureau, to local governments, state agencies, private companies, utilities providers, and natural resource management groups. Data was collected on the asset types, tenure, location, type, flood classification and Bureau classification.

The next task was to build a spatial database to manage the many datasets into a common format. A comprehensive data cleansing process was undertaken, which included spatial and technical data accuracy checks. The data transmission network supporting the flood warning assets was also reviewed, including the backhaul and redundancy potential in the network.

Insights and recommendations
- Identify gaps in the network
- Prioritisation
- Improvements

Gauge Tiering
- Gauge Priority
- Gauge Suitablity
- Tiers 1 to 4
- Links to Level of Service

Visualisation Tool
- Current picture of FWI within the catchment
- Analytic purposes
- One-stop shop

Understanding of asset criticality
- Research and review
- BOM Priority
- Gauge functionality and location
- Asset owner priority

Data Collation
- Data on all FWI ASsets (SLS and Non-SLS Gauges)
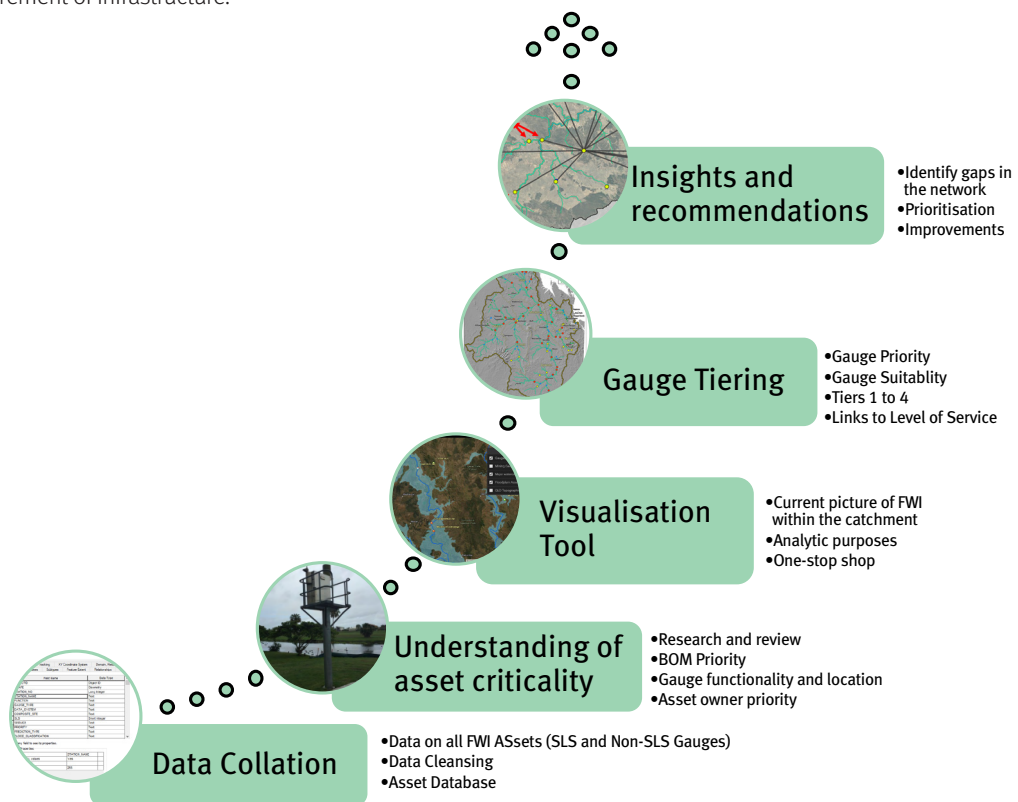- Data Cleansing
- Asset Database

Image: Lotus Creek crossing from the Marlborough-Sarina Road. Courtesy of QRA.

Visualisation tool

A visualisation tool was created to act as the single point of truth for the audit and analysis of all data received as part of the audit process. It was developed using an ArcGIS web portal online GIS package which was used along with conventional GIS programs to analyse the data provided by all the asset owners. The information is displayed by asset owner and gauge type.

The visualisation tool contains a number of overlays to contextualise the information and illustrate the major watercourses and flooding extents for reference purposes. The GIS portal was created to be an accessible platform to perform simple analytics and will be updated as new data becomes available. It looks like a dashboard and has the ability to summarise an individual or group of gauges in the context of the gauge type, SLS vs non-SLS, the communications network etc.

The visualisation tool will be very useful for ongoing knowledge building in the catchment and maintaining a fulsome view of the catchment assets as an analytical product not an operational product.

Audit results

The audit was the first time such a review had been undertaken in the catchment. It revealed that there are far more flood warning assets in the catchment that previously thought. This provides a significant opportunity for optimisation and improvement to forecasts/warnings and situational awareness in the catchment. There are a total of 427 gauges in three principal categories of rainfall, river, or river and rainfall gauges. In addition, there are 812 gauges used specifically for mining industry environmental performance (such as water quality monitoring) and currently do not contribute to the catchment body of knowledge for resilience.

The flood warning gauge tiering methodology was developed in collaboration with the project stakeholders, including discussions with the Bureau throughout the process. The final gauge tier was based on a matrix approach combining information from the gauge suitability and gauge priority. The gauge suitability rating captured the gauges ability to provide accurate, timely and focused flood warning information, and reviews properties of the asset such as:

• communications equipment
• known information about the gauge, such as datum details
• flood immunity of gauge equipment
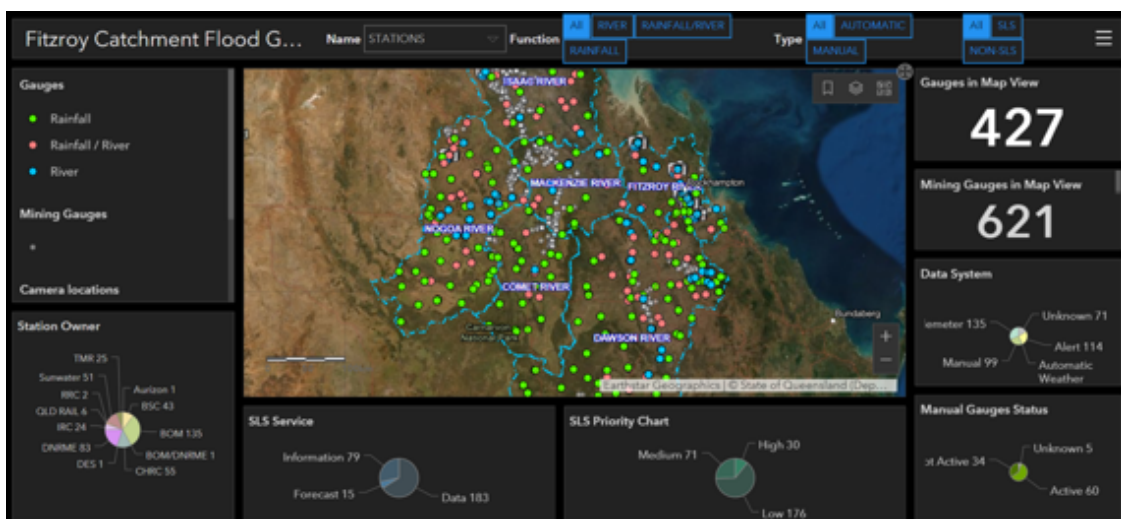• suitable hydraulic rating information.

Image: Melaleuca wetland in lower Fitzroy catchment. Courtesy of QRA.

Flood warning system analysis

The Strategy has undertaken a comprehensive tiering of all known flood warning infrastructure assets in the Basin. The gauge tiering methodology was developed in collaboration with stakeholders with the purpose of assisting forward planning for the location of flood warning infrastructure and the difficulty of upgrading existing gauges to meet the tiered gauge requirements.

The flood warning gauge tiering methodology was developed in collaboration with the project stakeholders. Based on a matrix approach combining information from on the gauge suitability and gauge priority, the tiering and mapping allows for an at-a-glance indication of how 'healthy' the Flood Warning Network is based on the number and location of high tier gauges.

The prioritisation encouraged leaving long-standing gauges in places that performed a critical role in comparing historic floods, allowing for the estimation of flood levels downstream during flood events. In the absence of all other data, comparing a historic flood level is a useful indicator. The analysis rated 229 gauges and the tiering was also undertaken to provide a framework for prioritisation of flood warning assets within the catchment which can be used to form the framework for common standards, levels of service, approach to upgrades, maintenance and asset management and priorities for new assets and locations. The analysis concluded with recommendations for all six sub-catchments which have been incorporated into the Common Asset Management Plan for the catchment.

Fitzroy Basin Gauge Summary
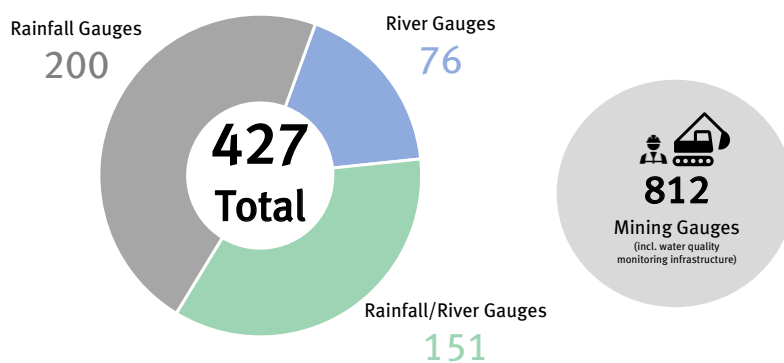

Rainfall Gauges
200

River Gauges
76

427
Total

812
Mining Gauges
(incl. water quality monitoring infrastructure)

Rainfall/River Gauges
151

Image: Fitzroy in flood in 2017.
Courtesy of Fitzroy Basin Association.

Catchment situational awareness concept tool

A key part of the total flood warning system framework is situational awareness. Not all flood warning infrastructure need be used for official forecasting/prediction or warning (which is the role of the Bureau of Meteorology) – rather, a lot of flood warning infrastructure can actually be used to improve awareness of rainfall and river flow behaviour and impact prior, during and immediately following a flood event.

Situational awareness is critical for disaster managers, decision makers, infrastructure owners, businesses, and even the general population. Knowing what might be happening further upstream, in real time, can help everyone enact their 'what-if' plans.

It is important to know when certain bridges are inaccessible, when roads are cut at low points, or when certain streams are running. Knowing where rainfall is occurring can even allow some people with excellent local knowledge of the catchment to predict where and how bad a certain flood may be, well ahead of formal warnings from the Bureau.

To this end, the Strategy has also piloted a concept situational awareness tool for further development by the stakeholders in the Basin, if desired - https://watech.maps.arcgis.com/apps/opsdashboard/index.html#/c2e6cc2c38074a6bb49aff1edafff9f3. It provides an example of how some key business requirements of local governments, agencies, and resource companies in relation to situational awareness could be represented visually.

It is intended that this concept tool be refined further – either via internal efforts of the stakeholders, or via a third party. The concept will be further tested in other regions over time through other flood warning infrastructure activities of the state government, and possibly integrated into other state government disaster management dashboards.
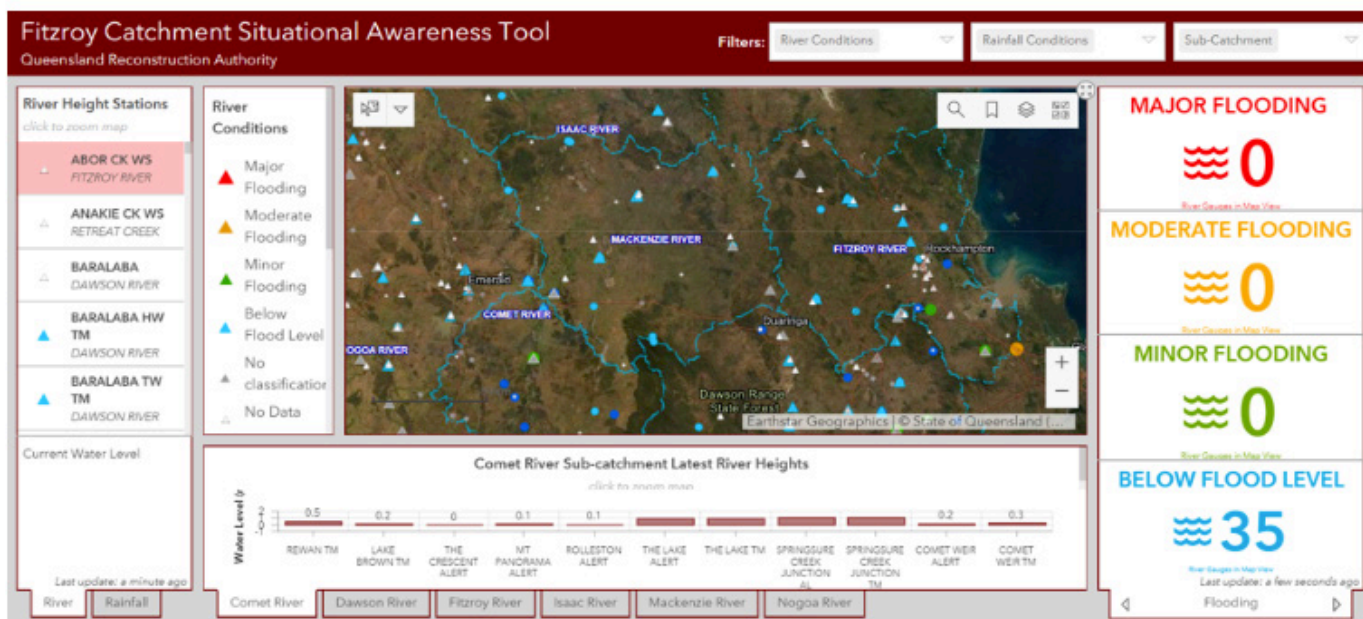

Image: Funnell Creek. Courtesy of QRA.

Strategic pathways to collaborate for resilience

Pathways to our resilience vision

A range of strategies to inform collaborative approaches to resilience objectives across the region are identified below. These strategic pathways form a regional 'blueprint' for collaborative resilience action on the flood warning infrastructure network across the Fitzroy Basin.

These strategic themes represent potential pathways to meet the aspiration of the region from governance, funding, action, and operational perspectives.

The themes and pathways are further supported by a range of regional and local actions that link back to the Queensland Strategy for Disaster Resilience, aligning with the Queensland Government's statewide priorities and commitments for disaster resilience. These strategic pathways and actions will be moved forward under the direction of the local governments as well as individual stakeholder groups.

Enduring Governance	**Committing to collaboration** We come together across the Fitzroy Basin to maintain a best practice catchment approach to flood warning system operation. We work across jurisdictions and tiers of government to plan for and operate the network for the benefit of our communities	**Sharing data for mutual benefit** We know how crucial situational awareness is to our stakeholders and the community. We commit to sharing the right data at the right time so that all decision-makers and operational personnel can access the information they need	**Simplifying maintenance for time and cost savings** Network maintenance can be costly and time consuming. We work collaboratively through a common, agreed framework for either internal or third parties to use so that we minimize cost, simplify requirements, and ensure quality
Proactive Funding	**Proactive planning for funding** We know how important it is to plan for upcoming funding opportunities. We keep our action plan up to date and are ready to submit for funding when the opportunity arises	**Collaborating for opportunities** We take every opportunity to seek funding for new assets, data, operations, and community awareness projects. We seek to maximise our funding success by submitting combined applications across multiple parties and geographic areas	**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
Sustained Action	**Clear program of action** It can be difficult to sustain effort in maintaining the network over time as people come and go. We maintain our common asset management plan and action plan over time so that it becomes both our forward program of work and our record of things we have achieved	**Systems-based approach** The flood warning system links to societal, economic, and infrastructure resilience. The flood warning network has a critical role in helping individuals, businesses, asset owners and operators understand their flood risk – and try to leverage flood warning actions to other initiatives when possible	**Supported up-skilling and knowledge transfer** People, and their knowledge of the catchment, and their technical capability in the network, are our biggest asset. We make sure we take every opportunity (whether formally or informally) to share learnings and upskill our people
Optimised Operation	**Creating asset management synergies** Our flood warning network is operated by many different stakeholders – and sometimes flood warning might not be the primary function of an asset. But we look for ways to simplify asset management across stakeholders and functions	**Asset redundancy for priority assets** We now know which assets are critical to forecasts and situational awareness. Ensuring these assets are provided with redundant communications and sites will help the resilience of the network under extreme conditions	**Common situational awareness for improved risk messaging** An optimised network provides the intelligence needed for disaster management personnel, the community, and decision makers. We work on providing a common picture to all of flood risk

Image: Fitzroy in flood, 2008.
Courtesy of Fitzroy Basin Association.

Strategy implementation

Working together to implement the strategy

This strategy will be implemented as a collaborative partnership across all levels of government, using existing governance structures. The strategy actions will be driven through local leadership and regional resourcing, with appropriate resourcing support from other coordinating bodies and entities such as District Disaster Management Groups (DDMGs), state government agencies, utilities operators, resource companies, and the like.

This approach recognises that while actions are best delivered locally, multi-disciplinary regional-level support is also required to encourage cross-jurisdictional collaboration, provide technical assistance and proactively assist project implementation. The simple benefits of open collaboration include:

- improved service coordination across disaster management
- enhanced knowledge and appreciation of roles and responsibilities
- greater flexibility to respond to changing, emerging or complex situations
- access to up-to-date information, new ideas and strategic thinking
- greater opportunity for innovation and improvement with more ideas circulating
- better policy development
- stronger relationships
- open channels of communications in place in extreme disasters.

The essence of collaboration is that strict hierarchical models are set aside for the purposes of information exchange and open dialogue. Once stakeholders understand that if they collectively contribute to goals, the joint efforts develop into a more daily practice of consultation, contribution with and learning between parties they have reached collaboration.

Collaboration in Action: embedded at all levels

"Whilst substantial challenges remain in fully assessing disaster risk there is a deeper understanding, that disaster risk management requires many partners working cooperatively and sharing information."

Queensland Emergency Response Framework Factsheet, P.1

"Recognising the commitment of stakeholders and the need for collaboration across all levels of government, community, industry, commerce, government owned corporations, private and volunteer organisations, and local communities in all aspects of disaster."

District Disaster Management Plan, Mackay Isaac Whitsunday , p.8

Effectively collaborate and share responsibilities for disaster management across all levels of government, industry and communities ."

Local Disaster Management Plan, Townsville, p.3

Image: Working together. Courtesy of QRA.

Collaborative governance

Federal, state and local governments working together

The Queensland Flood Warning Consultative Committee (QFWCC) was formed in 1996. The Committee's role is to coordinate the development and operations of the state's flood forecasting and warning services. It is an advisory body chaired by the Bureau of Meteorology that reports to and informs the Bureau and participating state and local government agencies twice each year. The membership includes:

- the Bureau of Meteorology (Chair/Secretariat)
- Queensland Department of Natural Resources, Mines and Energy
- Queensland Department of State Development, Manufacturing, Infrastructure and Planning
- Queensland Department of Transport and Main Roads
- Queensland Fire and Emergency Services
- Seqwater (Queensland Bulk Water Supply Authority trading as Seqwater)
- Queensland Reconstruction Authority
- Sunwater
- Local Government Association of Queensland.

The nationally consistent Terms of Reference for Flood Warning Consultative Committees are:

- identify requirements and review requests for new and upgraded forecasting and warning services
- establish the priorities for the requirements that have been identified using risk-based analyses of the Total Flood Warning System
- review and provide feedback on the Service Level Specification for the Bureau's flood forecasting and warning services on an annual basis
- coordinate the implementation of flood warning systems in accordance with appropriate standards
- promote effective means of communication of flood warning information to the affected communities
- monitor and review the performance of flood forecasting and warning services
- build awareness and promote the Total Flood Warning System concept.

Image: Agriculture, Fitzroy Basin.
Courtesy of QRA.

Fitzroy Basin technical working group

In line with emerging statewide governance improvements for the flood warning infrastructure network across Queensland currently underway, A Collaborative Catchment proposes the implementation of a Basin Working Group (BWG) within the proposed Queensland Flood Warning Infrastructure Alliance (QFWIA).

The QFWIA is a proposed governance arrangement that links the operation of the Queensland Flood Warning Consultative Committee (QFWCC), chaired by the Bureau with gauge owners including local government per the Bureau's SLS and other entities across the state that provide data for broader situational awareness. River basin working groups are the primary mechanism for coordination of activity at the regional level coming together with representation at the QFWCC Networks Subcommittee, chaired by the QRA.

To deliver on the Total Flood Warning System concept for the Fitzroy Basin, a new basin-level working group is proposed to be added to the existing flood warning infrastructure governance framework. This is intended to provide a forum to collaborate regionally, across jurisdiction boundaries, for whole-of-basin benefit on issues such as asset upgrades, funding opportunities, asset management and maintenance, and collaborative situational awareness improvements.

BWGs are intended to act as the primary decision-making bodies of the QFWIA in the regions. Each BWG is comprised of asset owners of water monitoring assets that can contribute to flood warning and can share situational awareness during events.

BWGs will provide reports to the Queensland Flood Warning Network Sub-Committee on a quarterly basis. BWGs are intended to have responsibility for:

- promoting opportunities for collaboration on key issues such as asset management, joint purchasing, resource and data sharing
- determining priorities for regional investment in flood warning infrastructure planning and prioritisation
- adopting and implementing practices for minimum standards, asset management and project prioritisation
- collaborating and coordinating on flood warning funding (capital and recurrent) in the basin/catchments they operate in
- identifying and acting on opportunities
- reviewing and planning for improved capability across each asset owner workforces
- investigating the merits of new or innovative technologies and/or delivery arrangements that could benefit the BWG and the QFWIA.

Local champions will be identified to lead the BWGs, supported by the QRA. In this way, basin-specific issues can be communicated to the Service Level Specification Sub-committee and the Network Sub-committee under the QFWCC.

The Fitzroy Basin Technical Working Group is also intended to be the mechanism to drive collaborative implementation of this strategy.

Common Flood Warning Asset Management Plan

A Common Flood Warning Asset Management Plan has been developed for the Basin, to be administered over time by the Basin Working Group. This is not intended to override existing agency or entity asset management systems, but rather provide a common picture of assets that require collaboration in upgrade, management, and maintenance for the benefit of the flood warning infrastructure network.

It is expected that those assets in the Basin originally put in place for non-flood warning purposes would continue to be maintained and administered as per their existing arrangements.

The Common Flood Warning Asset Management Plan identifies the assets, roles and responsibilities, asset conditions, suggested level of service, prioritisation (tiering), and lifecycle. It provides links to maintenance procedures via the 3rd party maintenance arrangement and is for use by all local governments and all flood warning infrastructure asset owners.

It provides a description and summary of all known assets that make up the Total Flood Warning Network in the Fitzroy Basin and seeks to:

- provide a Level of Service for the interoperability of flood warning assets
- actively encourage data sharing for improved situational awareness
- reduce the maintenance burden for local governments and asset owners

There are a number of opportunities and actions identified for network optimisation or improved situational awareness in the accompanying Action Plan. The Action Plan stems from the Common Asset Management Plan and draws on the audit and analysis for site-specific actions.

The Common Asset Management Plan is a comprehensive manual that guides the basin working group through the cost and health of the network, lifecycle considerations, maintenance options, risks to assets and triggers for new infrastructure demand and the action plan with 19 fundable actions.
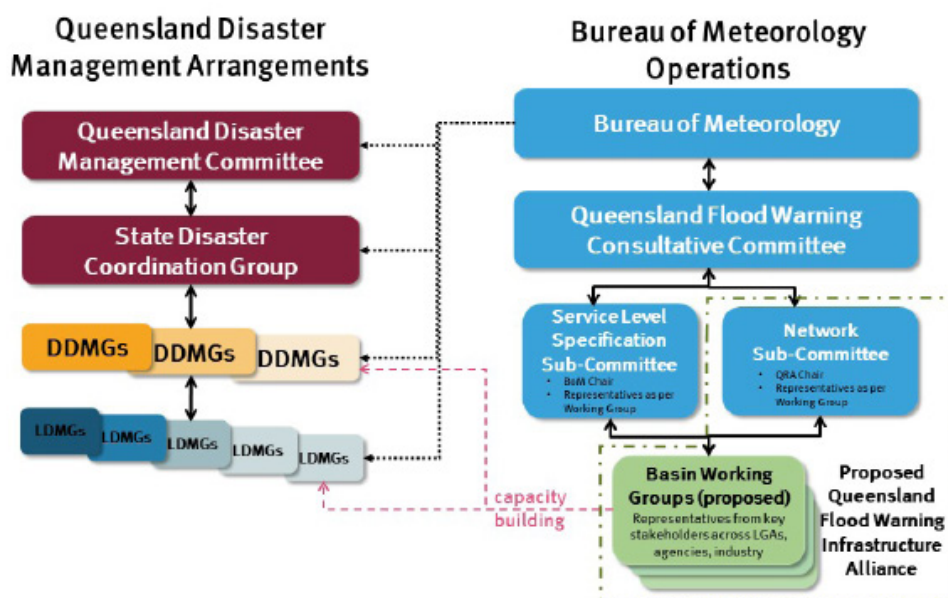

Image: Lake Maraboon.

Flood Modelling Master Plan

A catchment-scale flood modelling master plan has been developed as a project output. This work sets the framework for future implementation of discrete modelling efforts based on a review of currently available modelling, its fitness-for-purpose, and priorities for additional modelling across the catchment based on community need. Specific actions from the master plan have been incorporated into the Regional Action Plan to be programmed across future funding opportunities by the Basin Working Group.

Knowledge sharing and upskilling for organisation resilience and readiness

A key learning from the co-design process was a self-awareness that organisational readiness for flooding, like many other issues, largely revolved around the capacity and capability of specific individuals in the catchment, rather than an in-grained organisational capability. It was found that those with knowledge and skills had gained this through many years of learning and practice, and there was a need to share this knowledge and skills with newer people as they came into organisations. It was also felt that certain knowledge or capability was held strongly in certain parts of the catchment, with lower levels of capability in other parts of the catchment.

It was identified in subsequent workshops that this knowledge sharing and upskilling needed to focus on three key areas:

- local knowledge of landscape characteristics and flood behaviour
- technical expertise in the operation and maintenance of the flood warning infrastructure network
- disaster management knowledge of risk, community messaging, and decision-making.

A Stakeholder Knowledge Transfer and Upskilling Framework has been developed to encourage sustained interactions and learning in relation to catchment behaviour, succession planning, asset operation, and maintenance.

Proactive funding

A regional Action Plan has been developed to match the proposed optimisation of the network with options for pursuit of known funding programs, programmed against time and priority.

This Action Plan is held by the Basin Working Group and will form the basis of network upgrades as they are needed over time.
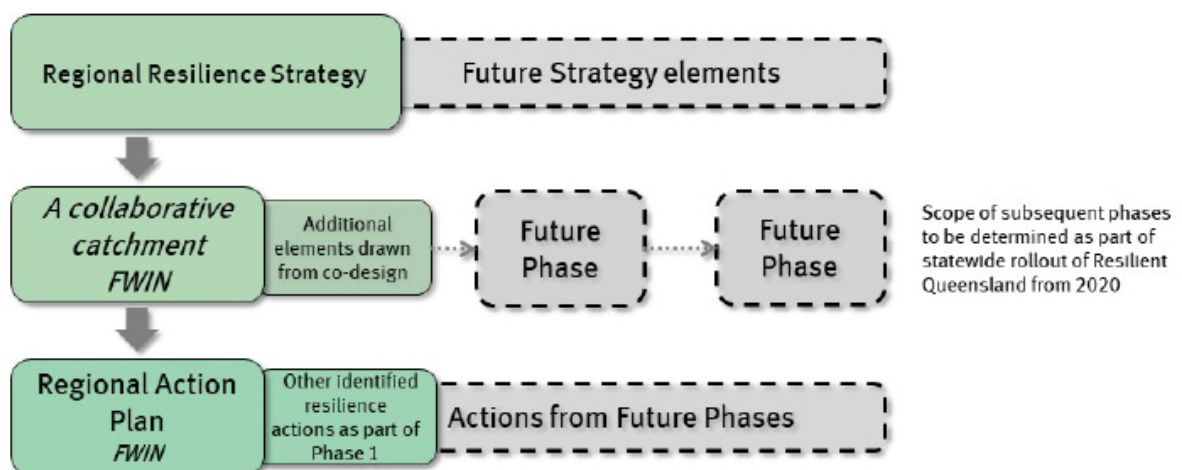
Image: Rolleston rail line damage, 2011.
Courtesy Fitzroy Basin Association.

Future strategy components

The subsequent phases of the strategy will be broader in nature than the flood warning infrastructure network, and provide the complete strategic linkage between the objectives of the Queensland Strategy for Disaster Resilience and the pathways to build disaster resilience locally and regionally within the Fitzroy Basin, including other catchment-scale projects to be undertaken in the future (addressing shared resilience challenges such as flood modelling, community awareness, and the like).

A diagram demonstrating the relationship of the flood warning elements of the first phase of work to the broader strategy framework is provided below.

Monitoring and evaluation

A key aspect of this strategy is to establish a clear standards-based implementation framework for integrated resilience planning. This approach focuses on deriving specific, regionally-based and fit-for-purpose benchmarks for resilience implementation that is cross-referenced to roles, responsibilities and funding. A benchmarking approach aims to provide a range of metrics that reflect the diversity of the region. It is proposed the identification and establishment of maturity benchmarking be further developed as implementation occurs over time.

www.qra.qld.gov.au/fitzroy